FOCUS

Mathematics in Stone and Bronze

S. B. Chamberlin

Several days before the exhibit's opening, a promotional banner, as sophisticated and enticing as any draped across a metropolitan museum, intrigued Washington's city strollers. Some even ventured inside the MAA's headquarters and politely inquired, "Just what is this 'Mathematics in Stone and Bronze' and may I see it?" On 2 November 1990, the curious returned and joined 173 guests for the opening reception of Helaman Ferguson's sculpture exhibit, *Mathematics in Stone and Bronze*. The exhibit, on display on the first two floors of the George Pólya Building, included thirty-three sculptures in bronze, marble, steatite, and expanded polystyrene. Their sizes ranged from one-half to three feet in height; some weighed only a few pounds; several weighed hundreds of pounds. All expressed the beautiful, sometimes profound, complexities of mathematics.

Marcia P. Sward, MAA Executive Director, graciously welcomed these visitors and encouraged them to meet the artist and discuss his work. She then introduced several representatives from the Mathematical Sciences Education Board (MSEB) who, on 2 December 1990, immediately after the exhibition's close, became the Association's new tenants in the George Pólya Building. Following Dr. Sward's remarks, President Lida K. Barrett narrated the history of the Association's interest in Ferguson's art and explained

Albers Appointed Associate Director

The Mathematical Association of America is pleased to announce its appointment of Donald J. Albers as Associate Director for Publications and Programs (ADPP), beginning 1 September 1991. Albers will serve as Associate Director Designate starting 1 January 1991, and will work on a consulting basis until September. As the ADPP, he will oversee the Association's mathematical activities, including its publications and projects. He will also closely cooperate with our officers, editors, committee chairs, and project directors.

Albers' dedication to the MAA has taken many forms. From 1979 until 1983, he edited the *College Mathematics Journal*. He has also served as Second Vice-President, Chair of the Survey Committee of the Conference Board of the Mathematical Sciences (CBMS), and, from 1986 to the present, as Chair of both the Publications Management Committee and the Committee on Publications. Currently, Albers is Acting Dean of Student Services and Professor of Mathematics at Menlo College in Atherton, California. He also holds that institution's Trustees Distinguished Teaching Chair. For nineteen years, he served as Chair and Dean of Menlo College's Department of Mathematics and Computer Science. Albers has also coauthored several books including *Mathematical People*, the recently published *More Mathematical People*, and MAA Notes 7, *Undergraduate Mathematical Sciences in Universities, Four-Year Colleges, and Two-Year Colleges: 1985–1986*.

Photograph courtesy of Carol Baxter
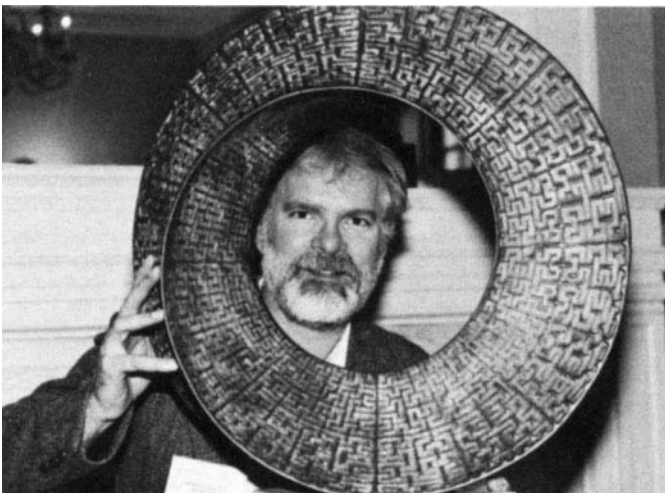
Helaman Ferguson with his *Umbilic Torus NC* in silicon bronze with antique green patina. This execution of the *Torus,* as well as the sculpture on permenent display in the Dolciani Mathematical Center, belong to an intended series of twelve.

Inside This Issue

(Ferguson continued from front page.)
the felicitous circumstances that brought the *Umbilic Torus NC* to the Dolciani Mathematical Center: Dr. James G. Timourian of the University of Alberta generously arranged for this piece to remain on display in the Center's Vaughn Building. Finally, Dr. Ferguson entertained the audience with mathematics and lively humor as he discussed the theory behind the Center's showpiece, *Torus.*

Many guests, unfamiliar with Ferguson's work, approached the exhibit pensively, perhaps even skeptically. Precisely how mathematical abstractions could manifest their essences in such weighty substances as marble and bronze posed a mystery. Clearly, the visual lyricism of Ferguson's work surprised and delighted the viewers. Some sculptures, such as the poetically titled *Whaledream I and II, Wild Sphere,* suggest lithe movement; *Whaledream's* realization of the 2¾ bifurcation stages achieved an organicism that, paradoxically, complemented the polished black steatite's cool elegance.

Since the opening, several guests have returned, many with friends, colleagues, and students, to tour the exhibit and discover more of Ferguson's distillation of mathematics and art. In the exhibition's guest book, an Argentinean diplomat from the neighboring embassy joins a surgeon from the Walter Reed Army Medical Center. Secondary school teachers, some with their mathematics classes, encounter research mathematicians from local universities. Indeed, the Ferguson exhibit constituted a fitting conclusion to the Year of National Dialogue. The visual and tactile medium of his sculptures conveyed the beauty of mathematics to mathematician and non-mathematician alike—a dialogue to pursue every year.   ■

Maureen A. Callanan, Development Assistant at MAA headquarters in Washington, DC, coordinated all the activities associated with the Ferguson exhibit, including its opening reception. She graciously furnished the author with the information detailed above.

MAA Seeks Assistant Director

Mathematics Olympiad Training Session

The Mathematical Association of America invites applications from qualified candidates for the position of assistant director of the Mathematics Olympiad Training Session (MOTS), conducted during June and July at the US Naval Academy and the US Military Academy in alternate years. Each year, the American Mathematics Competitions (AMC) select twenty-four precollegiate students to participate in this intensive study program according to results of the USA Mathematical Olympiad (USAMO) and other examinations associated with the AMC.

Applicants should provide evidence of both the ability to create and solve Olympiad-type problems and prior experience in this area. The Association also seeks a candidate offering demonstrated effective teaching of students with exceptional mathematical ability. The top six participants of the MOTS are selected to represent the USA at the International Mathematical Olympiad (IMO).

To apply, send a letter of application and curriculum vitae by **20 February 1991** to:

Dr. Marcia P. Sward, Executive Director
The Mathematical Association of America
1529 Eighteenth Street Northwest
Washington, DC 20036-1385
Telephone: (202) 387-5200
E-mail: maa@hilda.umd.edu
FAX: (202) 265-2384.

The MAA is an Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to apply.

Double Torus Stonehenge: continuous linking and unlinking, L ≠ L, in twenty-eight pieces, one bronze, twenty-seven hard wax *(opposite).* Some of the most important and pervasive ideas of twentieth century mathematics are the notions of continuous deformation, isotopy, and homotopy. This dance of the double tori celebrates that idea by taking a pseudolink, which most right-thinking persons would call a link and deforming it continuously without cutting or tearing into what every other right-thinking person would declare an unlinked state. Small and agreeable continuous perturbations relate each double torus to its neighbor; the total sum of these to the opposite number on the henge is large and surprising. This kind of thinking is what proves the theorem about three crosscaps on a sphere being a single crosscap on a torus asserted in *Torus with Cross-Cap,* $x + h = 3x, 2x \neq h$.

"Let us celebrate some Mathematics. Some of the greatest myths of our age are mathematical equations; their equal signs are heros. The Atlas who holds up the world of aircraft today is the equal sign in the Navier-Stokes equation; airplane designs are simulated using such equations before they are considered safe to bear humans aloft. I regard mathematics as a design language for vital images. The creative interest for me here is the process of taking thoughts to physical materials; the process of responding to aesthetically motivated concepts embodied in languages of varying degrees of precision by sculpturing with material processes of varying degrees of cooperation. This exhibition includes four categories: tori, closed nonorientable surfaces, wild spheres, and double tori. Deeper descriptions of these categories are: matrix group representations, surface immersions in three dimensions, wild embeddings of surfaces, and hyperbolic three manifold knot complements as quotients by discrete matrix groups."

Helaman Ferguson

Incised Torus Wild Sphere, $\pi_1 \neq \pi_1$, in black steatite. "What most people think of as a sphere, the surface of a ball-like object, is distinguished by some as a tame sphere. There are wild spheres. The difference is in how the sphere is embedded into three dimensional space; context is important. That is, the homotopy group of loops of the exterior of the embedded sphere, π_1, of one embedding need not be π_1 of another embedding. The idea of A $\neq$ A is very common in everyday language: think of your name, say A, now think of someone else named A, so A $\neq$ A. Here the bifurcation stages yield two trunks, four arms, and then eight fingers. Note the long extension of stone of the arms."

Thurston's Knotted Wye Hyperbolic Space, in Carrara white marble. "Thurston describes the mathematical antecedent of this sculpture as the simplest hyperbolic three manifold with totally geodesic boundary. Pendent under the trefoil-like loops is the vertex of a wye the arms of which rise, link a neighbor, and descend below the wye foot-like; all three arms join the base to form a second wye. The evacuated spheroids stippling the surface of this marble recall the semicircle, hemisphere geodesic constructions of a hyperbolic three space. Because of the unusual extension achieved in this direct carving, the marble, when lightly tapped with a knuckle, rings like a bell."

EDITORIAL NOTE: The two photographs of Ferguson's sculptures above are transposed.

from the President's desk. . .
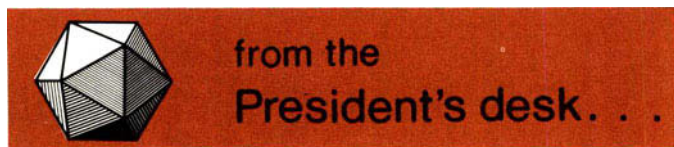
Lida K. Barrett, Mississippi State University

Serving as President of the MAA has been a real pleasure for me. I am grateful for the opportunities to serve the MAA and, through its activities, the broader mathematical community. The MAA has, over the years, provided leadership in collegiate and university mathematics education. This is a time of growing awareness of a need for change in the content and teaching of mathematics at all levels and of changes in the student clientele. (More minorities and women are entering college and the work force than white males). The renewed emphasis on undergraduate education which is spreading throughout the collegiate scene is in keeping with our on-going agenda and will permit us to be better heard as we speak to the academic community about needed change.

The MAA is providing all of its members, and others, both inside and outside of mathematics, with a comprehensive set of activities that address these concerns and provide direction for the future. During the past two years the Committee on the Undergraduate Program in Mathematics (CUPM), under Lynn A. Steen's leadership, has begun a wide-ranging look at the collegiate curriculum. A National Science Foundation (NSF) grant this year will help us move ahead with a strategy for future curriculum development. Our Committee on the Role of Women in Mathematics has helped increase the involvement of women in our organization and is providing us with information on how to attract more women to mathematics and how to treat them appropriately when they arrive.

This is a time of growing awareness of a need for change in the content and teaching of mathematics at all levels . . . .

Our new Committee on Minority Participation has developed a comprehensive plan to enhance minority participation in mathematics, and we are moving to implement this plan. (For further information on this plan, see the feature on SUMMA on page 19 of this issue). Our Student Chapters also address the human resource issue. Through them we encourage the next generation to know and love mathematics as we do. There are now 268 Student Chapters with more than 3,000 student members. New information is available from the MAA on careers in the mathematical sciences. Ten thousand copies of a new brochure have been distributed since August 1990. Another publication, *Mathematical Scientists at Work*, is due for release in January, and we are sending one-page flyers, "Mathematician of the Month," to our Student Chapters.

Activities putting the MAA at the forefront of change have been undertaken by two MAA committees—Calculus Reform and the First Two Years (CRAFTY) and the Committee on the Mathematical Education of Teachers (COMET). CRAFTY's new publication, *Priming the Calculus Pump: Innovations and Resources,* reports on activity in calculus reform and provides rapid dissemination of work taking place in many colleges and universities. COMET is preparing a timely report on the preparation of teachers which will be released in March together with related reports from the National Council of Teachers of Mathematics (NCTM) and the Mathematical Sciences Education Board (MSEB).

Beyond our external activities, for me an important raison d'etre, are internal activities that provide the source of our leadership strength. During the past two years we have published fifteen books including MAA Notes on college teaching and on writing in the mathematics curriculum. Our Section meetings have continued to be a special source of strength. The real high point of my term was the Seventy-Fifth Anniversary Meeting in Columbus. MAA Day was very special—the opening ceremony with banners for each Section, the talks, the group picture, the circus, the talks presented jointly with other organizations—and it was followed by an outstanding summer meeting. I was proud of our committee, ably lead by Gerald L. Alexanderson, which planned a program of such high quality.

I have barely touched on the work of over one hundred committees, subcommittees, and joint committees. It is difficult to comprehend it all or to report here on much more. The level of activity—its complexity and the interrelatedness of our venture—has lead us to take the important step of organizing our committee structure. Under the able leadership of Deborah Tepper Haimo, we have grouped our committees into six Areas and look forward to the Coordinating Councils for the Areas as sources for direction, new initiatives, and important new actions among committees.

The need for additional structure is in part a product of our growth in size from 27,560 members at the beginning of 1989 to over 31,000 at present. It is no longer possible to keep up in an informal manner. The growth is also due to our increased activity internally and to the astounding amount of activity related to mathematics externally. Outside funding has enabled several committees to accomplish their work in a more timely fashion. In 1989, SUMMA, the Olympiad, the Women and Mathematics program (WAM), and Student Chapters received external support. In 1990 we accepted a four-year grant of over a million dollars from the NSF, supplemented by an equipment grant from Texas Instruments, for a project on teaching with calculators. We also received both a grant from the Fund for the Improvement of Postsecondary Education (FIPSE) for the Committee on the Preparation of College Teaching and an NSF grant to begin a curriculum review process. Increasingly, external support allows our work to move forward more expeditiously.

The decision to stay in Washington, DC and renovate our building has proved a wise one. Our capital campaign to cover the $600,000 in expenses has moved ahead, with almost $400,000 raised. Campaigns are underway to seek contributions to name rooms after several leaders and several more are in the planning stages. Your Section might wish to designate gifts to name a room in honor of one of your members.

The activity level in the building has increased with the expansion of the Conference Board of the Mathematical Sciences (CBMS) space to provide a Washington office for leaders of other organizations, the return of the Office of Governmental and Public Affairs (OGPA) of the Joint Policy Board for Mathematics (JPBM), the new SUMMA office, and the recent rental of the first two floors of the Pólya Building (formerly occupied by lawyers) to staff from the Mathematical Sciences Education Board. Except for the second floor of the Carriage House, our buildings are fully occupied by mathematical endeavors.

Early in my term of office, Donald L. Kreider, Treasurer, and I had the pleasure of negotiating Marcia P. Sward's return to the MAA.

Lida K. Barrett

(President continued from previous page.)
Since that time she has added Rhoda D. Goldstein as Associate Director for Finance and Administration. Rhoda had held a similar post with an organization of Catholic schools. The addition of this new administrative position has made it possible for our Executive Director to delegate financial analysis, staffing issues, and building matters in a way not possible in the past. Marcia and Rhoda were able to get the new organizational structure under way with the appointment of an Interim Associate Director for Programs—Andy Sterrett, who retired from Denison University into this position as a volunteer with only very modest support from the organization, a tremendous gift to all of us. The cover story announcement in this issue of the new Associate Director for Programs and Publications, Donald J. Albers, rounds out the leadership staff proposed in the reorganization plan developed in 1988.

The excellent staff support and the strategically located headquarters in Washington, DC have made it possible for me to function effectively as both President of the MAA and Dean of Arts and Sciences at Mississippi State University. Without Marcia Sward's extraordinary administrative skills it would not have been possible. Not only have I been able to maintain my job but I have also found time to continue to serve on the National Academy of Sciences'

Mathematical Sciences in the Year 2000 (MS 2000) Task Force and the MSEB. Recently I was appointed to the National Board for Professional Teaching Standards Committee to Develop Standards for Teachers of Mathematics, Adolescents, and Young Adults. These activities and my role in the MAA have enhanced each other.

If I had to summarize my term in office I would say three things:

1. It has been a struggle to keep up with and systemize the vast amount of MAA activity supported by the new staff, the "new" building, the work on committee structure, and the wonderful officers and members of the MAA;

2. It has been a struggle to keep up with the frantic pace of activity related to mathematics outside of the MAA of which I have been fortunate to be a part, both as a representative of the MAA, and, as myself, a mathematician, educator, and administrator;

3. It has been a wonderful opportunity to be President in the seventy-fifth year of our organization, as we celebrate our accomplishments!

I look forward to the end of the January meeting and to turning the leadership over to Deborah Tepper Haimo's able hands.   ■

M A T H E M A T I C S

Industry Technology Science FUNDAMENTAL

Mathematics Awareness Week 1991

January 1991: time to organize your Mathematics Awareness Week (MAW) 1991 festivities—our annual national celebration of the beauty and complexity of mathematics and its relevance to everyday life. In 1991, the MAW theme will emphasize *Mathematics: It's Fundamental.* We selected this theme because the public does not yet fully appreciate the diverse applications of mathematics—applications increasingly crucial to progress in science, technology, industry, and society. Mathematics Awareness Week 1991, however, provides an exciting opportunity for you to convey this overwhelming significance of mathematics.

You can observe Mathematics Awareness Week with many enjoyable activities: sponsor a mathematics competition for students in nearby secondary schools; offer a colleague as a guest speaker to a nearby elementary, middle, junior high, or senior high school; fly a banner proclaiming Mathematics Awareness Week above the door of your department; coordinate a public forum during which members of your community can discuss proposed changes in mathematics education; or organize a mathematical art contest for students in your department or in your geographic area.

We have assembled two packets to encourage your MAW 1991 celebration. The first packet includes:

■ **Sample Proclamation,** which you can use to work with local officials to draft a similar proclamation for your city or state;

■ **1990 MAW Successes,** a sampling of projects from last year which you may replicate or adapt to your situation;

■ **Audio Visual Resources,** an updated listing of films and tapes which offer good focal points for MAW events; and

■ **Publications** and other items to order for MAW.

In February, we will provide you with a second packet:

■ **Sample News Release** to adapt for local media outlets;

■ **Sample Editorial** to submit to local newspapers

■ **Posters and Postcards** featuring beautiful graphics detailing some of the many achievements of modern mathematics;

■ **Pamphlets** on careers in mathematics; and

■ **Information** on additional ways to communicate the idea, *Mathematics: It's Fundamental.*

To receive either or both these MAW 1991 packets, contact: the Joint Policy Board for Mathematics, 1527 Eighteenth Street Northwest, Washington, DC 20036-1385; (202) 234-9570.

Across the country the cumulative impact of Mathematics Awareness Week increases. We need you, however, to help us realize the largest, most comprehensive celebration ever. Appoint a Mathematics Awareness Week coordinator and discuss with your colleagues the avenues by which your institution can participate in the celebration. Mark the dates now: **21–27 April 1991.** If these national dates coincide with your spring break, schedule your MAW activities during another week in April. Whatever you do, don't neglect this important opportunity to communicate mathematics.

WASHINGTON OUTLOOK . . .

Lisa A. Thompson
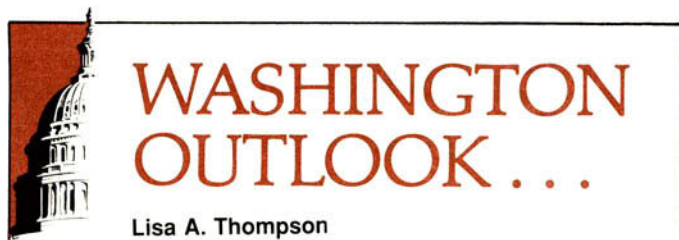
Politics and Process Influence NSF Budget

The new staff of the Joint Policy Board for Mathematics' (JPBM) Office of Governmental and Public Affairs (OGPA) is recommitting the organization to an effective strategy to support its role as advocate for mathematics in federal policy debates. A successful public policy program will require the help of people dedicated to the notion that a robust mathematics enterprise is crucial to the progress of society, industry, and technology. On behalf of Edward A. Connors, the new and determined Director of OGPA, I invite all mathematicians to work with us to raise our political leaders' awareness of the contributions of mathematics.

As the end-of-year political battle over the budget fades from memory, it is interesting to note the impact the fiscal climate and budget process have on the spending allowances of the National Science Foundation (NSF), keeping in mind that the NSF is a relatively small agency, critically important to the scientific community, but largely unknown to the public. It becomes clear that funding for the NSF, and to some extent basic research in general, is subject to political and economic forces that overwhelm consideration of the all-but-academic policy question: What level of spending is needed to satisfy the scientific and education objectives, central to the NSF's raison d'être? There are few signs that this state of affairs will allow the now long-standing proposal to double the NSF budget.

This was a year of ups and downs for the fiscal year (FY) 1991 NSF budget, which unfortunately emerged from the process "down," at least as far as its research component is concerned. Congressional markup of the proposed budget resulted in a total NSF appropriation of $2.316 billion, an 11% increase above the FY 1990 amount, but $67 million below the President's request for a 14.4% increase.

NSF research programs were funded at $1.694 billion, only $101 million (6.4%), above the comparable FY 1990 level. The President had requested an increase of over $215 million. As expected, the NSF's education and human resources programs received a significant funding increase, much of which was earmarked for teacher preparation and enhancement. Congress added $49 million to the administration's request for a total of $322.4 million, $102 million (46%), above last year's level. Spending for the academic research facilities modernization program was set at $20.5 million, a 4% increase above last year's level. This outcome is not too surprising, but retracing the path that led to it reveals just what the scientific community is up against in efforts to convince the government to allow significant real growth in the NSF's research programs.

Early last year, everyone knew FY 1991 would be a tight budget year: the Gramm-Rudman-Hollings deficit target was $64 billion. The FY 1990 budget had been tough enough to produce and was still subjected to a partial sequester (automatic cuts to bring the budget in line with the Gramm-Rudman-Hollings deficit target). Congressional staffers said that every trick in the book had been pulled to find as many dollars as possible for discretionary spending and that there weren't any tricks left. (You might recall the flap over changing a federal payday so it could be charged to FY 1989; the process is structured so that last year's actual deficit is less relevant than this year's projected deficit.) The NSF in particular benefitted from these maneuvers, even though its FY 1990 spending allocation did not so indicate.

Because the appropriations package that funds the NSF also includes the Departments of Veterans Affairs (VA) and Housing and Urban Development (HUD) and other agencies whose budgets the Reagan Administration consistently tried to cut, the House and Senate subcommittees responsible for the package had to work with spending allocations that were insufficient to provide as much as the Administration wanted for the NSF and as much as Congress wanted for VA and HUD. The NSF ended up getting squeezed. But in FY 1991, President Bush's budget called for increases for the VA and HUD. This boded well for the NSF's proposed 14% increase.

Early in the process, however, the slumping economy and growing cost estimates for the savings and loan bailout indicated that the President's proposal would result in a deficit nowhere near the target. But after the President abandoned his no-new-taxes pledge, the Administration and Congress agreed to work together to forge a multiyear deficit reduction package that would not rely solely on domestic discretionary spending cuts. Defense spending, taxes, and entitlements would be included in the equation, a welcome change from agreements of years past. The budget plan that was ultimately agreed upon allows discretionary spending to grow in real terms this year, but holds future increases to under 5%, at or below the projected rate of inflation.

What level of spending is needed to satisfy the scientific and education objectives, central to the NSF's raison d'être?

Meanwhile the House and Senate appropriations subcommittees on VA, HUD, and Independent Agencies, still unhappy even with a 12% increase in their spending allocations, nevertheless recommended an increase of around 13% for the NSF—in the neighborhood of 8% for the research programs and 40% for education and human resources programs. The subcommittees came up with these figures, later affirmed by the House-Senate conference, largely at the expense of the space station, whose budget request was slashed by $500 million (to $1.9 billion).

As the results of the House and Senate conference agreement were being celebrated by the NSF's supporters and the conference report was being prepared, the Office of Management and Budget, which as a result of the budget agreement gained authority to make final decisions about such things, decided against reallocating several hundred million dollars from the defense budget to the subcommittee's agencies. The conference had to revisit their package and make additional cuts. At the last minute, the proposed increase for the NSF's research programs was cut another $40 million.

The NSF faces an even tougher challenge next year, and NSF officials are privately pointing at the space station as their primary competitor for funds. At the same time discretionary spending is being held to 5% growth, the conference report directs NASA to plan for 10% annual increases in the space station budget. (This is far lower than what NASA and the President want. In fact, the conference report calls for a redesign of the orbiting facility in accordance with realistic funding prospects.)

Furthermore, the Congress will continue to add money to the proposed budgets of the VA and HUD, as well as the NSF's education and human resources programs. While most members favor strong federal support for research and education, and a few look out for the NSF's research programs, no member takes it upon himself or herself to see that these programs receive adequate funding. Many discretionary programs have just such a champion: agricultural subsidies, the National Institutes of Health, weapons systems, even the superconducting super collider.

In this political and fiscal climate, public interest organizations struggle to maintain the programs they deem vital to the nation's welfare. Much time and effort must be devoted to convincing policymakers that certain activities deserve a high priority in the allocation of scarce federal funds. Newspaper columns, Congressional testimony, press conferences, letter-writing campaigns, and personal visits are arranged to maintain the visibility that leads to funding.

Mathematics research and education is most certainly an interest that should not be allowed to get overlooked. The concerns of mathematicians for the future vitality of the mathematical sciences need to be thoroughly and repeatedly conveyed to federal policymakers. The recommendations embodied in *Renewing US Mathematics: A Plan for the 1990s* ("David II") will go unheeded if not reinforced by mathematicians acting as constituents.

Despite the vigorous efforts of the scientific community and the high priority given by the Administration, support for scientific research, and especially for basic research, has not been sufficient to bring about the proposed doubling of the National Science Foundation budget. The President's Assistant for Science and Technology, D. Allan Bromley, has urged scientists to redouble their efforts to persuade Congress that funding for science and mathematics must be strengthened. He has said that Senator Barbara Mikulski (Democrat, Maryland), chair of the panel responsible for NSF appropriations, told him that she never hears from scientists. She

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undoubtedly receives mail from scientific societies and academic research organizations. But one suspects she does not hear often enough from scientists and mathematicians working in Maryland.

JPBM's Office of Governmental and Public Affairs, mathematics' Washington presence, would like to correct this situation by facilitating communications between the mathematics community and public-policy officials. OGPA encourages mathematicians to engage their members of Congress in a dialogue on the importance of mathematics. We invite all members of mathematical organizations to visit us here in Washington, DC, to discuss ways we can work together to ensure an adequate federal commitment to mathematics. If you are going to be in Washington, let us know in advance and we will attempt to arrange a meeting with you and your member of Congress or his or her staff. We will also provide any materials or other information you might find useful in getting the message across. Ideally, a long-term relationship based on mutual trust and understanding with your representatives is the most effective way to maintain their support for mathematics, which might otherwise be suspended amid competing priorities and issues that command more attention.

Finally, if you are interested in familiarizing yourself with the hot issues in science and mathematics policy, we invite you to subscribe to TIDBITS, a weekly electronic newsletter sent over INTERNET, by sending an e-mail message to me at jpbm@athena.umd.edu. I believe, as D. Allan Bromley believes, that with some thought, mathematicians can make a difference in the way politicians perceive mathematics. I look forward to working with you.   ■

Lisa A. Thompson is the Assistant for Governmental Affairs at the Office of Governmental and Public Affairs (OGPA) of the Joint Policy Board for Mathematics (JPBM) in Washington, DC. She did graduate work in the field of science and technology policy and has served on the staffs of the Council of Scientific Society Presidents (CSSP) and on the Office of Science and Technology Policy.

National Science Foundation Budget Summary

	FY 1990 estimated	FY 1991 request	FY 1991 appropriation	% change 91 app/90
Research and Related Activities	1,592.8	1,803.7	1,694.2	6.4%
Education and Human Resources	220.5	273.4	322.4	46.2%
Academic Research Facilities	19.7	20.0	20.5	4.1%
U.S. Antarctic Program	151.7	175.0	175.0	15.4%
Program Development & Management	96.4	102.5	101.0	4.8%
Office of Inspector General	2.6	3.0	3.0	17.2%
NSF Relocation	N/A	5.5	0.0	N/A
Total, National Science Foundation	2,083.6	2,383.0	2,316.1	11.1%

(Dollar figures in millions; columns may not add due to rounding; percentages were computed using actual dollar amounts; FY 1990 figures have been adjusted to reflect subsequent program reorganizations; Sources: National Science Foundation and Congressional documents)

**A Wellspring of Workshops
A Cornucopia of Conferences**
Summer Activities for the Mathematical Scientist

'91

Mary Ellen Rudin Conference: General Topology and Applications

University of Wisconsin at Madison
26–29 June 1991

PROGRAM DESCRIPTION   Principal speakers include: Mary Ellen Rudin of the University of Wisconsin; Amer Bešlagić of George Mason University; Alan Dow of York University; William G. Fleissner of the University of Kansas; Gary F. Gruenhage of Auburn University; Judy Anita Kennedy of the University of Delaware; Sabine Koppelberg of the Free University in Berlin; Kenneth Kunen of the University of Wisconsin; Kenneth D. Magill, Jr. of the State University of New York at Buffalo; Peter J. Nyikos of the University of South Carolina; B. E. Shapirovskii of Moscow; Michael Starbird of the University of Texas; Franklin D. Tall of the University of Toronto; Stevo Todorcevic of York University; Stephen Watson of York University; and William Weiss of the University of Toronto.

Several institutions will sponsor this unique conference: the University of Wisconsin; Wesleyan University; Long Island University; the University of Toronto; and several colleges of the City University of New York, including Queens College, the College of Staten Island, and the City College of New York.

Photograph courtesy of Mary Ellen Rudin

Mary Ellen Rudin

The conference organizers invite participants to deliver briefer talks of approximately 25 minutes. You should prepare your abstract on one and one-half spaced (four lines per inch), 7.5 inch by 5 inch paper. The organizers especially desire TEXfiles submitted via e-mail or camera-ready copy submitted via the postal service. If necessary, however, the organizers can arrange retyping for a modest fee. Submit your abstract as soon as possible but no later than **1 May 1991** to: Ralph D. Kopperman (see address below) or Franklin D. Tall, University of Toronto, Toronto, Ontario, Canada M5S 1A4; TALL@MATH. TORONTO.EDU. FAX: (416) 978-4107. In addition, the conference organizers have applied to the National Science Foundation for support for graduate student participation. They especially encourage nominations of women and minorities. Your institution should direct these student nominations to: Melvin Henriksen, Harvey Mudd College, Claremont, California 91711; HENRIKSEN@HMCVAX.ED.

REGISTRATION AND FEES   Costs include a $40 fee for registration before **1 June 1991**: $50 thereafter. Air-conditioned dormitory accommodations are available on campus. Make your check payable to Mary Ellen Rudin Summer Conference and direct to: Ralph D. Kopperman, City College of New York, New York, New York 10031; MATHRDK@CCNYVME.BITNET. FAX: (212) 650-6970.

Faculty Workshop on Computer-Aided Instruction

University of New Hampshire
9–28 June 1991

PROGRAM DESCRIPTION   This National Science Foundation supported workshop targets undergraduate mathematics faculty who teach linear algebra or differential equations, but have minimal experience with computer-aided instruction (CAI). Participants will seek to enhance their teaching by creating CAI materials, e.g., in-class demonstrations, problem sets, syllabi, and operational procedures, that effectively integrate computer technology into their instructional plans. Guest speakers will supplement regular activities with talks and discussions on applications and broad pedagogical issues raised by the use of CAI. Hüseyin Koçak, author of the award-winning PHASER package, will be in residence during all three weeks of the workshop. Other visitors include Gilbert Strang, Deborah Hughes Hallett, Lester J. Senechal, Kathy Heid, Jere Confrey, and Gareth Williams.

APPLICATION INFORMATION   The workshop will provide room and board for thirty participants. Project directors Lee L. Zia and Homer F. Bechtell, both of the University of New Hampshire, have recently distributed detailed information on the program and on the application procedure to department chairs. For further information, contact: CAI Workshop, c/o Department of Mathematics, University of New Hampshire, Durham, New Hampshire 03824; (602) 862-2320; e-mail: l_zia@unhh.unh.edu.

1991 Summer Mathematics Institutes

University of California at Berkeley and Mills College
17 June–26 July 1991

PROGRAM DESCRIPTION   In an effort to increase the number of underrepresented minority and women students seeking careers requiring a PhD degree in the mathematical sciences, the University of California at Berkeley (UCB) and Mills College will each offer a residential summer program for undergraduate students, 17 June–26 July 1991 (thirty students at UCB; twenty-four at Mills). Each participating student will explore two areas of mathematics. The UCB Institute seeks African-American, Mexican-American, Chicano, Puerto Rican, Latino, and American Indian undergraduates. The Mills Institute seeks women of all ethnicities. All applicants must have completed two years of collegiate mathematics with distinction by June of 1991.

APPLICATION INFORMATION   Projected application deadline: **22 February 1991.** For further information, contact: 1991 Summer Mathematics Institutes, c/o Charles A. Dana Center for Mathematics and Science Education, 230 B Stephens Hall, University of California at Berkeley, Berkeley, California 94720; (415) 642-5881. (For a more detailed description of these Institutes, see page four of the November–December 1990 FOCUS.)

Theory and Applications of Discrete Dynamical Systems

Allegheny College
24–28 June 1991

James T. Sandefur of Georgetown University will present the Seventh Annual Allegheny Mountain Section Summer Short Course, "Theory and Applications of Discrete Dynamical Systems," at Allegheny College, 24–28 June 1991.

PROGRAM DESCRIPTION   Professor Sandefur, author of the undergraduate-level textbook, *Discrete Dynamical Systems: Theory and Applications,* recently published by Oxford University, will focus on how the sciences and social sciences have traditionally applied the theory of discrete dynamical systems. The course will develop solution techniques for linear discrete dynamical systems using linear algebra, and will study the stability of nonlinear equations using calculus (linearization) and graphing. In addition, Professor Sandefur will discuss chaos as one possibility when stability fails. He will then apply the results to genetics, economics, Markov chains, harvesting, and medicine. The course will use the TI-81 graphing calculator to enhance the material.

FEES AND INFORMATION   Course expenses include $115 for tuition and $95 for room and board. For further information, contact: Richard F. McDermot, Department of Mathematics, Allegheny College, Meadville, Pennsylvania 16335; (814) 332-3393; or David M. Wells, Department of Mathematics, Penn State University, New Kensington, Pennsylvania 15068; (412) 339-6049.

Conference Honors Howard Eves
University of Central Florida   9–11 May 1991

Howard Eves

Howard Eves, the eminent teacher, geometer, and historian of mathematics, truly ranks as a national treasure. His career spans a broad mathematical spectrum, from that of the junior high school teacher to that of the university research professor. After thirty years, his volume on the history of mathematics, *Introduction to the History of Mathematics,* remains the leading text for that subject. In addition, he has published more than 15 books and more than 100 papers in journals that range from *The Mathematics Teacher* to *The American Journal of Physics.* He edited the "Elementary Problems and Solutions" section of *The American Mathematical Monthly* for 25 years, and for several years edited the "Historically Speaking" section of *The Mathematics Teacher.* Clearly, Howard Eves' career interests in teaching, history, and geometry provide an ideal setting within which mathematics teachers and university professors can discuss their experiences and research. In the year which marks the eightieth anniversary of Eves' birth, it is a fitting tribute, indeed, that a conference be organized which brings together representatives of these diverse groups to discuss common interests and to learn from others' perspectives.

PROGRAM DESCRIPTION   The organizers have designed this international conference, open to all members of the mathematics community, to appeal to a wide audience—from the secondary school mathematics teacher to the university research mathematician. Keynote speakers include Clayton W. Dodge of the University of Maine; Peter J. Hilton of the State University of New York at Binghamton; Murray S. Klamkin of the University of Alberta; Bruce E. Meserve of the University of Vermont; V. Frederick Rickey of Bowling Green State University; Marjorie Senechal of Smith College; and, of course, Howard Eves. The program also includes parallel workshop and contributed paper sessions of shorter duration. In addition, we invite participants to join a banquet-birthday party for Professor Eves on Thursday evening and, then, on Friday, to visit the International Science Fair, also in Orlando. Indeed, we encourage participants to serve as judges for this fair.

ABSTRACTS   Furthermore, the conference organizers seek both contributed papers on the history of mathematics, geometry, and mathematics education and fifty-minute mathematics workshops for secondary school teachers. Interested mathematicians should submit a one-paragraph summary of approximately one hundred words concerning their proposed paper or workshop by **1 March 1991.**

REGISTRATION   The conference will be held from Thursday, 9 May 1991 through Saturday, 11 May 1991 at the University of Central Florida in Orlando, Florida. We require advance registration for all participants since the number of attendees is limited. For further information, contact: Joby Anthony, Department of Mathematics, University of Central Florida, Orlando, Florida 32816-6990; (407) 823-2700; FAX: (407) 281-5156.

Geometry in the Machine Age

Mount Holyoke College
1–26 July 1991

PROGRAM DESCRIPTION   Amherst, Hampshire, Holy Cross, Mount Holyoke, Smith, and Williams Colleges and the University of Massachusetts at Amherst will host a National Science Foundation (NSF) funded Regional Geometry Institute entitled, "Geometry in the Machine Age." The Institute's first year will focus on optimization problems in geometry. We have invited as principal lecturers Marcel Berger of the Institut des Hautes Etudes Scientifiques, Richard S. Palais of Brandeis University, and Chuu-Liang Terng of Northeastern University. Frederick J. Almgren, Jr. of Princeton University, Thomas F. Banchoff of Brown University, David A. Hoffman of the University of Massachusetts at Amherst, and Frank Morgan of Williams College have also agreed to deliver lecture series.

The Institute will draw together geometry researchers, high school faculty, education researchers, and undergraduate and graduate students; we expect substantial interaction among these groups. Furthermore, the Institute seeks forty geometers who demonstrate:

1. an established research program (or active research interests) in the area of focus (e.g., minimal surfaces, calibrations, harmonic maps, isoparametric foliations); and

2. an openness to educational activities and a willingness to engage in discussion with members of our profession outside of university mathematics departments.

APPLICATION INFORMATION   Submit a letter of interest, a research plan, and a curriculum vitae listing two references to the address below. The Institute will extend preference to those individuals who can participate in the Institute's program for its entire month's duration. In addition, the Institute will pay for lodging, meals, and transportation; participants not supported by regular NSF grants will also receive a modest stipend. Finally, the Institute will help participants arrange suitable child care for accompanying children. For further information, contact: Donal B. O'Shea, NSF RGI Program, Five Colleges, Incorporated, PO Box 740, Amherst, Massachusetts 01004; e-mail: geometry@mhc.bitnet or geometry@math.umass.edu.

Mathematical Scientists in Their Youth

Boston University
30 June–10 August 1991

PROGRAM DESCRIPTION   The Program in Mathematics for Young Scientists (PROMYS) offers a lively mathematical environment in which ambitious high school students explore the creative world of mathematics. Through their intensive efforts to solve a large assortment of unusually challenging problems in number theory, the participants practice the art of mathematical discovery—numerical exploration, formulation and critique of conjectures, and techniques of proof and generalization. More experienced participants may also study algebra, combinatorics, and the theory of algebraic curves. Problem sets are accompanied by daily lectures given by research mathematicians with extensive experience in Professor Arnold E. Ross' long-standing Summer Mathematics Program at Ohio State University. In addition, the program includes a highly competent residential staff—eighteen college-age counselors live in the dormitories and are always available to discuss mathematics with students. Furthermore, each participant belongs to a problem-solving group which meets with a professional mathematician three times per week. Special lectures by outside speakers offer a broad view of mathematics and its role in the sciences.

ADMISSION GUIDELINES AND FEES   PROMYS is a residential program designed for sixty ambitious high school students entering grades ten through twelve. The program will base its admissions decisions on the following criteria: applicants' solutions to a set of challenging problems included with the application packet; teacher recommendations; high school transcripts; and student essays explaining their interest in the program. Costs to participants include $1,150 for room and board and an additional $100 for books. **Financial aid is available.** PROMYS is dedicated to the principle that no student will be unable to attend because of financial need.

APPLICATION INFORMATION   Professors Glenn H. Stevens and David Fried of Boston University direct PROMYS. To obtain application materials, contact: PROMYS, Department of Mathematics, Boston University, 111 Cummington Street, Boston, Massachusetts 02215; (617) 353-2560. The program will accept applications from **1 March** until **15 June 1991.**

Calculus Renewal: Adaptation, Refinement, and Implementation

The National Science Foundation (NSF) seeks calculus proposals that emphasize the Foundation's new direction towards "Adaptation, Refinement, and Implementation." Proposals funded under this thematic may be regional or local and should adapt, refine, and implement new approaches to calculus instruction previously developed and tested on at least a small scale. At each participating institution, these projects will involve substantial proportions of the calculus students and of the faculty who normally teach calculus. The NSF need not have supported the approaches adapted. The recently published MAA Note 17, *Priming the Calculus Pump: Innovations and Resources,* edited by Thomas W. Tucker, discusses several approaches now under development. These approaches address issues such as integration of content and computer technology, applications rooted in reality, laboratory experiences, amplified student participation, and the need to explore vital mathematical *concepts.*

Priming the Calculus Pump:

Innovations and Resources

In addition, as in past years, the NSF will continue to fund especially promising curriculum development projects. Currently, the NSF supports several pilot projects concerned with the differential equations and linear algebra topics typically included in two-year calculus sequences. The NSF especially desires curriculum proposals in these topic areas, as well as in the core calculus. Projects that include features similar to those being addressed by other calculus curriculum development projects should demonstrate how the proposed project improves upon or significantly differs from the similar project.
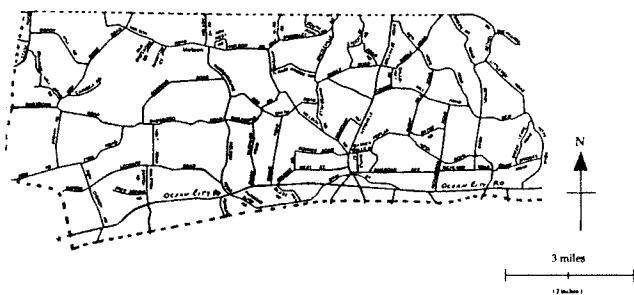
The closing date for proposals is **8 February 1991.** For further information, including the program announcement, contact: John S. Bradley, USEME Room 639, the National Science Foundation, 1800 G Street Northwest, Washington, DC 20550; (202) 357-7051; jbradley@note.nsf.gov (Internet) or jbradley@nsf (Bitnet).

Mathematical Contest in Modeling 1990

Rear vertical section

164	442	1320	414	188
480	7022	14411	5158	352
2091	23027	28353	13138	681
789	21260	20921	11731	727
213	1303	3765	1715	453

Front vertical section

163	324	432	243	166
712	4055	6098	1048	232
2137	15531	19742	4785	330
444	11431	14960	3182	301
294	2061	1036	258	188

Two Snow Plow Problem

The solid lines on the map below represent paved, two-lane roads in a snow-removal district in Wicomico County. The broken lines are state highways. After a snow fall, two plow-trucks are dispatched from a garage that is about 4 miles west of each of two points (*) marked on the map. Find an efficient way to use two trucks to sweep snow from the county roads. The trucks may use the state highways to access the county roads.

Assume that the trucks neither break down nor get stuck and that the road intersections require no special plowing techniques.
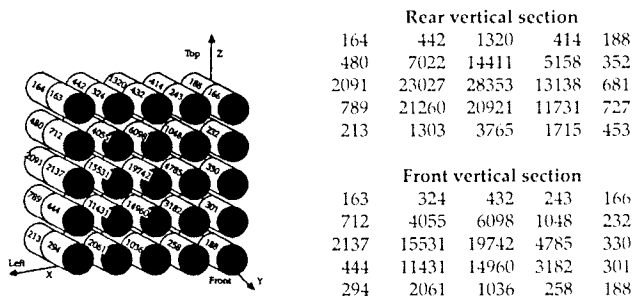
N

3 miles

Brain-Drug Problem

Researchers on brain disorders test the effects of the new medical drugs—for example, dopamine against Parkinson's disease—with intracerebral injections. To this end, they must estimate the size and shape of the spatial distribution of the drug after injection, in order to estimate accurately the region of the brain that the drug has affected.

The research data consists of the measurements of the amounts of drug in each of 50 cylindrical tissue samples. Each cylinder has length 0.76 mm and diameter 0.66 mm. The centers of the parallel cylinders lie on a grid with mesh 1 mm x 0.76 mm x 1 mm, so that the cylinders touch one another on their circular bases but not along their sides, as shown in the accompanying figure above. The injection was made near the center of the cylinder with the highest count. Naturally, one expects that there is drug also between the cylinders and outside the region covered by the samples. Estimate the distribution in the region affected by the drug. One unit represents a scintillation count, or 4.753×10^{-13} mole of dopamine. For example, the table shows that the middle rear cylinder contains 28,353 units.

B. A. Fusaro

During a weekend in late February 1990, 235 teams of three undergraduates each, oblivious to all pessimism concerning the state of mathematics education, attacked two tough, tricky, but realistic problems in applied mathematics. These student teams met the challenge of the sixth Mathematics Contest in Modeling (MCM). In addition to their creativity and knowledge, they were permitted to use libraries, microcomputers, or any other inanimate source.

On Friday morning, MCM faculty advisors opened their problem packets and entrusted their teams to choose one of the two problems before noon. The students' objective? To deliver a typed solution by 11:59 pm the following Monday. In 1990, the MCM featured two intriguing problems dealing with a brain drug and with snow plows.

Yves Nievergelt of Eastern Washington University submitted the "Brain Problem," chosen by 73 teams. The problem poses a slightly simplified version of an actual medical situation that suggests mathematical applications. In particular, it challenges the teams to estimate the distribution of a drug (e.g., dopamine, in the care of Parkinson's disease) after intracerebral injection. The MCM problem also specified fifty cylindrical tissue samples.

The judges designated fifteen teams as Meritorious and selected two of them as winners. The two winning teams and their advisors are California Polytechnic State University, San Luis Obispo (Thomas D. O'Neil) and Humboldt State University (Charles M.

Biles), also in California. Both teams employed partial differential equations to model the diffusion process. The California Polytechnic State University team used spherical symmetry and Fick's law. The Humboldt State University team ddid not assume symmetry but did make assumptions about instantaneous point sources.

Kirk Banks, roads engineer for Wicomico County in Maryland, suggested the "Snow Plow" problem. Essentially, he wanted to know how to assign three snow plows to a section of roads, and 162 teams offered Banks an answer. This snow plow or street-sweeping problem remains an old mathematical chestnut when involving one vehicle. However, multiple vehicles impart a new and daunting wrinkle to the problem. I changed the number of plows from three to two, mistakenly believing this complication would have overwhelmed the teams. It might have taxed the judges, but there is every evidence that most of the teams could have handled a three-plow problem. The judges designated twenty-six teams as Meritorious and selected four of them as winners.

The four winning teams and their advisors are Rose-Hulman Institute of Technology (Arlo W. Schurle), Southern Oregon State University (Kemble R. Yates), the US Air Force Academy (W. E. Skeith), and the University of Alaska at Fairbanks (John Patrick Lambert). These four teams used fairly similar approaches. They assigned plowing time as the main measure of efficiency and then constructed two Euler circuits of approximately equal length. *(Modeling continues on page twelve.)*

Photograph courtesy of Ben A. Fusaro

Photograph courtesy of Ben A. Fusaro
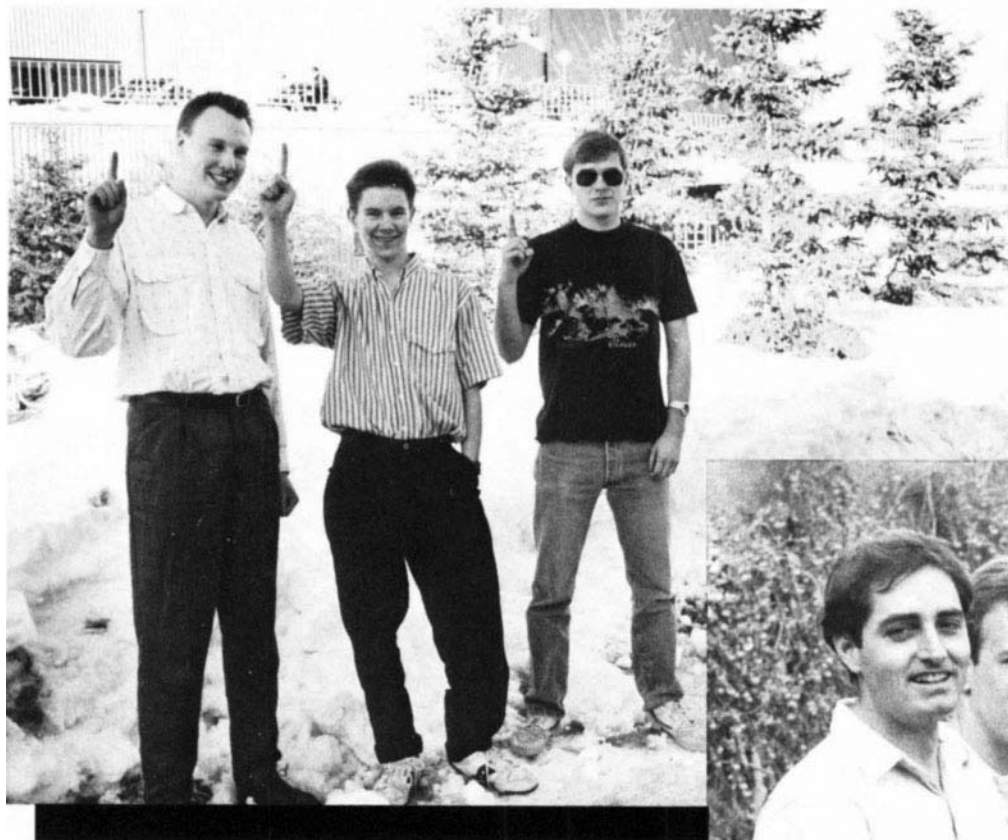
Above (left to right): **John Miller, Chris Hartman, and Kirk Hogenson of the University of Alaska at Fairbanks assigned two snow plows to sweep the roads of Wicomico County, Maryland. Their efforts earned top honors in the 1990 MCM.**

Right (left to right): **Members of the winning team from Humboldt State University: Gian Pauletto, Christopher Malone, Jim Zoellick, and their Coach, Professor Charles Biles. These students estimated the spatial distribution of dopamine after intracerebral injection.**

*(**Modeling** continued from page eleven.)*
Readers interested in learning more about 1990 MCM should consult the Fall 1990 issue of the UMAP journal—it includes a complete statement of the problems and the six winning solution papers, as well as critiques and other contest data.

The schools of the six winning teams received beautiful bronze plaques. Furthermore, the Operations Research Society of America (ORSA) tapped two teams for an all-expenses-paid presentation at its May 1990 meeting in Las Vegas, Nevada. The ORSA-designated winners include Humboldt State University and the University of Alaska. The Society for Industrial and Applied Mathematics (SIAM) also invited two of the teams to present their results at its July 1990 meeting in Chicago, Illinois. The presentation included an awards ceremony and cash prizes. The SIAM-designated winners are the California Polytechnic State University and Rose-Hulman Institute of Technology.

The MCM experience over the last five years has made it abundantly clear that mathematics undergraduates, no less than those in biology or chemistry, are capable of intense and serious work. It is worth noting, too, that a variety of institutions, both large and small, public and private, have produced outstanding teams.

The Consortium for Mathematics and Its Applications (COMAP), which administers the Mathematical Modeling Contest, urges faculty members to sponsor a team for their undergraduates in 1991. To encourage and facilitate participation, COMAP distributed announcements to all department heads in October 1990. If you have not yet received an announcement and wish to learn more about the contest, contact: B. A. Fusaro, Department of Mathematics, Salisbury State University, Salisbury, Maryland 21801, (301) 543-6470; or COMAP, 60 Lowell Street, Arlington, Massachusetts 02174, (617) 641-2600. The 1991 Mathematical Contest in Modeling weekend begins on Friday the first of March, 1991. ∎

B. A. Fusaro, Professor of Mathematics at Salisbury State University in Salisbury, Maryland, originated and continues to direct the Mathematical Contest in Modeling.

1990 Annual AMS-MAA Survey

The first report on the 1990 Survey includes information on new doctorates and their salaries, salaries of faculty in four-year colleges and universities, and the names and theses titles for members of the 1989–1990 PhD class. The AMS-MAA Data Committee, its chair, Edward A. Connors, and Donald E. McClure, author of the *First Report,* based this report on information collected from questionnaires distributed in May 1990 to departments in the mathematical sciences in colleges and universities in the United States and Canada and, later, to the recipients of doctoral degrees granted by these departments between July 1989 and June 1990, inclusive. In September, the committee distributed a second questionnaire, concerned with data on fall enrollments, majors, and departmental size. The data gathered from this additional questionnaire will appear in the *Second Report* on the 1990 Survey in a spring issue of *Notices* of the American Mathematical Society. A spring issue of FOCUS will include highlights from this *Second Report.*

In the period 1 July 1989 through 30 June 1990, US institutions awarded 933 doctorates in the mathematical sciences. This represents a 3% increase over last year and is 15% greater than the average of the fall counts for the last four years.

US citizens received 401 or 43% of these 933 doctorates awarded—the lowest percentage ever reported. The relatively high number of new doctorates awarded to non-US citizens explains, in part, this low percentage. Furthermore, the number of US citizens receiving doctorates is slightly lower than the number reported last year, and still strikingly lower than the numbers reported up to the early 1980s. It remains, however, 10% above the record low numbers reported in 1986–1987 and 1987–1988.
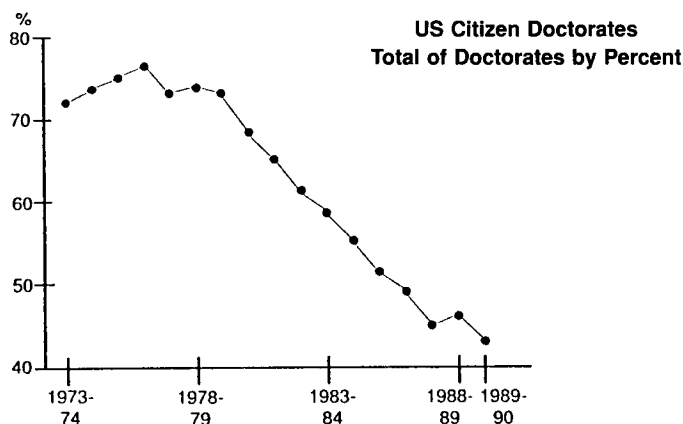
Women earned 22% of the US citizen doctorates—less than the historical high of 24% in 1988–1989, and equal to the percentage awarded to women over the preceding years.

Of the new doctorates hired in US doctorate-granting departments, 17% were women, while 18% of the new doctorates (regardless of citizenship) were women.

Of the 401 US citizen doctorates, only 4 were black. The higher number (9) reported in 1988–1989 apparently does not signal a trend of increased representation of blacks among new doctorates.

Median starting salary of new doctorates reporting teaching (or teaching and research): $32,000 for men and $32,500 for women.

A detailed report of the 1990 AMS-MAA Survey appears in the November 1990 *Notices,* pages 1217–1230. For a reprint of this complete report, contact: Monica Foulkes, AMS, PO Box 6248, Providence, RI 02940; (401) 272-9500.

US Citizen Doctorates
Total of Doctorates by Percent

People in the News

The University of Waterloo in Ontario, Canada awarded **Paul R. Halmos** an honorary doctorate in mathematics during its Spring Convocation in 1990. Halmos, who also delivered that university's Convocation Address, accepted the degree in recognition of "[his] outstanding contributions to mathematics, both through [his] own research and writings and through the profound influence [his] work has had on students, teachers, and scholars throughout the world."

Denison University in Granville, Ohio, recently appointed **Zaven A. Karian** to its Benjamin Barvey Chair of Mathematics, one of the university's most prestigious chairs.

Warren Page, Professor of Mathematics at New York City Technical College of the City University of New York, recently received the 1990 Mathematics Excellence Award of the American Mathematical Association of Two-Year Colleges (AMATYC). Dr. Page accepted the award during AMATYC's annual meeting in Dallas, Texas. This award, presented every two years, recognizes a mathematics educator who has made an outstanding contribution to mathematics and/or mathematics education at two-year colleges.

Deborah Tepper Haimo, MAA President-Elect, recently joined Harvard University's Board of Overseers after winning election to that advisory body.

Every four years, during the International Congress of Mathematicians (ICM), Fields Medal recipients are announced. This medal, comparable to the Nobel Prize, remains the most prestigious award in mathematics. It recognizes mathematicians under the age of 40 whose seminal research suggests current and future progess in mathematical exploration. On the 21 August 1990 in Kyoto, Japan, at ICM-90, the following mathematicians received Fields Medals:

- **Vladimir Gershonovich Drinfeld** of the Institute for Low Temperature Physics and Engineering in Kharkov, USSR. Drinfeld's research, related to mathematical physics, centers on the theory of quantum groups.

- **Vaughan F. R. Jones** of the University of California at Berkeley. Jones discovered an equation, the "Jones polynomial," that offers the best route yet available for distinguishing knots from one another.

- **Shigefumi Mori** of the Research Institute of Mathematical Sciences of Kyoto University in Japan. Mori's interest in algebraic three-dimensional manifolds recently extended classical theory of algebraic surfaces to three dimensions.

- **Edward Witten** of the Institute for Advanced Study at Princeton University. Witten's research explores the relationship between the differential topology of two- and three-dimensional manifolds and quantum field theory.

Zaven A. Karian   Warren Page

Congress Seeks Excellence in Mathematics, Science, and Engineering Education

Lisa A. Thompson

In its waning days, the 101st Congress passed comprehensive science and mathematics education legislation, the result of numerous hearings over the past two years on at least a dozen proposals from House and Senate members, as well as from President Bush. Although it endured the usual partisan sniping and interbranch differences of opinion, the package survived on its merits through the concerted efforts of influential legislators who made mathematics and science education a top priority. The bill was passed by a Congress that shares with the scientific community a belief that high quality mathematics and science education at all levels is absolutely crucial to the future of the nation's security and prosperity.

"The Excellence in Mathematics, Science, and Engineering Education Act" authorizes over $150 million for new and existing programs, including $125 million for education and human resources programs at the National Science Foundation (NSF). Declaring that the federal government has a "significant role in promoting the study of mathematics and science," the package is designed to encourage American students to pursue careers in mathematics, science, and engineering; improve the quality of teaching in mathematics and science made available to all Americans; have American students rank first in the world in mathematics and science; substantially increase the number of graduates with degrees in mathematics, science, and engineering; and, substantially increase the number of women and minorities pursuing careers in mathematics, science, and engineering.

Addressing Congressional concern that some US universities place too much emphasis on research at the expense of education, the Act provides for a new NSF program of competitive, merit-based grants to college and university professors with records of excellence in teaching. The grants are to be used for developing innovative curriculum or teaching methods, purchase of educational equipment, support for research or professional activities, and support of teaching fellows. Criteria for the awards specifically include the commitment of the institution to improving undergraduate education and considering undergraduate instruction when determining faculty compensation and promotion, as well as evidence that faculty members have kept current with research in their field. Institutions that receive grants will be designated Centers of Excellence for Undergraduate Teaching.

The new law also authorizes a gradual increase in NSF spending on graduate fellowships to bring the number awarded to 1,200 per year by fiscal year (FY) 93, for a total cost of $37.9 million this year (FY 91) and $67.8 million in FY 93. It also directs the NSF to ensure that the number of fellowships going to women and minorities increases substantially every year through the year 2000. The NSF is also authorized to spend $10 million this year on a graduate traineeship program for colleges and universities that are attended by few NSF fellows, but are committed to upgrading their capacities for high quality research and to graduating significant numbers of women and minorities in mathematics, science, and engineering.

The NSF's women and minorities programs are to be expanded with $17 million in increased support this year for institutions to make women and minority faculty members available to those that have few such faculty; for colleges and nonresearch universities to attract and retain women and minority faculty members; and for alliances among research universities and institutions with predominantly minority enrollment.

. . . high quality mathematics and science education at all levels is absolutely crucial to the future of the nation's security and prosperity.

(**Excellence** continued from previous page.)
The Department of Education, in cooperation with the NSF, is authorized by the Act to spend almost $10 million this year and increased amounts in following years on three new scholarship programs that would provide money to over 6,000 undergraduates every year after the fourth year of full enactment of the programs. **National Science Scholarships** are to be awarded each year to two high school seniors, at least one of whom is female, from every Congressional district. Each award will be up to $5,000 per academic year for four years, depending on the recipient's cost of attendance and on the amount appropriated to the Department to spend on the program. Scholars are to be chosen on the basis of demonstrated achievement in the physical, life, or computer sciences, mathematics, or engineering and must continue to major and excel in one of these fields to receive the funds. From among nominations by state review panels, the President, in consultation with the Secretary of Education and the Director of the NSF, selects the recipients.

Robert Noyce Scholarships are for undergraduates in the third and fourth years of study majoring in and demonstrating high academic achievement in physical, life, or computer sciences, mathematics, or engineering degree programs. From nominations submitted by a merit review panel, the President selects up to 500 recipients every year. After graduation, scholarship awardees, to be known as the Robert Noyce Mathematics and Science Teaching Corps, will be required to teach in US secondary or elementary schools for two to four years, depending on the number of award-years, or to repay the amount awarded plus interest. Each award will be up to $5,000 per academic year required to earn the degree, and if necessary, up to $5,000 for another year to complete education courses required to fulfill the obligations of the award. The amount of each scholarship will depend on the recipient's cost of attendance and on the amount appropriated to the Department.

The **National Science, Space, and Technology Corps** is to be selected from among nominations by members of the House of Representatives. Every year, one high school senior who has excelled in and plans to major in the physical, life, or computer sciences, mathematics, or engineering will be chosen from every Congressional district and will receive up to $5,000 per academic year for four years, depending on the recipient's attendance costs and on the amount appropriated to the Department to spend on the program. Awardees can attend any US institution of higher education, and those institutions enrolling members of the corps will be members of the National Academy of Science, Space, and Technology. Members of the corps will be required to spend four years working in the physical, life, or computer sciences, mathematics or engineering in the employ of the United States or a US company or pursuing postgraduate education in one of these fields. Those failing to complete this service obligation must repay the award amount with interest. All three scholarship programs provide for special consideration of the financial need of nominees and the promotion of participation by minorities and persons with disabilities.

At the precollege level, the law allows for new and expanded programs at both the NSF and the Department of Education, agencies Congress would like to see cooperate more in the area of mathematics and science education. This section of the legislation is also designed to encourage the formation of alliances among states, state education agencies, colleges, universities, nonprofit associations, and industry. The Department is authorized to make competitive, merit-based awards totalling $17 million to a network of regional consortia to disseminate exemplary instructional materials and to provide technical assistance for their implementation in mathematics and science classes in elementary and secondary schools. These consortia would work with a Department-supported national clearinghouse for educational programs and materials, to which curricula developed with federal funds would be deposited. The regional consortia and the national clearinghouse are required to obtain nonfederal contributions.

The Department is also provided with authority to make grants to model programs for training and instruction in the use of computers as part of precollege mathematics and science curricula, with emphasis on programs that integrate higher order analytical and problem-solving skills into the curricula. The NSF is authorized to undertake a complementary, merit-reviewed program to develop and expand the uses of innovative technologies for mathematics and science instruction. The NSF is also authorized to spend $17 million more this year on informal mathematics, science and technology education in the form of grants to public science-technology centers—museums, planetariums, libraries, zoos, aquariums, etc.—for the development of interactive exhibits and programs; replication and dissemination of effective programs; and development of new centers. And the law states that $17 million more can be spent on grants to education agencies for systemic reform of mathematics and science education, a program undertaken just recently by the NSF.   ■

Curriculum Action Project

As a first step towards implementing recommendations from the forthcoming Mathematical Sciences in the Year 2000 (MS 2000) project, the MAA intends to prepare a volume containing an agenda of curricular issues—beyond calculus—that college and university mathematicians must address during the next several years. This "Curriculum Action Project" will highlight four themes: statistics, geometry, quantitative literacy, and assessment. In addition, the volume will include other topics to the extent that the Association receives suitable proposals or reports.

We invite MAA members to submit for review and possible inclusion in this curricular volume short documents that reflect well-developed curricular plans from different campuses. The Association eagerly seeks to disseminate exemplary statements of objectives or curricular strategies originally developed for local purposes but helpful in framing other colleges curricular discussions. We especially welcome contributions dealing with statistics, quantitative literacy, geometry, and assessment, as well as statements on other curricular areas needing revitalization.

Submit contributions to: James R. C. Leitzel, Curriculum Action Project, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385.
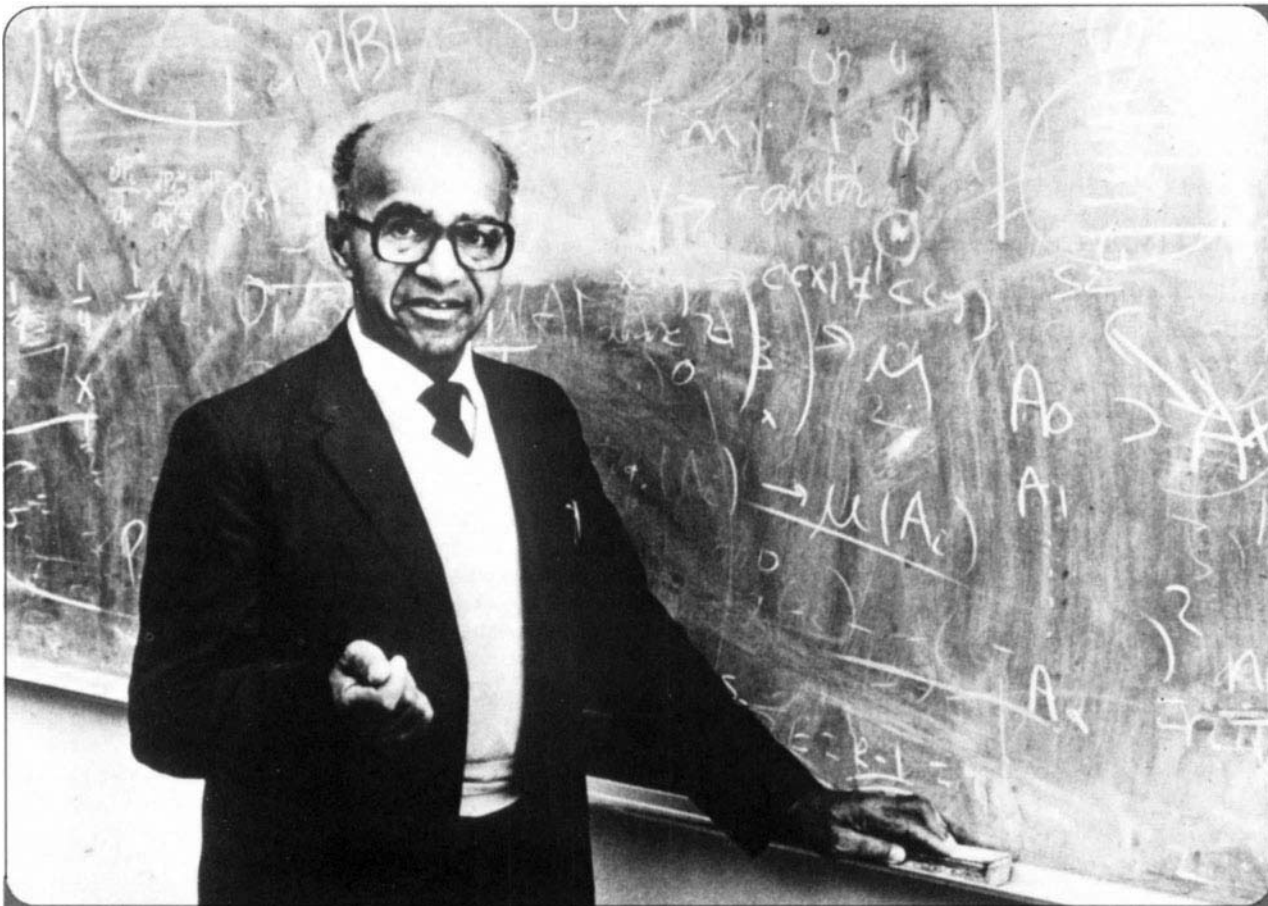
FOCUS on Underrepresented Minorities in Mathematics

Minorities and Mathematics: Overcoming the Obstacles

William A. Hawkins, Jr.

The Eastern Pennsylvania and Delaware Section of the MAA (EPADEL) sponsored a day-long, very successful symposium, "Underrepresented Groups in Mathematics: Overcoming the Obstacles," on 13 October 1990 at the Community College of Philadelphia (CCP). This symposium, coordinated by Professor Joanne Darken of CCP, is a model Sectional activity concerning issues of vital importance to the MAA and to the future of American mathematics. The symposium grew out of conversations among EPADEL members, and the planning committee for it attracted a number of minority mathematicians previously unaffiliated with the MAA. The committee hopes to sponsor more activities in the future.

A brief welcome by Dr. Ronald Temple, president of CCP, preceded the morning session of two invited addresses on "Nurturing the Next Generation of Mathematicians, Especially Minorities." The dynamic speakers—Dr. Johnny Houston of Elizabeth City State University and Executive Director of the National Association of Mathematicians (NAM), and Dr. Uri Treisman of the University of California at Berkeley and Swarthmore College and Director of the Charles A. Dana Center—inspired and informed the audience.

Professor Houston identified the underrepresented groups as native, Hispanic, and African Americans. He gave facts about blacks and mathematics (eighteenth century–twentieth century), three twentieth century world-class black mathematicians, the present demographic picture, and how to nurture all students. He began with Benjamin Benneker (1731–1806), the self-taught mathematician and astronomer who did the daily field observations needed to correctly determine latitude and longitude in support of the survey of the federal district of Washington. He spoke next about Edward Alexander Bouchet (mathematical physics, Yale University, 1876) who was not only the first black PhD, but also one of only six PhDs in physics and one of only twenty PhDs in the US at that time in all fields. He told us of the first blacks to earn doctorates in mathematics: Elbert Frank Cox (Cornell University, 1925), Dudley Woodward (University of Pennsylvania, 1928), William W. S. Claytor (University of Pennsylvania, 1933), and Walter Talbot (University of Pittsburgh, 1934). Talbot also founded NAM in 1964. Houston remarked that the oldest, historically black university, Cheyney State University, was founded in 1837 in Pennsylvania.

The three world-class mathematicians are David Blackwell, the late Albert T. Bharucha-Reid, and J. Ernest Wilkins. Blackwell, the only black member of the National Academy of Sciences, recently retired from the Department of Statistics at the University of California *(**Overcoming** continues on next page.)*

(Overcoming continued from previous page.)
at Berkeley after twenty-five years. Bharucha-Reid never earned a degree beyond a BS in mathematical biology, but wrote over 75 refereed articles and several books, chaired the Department of Mathematics at Wayne State University for many years, and was a Distinguished Professor at Georgia State and Atlanta Universities. Wilkins earned his PhD in mathematics from the University of Chicago in 1942 at age 19 and is a member of the National Academy of Engineering. A former president of the American Nuclear Society, Wilkins is a frequent consultant to the government on nuclear matters and now teachers at Clark Atlanta University.

Houston estimated that 200–250 blacks hold PhDs in mathematics in this country and presented demographics. According to statistics from the American Mathematical Society, US blacks earned 131 (1.47%), US Hispanics 74 (0.83%), and native Americans 32 (0.36%) of the doctorates awarded in the mathematical sciences from July 1973 through June 1990. This is far below the corresponding population percentages of 12% for blacks, 9% for Hispanics, and 0.7% for native Americans. The percentage of minorities in the population is growing, but these groups are least represented in mathematics and science. In the meantime, the need for trained personnel in these fields is growing rapidly.

Houston concluded with some remarks on nurturing students. His suggestions include encouragement and support of mathematics students at all levels, excellence of teaching coupled with high motivation and expectations, and guidance of students into nonparasitic study groups. He strongly urged advocacy of the idea that the average person can do mathematics.

Professor Treisman, whose mentor was Leon A. Henkin, described his work at Berkeley with minority calculus students. Initially, neither he nor his colleagues had any knowledge of minority communities. Mathematicians on majority campuses made assumptions about the reasons for the performance of minority students: (1) there was a motivation gap among minorities; and anyway, it was not the mathematician's fault; (2) it was the fault of the high school teachers; (3) it was the fault of their families; (4) it was income-dependent and not affected by ethnicity.

Treisman conducted a study of twenty black and twenty Cantonese students, living with both groups and collecting over eight hundred hours of videotape. On analysis, the first finding was the diversity existing within the groups. No pattern emerged until John Ogbun, an African psychologist at Berkeley, helped. Treisman discovered that these minority students were highly motivated, had excellent backgrounds, but the best students failed first.

Blacks and blue-collar white students were found to be highly self-reliant and spent the suggested 6–8 hours studying calculus per week. On the other hand, the Asians averaged 14.2 hours study per week—8–10 hours alone and the remainder together. They reviewed problems where there was disagreement among various answers until the correct one was found. The very traits of self-reliance and independence instilled into black students contributed to their downfall. But, in visiting several historically black colleges, he found self-reliant students there to be successful.

Treisman commented that calculus is harder and more compressed these days. Traditionally, departments of mathematics have not been interested in the underrepresentation issue but have relegated it to academic support centers. Senior faculty need to take the leading role in working on these problems in Treisman's opinion. It cannot be the province of younger faculty, no matter how enthusias

Opposite, above. **David Blackwell of the University of California at Berkeley. Blackwell remains the only black member of the National Academy of Sciences.**

tic. They do not have the departmental clout nor can they afford to neglect their publication record. According to Treisman, fifty institutions have started Emerging Scholars programs. He believes that departments must work on building academic communities. This point of view is borne out by Professor Treisman's survey of the ten high schools in the country producing the greatest number of minorities scoring at least 3 on the AP Calculus examination. The senior faculty in these places have strengthened the basic courses and built an academic community inside the school. Fewer than 1,200 black students nationwide have mathematics SAT scores of 600 or more. He urged mathematicians to treat them as national treasures. Strong teachers are needed to work with ninth graders. It turns out that eighth grade attendance is the best indicator for academic success in high school and beyond.

Houston and Treisman answered audience questions for a short while after lunch. Professor William A. Hawkins, Jr., Director of SUMMA (Strengthening Underrepresented Minority Mathematics Achievement), briefly described the SUMMA Program (see page 19 in this issue of FOCUS for additional information on SUMMA). In the afternoon, there were two panels, "Filters in the Pipeline," moderated by Joan Countryman of Germantown Friends School, and "Pumps in the Pipeline," moderated by Marvin L. Brubaker of Messiah College.

Members of the first panel discussed negative experiences associated with being a black or female mathematics student that discouraged them from becoming mathematicians. They also identified circumstances that helped them overcome the obstacles. Perseverance was the key despite the inhospitableness of the graduate programs at many majority institutions. One panelist related how sexism of both faculty and male graduate students caused her to leave one graduate school.

The second panel centered on various institutional programs to assist minority and female students in overcoming academic and other problems. The RISE Program of the University of Delaware, the Comprehensive Regional Center for Minorities of the Philadelphia Renaissance in Science and Mathematics (PRISM) and the Bucknell College-CCP transfer program were described. The chair of the mathematics department at a women's college discussed the success of her program in producing women mathematicians.

As a result of the symposium, contacts were made between individuals working toward similar goals. A working community has been established within the Section to share information and plan future meetings. One meeting was held in November at Swarthmore College and involved high school and college teachers.
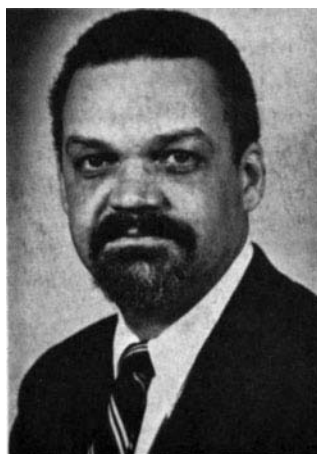
Albert T. Bharucha-Reid   **J. Ernest Wilkins, Jr.**

Black Pioneers in Mathematics:
Brown, Granville, Cox, Claytor, and Blackwell

Jacqueline Giles-Giron

The wholesome survival of a nation depends upon its developing each citizen to full capability. Today, black Americans and other minorities, especially, need inspiration and help. This article highlights the accomplishments of five outstanding black mathematicians as a tribute to those who have overcome social obstacles.

In 1949 Marjorie Lee Brown and Evelyn Boyd Granville became the first black women to receive doctorates in mathematics. **Marjorie Lee Brown** (1914–1979), a woman with a supportive father, a melodious voice, and natural beauty, received her PhD from the University of Michigan. Her dissertation was written under G. Y. Rainich. In 1955, the *American Mathematical Monthly* published her article, "A Note on the Classical Groups." In 1965, she continued her study of differential topology as a National Science Foundation fellow at Columbia University. She was on the faculty of North Carolina Central University from 1949 to 1979, serving as department head from 1951 to 1979. She died suddenly only a few months after retirement.

Evelyn Boyd Granville received her PhD from Yale University. Her advisor was Einar Hille, a former president of the American Mathematical Society. She had graduated from Smith College summa cum laude in 1945. For sixteen years she was in government and industry, where she did research on space trajectories, helped develop missile fuses, and worked with celestial mechanics. She participated in Project Vanguard, Project Mercury, and the Apollo project. After teaching for seventeen years at California State University in Los Angeles, she "retired" to Texas, where she now teaches part-time.

In 1925 **Elbert Cox** (1895–1969) became the first black man in the world to receive a doctorate in mathematics. He met his advisor, William Lloyd Garrison Williams, when Cox was a traveling Fellow at McGill University in Canada, where Williams was on the faculty. Although Cox officially received his PhD from Cornell University, Williams arranged to have his dissertation also accepted in Japan to establish Cox's position as the first black man in the world to receive a doctorate in mathematics. Cox taught from 1929 to 1965 at Howard University, where he supervised more master's theses than any other member of the faculty.

William Waldron Shiefflin Claytor (1908–1967) became the third black to receive a PhD in mathematics in 1933. He had attended the public schools of Washington, DC, Hampton Institute, and Howard University, from which he received his bachelor's degree in 1929 and his master's degree in 1930. Dudley Welcon Woodard, the second black recipient of a PhD in mathematics, supervised his master's thesis. Claytor then went to the University of Pennsylvania, where he studied under J. R. Kline, who had also been Woodard's dissertation advisor.

Gail Young, a former MAA president and another specialist in point-set topology, has described Claytor's research as "brilliant." Nevertheless, the best position Claytor could obtain in 1933 was at West Virginia State College, a woefully underfunded, segregated school with a very heavy teaching load, scientific isolation, no scientific library, and no opportunity to go to scientific meetings. After he spent three years there, Kline helped Claytor obtain a Rosenwald Foundation fellowship for postdoctoral studies at the University of Michigan. The mathematics faculty there liked and respected Claytor greatly, and tried hard to have him remain with them to fill a vacancy for which he was eminently qualified. Although their efforts were remarkably unanimous and strong, R. I. Wilder observed that "the administration was simply *afraid*." The Michigan mathematics faculty then tried to get Claytor an appointment at the Institute for Advanced Study at Princeton, but racial issues again frustrated their efforts. Claytor then joined the army. After World War II, he joined the faculty of Howard University, from which he retired in 1965.

David Blackwell, one of the most renowned mathematicians in the United States, recognizes Claytor as "a real pioneer" and believes that the effort to obtain Claytor for an appointment at the Institute of Advanced Study made it easier for Blackwell to be admitted a few years later. Blackwell was the first black person in any field to be elected to membership in the National Academy of Sciences. He received three degrees from the University of Illinois, culminating with a PhD at the age of 22 under Joe Doob. When he began college, he had planned to become an elementary school teacher, but instead he became the first black person to join the Institute for Advanced Study in 1941.

Marjorie Lee Brown

Evelyn Boyd Granville

Elbert Cox

SUMMA

William A. Hawkins, Jr.

Strengthening Underrepresented Minorities Mathematics Achievement

SUMMA (Strengthening Underrepresented Minority Mathematics Achievement) was established in August 1990 as a result of recommendations made by the MAA Task Force on Minorities in Mathematics which completed its two-year, ground-breaking work in January 1989. Leaders of the MAA, recognizing the magnitude of the problem of underrepresentation of minorities in the mathematical sciences and mathematics-dependent fields, affirmed that strong moral, societal, and economic justifications exist for this comprehensive, five-pronged national program which has two goals: increase the representation of minorities in the fields of mathematics, sciences, and engineering and improve the mathematical education of minorities. In its September 1989 policy statement, the MAA committed its human and financial resources to provide leadership to carry out these goals, apparently the first professional organization in the country to make such a resolution. Operating with grants from the Exxon Education Foundation, the Carnegie Corporation of New York, and the MAA, the staff of SUMMA is now planning the structure of each of the program's five components and seeking additional funding for these ten-year initiatives.
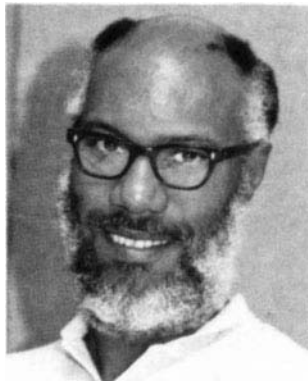
Dr. William A. Hawkins, Jr. directs SUMMA and its programs. An algebraic geometer, Hawkins is on leave from the University of the District of Columbia, the second oldest of the historically black colleges and universities, where he is associate professor and former chair. Dr. Florence D. Fasanelli, recently Associate Program Director at the National Science Foundation, is SUMMA Consultant. The MAA Committee on Minority Participation in Mathematics (CMPM) and its chairs, Dr. Manuel P. Berriozábal of the University of Texas at San Antonio and Dr. Sylvia T. Bozeman of Spelman College, oversee the planning activities. The mission of SUMMA is to challenge and involve the collegiate mathematics community in making fundamental changes in its attitude and practices, particularly with regard to minority students. Each of the five overlapping components, now under development, provide opportunities for every member of the MAA to participate in this mission.

William A. Hawkins, Jr.

The activity that has been given top priority by CMPM is to assist mathematicians in building mathematics-based intervention projects for middle and high school students in each state. Many mathematicians and other scientists have participated in such projects in their youth and easily recognize their importance in the development of an interest in mathematics. Numerous national reports cite intervention projects as the best way to reach minority students at this time. Working locally through the twenty-nine MAA Sections, SUMMA will identify MAA members who want to learn how to replicate existing intervention projects, adapt such projects, or originate projects, disseminate information about successful projects through publications, workshops, and short courses, and provide technical support and advocacy for individuals and local projects. Funding is now being sought to provide small planning grants to mathematicians and institutions interested in hosting intervention projects. Application guidelines for these small planning grants will be distributed at the workshop, "Models of Successful Intervention Projects for Minorities," in San Francisco on 17 January 1991, and are available from the SUMMA office now.

Working in collaboration with the Charles A. Dana Center for Mathematics and Science Education, a project of the Faculty Senate of the University of California at Berkeley, SUMMA will establish MAA-University Alliances for Minority Participation in Mathematics to assist mathematics departments in re-examining their programs, setting goals for minority participation, and establishing programs designed to help them achieve these goals. In this joint venture, the MAA will provide the standards and the infrastructure for dissemination (through publications, short courses, and national and Sectional meetings) of relevant information. Working through the MAA's Sections, SUMMA and high school teachers of underrepresented minorities will encourage the latter to enroll in collegiate mathematics courses.

Another highly significant component is the Program to Attract Minorities into Teaching. In 1990–1991, 5% of precollege teachers in the United States are minorities whereas, in the year 2000, 29% of the students will be black, Hispanic, and native American. As a consequence, most students from groups underrepresented in mathematics, engineering, and science have no acquaintance with appropriate role models. During 1991, SUMMA will develop plans for a multifaceted program to attract minority students into teaching

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The mission of SUMMA is to challenge and involve the collegiate mathematics community in making fundamental changes in its attitudes and practices, particularly with regard to minority students.

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mathematics at all educational levels, in partnership with the National Council of Teachers of Mathematics (NCTM), the Mathematical Sciences Education Board (MSEB), and other organizations.

SUMMA will establish a nationwide mentorship project involving minority professionals in the mathematical sciences. Building on its experience with Blacks and Mathematics (BAM) and Women and Mathematics (WAM), Mentoring Minorities in Mathematics (MMM) will provide new opportunities for minority professionals in the mathematical sciences and mathematics-dependent sciences to serve as mentors in their own communities and on their own campuses.

In its Development Assistance component, SUMMA will disseminate information about sources of funding for projects concerned with minority faculty career development, curriculum updating, and minority student research career opportunities. Technical assistance will be given for the development of proposals through workshops, minicourses, individual consultation, and publications. SUMMA will seek to assist with funding on a broader scale by establishing linkages with many organizations including federal agencies and corporations, informing them about worthy projects in need of funding and other types of assistance.

In particular, SUMMA encourages college and university professors, through their research, teaching, and community activities, to address these two goals—the improvement of education for minorities and the increase of minorities in mathematics. For further information on SUMMA, contact: Dr. William A. Hawkins, Jr. MAA/SUMMA, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385; (202) 387-5200.
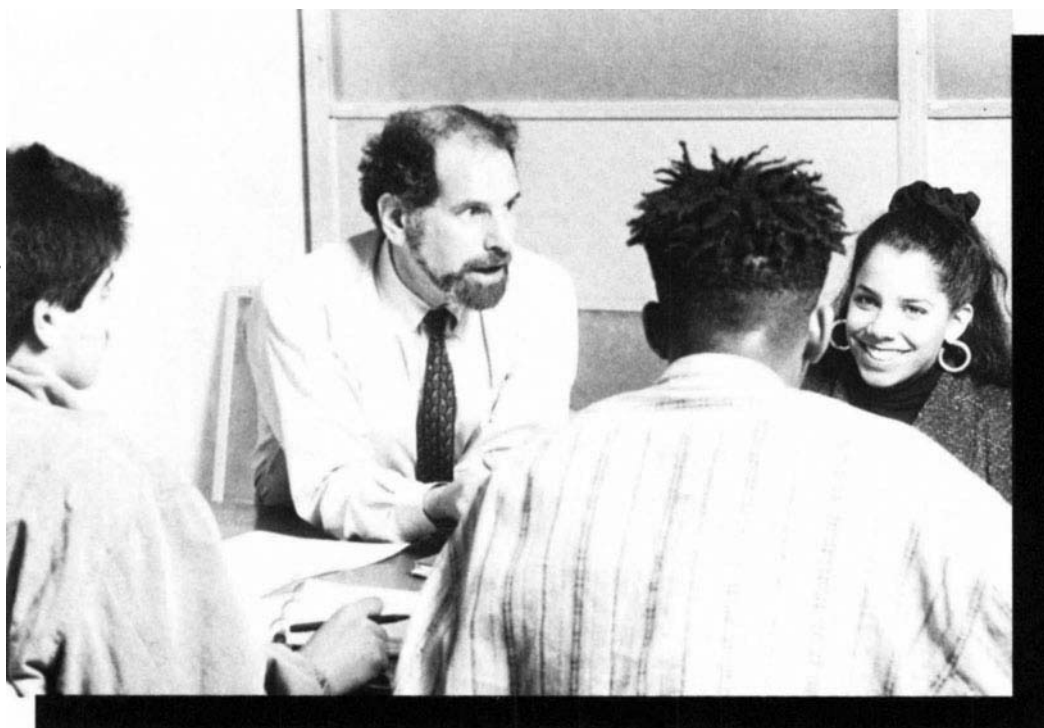
"We will need to create in each of our departments a community life that is invitational, i.e., that truly welcomes our students, all of our students, to mathematics and challenges and inspires them to choose our profession. Such work cannot be accomplished by 'special programs,' but must be an integral and vigorous part of departmental and institutional life."

The Role of Majority Institutions in Developing Minority Students as Mathematics Majors

Remarks made by Uri Treisman at a national convocation, "Making Mathematics Work for Minorities," a program sponsored by the Mathematical Sciences Education Board, 4 May 1990

Looking at the audience, it seems we've succeeded at the inverse task. It looks as if we're making minorities work for mathematics.

The previous speakers have made it clear that there is an enormous amount that college and university faculty can and must do to make "mathematics work for minorities." They have advocated a massive effort aimed at strengthening K–12 education, and, especially, mathematics and science education. Many examples of beautiful programs have been presented at this conference that suggest ways that we as individual mathematicians and mathematics educators can contribute to the solutions of the problems which we have come together to address.

I wish to suggest, however, that the bulk of our energy first must be directed toward getting our own house in order. What sense does it make to bring thousands more minority students into a system which routinely fails to serve them? What sense does it make, and I mean here ethical or moral sense as well as political sense, to mount a massive recruitment effort when, in most institutions, it will take only fifteen weeks to dash hopes and aspirations which we, ourselves, have fostered?

Estimates are that one-third to one-half of the roughly 500,000 freshman who take calculus every year fail it. The proportion that receives grade B or better is abysmally low. What a tragedy. The mathematicians in the audience know that calculus is one of the greatest achievements of western civilization; the subject drips with power. It has rendered thousand-year-old questions immediately transparent. It's hard to imagine a more beautiful subject for teaching, yet, think of the failure rate. Think about how few of these half-a-million students are amazed by the power of the subject. How many of them say, "Holy Cow! That's beautiful!"?

In 1988, the California State University system, which now has twenty campuses in California enrolling more than 100,000 students of color, graduated only eight black or Latino students with baccalaureate degrees in mathematics, chemistry, or physics. Only eight! The record of failure at many of this country's leading colleges and universities is equally alarming. I recently reviewed the transcripts of approximately four hundred black and Latino students who took first-term calculus as freshman at ten highly selective liberal arts colleges over the last several years. Their average grade for this course was 1.7! Those of you who know those institutions and their tuitions know how hard it is to earn a grade below C.

In many institutions, precalculus is the starting point for most minority students. This course is a disgrace and our teaching of it is a disgrace. At Berkeley, in a recent year, 422 students enrolled in Math P, our precalculus course. Only one student, Danny Loscano, went on to earn a grade of B- or better in Math 1B, second-semester calculus. Only one student of the sixty or so students who made As in our precalculus course went on to receive a grade of B or better in Calculus II. In what sense, then, is this course calculus preparatory, if fewer than 1% of the students who enroll in it complete the freshman calculus sequence with some measure of distinction? I'd be happy to learn of a mathematics department in which this rate is greater than 10%. We must make sure that students who excel in one course are prepared adequately for success in the next.

There are many challenges that must be addressed in developing an effective precalculus course. One is that the course lacks mathematical integrity. Its roots lie in high school mathematics, presenting a rather static view of functions, antithetical to that which is useful in the calculus. Second, the course serves too many *(Minority Students continues on next page.)*

(Overcoming continued from page seventeen.)
It is important to remember that minority populations vary around the nation. Many African-Americans are found in the southeastern and northeastern parts of the country. The southwestern region is home to many Hispanic Americans. The largest populations of native Americans are found in western states but North Carolina, Michigan, and New York rank among the top ten states in Indian population. Interestingly, 12 of the 24 tribal colleges are in the states of Montana and North Dakota; Montana State University has established a strong linkage with those colleges in its home state. Section meetings held at minority institutions could serve to involve their faculty and students in the MAA to a much greater extent. It might prove possible to establish student chapters at these institutions as a follow-up to a successful Section meeting.

Organizations such as the American Indian Science and Engineering Society (AISES) are interested in collaborating with the MAA. Section participation would be beneficial at their 1991 annual meeting. SUMMA encourages all Sections to consider activities along these lines and to recognize that progress on resolving the problem of underrepresentation of minorities in mathematics cannot be expected unless they do.

For further information on the October 1990 EPADEL conference, contact: Professor Joanne Darken, Department of Mathematics, Community College of Philadelphia, 1700 Spring Garden Street, Philadelphia, Pennsylvania 19130; (215) 751-8721.

If you are interested in SUMMA, contact: Professor William Hawkins, MAA/SUMMA, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385; (202) 387-5200.   ■

(Pioneers continued from page eighteen.)
After teaching at Howard University from 1942 to 1954, he accepted a position at the University of California at Berkeley. He is now retired from the faculty, but maintains an office there. He wrote recently, "The first three blacks to get a PhD in mathematics—Cox, Woodard, and Claytor—were all three professors at Howard University, and Claytor had been a student there as well. This illustrates the key role played by Howard University in encouraging black scholars."

The accolades to Blackwell are numerous and impressive. They include honorary degrees from the University of Illinois, Michigan State University, Southern Illinois University, and Carnegie-Mellon University. He is an Honorary Fellow of the Royal Statistical Society and received the Von Neumann Theory Prize from the Operations Research Society of America (ORSA). He has been president of the Institute for Mathematical Statistics and vice president of the American Mathematical Society. He delivered an invited address to the International Congress of Mathematics (ICM) in 1954.

The careers of Brown, Granville, Cox, Claytor, and Blackwell sparkle like rare and precious gems in the sunlight. As we review the history of American blacks in mathematics, we appreciate their important contributions and determination.   ■

Jacqueline Giles-Giron teaches mathematics at Houston Community College in Houston, Texas. She earned her master's degree at Texas A&M University.

William A. Hawkins, Jr. graciously supplied the photographs of Bharucha-Reid and Wilkins, Jr. on page seventeen and of Brown, Granville, and Cox on page eighteen.

(Minority Students continued from previous page.)
masters. For many students is it a terminal course (in ways unintended). A course named pre- anything should never be a terminal course. Worse, in an increasing number of institutions precalculus is taught by part-timers paid $1,500 a course with no benefits and, as a consequence, with no commitment to departmental initiatives. I have heard these individuals referred to as the new migrant workers and have visions of them traveling from campus to campus teaching precalculus and remedial mathematics wherever there is a spot need. And the reality is, of course, that, like migrant workers, they are an oppressed and disenfranchised group—one of the great failings of higher education.

How might we "get our own house in order?" First, we must ask some difficult questions about our entry-level courses. Which students make good use of these courses? What role do these courses play in inspiring students to continue their study of mathematics? What are the true prerequisites for excellence in upper-division work?

The calculus reform movement has focused a great deal of energy on these pivotal introductory courses. Many constructive suggestions have been made toward making them more coherent, toward the inclusion of appropriate technology, and, simply, toward making the courses more interesting. But much more needs to be done. We need to examine pedagogical issues; we need to look at departmental priorities that affect who teaches calculus and toward what end. It is no longer useful to think of calculus as only a "service" course, a course designed to prepare students for someone else's majors; and there is no reason to think that course structures inherited from another age can meet the needs of today's students. We need to make calculus an effective route into the major.

These courses—precalculus and calculus, and for that matter, the courses which preceded them—are important to the survival of the discipline. They are especially important if we are to increase minority participation in the mathematics major. We must teach them with vigor and imagination, and we must make them a source of mathematicians.

My work and that of others suggests that improving the curriculum and how we teach it is necessary, but not sufficient to meet the challenges before us. We will need to create in each of our departments a community life that is invitational, i.e., that truly welcomes our students, *all* of our students, to mathematics and challenges and inspires them to choose our profession. Such work cannot be accomplished by "special programs," but must be an integral and vigorous part of departmental and institutional life.

Photograph courtesy of Jane Scher

If we are to be successful in resuscitating calculus, and making it an entry way to mathematics for minorities and others, we must remember that it is not only the reformers who must teach the new courses, but their colleagues as well. We must engage in this reconstructive work as a concerted and sanctioned activity of our departments—not as personal work. The task is too important to be the pet project of a particular individual or group.   ■

Uri Treisman

Black Women Earn PhDs in Mathematics

Teresa Edwards and Wanda Patterson, both members of the Department of Mathematics at Spelman College, recently received doctorates from the Georgia Institute of Technology.

Dr. Edwards, a native of Nashville, Tennessee, completed her undergraduate work in mathematics at Spelman College. In September 1990, the Georgia Institute of Technology awarded her the PhD for her accomplishments in operations research. Furthermore, Dr. Edwards recently presented her research at the International Federation of Operations Research Conference in Athens, Greece.

Dr. Patterson, who earned both her bachelor of science and her master of science degrees at North Carolina State University, accepted her PhD in mathematics in December 1988. She recently presented some results of her research in function spaces at a Southeastern Section meeting in Davidson, North Carolina and at the MAA's Seventy-Fifth Anniversary Meeting in Columbus, Ohio.

Teaching Programs That Work
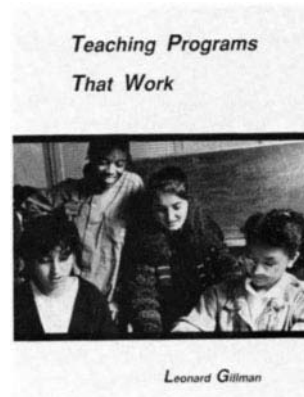
Leonard Gillman

On 19 January 1990, Leonard Gillman, Professor Emeritus at the University of Texas at Austin, delivered his Retiring Presidential Address at the Seventy-Third Annual Meeting of the Mathematical Association of America, in Louisville, Kentucky. In his address, "Teaching Programs that Work," Professor Gillman discusses five innovative teaching programs designed to help students, particularly minority students, succeed in mathematics. His commentary is detailed and insightful; his lively, engaging style, quintessential Gillman. If you would like to receive a copy of this address, contact: Siobhán B. Chamberlin, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036; (202) 387-5200; e-mail: maa@hilda.umd.edu; FAX: (202) 265-2384.

1991 Annual Meeting in San Francisco:
Underrepresented Minorities in Mathematics

Wednesday, 16 January

afternoon

3:20–4:10   **MAA Invited Address:** *An Analogue of Hüber's formula for Riemann's zeta function,* Floyd L. Williams, University of Massachusetts at Amherst

Thursday, 17 January

morning

8:00–9:30   **AAAS-AMS-MAA Committee on Opportunities in Mathematics for Underrepresented Minorities (COMUM)**

9:00–10:55   **Workshop:** *Models of Successful Intervention Projects for Minorities,* William A. Hawkins, Jr., Director of SUMMA (Strengthening Underrepresented Minorities Mathematics Achievement), organizer. Speakers: Manuel P. Berriozábal of the University of Texas at San Antonio and Director of Tex-PREP; Ardel J. Boes of the Colorado School of Mines and Director of the American Indian Young Scholars Program; Claudette Bradley of the University of Alaska at Fairbanks and a teacher in the American Indian Young Scholars Program; and Lloyd A. Gavin of California State University at Sacramento and Director of STEP-TO-COLLEGE. The workshop will distribute several materials including a project directors handbook, a list of funding sources, and flyers from currently active projects organized by MAA members. The workshop will conclude with videotapes of projects.

afternoon

12:30–2:00   **MAA Committee on Minority Participation in Mathematics (CMPM)**

Friday, 18 January

morning

8:00   **NAM Contributed Paper Session:** *Presentations by recent doctoral recipients,* Gerald R. Chachere, Howard University

afternoon

1:00–2:30   **NAM-MAA Panel Discussion:** *Nurturing minority graduate students in mathematics,* Sylvia T. Bozeman, Spelman College, organizer and moderator. Panelists: Mary W. Gray of the American University; Raymond L. Johnson of the University of Maryland at College Park; Abdulalim Shabazz of Clark Atlanta University; and Richard A. Tapia of Rice University.

2:15–4:15   **MAA Invited Address:** *Algebraic curves and error-correcting codes from a modern point of view,* Carlos Julio Moreno, Baruch College of the City University of New York

6:00–8:00   **NAM Banquet**

Saturday, 19 January

afternoon

1:00   **William W. C. Claytor Lecture:** *Projective subspaces of Hermitian symmetric spaces,* Amassa C. Fauntleroy, North Carolina State University

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Box 8162 University Station
Grand Forks, ND 58202-8162

Applications are invited for 2 or more tenure-track positions at the assistant professor level starting August 16, 1991. Consideration will be given to all areas of mathematics, as well as statistics and math education. Applicant must possess a strong commitment to teaching and research and have completed PhD requirements by starting date. Teaching loads are three courses/semester. Must be eligible to work in US. Salary and fringes competitive. Application deadline: March 1, 1991. Send resumé, copy of transcripts, and three letters of reference to: Selection Committee. UND is an AA/EOE.

TRINITY COLLEGE

The Department of Mathematics at Trinity College invites applications for a tenure-track position at the rank of assistant professor, beginning in the academic year '91–'92. The normal teaching load is five semester-courses per year ("3/2"). While we will be happy to receive applications from those with any specialty, we will be particularly interested in algebraists, logicians, and persons whose research interests might intersect with current department members' areas: complex analysis, functional analysis, geometry, graph theory, combinatorics, and mathematical statistics. Requirements for the position: PhD in mathematics, evidence of teaching excellence at the undergraduate level, indications of promise in research, and interest in curriculum development.

SOUTHWESTERN UNIVERSITY
Georgetown, Texas

Southwestern University invites applications for a tenure-track position in computer science, beginning August 1991. Responsibilities include teaching nine credit hours per semester, continuing scholarly activity, and assisting in the design of a new curriculum emphasizing formal mathematical methods such as derivation and verification of programs. A PhD in computer science or in mathematics with strong supporting work in computing is required. Rank and salary are commensurate with experience and expertise.

Southwestern University is a selective, undergraduate institution committed to a broad-based liberal arts and sciences education. Affiliated with the United Methodist Church, it has over 1,200 students and a history of stable enrollment. Southwestern's endowment of more than $126 million ranks among the highest per student of undergraduate institutions in the country. The University has a strong commitment to faculty support, with faculty salaries at the 92nd percentile for IIB institutions, and an endowment in excess of $1 million for faculty development. The University is located in Georgetown, Texas, 28 miles north of Austin, the state capital, and site of the University of Texas.

Applicants should send a letter of application, vita, and three current letters of recommendation to: Search Committee, Department of Mathematics and Computer Science, Box 6399 SU Station, Georgetown, TX 78626. Review of applications will begin on January 8, 1991. Women and minority candidates are encouraged to apply. Southwestern University is an Affirmative Action, Equal Employment Opportunity Employer.

AUGUSTANA COLLEGE
Sioux Falls, South Dakota

Augustana College invites applications for a tenure-eligible position in the Department of Mathematics at the rank of assistant professor beginning September 1991. Responsibilities include teaching of lower and upper division courses and involvement in student research projects. PhD in mathematics is required. Candidates must demonstrate excellence in teaching, potential for excellence in research, and a commitment to the mission of Augustana as a church-related, liberal arts college is expected. Priority given to applications received prior to March 1, 1991. Send letter of application, vita, three current letters of reference, graduate transcripts (direct from Registrar's Office), and a statement of personal and professional goals to: Jeanne Kruse, Administrative Assistant, Office of Academic Affairs, Augustana College, 29th and Summit, Sioux Falls, SD 57197. EOE/AA.

UNIVERSITY OF SOUTHERN COLORADO
Department of Mathematics
Pueblo, CO 81001-4901

Applications are invited for at least one tenure-track assistant professor position for fall 1991. Doctorate in mathematics in numerical analysis, optimization, modeling, or combinatorics required. Evidence of commitment to teaching excellence necessary. Active research desirable. Send letter of application, resumé, graduate transcripts, and three letters of reference to: Search and Screen Committee. Evaluation of applications will begin 7 February 1991 and continued until position is filled. USC is an AA/EO employer.

Applicants should send a cv, three letters of reference (at least one of which addresses teaching) and a statement of teaching and research interests to:

Search Committee Chair
Dept. of Mathematics
Trinity College
Hartford, CT 06106

No decision will be made prior to January 21, after which the position may be filled at any time.

Representatives of the Department will attend the employment register at the Joint Annual Meetings in San Francisco in January 1991.

Trinity College is an Equal Opportunity/Affirmative Action employer. Women and members of minority groups are especially encouraged to apply.

KINGS'S COLLEGE
Wilkes-Barre, PA 18711

Math Position: assistant professor. PhD required. ABD will be considered. Successful applicant will teach an advanced course for majors in addition to introductory courses. Primary interest and commitment must be to quality undergraduate instruction and to formally training young mathematicians. Public scholarship and active involvement in the mathematical community are also expected. Applications, consisting of teaching and research interests, vita, transcripts, and three letters of recommendation should be submitted to: Dr. William Shergalis, Dean of the College of Arts & Sciences, King's College, Wilkes-Barre, PA 18711. Review of applicants will begin on December 1, 1990. KING'S COLLEGE IS AN EQUAL OPPORTUNITY EMPLOYER AND SPECIFICALLY INVITES AND ENCOURAGES APPLICATIONS FROM WOMEN AND MINORITIES.

UNIVERSITY OF WISCONSIN RIVER FALLS

Mathematics Faculty Position

Applications are invited for two tenure-track positions at the assistant professor level beginning September 1, 1991. PhD in mathematics or a closely related discipline is required. Applicants must have a strong commitment to excellence in undergraduate education and continuing scholarly activity. The current full-time teaching load averages 12 credit hrs/week; other responsibilities include advising students and departmental, college, and university work. Salaries are competitive.

The University of Wisconsin-River Falls is located in west central Wisconsin, 30 miles east of St. Paul and Minneapolis, Minnesota. Enrolling 5,200 students, the university offers bachelor's and master's degrees in the Colleges of Arts & Sciences, Agriculture, Education, and in the Graduate School.

Applicants should submit resumé, transcripts, and three letters of recommendation to:

Prof. Stephen E. List, Chair
Search and Screen Committee
Department of Mathematics/Computer Systems
University of Wisconsin-River Falls
River Falls, WI 54022

Applications will be received until **March 1, 1991** or until position is filled.

(UW-RF is an equal opportunity, affirmative action employer. Women and minorities are encouraged to apply.)

MATHEMATICS

The University of Southern Indiana invites applications for a tenure-track position as assistant or associate professor of mathematics beginning August 1991. The position requires a PhD in mathematics, applied mathematics, or computer science. A strong background in computer science is preferred. Responsibilities include teaching twelve semester hours of a wide variety of undergraduate courses and assisting in the development of the department and the university. Salary and rank commensurate with qualifications and experience. Submit letter of application, resumé, transcripts, and the names of three professional references by February 15, 1991 to: Dr. Victoria M. Pohl, Chair, Department of Mathematics, University of Southern Indiana, 8600 University Blvd., Evansville, IN 47712. AA/EOE.

BENTLEY COLLEGE

Waltham, Massachusetts

The Department of Mathematical Sciences anticipates at least one opening for a tenure-track position starting in fall 1991. A PhD in mathematics, statistics, quantitative methods, operations research, or a related field is required. Located in suburban Boston, Bentley College has long been known for its leadership in the education of business professionals. In recent years, the school has experienced dramatic growth and currently enrolls about 7,500 graduate and undergraduate students in both business and liberal arts programs. While heavy emphasis continues to be placed on quality teaching, research and other scholarly activities are also encouraged and expected. Send resumé to: Prof. Charles. R. Hadlock, Chair, Department of Mathematical Sciences, Bentley College, 175 Forest Street, Waltham, MA 02154-4705. Bentley College is an Equal Opportunity/Affirmative Action employer.

MATHEMATICS DEPARTMENT

UNITED STATES NAVAL ACADEMY
ANNAPOLIS, MARYLAND 21402-5002

We anticipate one or two tenure-track appointments at the assistant professor level, commencing August 1991. Ten month salary, commensurate with experience and qualifications. Research opportunities exist for augmenting salary during summer. Applicants must possess PhD, have a commitment to excellence in teaching, and be capable of pursuing independent research. Send inquiries and applications to: J. M. D'Archangelo. Required of each applicant are a resumé, transcripts, and three letters of recommendation discussing applicant's teaching and research. The Naval Academy is an EO/AA employer.

DEPAUW UNIVERSITY

Department of Mathematics and Computer Science

Applications are being accepted for a tenure-track position in mathematics. Requirements include a PhD in mathematics (any specialty), excellence in teaching, achievement or promise in research, and commitment to the goals of a liberal arts college. Duties include teaching twelve hours per week, maintaining scholarship or research, and service to the university through advising, committee work, and the like.

Applicants should send a letter indicating interest in teaching in a liberal arts setting, transcripts, vita, and three letters of recommendation with at least one addressing the applicant's demonstrated teaching ability to: Underwood Dudley, Mathematics Department, DePauw University, Greencastle, Indiana 46135. Women and minorities are encouraged to apply.

Applications will be accepted until the position is filled. DePauw is an Affirmative Action, Equal Opportunity Employer.

PURDUE UNIVERSITY
North Central Campus
Mathematics/Physics Section

Applications are invited for two anticipated positions in mathematics. Starting date August 12, 1991. Review of applications begins January 15, 1991 and will be accepted until a suitable candidate is selected.

1. Assistant Professor. Tenure-track. Required qualifications are an earned doctorate (or near completion) in statistics, mathematics, applied mathematics, or closely related field and evidence of an ongoing research interest required. Master's in statistics and successful teaching at the college level preferred.

2. Visiting Assistant Professor. Nontenure-track. Required qualifications are a minimum of master's degree in mathematics, applied mathematics, statistics, or closely related field. Successful teaching experience at the college level preferred.

Send letter of application, resumé, and other supportive documents to: Mrs. Diane M. Carpenter, Academic Operations Assistant, Purdue University North Central, Westville, IN 46391.

Purdue University is an EO/AA Employer. Women and minorities are encouraged to apply.

ACTUARIAL SCIENCE OR STATISTICS

Ball State University
Muncie, Indiana

Applications are invited for a tenure-track position in actuarial science or statistics at the rank of assistant professor in the Department of Mathematical Sciences effective August 1991. Qualifications for the actuarial position include a PhD in a mathematical science, and associateship in the Society of Actuaries. Qualifications for the statistics position include a PhD in statistics with experience in statistical computing or biostatistics preferred. It is expected that applicants will present evidence of accomplishment or promise in teaching and research. Salary and benefits are competitive and commensurate with qualifications. Duties include teaching, predominantly the undergraduate level, research, and professional service. In addition to the qualifications listed, consideration will be given to the practical work experience of applicants; i.e. life insurance actuarial work, consulting actuarial work, or statistical work for a company or governmental unit. Initial evaluation of applications will begin January 24, 1991, and will continue until the position is filled. Send letter of application, curriculum vitae, research plan or list of publications, and at least three letters of reference to: Dr. John A. Beekman, Faculty Search Committee, Department of Mathematical Sciences, Ball State University, Municie, Indiana 47306-0490.

Ball State University practices Equal Opportunity in Education and Employment.

MERRIMACK COLLEGE

Dept. of Mathematics & Computer Science
315 Turnpike Street
North Andover, MA 01845

TWO OR THREE POSITIONS available beginning fall 1991. One tenure-track in math—PhD in math and ability to teach statistics, discrete math, combinatorics preferred. One or two one-year positions (possibly renewable) in math, computer science, or combination of both—PhD in math or master's in computer science with demonstrated teaching experience preferred. Small, Catholic, comprehensive college. Teaching load 12 hours/week. Send resumé and 3 letters of reference to: Dr. Michael Bradley, Dept. Chair.

An Equal Opportunity Employer

WESTERN WASHINGTON UNIVERSITY

Applications are invited for tenure-track positions in mathematics education to begin fall 1991. Responsibilities include teaching mathematics and methods courses, developing inservice opportunities and research projects, and improving our master's program. A doctorate in mathematics education-mathematics and recent elementary/secondary teaching experiences are preferred. An enjoyment of mathematics is required.

Interested candidates should submit a letter of application, a vita, complete transcripts, and three letters of recommendation to: Professor Thomas T. Read, Chair, Dept. of Mathematics, Western Washington University, Bellingham, WA 98225-9063. Deadline for applications is February 1, 1991; late applications will be considered if positions remain open. Western Washington University is an Equal Opportunity-Affirmative Action Employer.

SAM HOUSTON STATE UNIVERSITY

Mathematics Education Position

The Division of Mathematical and Information Sciences invites applications for a tenure-track assistant or associate professorship in mathematics education. Doctorate in mathematics or mathematics education is required. Preference will be given to persons with a strong background in mathematics and a record of (or potential for) leadership in mathematics education. Review begins 15 January 1991 and continues until position is filled. Send a letter of application, vita, transcripts, and three letters of reference to: Dr. John C. Huber, Mathematics Education Search, Sam Houston State University, Huntsville, TX 77341-2206. SHSU is an Equal Opportunity, Affirmative Action Employer. Women and minority candidates are encouraged to apply.

FERRIS STATE UNIVERSITY

Mathematics

Tenure-track position teaching Developmental Mathematics beginning September 1991. Responsibilities will be teaching arithmetic and elementary algebra, and advising students in science-oriented curricula. Master's degree in mathematics or mathematics education with specific interest/concentration in developmental mathematics, or bachelor's degree with major in mathematics and master's in education with area of concentration in developmental mathematics instruction required. Candidate must demonstrate ability to communicate and work closely with students and colleagues. Minimum of two year's full-time experience in developmental mathematics required. Salary and rank commensurate with candidate's qualifications and experience. Send letter of interest indicating specific position #4841 desired, current vita, official transcripts of undergraduate and graduate study, and three letters of reference to: Dr. Fred Wilson, Search Committee Chair, Department of Mathematics, Science 118H, Ferris State University, Big Rapids, MI 49307. Letter of interest and all supporting documents must be received no later than March 4, 1991. Review of completed applications will begin February 10, 1991. EO/AAE.

FERRIS STATE UNIVERSITY

Mathematics

Tenure-track position teaching undergraduate mathematics beginning September 1991. Responsibilities will include teaching most levels of undergraduate mathematics and advising students in science-oriented curricula. Opportunity exists for contributing to programs in actuarial science, applied mathematics, and mathematics education. Candidate must demonstrate ability to communicate and work closely with students and colleagues. Documented quality college teaching experience (including teaching assistant) required. Salary and rank commensurate with candidate's qualifications and experience. Send letter of interest indicating specific position #4843 desired, current vita, official transcripts of undergraduate and graduate studies, and three letters of reference to: Professor Edward Straley, Search Committee Chair, Department of Mathematics, Science 118H, Ferris State University, Big Rapids, MI 49307. Letter of interest and all supporting documents must be received no later than March 4, 1991. Review of completed applications will begin February 10, 1991. EO/AAE.

FERRIS STATE UNIVERSITY

Mathematics

Tenure-track position teaching undergraduate mathematics and/or undergraduate computer science beginning September, 1991. Responsibilities will include teaching most levels of undergraduate mathematics and/or undergraduate computer science, and advising students in science-oriented curricula. Opportunity exists for contributing to programs in actuarial science, applied mathematics, and mathematics education. Master's in mathematics with background in computer science and ability and willingness to teach microcomputer assembly language, logic circuit design, and programming language concepts required. Candidate must demonstrated ability to communicate and work closely with students and colleagues. Documented quality college teaching experience (including teaching assistant) required. Salary and rank commensurate with candidate's qualifications and experience. Send letter of interest indicating specific position #4844 desired, current vita, official transcripts of undergraduate and graduate studies, and three letters of reference to: Professor Robert McCullough, Search Committee Chair, Department of Mathematics, Science 118H, Ferris State University, Big Rapids, MI 49307. Letter of interest and all supporting documents must be received no later than March 4, 1991. Review of completed applications will begin February 10, 1991. EO/AAE.

FERRIS STATE UNIVERSITY

Mathematics

Tenure-track position teaching undergraduate mathematics beginning September 1991. Responsibilities will include teaching most levels of undergraduate mathematics, and advising students in science-oriented curricula. Opportunity exists for contributing to programs in actuarial science, applied mathematics, and mathematics education. PhD in mathematics required. Expertise in statistics or actuarial science preferred. Candidate must demonstrate ability to communicate and work closely with students and colleagues. Documented quality college teaching experience (including teaching assistant) required. Salary and rank commensurate with candidate's qualifications and experience. Send letter of interest indicating specific position #4845 desired, current vita, official transcripts of undergraduate and graduate studies, and three letters of reference to: Dr. Ronald Shepler, Search Committee Chair, Department of Mathematics, Science 118H, Ferris State University, Big Rapids, MI 49307. Letter of interest and all supporting documents must be received no later than March 4, 1991. Review of completed applications will begin February 10, 1991. EO/AAE.

SANTA CLARA UNIVERSITY

The Applied Mathematics Department in the School of Engineering of Santa Clara University invites applications for a position to begin in the fall of 1991. The position is tenure-track with a rank of assistant or associate professor. Applicant should have a PhD in mathematics, applied mathematics, or mathematical statistics and a commitment to both teaching and research. The department offers a master's degree in applied math and service courses for the School of Engineering. Send letter of application and vita, and direct 3 letters of reference to: George R. Fegar, Chair, Applied Math Department, School of Engineering, Santa Clara University, Santa Clara, CA 95053. Deadline is March 15, 1991.

BAYLOR UNIVERSITY

Mathematics—Lecturer Position

Lecturer position open fall 1991. Teaching duties: teaching freshman mathematics courses. Applicants should hold at least the master's degree in mathematics. Baylor University is a private university with an enrollment of 12,000 students. It emphasizes and appreciates good undergraduate teaching. Baylor University is an Equal Opportunity/Affirmative Action Employer chartered in 1845 by the Republic of Texas and is under the patronage and general direction of the Baptist denomination of the state of Texas as represented by the Baptist General Convention of Texas. Provide resumé, transcript, and three letters of reference to: Howard L. Rolf, PO Box 97328, Waco, TX 76798-7328.

BARD COLLEGE

Director of Quantitative Skills Program

Bard College seeks a director/teacher for a quantitative skills program, beginning July 1, 1991. The position will involve working closely with both students and faculty. Responsibilities include assessing student readiness for quantitative courses; designing and teaching skills development courses and programs, including tutorials; serving as a resource for curriculum development; and supervising student tutors. Candidates should have a strong background in mathematics education and skills assessment; an advanced degree and teaching experience required. Applications will be reviewed as received.

Bard College is a highly selective liberal arts and sciences institution located in the Hudson River valley approximately 90 miles north of NYC. Please send letter of application, cv, and the names of three references to:

Dean Elaine Sproat
Assistant Dean of the College
Bard College
Annandale-on-Hudson, NY 12504

Bard College is an Equal Opportunity/Affirmative Action employer.

PHILLIPS ACADEMY
Andover, MA 01810

Department of Mathematics

Phillips Academy, an independent national and international residential high school for 1,200 able, college-bound students, maintains high academic standards. Approximately 70% of the faculty hold MA and PhD degrees. The school desires and supports a multicultural curriculum and a diverse faculty.

The Mathematics Department seeks a highly energetic teaching with a master's or doctor's degree who enjoys working with students and who wants to teach algebra, geometry, calculus, and discrete math, as well as think about curricular questions and how to use computers in the teaching of math. A small number of the most advanced students take mathematics through vector calculus and linear algebra. Applicants need to be enthusiastic about living in a residential school that thrives on the challenges of diversity. Teaching includes advising as well as coaching intramural and intermural sports.

Applicants should submit a resumé and a letter outlining how they foresee contributing to the school. Letters should be addressed to the Dean of Faculty. (AA/EOE).

MATHEMATICS

Full-time continuing position at East Stroudsburg University effective with the 1991-92 academic year. Assistant/associate professor. Doctorate in mathematics or related field preferred. Master's degree plus 10 credits in mathematics considered. Preference will be given to candidates with strong background in analysis. The position consists primarily of teaching undergraduate mathematics courses. Included will be instruction and development of courses in analysis. Salary—assistant: $28,686–$38,442; associate: $34,868–$46,727—plus excellent benefit package. Deadline for application is February 1, 1991. Send letter of application, resumé, transcripts, and three letters of recommendation to: Professor Edward Hogan, Chair, Search and Screen Committee, Department of Mathematics, East Stroudsburg University, East Stroudsburg, PA 18301. A Pennsylvania State System University. An Affirmative Action/Equal Opportunity employer.

CALIFORNIA STATE UNIVERSITY CHICO
Department of Mathematics and Statistics

The Department anticipates a tenure-track position in mathematics education at the assistant professor level, beginning with the 1991-92 academic year. A doctorate in mathematics or mathematics education, evidence of teaching excellence, a strong mathematics background, and a commitment to undergraduate education are required. Faculty teach 12 units each semester; faculty are expected to strive for excellence in teaching, be actively engaged in scholarly activities and in the activities of our mathematics education program, and contribute to the governance of the department and university. The salary range is currently $30,276–$41,844 per academic year, depending on the level of appointment. Qualified candidates should submit a resumé, graduate transcripts, supporting documents, and at least three letters of recommendation, prior to the closing date of February 1, 1991, to:

Thomas McCready, Chair
Department of Mathematics and Statistics
California State University, Chico
Chico, CA 95929-0525

CSU, Chico is an Equal Opportunity/Affirmative Action Employer and employs only individuals lawfully authorized to work in the United States.

THE UNIVERSITY OF SCRANTON
Mathematics Department

The University of Scranton is a Jesuit university with over 3,500 undergraduates. The Mathematics Department has 15 full-time faculty and about 50 majors.

One (possibly two) tenure-track position is available for fall 1991 for faculty interested in a teaching environment where research is encouraged and supported. Individuals with expertise in any area of mathematics will be considered. Preferred areas include applied mathematics, probability/statistics, actuarial mathematics, algebra, and analysis. Rank and salary are open and competitive.

Submit a vita, transcripts, and three references to: Mathematics Faculty Search Committee, University of Scranton, Scranton, PA 18510 or phone: (717) 941-6113. Screening will begin at once and applications will be considered until all positions have been filled. An AA/EO Employer and Educator.

LYNDON STATE COLLEGE
Lyndonville, Vermont

Tenure-track position in Department of Mathematical Sciences, with concentration in algebra. PhD for award of tenure; may consider for employment candidates with ABD and in active pursuit of doctorate. Teaching assignment will range from introductory service courses to upper-division math major courses. Experience in mathematics education programs a plus. Salary is commensurate with experience; generous fringe benefits package is provided without employee contribution. Academic year opens August 27, 1991.

Lyndon State College is a vigorously growing comprehensive institution with degrees through the master's level. Nestled in the mountains of Vermont's Northeast Kingdom, Lyndon enrolls 1,150 undergraduates and 200 graduate and nondegree students, and employs 60 full-time and 50 adjunct faculty.

Lyndon's faculty are especially attentive to an academically diverse student body, including a growing number of nontraditional students. The College's mission emphasizes personal attention to individuals. Faculty are active in campus governance and community service, while effective teaching is an important measure for continued employment. Successful candidates will also demonstrate ability to work harmoniously with colleagues in the department. Prior teaching experience is desirable unless noted.

Send letter of application and vita (listing at least three references) to: Chair, Faculty Search Committee, c/o Associate Dean Hruska, Lyndon State College, Lyndonville, VT 05851. Closing date: February 1, 1991. Lyndon, as an equal opportunity employer, invites applications from women and from minority and handicapped persons.

WHITTIER COLLEGE

The Department of Mathematics and Computer Science invites applications for a tenure-track position, pending final approval, at the asst. prof. level, beginning fall 1991. The five members of the department teach a wide range of undergraduate courses in mathematics and computer science. PhD in mathematics is expected, but no particular field is required. Participation in the teaching of college-wide courses such as College Writing is most welcome. Candidates should send a vita, a statement of teaching philosophy, and three letters of recommendation to: Chairman, Department of Mathematics and Computer Science, Whittier College, Whittier, CA 90608. The processing of applications will begin on Jan. 15, 1991, with campus interviews in late February. Women and minorities are encouraged to apply.

METHODIST COLLEGE

MATHEMATICS-COMPUTER SCIENCE: Methodist College, equal opportunity employer, anticipates an opening for an assistant or associate professor of mathematics beginning fall 1991. Teaching responsibilities include mathematics and if appropriate, computer science courses, Doctorate preferred, ABD acceptable. Minority candidates are especially encouraged to apply. Send resumé, graduate transcripts, and three letters of reference, *by March 1*, to: Mrs. Patricia Jones, Head Department of Mathematics and Computer Science, Methodist College, 5400 Ramsey Street, Fayetteville, North Carolina 28311-1499; (919) 488-7110.

CREIGHTON UNIVERSITY

Creighton University invites application for *two* 3/4 time renewable positions in the Mathematics and Computer Science Department.

QUALIFICATIONS

1. MS in mathematics

2. Commitment to quality teaching.

POSITION DESCRIPTION

1. Adjunct instructor in mathematics, 3/4 time (with equivalent benefits).

2. Salary: will depend on qualifications of the applicant.

3. Duties: 9–12 hour semester teaching load, departmental duties such as advising.

Applicants must submit a current curriculum vitae; three letters of recommendation independent of the candidate; original transcripts of all college-level work; evidence of successful teaching. Applications are accepted until positions are filled. Applications should be addressed to: **Dr. James Carlson, Chair, Search Committee, Department of Mathematics/Computer Science, Creighton University, Omaha, NE 68178-0109.**

Creighton University is an equal opportunity-affirmative action employer. Women and minorities are encouraged to apply.

AUGUSTA COLLEGE
Augusta, Georgia
Department of Mathematics

Applications are invited for positions in mathematics available fall 1991, some of which are tenurable. Applicants should have a strong commitment to excellence in teaching, and an active interest in scholarly pursuits. Preference will be given to candidates who have the PhD and to candidates with research interest in statistics, numerical analysis, combinatorics, or other areas of applied mathematics. Candidates must be able to provide evidence of outstanding teaching skills.

Formal screening of candidates is ongoing and will continue until all positions are filled. At least one position will be held open until March 18, 1991. Applicants should send a letter of application, a resumé, three letters of recommendation, and two additional names of references to: Dr. James M. Benedict, Department of Mathematics and Computer Science, Augusta College, Augusta, Georgia 30910.

Augusta College is an Affirmative Action/Equal Opportunity Institution.

FURMAN UNIVERSITY
Greenville, South Carolina 29613

The Department of Mathematics at Furman University, an undergraduate, liberal arts college, invites applications for a tenure-track assistant professorship beginning September 1, 1991. A PhD in a mathematical science is required. All areas of specialization are acceptable. Excellence in teaching and continued scholarly activity are expected of all faculty. A vita, graduate and undergraduate transcripts, and three letters of recommendation should be sent to: Robert Fray, Department of Mathematics. Application deadline: February 1, 1991. EOE/AAE.

OAKLAND UNIVERSITY
Chairperson
Department of Mathematical Sciences

Applications and nominations are invited for the position of Chairperson of the Department of Mathematical Sciences, Oakland University. Minimum qualifications include an earned PhD in a mathematical science, significant postPhD academic experience in the mathematical sciences or comparable activity, a substantial research record and an active commitment to research, demonstrated experience in various academic or professional leadership positions, and an academic record to justify appointment at the rank of professor in the department of mathematical sciences with tenure. The department has 30 regular faculty members and about 30 part-time faculty and graduate assistants and is in the planning process for establishing a PhD program. The department has cooperative graduate scholarship programs with the auto industries. An applicant should send a letter, vita, and the names, addresses, and telephone numbers for at least three references. Send nominations and applications to: Chairperson, Search Committee, Department of Mathematical Sciences, Oakland University, Rochester, MI 48309-4401. Review of applications will begin December 12, 1990. OU is an AA/EO employer.

CALIFORNIA STATE UNIVERSITY NORTHRIDGE

Applications are invited for two tenure-track positions at the rank of assistant professor for the fall of 1991. We will consider candidates in the areas of algebra, analysis, topology, applied mathematics, or mathematical physics. Requirements include receipt of a PhD by the fall of 1991, demonstrated record or potential in research, and a strong commitment to teaching. Responsibilities include teaching 9–12 hours, depending on research and/or other contributions. Send vita and three letters of recommendation to: Mary Rosen, Hiring Committee Chair, Dept. of Mathematics, California State University, Northridge, Northridge, CA 91330 by February 15, 1991 for full consideration. Women and minorities are especially encouraged to apply. CSUN is located in a northwestern suburb of Los Angeles and is in proximity to Cal. Tech., USC, and UCLA.

AN EQUAL OPPORTUNITY-AFFIRMATIVE ACTION, TITLE IX, SECTION 504 EMPLOYER.

MATHEMATICS DEPARTMENT KENNESAW STATE COLLEGE
PO BOX 444, MARIETTA, GA 30061

At least one tenure-track position in mathematics at the level of assistant professor beginning in September 1991. A PhD is required with a strong commitment to undergraduate education as well as an interest in scholarly activities. Statistics preferred; other areas considered. Salary and rank are competitive and commensurate with credentials and experience. The College is located in northwest metro Atlanta, and enrolls over 10,000 day and evening students in undergraduate and graduate programs. The department of Mathematics has 19 full-time faculty and shares 6 others with the Department of Computer Science. Send resumé and list of three references to: Dr. Christopher Schaufele, Chair, Search Committee. Position will remain open until filled, but to ensure consideration, apply before Feb. 1, 1991.

CENTRE COLLEGE

Faculty position, computer science/math. A one-year, full-time teaching (sabbatical replacement) position starting September 1, 1991. The successful candidate will teach traditional undergraduate courses in mathematics and computer science, offer special topics courses in computer science in her/his area of expertise, and conduct student-faculty collaborative research. Advanced degree in mathematics or computer science required; PhD preferred. Rank and salary dependent on qualification. Consideration of qualifications will begin Feb. 15. Send inquiries & vita to: Dr. John Ward, Dean of the College, Centre College, Danville, KY 40422. EOE.

NORTHEAST MISSOURI STATE UNIVERSITY
Division of Math and Computer Science
Kirksville, MO 63501

Selective, public, liberal arts and sciences university seeks applicants for at least four tenure-track positions open August 1991. PhD in statistics, analysis, combinatorics, differential equations, applied mathematics, or computer science preferred; other specialities considered. Nine hours per week teaching. Commitment to excellence in teaching and evidence of potential for research and professional growth required. The division has 35 faculty and 275 majors from a total enrollment of 6,000. A complete application requires a letter, resumé, transcripts of all graduate and undergraduate study, and three letters of reference. Direct all materials to: Lanny Morley, Head. EQUAL OPPORTUNITY EMPLOYER.

NORTHEAST MISSOURI STATE UNIVERSITY
Division of Math and Computer Science
Kirksville, MO 63501

Selective, public, liberal arts and sciences university seeks applicants for at least four temporary instructor positions available for 1991–92. Master's degree in mathematics or statistics required. Twelve hours per week teaching, primarily precalculus mathematics or beginning statistics. Commitment to excellence in teaching essential. Appointment likely to be renewable for one or two years upon satisfactory performance. A complete application requires a letter, resumé, transcripts of all graduate and undergraduate study, and three letters of reference. Direct all materials to: Lanny Morley, Head. EQUAL OPPORTUNITY EMPLOYER.

UNIVERSITY OF AKRON
Akron, Ohio

A tenure-track position in mathematics in the Community and Technical College at the University of Akron is available beginning August 1991. Applicants must have at least a master's degree in mathematics or a related field. The candidate will be expected to teach a variety of topics from algebra to differential equations. Evidence of effective teaching will be required and a strong commitment to two-year college education and professional activity is expected. There is no released time for research.

Applications will be accepted until March 1, 1991. Send vita, three letters of reference, and transcripts to: Wendell Johnson, Math Search Chair, Associate Studies, The Community and Technical College, The University of Akron, Akron, Ohio 44325-6105.

TRANSYLVANIA UNIVERSITY
Lexington, KY 40508

COMPUTER SCIENCE: assistant/associate professor, Transylvania University. Full-time, tenure-track. PhD in computer science, or master's in computer science with PhD in a closely related field. Rank and salary dependent upon background. Exceptionally well-qualified candidates may be considered for a Bingham Award for Excellence in Teaching; smaller "start-up" grants are available for less experienced faculty. This recognition provides a supplement of up to 50% of base salary for the position. Transylvania is a private, liberal arts college with a strong commitment to excellence in undergraduate education. The program in computer science is of long-standing and is recognized for its outstanding quality. Please send letter of application, curriculum vitae, and names of three references to: Dr. Dwight W. Carpenter, Computer Science Program, Transylvania University, Lexington, KY 40508. An Equal Opportunity Employer.

TRANSYLVANIA UNIVERSITY
Lexington, KY 40508

The Mathematics Program invites applications for a tenure-track position commencing in the fall of 1991 and a possible one-year sabbatical replacement for 1991–92. Transylvania University is a private, liberal arts college with a strong commitment to academic excellence. Applicants must have a PhD in mathematics and a commitment to undergraduate teaching. Salary and rank will depend on qualifications and experience. Exceptionally well-qualified candidates may be considered for a Bingham Excellence in Teaching Award which supplements faculty member's salary by up to 50%; smaller, "start-up" grants are available for less experienced faculty. Send letter of application, resumé, undergraduate and graduate transcripts, and three letters of reference to: David L. Shannon, Mathematics Program Director, Transylvania University, Lexington, KY 40508. The search will remain open until the positions are filled. Transylvania University is an Equal Opportunity Employer.

OBERLIN COLLEGE
Department of Mathematics
Oberlin, OH 44074

Four-year, full-time, continuing position at the level of instructor, assistant professor, or higher, starting 1991–92. PhD in hand or expected by September 1991. Background in modern applied analysis essential. *All specialities considered* but preference given to chaotic dynamical systems, numerical analysis, and approximation theory. Excellence in teaching and productive scholarship required. Five courses per year, including at least one advanced course in modern applied analysis. Salary commensurate with qualifications and experience. Vita, transcripts, and three letters of reference to be received by February 1, 1990. Send to: Michael Henle, Department of Mathematics, Oberlin College, Oberlin, Ohio 44074. Affirmative Action, Equal Opportunity Employer. Applications will continue to be accepted until the position is filled.

OBERLIN COLLEGE
Department of Mathematics
Oberlin, OH 44074

Four-year, full-time, continuing position at the level of instructor, assistant professor, or higher, starting 1991–92. PhD in hand or expected by September 1991. Background in operations research and interest in applied mathematics essential. Excellence in teaching and productive scholarship required. Five courses per year, including a two-course OR sequence. Salary commensurate with qualifications and experience. Vita, transcripts, and three letters of reference to be received by February 1, 1990. Send to: Michael Henle, Department of Mathematics, Oberlin College, Oberlin, Ohio 44074. Affirmative Action, Equal Opportunity Employer. Applications will continue to be accepted until the position is filled.

OBERLIN COLLEGE
Department of Mathematics
Oberlin, OH 44074

Two-year, full-time, continuing position at the level of assistant professor starting 1991–92. PhD in hand or expected by September 1991. The incumbent will teach 5 courses in the general area of mathematics and/or computer science. Excellence in teaching and productive scholarship required. In addition, the ability to teach computer science and/or statistics is highly desirable. Salary commensurate with qualifications and experience. Vita, transcripts, and three letters of reference to be received by February 1, 1991. Send to: Michael Henle, Department of Mathematics, Oberlin College, Oberlin, Ohio 44074. Affirmative Action, Equal Opportunity Employer. Applications will continue to be accepted until the position is filled.

MATHEMATICAL SCIENCES

Assistant professor. PhD or dissertation in progress. Teach a broad range of classes, including some of the following: geometry, mathematics education, applied mathematics, and analysis, as well as calculus and lower division courses. Applications received by January 15 will be ensured of consideration. Contact: Dr. G. Daniel Callon, Chair, Mathematical Sciences, (317) 738-8247. Send letter, vita, transcripts, and 3 current letters of reference to: Bonita Pribush, Acting Vice President and Dean, Franklin College, Franklin, IN 46131. AA/EOE

MATHEMATICS EDUCATION

The University of Iowa's Division of Curriculum and Instruction is seeking applicants for the position of assistant professor of mathematics education. The position's responsibilities include teaching two courses per semester in the elementary or secondary mathematics teacher preparation programs and/or the MA and PhD mathematics education programs. Directing and conducting significant research on mathematics education is also an expectation. Candidates should hold a PhD in mathematics education or equivalent program; have successful teaching experience at either the elementary or secondary school level; show strong preparation in mathematics; be experienced in the use of technology in mathematics instruction; demonstrate a commitment to research and publication in the areas of learning and teaching mathematics; and have a commitment to excellence in teaching. Applications will be reviewed beginning January 30, 1991 and continue until the position is filled. *Send letter of application, vita, transcripts, and three letters of recommendation to: Mathematics Education Search Committee, c/o Dr. Marilyn Zweng, Division of Curriculum and Instruction, Lindquist Center, The University of Iowa, Iowa City, IA 52242.* The University of Iowa is an equal opportunity, affirmative action employer. Women and minorities are especially encouraged to apply.

UNIVERSITY OF DELAWARE
Department of Mathematical Sciences
Chairperson

The University of Delaware invites applications for the position of Chair of the Department of Mathematical Sciences in the College of Arts and Science. Applicants for the position should have an outstanding record of research and scholarly activity and should have the skills to chair a department with major research, teaching, and service responsibilities.

The Department has 40 regular faculty positions and an active graduate (PhD) program. Programs include pure mathematics, applied mathematics, and statistics. The Department is unusual in its strength and commitment to applied mathematics and related areas of analysis. The University has good computing and library facilities, and in addition, the Department has a number of workstations and two Sun 3/180 file servers. The University of Delaware is located in the pleasant university town of Newark midway between Washington, DC and New York City.

Applicants should submit a resumé, the names and addresses of three references, and a letter of interest to (or contact):

Prof. B. F. Caviness
Chair: Search Committee for Mathematics
Department of Computer
    and Information Sciences
103 Smith Hall
University of Delaware
Newark, DE 19716
Phone: (302) 451-8234
e-mail: caviness@udel.edu

The position will be available beginning September 1, 1991. The deadline for receipt of applications is March 1, 1991.

The University of Delaware is an equal opportunity employer and invites and encourages applications from women and minorities.

MEMORIAL UNIVERSITY OF NEWFOUNDLAND
St. John's, Newfoundland, Canada
Department of Mathematics and Statistics

Applications and nominations are invited for the position of Head of the Department of Mathematics and Statistics. The department, situated in the Faculty of Science, offers undergraduate and graduate programs in mathematics, applied mathematics, statistics, and applied statistics up to the PhD level. The department presently has 37 mathematicians, 11 statisticians, and 11 support staff.

Applicants should have demonstrated excellence in research and teaching in mathematics and/or statistics, and be able to show leadership and administrative ability appropriate to the position of head of a multidisciplinary department. The appointment will normally be made at the rank of professor and qualifications in either mathematics or statistics commensurate with this rank are expected. The deadline for applications is 1 March 1991.

Memorial University has a student population of about 17,000 and is the only university in the province of Newfoundland and Labrador. St. John's is the provincial capital with a population of over 150,000 in the metropolitan area and one of the oldest cities in North America. It enjoys a moderate climate and offers numerous outdoor activities throughout the year.

Please address inquiries, nominations, and applications, including a full curriculum vita and the names of at least three referees, to:

J. M. Foltz, Associate Dean of Science
Chair, Search Committee for
    Head of Mathematics and Statistics
Memorial University of Newfoundland
St. John's, Newfoundland, Canada A1B 3X7
Telephone: (709) 737-8155
e-mail: JANE@MUN.BITNET
FAX: (709) 737-3316

Memorial University of Newfoundland encourages both men and women to apply for this position.

In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

SOUTHWEST MISSOURI STATE UNIVERSITY
Mathematics Development Center

The Mathematics Development Center of Southwest Missouri State University has an opening for a preparatory mathematics specialist. Duties of a preparatory mathematics specialist include teaching beginning, intermediate, and college algebra. Teaching experience at the high school or junior college level desirable. Starting date is August 19, 1991. References should evaluate the applicant's ability to teach basic mathematics courses. Minimum requirement is the bachelor's degree in mathematics or mathematics education, with a master's degree preferred. The position is for nine months with the possibility of annual renewal. The salary range is $18,000–$22,000 depending upon qualifications. A letter of interest, college transcripts, resumé. and three letters of recommendation should be sent to: Dr. John Kubicek, Director of the Mathematics Center, Southwest Missouri State University, Springfield, Missouri 65804-0094, phone (417) 836-5941. Application deadline is March 1, 1991. Southwest Missouri State University is an Equal Opportunity/Affirmative Action employer.

UNIVERSITY OF MINNESOTA MORRIS

The UNIVERSITY OF MINNESOTA, MORRIS invites applications for a tenure-track assistant professor position in the mathematics discipline to begin September 16, 1991. The appointee will be required to fill a dual role. One responsibility will be the development and teaching of courses in mathematics as applied in such areas as (but not restricted to) systems analysis, optimization theory, distribution theory, applied probability, graph theory, or modern multivariate analysis. Secondly, the appointee must be qualified for and willing to share in the teaching of undergraduate statistics courses, if required. The teaching load may also include other mathematics courses. Candidates must have/expect a PhD degree in applied mathematics, statistics, or a closely related field by September 16, 1991. They must be able to display excellence in teaching. Candidates must show promise of being able to establish a research program suitable to a liberal arts college. Other responsibilities include sharing the administration of the mathematics discipline, serving the wider activities of the college with other faculty, and advising students. Applications including resumé and transcript, should be submitted by February 11, 1991 to: Dr. James Olson, Chair, Division of Science and Mathematics, University of Minnesota-Morris, Morris, MN 56267. Candidates also must arrange for three letters of reference.

The University of Minnesota, Morris is an equal opportunity educator and employer and specifically invites and encourages applications from women and minorities.

ROBERT MORRIS COLLEGE

**Dept. of Quantitative & Natural Sciences
Narrows Run Rd., Coraopolis, PA 15108**

Applications are invited for one or more permanent positions beginning August 30, 1991. Qualifications include a PhD in mathematics or mathematics education with a strong background and commitment to and excellence in teaching. ABD's will be considered. Responsibilities include but are not limited to teaching mathematics and statistics for business at the undergraduate and graduate levels, counseling and advising students, and participation in appropriate professional activities beyond teaching. Send resumé, transcripts, and three letters of recommendation to: Mr. F. A. Defino, Head, Department of Quantitative & Natural Sciences at the above address. Robert Morris College is an Affirmative Action/Equal Opportunity Employer.

ELON COLLEGE

Applications are invited for a permanent position as an assistant professor of mathematics. Applicants must hold a PhD in mathematics by the effective date of appointment, fall 1991. A strong commitment to teaching at the undergraduate level is required. Preference will be given to candidates with experience in teaching and a demonstrated interest in curriculum development. Evidence of experience in areas of applied mathematics is desired. Salary and rank will be commensurate with qualifications and experience. Representatives will be attending and interviewing at the San Francisco AMS/MAA meetings in January 1991. Send letter of application, resumé, and at least two letters of reference by the deadline date of February 15, 1991 to: Dr. Rosalind Reichard, Department of Mathematics, Box 2163, Elon College, Elon College, NC 27244.

BLUFFTON COLLEGE

**Department of Mathematics
Bluffton, OH 45817**

Tenure-track position at the level of assistant professor or higher, beginning September 1991. PhD in mathematics or mathematics education is required. Excellence in teaching and commitment to undergraduate education in a church-related, liberal arts environment are essential. Active scholarship is encouraged. Willingness to teach all areas of mathematics and mathematics education is expected. **Send letter of application, curriculum vitae, and 3 letters of reference to: Howard E. Krehbiel, Chair, Mathematics Department, Bluffton College, Bluffton, OH 45817.** Affirmative Action, Equal Opportunity Employer. For full consideration, applications should reach Bluffton College by 15 January 1991.

APPALACHIAN STATE UNIVERSITY

Department of Mathematical Sciences

The Department of Mathematical Sciences at Appalachian State University, in the University of North Carolina system, with approximately 11,500 students, invites applications for two tenure-track positions in the mathematical sciences beginning August 1991. A PhD in mathematics is required for one position and in mathematics education for the other. Applications will be considered in the areas of mathematics education, algebra, topology, analysis, differential equations, statistics, or other applied areas. Appointments are expected to be at assistant professor level. A commitment to teaching is essential. Research is encouraged and supported. Salary is commensurate with qualifications. Send letter of application, resumé, graduate transcripts, and have three current letters of recommendation forwarded to: Dr. H. W. Tall, Search Committee M, Department of Mathematical Sciences, Appalachian State University, Boone, North Carolina 28608. Completed applications must be received by March 1, 1991. Appalachian State University is an Equal Opportunity Employer.

GEORGIA SOUTHERN UNIVERSITY

**Mathematics/Computer Science Department
Statesboro, GA 30460**

MATHEMATICS-COMPUTER SCIENCE: Send letter of application, vita, unofficial transcripts of all college work, evidence of dedication to outstanding teaching and three letters of reference or placement file to: Prof. Elizabeth Hardy, Landrum Box 8093. Deadline: February 1, 1991.

One tenure-track position: Assistant or associate professor. Doctorate in a mathematical science required; PhD or EdD in mathematics education preferred. Primary interest in mathematics education required.

One tenure-track position: MA or MS in computer science or a mathematical science required; PhD or MS in computer science preferred.

One tenure-track position: MA or MS in a mathematical science and experience required. Primary duties will include teaching freshman-level mathematics. A second position is possible.

Several temporary instructor positions may be added in the area of teaching freshman-level mathematics. Master's degree in mathematics required.

MATHEMATICS-DEVELOPMENTAL STUDIES: Three tenure-track (no time limit) positions. Master's degree required; two to three years' teaching experience preferred. Duties will include teaching developmental studies and freshman-sophomore-level mathematics courses. Send letter of application, vita, unofficial transcripts of all college work, evidence of dedication to outstanding teaching and three letters of reference or placement file to: Prof. Susan Groover, Landrum Box 8093. Deadline: January 14, 1991.

Starting date is: September 1, 1991.

The names of applicants and nominees, resumés, and other general nonevaluative information are subject to public inspection under the Georgia Open Records Act. Georgia Southern is an Affirmative Action, Equal Opportunity Institution.

PHILLIPS EXETER ACADEMY

Coed, boarding school 9–12. Full-time position in mathematics, beginning September 1991. Duties include teaching four courses, dormitory supervision, athletic coaching. Courses: beginning algebra through BC calculus, discrete mathematics, advanced topics. Applicants should have done graduate study in mathematics and several years teaching, preferably in a boarding school. Inquiries, accompanied by vita and references, to:

Andrew W. Hertig
Dean of Faculty
Phillips Exeter Academy
Exeter, New Hampshire 03833

EOE

UNIVERSITY OF HARTFORD

West Hartford, Connecticut 06117

COLLEGE OF BASIC STUDIES

The College of Basic Studies of the University of Hartford invites applications for a full-time, tenure-track, assistant professorship in mathematics for fall 1991. PhD or EdD and evidence of successful ability to teach freshman foundations, analytic geometry, and calculus and computer science. Salary range will depend upon qualifications and experience.

All positions involve instruction at the undergraduate level. Faculty of the College normally teach four (4) courses each semester and participate in student advising. Tenure decisions are based upon the demonstration of excellence in teaching and advising, noteworthy scholarly activity, and participation on departmental, College, and University committees.

TO APPLY: Please send a letter of intent, curriculum vitae, three references, and transcripts of course work to: Mathematics Search Committee, College of Basic Studies, University of Hartford, 200 Bloomfield Avenue, West Hartford, CT 06117. The screening of applications will begin February 1, 1991 and continue *until the position is filled.* The University of Hartford is an equal opportunity/affirmative action employer and specifically invites and encourages applications from women and minorities.

NORTHERN ARIZONA UNIVERSITY
Flagstaff, Arizona

ORDINARY DIFFERENTIAL EQUATIONS: Tenure-track assistant professor with specialty in the geometric theory of dynamical systems supporting work of our existing special research focus. Current research of this group concentrates on planar systems with polynomial right hand sides and bifurcation theory.

MATHEMATICS EDUCATION: Two positions are line authorized. (1) Professor with commensurate record of research, leadership at the university and regional and national levels, and experience with teacher education programs. (2) Assistant professor. Specialty in the use of technology in instruction is preferred, but all areas will be considered. The department has a long-standing commitment to teacher education programs.

STATISTICS: Tenure-track assistant professor in statistics. Strong theoretical background, interest in applied statistics and intramural consulting, and the ability to contribute to the development of an interactive research group. The department has four statisticians, including the advertised position.

For all positions, qualifications include a doctorate in the advertised specialty, substantial evidence of high quality teaching, and demonstrated potential for a productive, quality research program. The starting date is August 19, 1991.

NAU has an on-campus enrollment of approximately 14,000. The department of 34 faculty offers bachelor's and master's degree programs with emphases including mathematics, mathematics education, statistics, and actuarial science. Flagstaff is located at an altitude of 7,000 feet in the cool pine forests of northern Arizona near high mountains, the Grand Canyon, and numerous other natural attractions.

Send letter of application and vita, and direct three letters of reference to: Screening Committee, Department of Mathematics, PO Box 5717, Flagstaff, AZ 86011. The searches will remain open until the positions are filled; however, the Screening Committee will begin reviewing applications on January 7, 1991.

NAU is an Equal Opportunity/Affirmative Action Institution. Women and minorities are encouraged to apply.

MOREHEAD STATE UNIVERSITY
Department of Mathematical Sciences
Assistant Professor of Mathematics

Morehead State University invites applications and nominations for a tenure-track position as assistant professor of mathematics beginning August, 1991. **Responsibilities:** Teach twelve hours per semester (reassigned time for research possible) of primarily undergraduate courses in mathematics together with scholarly production and service. **Qualifications:** PhD in mathematics is required. A strong commitment to quality instruction is expected. Preference will be given to those applications with experience and/or training in computing. Review of credentials begins January 10, 1991; applications accepted until January 31, 1991. Submit letter of application, resumé, graduate transcripts, and three letters of recommendation to:

OFFICE OF PERSONNEL SERVICES
MOREHEAD STATE UNIVERSITY
HM 101
MOREHEAD, KY 40351

MSU is an EEO/AA employer.

NORTHERN ARIZONA UNIVERSITY
Instructor or Lecturer

Positions at the instructor or lecturer rank are anticipated for fall 1991.

Duties include teaching lower division mathematics, service to the department, and scholarship commensurate with professional background. Instructorships are temporary positions. Lecturerships are three-year positions with the opportunity for renewal. Qualifications include a master's degree in an area of mathematics or statistics. Substantial evidence of quality teaching and a record of or potential for contribution to the lower division mathematics program. Send letter of application, vita, three letters of reference, and transcripts to: Screening Committee, Department of Mathematics, PO Box 5717, Northern Arizona University, Flagstaff, AZ 86011-5717. The search will remain open until the positions are filled; however, contingent on funding, the screening committee will begin reviewing applications on April 1, 1991. NAU is an Equal Opportunity/Affirmative Action Institution. Women and minorities are encouraged to apply.

TENURE-TRACK POSITION
Harvey Mudd College
Department of Mathematics

Harvey Mudd College invites applications from outstanding candidates for appointment to an assistant/associate professorship in the Department of Mathematics starting in 1991/1992. Preference will be given to applicants whose research and teaching interests are in differential equations, dynamical systems, or applied analysis.

The successful candidate will be expected to teach courses in her area of specialization, as well as general introductory calculus and differential equation courses, and to pursue an active research program. The College provides funds to support the summer research of recent appointees and for the purchase of computer equipment.

Harvey Mudd College is a selective institution specializing in engineering, mathematics, and the sciences. It is a member of the Claremont Colleges, an internationally renowned group of five independent undergraduate colleges plus a graduate school which offers a PhD program in mathematics and provides opportunities for graduate level teaching and thesis supervision. The applied mathematics program includes the Mathematics Clinic, a mode of instruction pioneered by Claremont which attracts projects funded by industrial organizations.

Interested applicants should send a curriculum vitae, a statement of current research interests, and information on teaching experience. Candidates should arrange to have three letters of reference sent and those candidates at the beginning assistant professor level should also arrange for official transcripts to be sent. All application materials should be sent to meet a February 1, 1991 deadline. Please address inquiries and applications to:

Dr. H. Krieger, Chair,
Department of Mathematics
Harvey Mudd College
Claremont, CA 91711
(714) 621-8023
FAX: (714) 621-8465

Harvey Mudd College is an equal opportunity, affirmative action employer.

MATHEMATICS

The Mathematics Department of the Southern College of Technology seeks applicants for one or more tenure-track positions at the rank of assistant or associate professor. The Department desires faculty who can contribute to the newly created BS program in mathematics. PhD in mathematics or mathematical statistics required. Research is desirable but is neither required nor heavily weighed.

The ideal candidate will show a strong mastery of the discipline, a commitment to professional growth and development, an ability for and commitment to excellence in teaching, and the potential and desire to enhance the college's intellectual community.

The Mathematics Department has fifteen tenure-track positions. The department has a new BS in mathematics, dual major programs with other departments, and several minor programs. The bulk of the teaching is in service courses.

Southern Tech is a state supported senior college in the University System of Georgia. Situated on a 230 acre site 15 miles northwest of Atlanta, the college enrolls about 4,000 students in technically oriented programs through the master's level.

A complete application consists of a letter of application, a curriculum vitae, transcripts of all college work, and a minimum of two letters of reference. The deadline for applications is February 15, 1991; applications not *completed* by that date will not be considered. Applications who are not US citizens should state visa type and authorization for permanent employment in the US.

Applications and inquiries should be addressed to:

Dr. James C. Kropa
Mathematics Department
Southern College of Technology
Marietta, Georgia 30060-2896.

Southern College of Technology is an equal opportunity/affirmative action employer.

GANNON UNIVERSITY
Mathematics Department
University Square, Erie, PA 16541

The Department of Mathematics invites applications for a tenure-track position beginning August 1991. Applicant must possess a PhD with strength in probability and statistics, and demonstrate evidence of good undergraduate teaching with research potential. Send resumé and three letters of recommendation to: Dr. Rafal Ablamowicz, Chairman. For full consideration, please apply by March 1, 1991. Gannon University is an Equal Opportunity/Affirmative Action Employer.

CALVIN COLLEGE

The Calvin College Department of Mathematics and Computer Science expects to have a tenure-track opening for the 1991-1992 academic year. Interest in mathematics education or statistics is preferred, but other specialities will be considered. The department currently has eighteen full-time faculty positions and nearly 100 majors at the junior-senior level. Calvin College is a Christian liberal arts college, and all faculty members are expected to demonstrate a Reformed and Christian perspective in their teaching and other professional activities. To apply, send a vita to: professor G. Venema, Chair, Dept. of Mathematics and Computer Science, Calvin College, Grand Rapids, MI 49546. Calvin College is an equal opportunity, affirmative action employer.

OCCIDENTAL COLLEGE
Los Angeles, California

Applications are invited for a tenure-track position in the Department of Mathematics at the assistant or associate professor level. Preference will be given to applicants with experience and expertise in an applied mathematical science, including differential equations, numerical analysis, applied statistics, and computer science.

Excellence in teaching and substantial professional achievement are the major expectations. The normal teaching schedule is two courses during each of three ten-week terms; new faculty members are released from one course during the initial year. Each faculty member receives a sabbatical term every three years; some institutional support for extended leaves is available.

Occidental College is a selective private college of the liberal arts and sciences with 1,650 undergraduate students, a college faculty of 133, and a mathematics faculty of nine. Occidental is located in northeast Los Angeles, a fifteen minute drive from downtown Los Angeles and ten minutes from Pasadena.

Salary is competitive. An excellent benefits package includes a choice of health care plans, tuition grants for children of faculty, and a mortgage subsidy program.

Completed applications, including current resumé, a statement of professional goals, and three letters of reference (at least one evaluating teaching performance and potential) should be received by February 16, 1991. Address all materials to: Faculty Search Committee, Department of Mathematics, Occidental College, Los Angeles, CA 90041.

Occidental College is an equal opportunity and affirmative action employer and encourages applications from women and ethnic minorities.

TENNESSEE TECHNOLOGICAL UNIVERSITY
Department of Mathematics

Tenure-track position in mathematics at the rank of assistant professor, available 15 August 1991. PhD in mathematical sciences, evidence of excellent teaching ability at all levels, and strong potential in research are required. Duties include graduate and undergraduate teaching and supervision, research activities, and course development. Position is open until filled. Send transcript and curriculum vitae, and have three letters of recommendation sent, ASAP, to: Prof. B. M. O'Connor, Chairperson, Search Committee, Department of Mathematics, Box 5054, Tennessee Technological University, Cookeville, Tennessee 38505, or come by the Tennessee Tech table at the Employment Register. AA/EOE.

MATHEMATICS

One or more tenure-track positions in mathematics, subject to funding approval for fall 1991. Master's degree in mathematics required. PhD preferred. Preference given to US citizens. Salary or rank negotiable. Review of applications begins February 1, 1991. Position open until filled. Send letter of application, a detailed resumé, transcripts, and names, addresses, and telephone numbers of three references to: Dr. William F. Denny, Chairperson, Mathematics Faculty Search Committee, McNeese State University, PO Box 92340, Lake Charles, Louisiana 70609-2340. MSU is an Affirmative Action/Equal Opportunity Employer.

BOWDOIN COLLEGE
Brunswick, Maine 04011

Mathematics Department: Two tenure-track assistant professorships starting fall 1991. Initial appointment for three years with renewal possible. PhD required and strong research record or potential expected. Field open, but a preference will be given to candidates in applied mathematics for one position. Normal teaching load is two courses per semester. Candidates with record of effective undergraduate teaching preferred. Review of candidates begins 15 January, but applications will be considered until both positions are filled. Women and minorities are encouraged to apply. Send resumé and 3 letters of recommendation to: Wells Johnson, Chair, Department of Mathematics, Bowdoin College, Brunswick, ME 04011. Bowdoin College is committed to Equal Opportunity through Affirmative Action.

FACULTY VACANCIES IN MATHEMATICS AND STATISTICS
Assistant Professor Position available for 1991-1992

One tenure-track position in mathematics. Additional temporary positions in mathematics and/or statistics may also become available.

QUALIFICATIONS: PhD in mathematics and evidence of strong teaching and scholarship are required. Those with experience in actuarial science are especially invited to apply.

RESPONSIBILITIES: Both undergraduate and graduate teaching, scholarship, student advising, and university service.

Competitive salary, commensurate with qualifications and experience. Position subject to final budgetary approval. Send cv and names of three references. Preference given to applications received by March 1, 1991.

Professor Robert W. Jernigan
Chair, Department of Mathematics and Statistics
The American University
4400 Massachusetts Avenue, NW
Washington, DC 20016-8050

An EEO/AA University; minorities and women candidates are encouraged to apply.

THE VIRGINIA MILITARY INSTITUTE
Mathematics/Computer Science

A tenure-track position beginning August 1991. Applicant should have a strong interest in teaching.

Preference will be given to applicant with a PhD in computer science. Applicants with significant progress toward a PhD will be considered. Duties include teaching both computer science and mathematics. Salary and rank commensurate with qualifications.

VMI is state-supported with 1,300 undergraduates in engineering, liberal arts, and science. It is located in an attractive college town with three colleges within a six mile radius. Faculty wear uniforms but have no other military duties.

Deadline for applications is February 1, 1991, but will be extended as necessary. Send resumé, three letters of recommendation, and a graduate transcript to: George Piegari, Department of Mathematics and Computer Science, Virginia Military Institute, Lexington, VA 24450.

AA/EEO Employer.

CALIFORNIA STATE UNIVERSITY SAN MARCOS

California State University, San Marcos, located 30 miles north of San Diego, is the newest campus in the California State University system. CSUSM seeks a PhD mathematician in either **mathematical analysis** or **numerical mathematics** for a tenure-track assistant/associate professor position to begin in August 1991. CSUSM seeks an individual with strong academic and professional preparation in the development of the mathematical sciences at a brand new institution. An application consists of a statement of interest, a complete resumé, and at least three reference letters which should comment on the applicant's credentials in teaching, research, and service. Copies of scholarly work may be included. Send to: Chair, Mathematics Search Committee, CSU, SAN MARCOS, 820 WEST LOS VALLECITOS BLVD, SAN MARCOS, CA 92069. Opening pending authorization. Review of candidates will begin January 15, 1991, and continue until the position is filled. Women and minorities are strongly encouraged to apply. CSUSM is an Affirmative Action/Equal Opportunity institution.

ASSISTANT PROFESSOR
Mathematics

The University of Pittsburgh at Johnstown antici- pates two tenure-track positions in mathematics at the assistant professor level to begin in fall 1991. Applicants should have specialization in analysis or applied mathematics. An interest in teaching all levels of undergraduate mathematics and a strong motivation for further professional development are expected. A doctorate by spring 1991 is required. Two-term teaching duties typically start Sept. 1 and end April 30. Salary is negotiable and depen- dent upon experience and qualifications. Applica- tion deadline is January 15, 1991 or until the posi- tion is filled.

Please send resumé, the names of three refer- ences, and other supporting documents to Dr. Ilde- fonso T. Cruz, Chair, Search Committee, Depart- ment of Mathematics, University of Pittsburgh at Johnstown, Johnstown, PA 15904.

UPJ is an Equal Opportunity/Affirmative Action Em- ployer.

WAKE FOREST UNIVERSITY
Department of Mathematics and Computer Science

Applications are invited for two tenure-track posi- tions in mathematics at the assistant professor level beginning August 1991. Duties include teaching mathematics at the undergraduate and graduate levels and continuing research. A PhD is required. The department has 22 members and offers a BS and MA in mathematics and a BS in computer sci- ence. Send letter of application and resumé to: Richard D. Carmichael, Chairman, Department of Mathematics and Computer Science, Wake Forest University, Box 7311, Winston-Salem, NC 27109. AA/EO Employer.

INSTRUCTOR
WRIGHT STATE UNIVERSITY
Department of Mathematics and Statistics
Dayton, Ohio 45435

One or more instructorships are anticipated for fall 1991. These are one-year, non-tenure-track posi- tions which may be renewed annually for up to five year. These positions offer competitive salaries and excellent benefits. The teaching load is 12–16 con- tact hours per quarter, mainly in service courses. Master's degree in mathematics or statistics re- quired. Previous full-time teaching experience pre- ferred. Please send resumé, graduate transcript(s), and three letters of reference to: Faculty Search Committee. Closing date: February 15, 1991, then every two weeks until selection or August 1, 1991. WSU is an AA/EOE.

HAMILTON COLLEGE
Department of Mathematics and Computer Science
Clinton, NY 13323

Two-year, tenure-track position. PhD and prior teaching experience desirable. Duties involve teach- ing five courses per year at a small, highly selective, four-year liberal arts college. Excellence in teach- ing required. To apply, send curriculum vitae and three letters of reference (at least one about teach- ing) to: Richard Bedient, Chair; (315) 859-4138. Women and members of minorities are encouraged to apply; Hamilton College is an Equal Opportu- nity/Affirmative Action Employer.

DARTMOUTH COLLEGE
John Wesley Young
Research Instructorship

The John Wesley Young Research Instructorship is a two-year, postdoctoral appointment for promising new or recent PhDs whose research interests over- lap a department member's. Current departmental interests include areas in algebra, analysis, alge- braic geometry, combinatorics, computer science, differential geometry, logic and set theory, num- ber theory, probability, and topology. Teaching du- ties of four ten-week courses spread over two or three quarters typically include at least one course in the instructor's speciality and include elemen- tary, advanced, and (at instructor's option) gradu- ate courses. Nine-month salary of $32,500, supple- mented by summer (resident) research stipend of $7,150 (two-ninths). Send letter of application, re- sumé, graduate transcript, thesis abstract, descrip- tion of other research activities and interests if ap- propriate, and 3 or preferably 4 letters of recom- mendation (at least one should discuss teaching) to: Phyllis A. Bellmore, Department of Math and CS, Bradley Hall, Hanover, NH 03755. Applica- tions received by Jan. 15 receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to affirmative ac- tion and strongly encourages applications from mi- norities and women.

DARTMOUTH COLLEGE

The Department of Mathematics and Computer Sci- ence has an opening for a tenure-track assistant professor of mathematics, with initial appointment in the 1991-1991 academic year. A candidate for the position must be committed to outstanding teaching at all levels of the undergraduate and graduate cur- riculum and must give evidence of a well-regarded research program that shows real promise for the future. Candidates with several years of experience should in addition be ready to direct PhD theses.

To create an atmosphere supportive of research, Dartmouth offers new faculty members grants for research-related expenses, a quarter of sabbati- cal leave for each three academic years in resi- dence and flexible scheduling of teaching respon- sibilities. The teaching responsibility is mathemat- ics is two courses per quarter for two ten-week quarters or once course for two quarters and two courses for one quarter. The department encour- ages good teaching with a combination of commit- ted colleagues and bright, responsible students.

Applications are welcome in all fields of mathe- matics, including statistics. To apply for the po- sition, send a letter of application, curriculum vi- tae, and a brief statement of research results and interests. Also arrange for four letters of refer- ence to be send, at least one of which addresses teaching, and, if the applicant's native language is not English, the applicant's ability to use English in a classroom. All application material should be addresses to Phyllis Bellmore, Recruiting Secre- tary, Department of Mathematics and Computer Sci- ence, Dartmouth College, Hanover, New Hampshire 03755. Applications completed by February 1 will receive first consideration. Dartmouth is committed to Affirmative Action and encourages applications from African Americans, Asian Americans, Hispan- ics, Native Americans, and women. Specific ques- tions on the selection process can be directed to Richard E. Williamson, Recruiting Chair.

UNIVERSITY OF TENNESSEE AT CHATTANOOGA
Department Head

The University of Tennessee at Chattanooga invites applications for Head of the Department of Math- ematics. A PhD in a mathematical science and at least five years of college mathematics teaching ex- perience are required. Applicants should provide evidence of leadership in curriculum development, teaching, public service, and research/scholarly ac- tivities. In this primarily undergraduate institution, the faculty is expected to exhibit excellence in teach- ing while maintaining a strong commitment to re- search and public service. The mathematics de- partment has 21 faculty members including a Chair of Excellence in applied mathematics. Located in a very scenic metropolitan area of 400,000, UTC has a student enrollment of 7,800. Send appli- cation with current vita to: Dr. Paul L. Gaston, Dean, College of Arts and Sciences, 119 Holt Hall, UTC, Chattanooga, TN 37403-2598. Applications received by January 31, 1991 will be assured full consideration. Women and minorities are encour- aged to apply. UTC is an Equal Opportunity Em- ployment/Affirmative Action/Title IX Section 504 In- stitution.

NORTHERN KENTUCKY UNIVERSITY
Department of Mathematics and Computer Science

The Department of Mathematics and Computer Sci- ence anticipates having two tenure-track positions. The positions are pending funding and would be- gin in August 1991. A doctorate in mathematics or a mathematical science is required. Statisticians are encouraged to apply. Responsibilities include undergraduate teaching (12 hours/semester), schol- arly activity, and service. The department's empha- sis is on quality teaching. Good oral and written communication skills in English are mandatory.

Review of applicants will begin February 1, 1991. Apply to: Professor Frank Dietrich, Chair of Search Committee, Department of Mathematics and Com- puter Science, Northern Kentucky University, High- land Heights, KY 41706.

NKU is an Affirmative Action/Equal Opportunity Em- ployer and actively seeks the candidacy of minori- ties and women.

UNIVERSITY OF HARTFORD
Mathematics, Physics, and Computer Science Department

Applications are invited for a full-time, tenure-track position at the rank of assistant professor begin- ning September 1991. Candidates must have a PhD in mathematics and a strong commitment to excellence in undergraduate teaching, scholarship, and professional development. Opportunities exist to teach in an interdisciplinary general education curriculum. Review of applications will begin Jan. 1 and will continue until the position is filled. Send resumé and three letters of recommendation to:

Dr. Joel Kagan, Chair
Department of Mathematics,
    Physics, and Computer Science
University of Hartford
West Hartford, CT 06117.

The University of Hartford is an equal opportunity, affirmative action employer and specifically encour- ages applications from women and minorities.

DEPAUL UNIVERSITY
Chicago, Illinois
Announcement of Positions in Computer Science

DePaul University invites applications for several tenure-track positions in computer science at all levels. The starting date is September 1991. Any area of specialization will be considered; however, persons in telecommunications and information systems will be given special consideration. Any applicant should hold a PhD in computer science or a related field, or be a candidate for such a degree. Duties include a six-hour teaching load, advising, and research. Tenure details and salary are negotiable. Benefits include TIAA and standard health insurance. US citizenship is not required.

The Department, which offers bachelor's, master's, and doctoral degrees, has over 500 undergraduate majors and over 800 graduate students. Facilities include a VAX 6000/410, a VAX 11/750, an IBM 4381, a Harris HCX-9, an AT&T 3B15, and a Harris 800. Each faculty office is provided with a high performance workstation connected to the Department's ethernet. In addition, the Department's Artificial Intelligence Laboratory is equipped with four Hewlett-Packard AI workstations, two Symbolics 3640s, and a Symbolics 3670. The Department's Computer Vision and Graphics Laboratory is equipped with an AT&T 3B2-1000, eight AT&T 6386 WGS Model E workstations, 15 AT&T 630 multitasking graphics terminals, two frame grabbers, and a dedicated vision processor. There are also numerous PC laboratories. Faculty interests include telecommunications, information systems, artificial intelligence, computer vision, neural computing, natural languages, applied statistics, applied graph theory, computer graphics, computer security, compiler design, semantics or programming languages, and computer architecture.

Applications will be received until positions are filled. To apply, send a resumé and at least three letters of reference to: Helmut Epp, Chairman, Department of Computer Science and Information Systems, DePaul University, 243 S. Wabash, Chicago, IL 60604.

DePaul University is an equal opportunity employer.

ROGER WILLIAMS COLLEGE
BRISTOL, RI 02809
School of Science and Mathematics

The School of Science and Mathematics of Roger Williams College welcomes applications for a full-time faculty position subject to funding approval, in mathematics, beginning September 1991. The School offers majors in mathematics and computer science and provides support courses for College programs in science, engineering, business, architecture, psychology, and general education. The College enrolls approximately 2,100 full-time and 1,700 part-time students in a variety of liberal arts and professional programs, It is situated in historic Bristol, RI on a bluff overlooking Mount Hope Bay. We seek candidates who would enjoy teaching undergraduates a variety of major and service courses. The normal teaching load is 4 courses/12 contact hours. Doctorate and full-time college teaching experience required. Salaries are competitive; fringe benefits excellent.

Send a letter of application, curriculum vitae, and three letters of reference to: Faculty Search Committee, School of Science and Mathematics, Roger Williams College, Bristol, RI 02809. Applications received by February 1, 1991, will be given first consideration. Roger Williams is an affirmative action/equal opportunity employer.

MONTCLAIR STATE COLLEGE
Faculty Positions

The Department of Mathematics and Computer Science invites applications for four positions in mathematics and mathematics education. There are two positions in mathematics. One position is a tenure-track position in applied mathematics at the assistant professor rank. The other position is a non-tenure, one-year only appointment in mathematics at the instructor rank. There are two tenure-track positions in mathematics education at the assistant professor rank. The two positions have different job descriptions as listed below. Candidates for mathematics education positions are expected to participate in curriculum development. Scholarly and professional activities are also expected. Teaching load is 12 credits per semester. Applicants must have a commitment to quality teaching.

■ *Applied Mathematics V11*

Expertise in operations research, mathematical modeling, discrete and continuous applied mathematics. Experience in problem solving on the computer. Teach applied mathematics courses at the undergraduate and graduate master's level. Candidates are expected to pursue grants, be active both as a scholar and with professional organizations. PhD in mathematics required. Tenure-track position.

■ *Mathematics V14*

Applicants will teach a general range of undergraduate mathematics courses including liberal arts students. MA/MS or PhD in mathematics plus teaching experience. Nontenure-track position.

■ *Mathematics Education V12*

Teach undergraduate mathematics and graduate mathematics education courses. Expertise in junior and senior high school mathematics curriculum and current software is required; supervisory experience preferred.

■ *Mathematics Education V13*

Teach primarily undergraduate mathematics. Expertise in remedial/developmental mathematics education programs at the college and secondary level; interest in elementary mathematics preferred.

Submit resumé with appropriate V number and the names, addresses, and phone numbers of three references to: Dr. Kenneth C. Wolff, Department of Mathematics and Computer Science, Montclair State College, Upper Montclair, NJ 07043.

Screening begins February 4, 1991 and continues until positions are filled.

Starting date is September 1, 1991. Positions subject to available funding.

Montclair State College is an Equal Opportunity-Affirmative Action employer.

TRENTON STATE COLLEGE
DEPARTMENT OF MATHEMATICS AND STATISTICS
ANTICIPATED FACULTY VACANCIES FOR FALL 1991

Assistant Professor, (specialty: mathematics) Tenure-track. Req'd: PhD (or within one year of completion); demonstrated commitment to quality teaching; strong research potential. All fields will be considered. Preference will be given to applied mathematics.

Assistant Professor, (specialty: statistics) Tenure-track. Req'd: PhD in statistics (or within one year of completion); demonstrated commitment to quality teaching; strong research potential. Both theoretical and applied statisticians will be considered.

Send vita and three letters of recommendation to: Aigli Papantonopoulou, Chair, Search Committee, Dept. of Mathematics and Statistics, Trenton State College, Hillwood Lakes CN 4700, Trenton, NJ 08650-4700. Application deadline is March 1, 1991 or until position is filled. Non US citizens must include statement of current visa status. The Department currently enrolls over two hundred majors in mathematics, statistics, or in mathematics education. A graduate program offers a master's degree in mathematics. To enrich education through diversity, TSC is an AA/EOE.

SALISBURY STATE UNIVERSITY
Dr. Donald Cathcart,
Search Committee Chair
Department of Mathematical Sciences
Salisbury, Maryland 21801

Applications are invited for one or more tenure-track positions to begin August 15, 1991 at the assistant/associate professor level. *All specialties will be considered,* but preference will be given to discrete math, visual mathematics, and dynamical systems. Commitment to the mathematical sciences point of view (a blending of pure and applied mathematics, statistics, and computer science), strong teaching, a doctorate in a mathematical science by September 1991, and scholarly activity are essential. Candidates must be able to teach service and major courses and those who can stimulate undergraduate mathematical activity will be given special consideration. Rank and salary will be commensurate with credentials and experience.

Salisbury State, a comprehensive university located on Maryland's Eastern Shore and enrolling over 5,700 students, is part of the University of Maryland system. Math classrooms have PCs equipped with a data display. Classrooms, faculty offices, and a student lab are served by a local area network and have direct access to the university's Vax cluster.

Send a letter of application, curriculum vitae, unofficial transcripts, and three letters of recommendation, at least one addressing teaching, to: the Search Committee. Screening of applications will begin February 15, 1991 and will continue until the position(s) are filled.

Salisbury State University is an Affirmative Action/Equal Opportunity Employer. Women, minorities, and the disabled are encouraged to apply.

VENTURA COUNTY COMMUNITY COLLEGE DISTRICT

FULL-TIME INSTRUCTORS IN:

■ **MATHEMATICS (4)**

■ **PHYSICS AND MATHEMATICS**

Vacancies exist at Moorpark, Oxnard, and Ventura Colleges.

Call Certificated Personnel at (805) 654-6424.

RESUMÉS ONLY WILL NOT BE ACCEPTED

71 Day Road
Ventura, CA 93003

"The Ventura County Community College District is an affirmative action, equal opportunity employer and actively seeks the candidacy of ethnic minorities, women, disabled, and Vietnam-era veterans."

YESHIVA UNIVERSITY
Department of Mathematics

The small, selective, liberal arts colleges of Yeshiva University invite applications for a tenure-track position starting in fall 1991 at the rank of assistant/associate professor. Responsibilities include teaching 12 hrs/sem and active scholarship at a level consistent with the teaching load. Rank and salary commensurate with background and experience. Qualifications: PhD, postdoctoral college teaching experience with a record of excellence, and a commitment to undergraduate teaching and productive scholarship. Send letter, vita, and have three letters of reference sent to: Dean Norman S. Rosenfeld, Yeshiva College, New York, NY 10033. (EOE).

CALIFORNIA STATE POLYTECHNIC UNIVERSITY-POMONA

Tenure-track position in mathematics at the assistant professor level, salary dependent upon qualifications, doctorate in mathematics or equivalent degree. Evidence of potential for excellent teaching and scholarly research required. Preference for mathematical modeling, history of mathematics, algebraic geometry, or mathematical physics. Application, resumé, copy of transcripts, and three current letters of reference to be postmarked by 1/31/91. For additional information or to apply, contact: Search Committee, Mathematics Department, California State Polytechnic University, 3801 W. Temple Ave., Pomona, CA 91768-4033; (714) 869-3467. EOE/AA.

PEPPERDINE UNIVERSITY
Mathematics Faculty Position

Seaver College, the undergraduate liberal arts college of Pepperdine University, seeks applicants for a tenure-track appointment in mathematics. PhD required. Candidates should be committed to excellence in undergraduate mathematics teaching at all levels and have an interest in continuing scholarly activity. Pepperdine is an independent Christian university under the control of a self-perpetuating Board of Regents and is related to the Churches of Christ. Forward curriculum vitae, a copy of transcripts, and three letters of recommendation, at least two of which comment on teaching, to: **Dr. Ken Perrin, Natural Science Division, Pepperdine University, Malibu, California 90263.**
An Equal Opportunity Employer.

DEPARTMENT OF MATHEMATICS
College of Natural Sciences
and Mathematics
Indiana University of Pennsylvania

INDIANA UNIVERSITY OF PENNSYLVANIA invites applications for a tenure-track position in the department of mathematics at the assistant profession level to begin fall 1991.

Responsibilities:

1. Teach undergraduate and graduate courses and advise students. Primary teaching responsibilities include mathematics content, methods of teaching , and curriculum for elementary and middle school teachers.

2. Participate in continuing scholarly activity.

3. Participate in university, college, and department committees.

Qualifications:

Required:

1. PhD/EdD by September 1991 in an area of mathematics education.

2. Evidence of effective teaching experience in mathematics at the K–8 level.

3. Academic preparation and evidence of ability to teach basic college mathematics.

4. Evidence of successful research or research promise in mathematics education.

Preferred:

1. Evidence of successful research in mathematics education at the K–8 level.

2. Active membership in recognized professional organizations.

3. Evidence of graduate course work in elementary/middle school education.

4. Experience with inservice presentations and/or curriculum consultation at the school district level.

Salary: Commensurate with experience. Excellent fringe benefits.

Review of applications will begin on January 15, 1991 and continue until position is filled.

Send letter of application, resumé, undergraduate and graduate transcripts, and three current letters of reference to:

Search Committee E
Mathematics Department
Indiana University of Pennsylvania
Indiana, PA 15705
(Phone : (412) 357-2608)
(Bitnet: MWOODARD@IUP)

IUP is an affirmative action/equal opportunity employer.

DEPARTMENT OF MATHEMATICS
College of Natural Sciences
and Mathematics
Indiana University of Pennsylvania

INDIANA UNIVERSITY OF PENNSYLVANIA invites applications for a tenure-track position in the department of mathematics at the assistant profession level to begin fall 1991.

Responsibilities:

1. To teach undergraduate and graduate courses with emphasis on courses in operations research.

2. To provide leadership in the implementation of a newly designed and approved MS program in applied mathematics with emphases in operations research and applied statistics.

3. To give direction to a graduate internship program and to graduate student projects in applied mathematics.

4. To help establish an academic and professional relationship between the graduate program at IUP and local and regional business/industrial organizations.

Qualifications:

1. A PhD in either operations research or applied mathematics.

2. Teaching and/or field experiences preferred but not required.

Review of applications will begin January 2, 1991 and continue until the position is filled.

Send letter of application, resumé, undergraduate and graduate transcripts, and three current letters of reference to:

Search Committee E
Mathematics Department
Indiana University of Pennsylvania
Indiana, PA 15705
(Phone : (412) 357-2608)
(Bitnet: MWOODARD@IUP)

IUP is an affirmative action/equal opportunity employer.

PENN STATE HARRISBURG
Head, Division of Science, Engineering, and Technology

Penn State Harrisburg invites applications and nominations for the position of Head of the Division of Science, Engineering, and Technology. The starting date for the appointment will be July 1, 1991. Review of applications will begin February 15, 1991.

Penn State Harrisburg, with an enrollment of over 3,400 students, is located 10 miles southeast of Harrisburg, the state capital. It is an upper-division college and graduate center of Pennsylvania State University, serving the rapidly growing area of south central Pennsylvania.

The Division of Science, Engineering, and Technology includes undergraduate bachelor of science programs in computer and mathematical sciences, electrical engineering technology, environmental engineering technology, mechanical engineering technology, structural design, and construction engineering technology and master's programs in engineering science and environmental pollution control. It includes 47 full-time faculty and 710 full-time and part-time students.

For more information, contact: Dr. Charles Cole, Chair, Search Committee, Office of the Dean of Faculty, Room 119, Penn State Harrisburg, Middletown, PA 17057; (717) 948-6103; FAX: (717) 948-6008.

The Pennsylvania State University is an affirmative action equal opportunity employer. Women and minorities are encouraged to apply.

THE UNIVERSITY OF PUERTO RICO AT MAYAGUEZ
Department of Mathematics

The Department of Mathematics has a tenure-track opening for an assistant professor in the area of applied mathematics (with emphasis in general relativity theory), with a salary of $23,820 per year. Fluency in spoken and written Spanish and English, a PhD degree in mathematics, and at least one year of academic or industrial/research experience are required. The appointee will be expected to teach graduate and undergraduate courses and do research. Send resumé and three letters of recommendation to: Prof. Julio C. Quintana-Diaz, Acting Chairperson, Department of Mathematics, UPR, PO Box 5000, Mayaguez, PR 00709-5000. EEO/AA.

DIRECTOR

Director, Academic Excellence Program in Mathematics and Chemistry, Occidental College. Faculty position to direct a workshop-based excellence program for the first year classes in mathematics and chemistry, work closely with the faculty in the two departments in coordinating the program's operation, advise math and science students, particularly minority students, concerning opportunities in science. The successful candidates must have an advanced degree in mathematics or chemistry and possess strong communication and administrative skills and experience working with student groups in a multicultural environment. To apply, submit a letter of application, a resumé, transcripts, and three letters of reference by 20 January 1991 to: **Dr. Chris Craney, Chemistry Department, Occidental College, 1600 Campus Road, Los Angeles, CA 90041.** Occidental College is an Affirmative Action/Equal Opportunity Employer and especially invites applications from women and minorities.

HILLSDALE COLLEGE
Department of Mathematics
Hillsdale, MI 49242

An independent, coeducational, liberal arts college of 1,100 students, seeks a mathematician for a tenure-track position as assistant professor of mathematics to begin August 1991. A candidate should hold the PhD in mathematics and should expect to teach all levels of undergraduate mathematics. In addition to a 12-hour teaching load per semester, duties will include academic advising and college service. A commitment to quality liberal arts education and experience in undergraduate teaching of mathematics will be important. Salary will be competitive and commensurate with qualifications. Send letter of application, resumé, and three letters of reference to: Prof. Mark J. Watson, Chairman, at the above address, by January 31, 1991, for full consideration.

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Calendar

National MAA Meetings

16–19 January 1991 74th Annual Meeting, San Francisco, California (Board of Governors, 15 January 1991)
8–11 August 1991 67th Summer Meeting, Orono, Maine (Board of Governors, 7 August 1991)
8–11 January 1992 75th Annual Meeting, Baltimore, Maryland (Board of Governors, 7 January 1992)

Sectional MAA Meetings

Allegheny Mountain West Virginia State College, Institute, West Virginia: 12 and 13 April 1991
Eastern Pennsylania and Delaware La Salle University, Philadelphia, Pennsylvania: 6 April 1991
Florida Eckerd College, St. Petersburg, Florida: 1 and 2 March 1991
Illinois Eastern Illinois University, Charleston, Illinois: 26 and 27 April 1991
Indiana Anderson University, Anderson, Indiana: 23 March 1991
Intermountain Ricks College, Rexburg, Idaho: 12 and 13 April 1991
Iowa Drake University, Des Moines, Iowa: Spring 1991
Kansas Southwestern College, Winfield, Kansas: 5 and 6 April 1991
Kentucky Northern Kentucky University, Highland Heights, Kentucky: 5 and 6 April 1991
Louisiana and Mississippi University of Mississippi, Biloxi, Mississippi: 1 and 2 March 1991
Maryland–District of Columbia–Virginia Virginia Commonwealth University, Richmond, Virginia: Spring 1991
Metropolitan New York Columbia University, New York, New York: 4 and 5 May 1991 (50th Anniversary)
Michigan Calvin College, Grand Rapids, Michigan: 10 and 11 May 1991
Missouri The University of Missouri at Rolla, Rolla, Missouri: 5 and 6 April 1991
Nebraska Nebraska Wesleyan University, Lincoln, Nebraska: 26 and 27 April 1991
Northeastern Vermont Technical College, Randolph Center, Vermont: 7 and 8 June 1991
Northern California California State University at Hayward, Hayward, California: February or March 1991
Ohio Bowling Green State University, Bowling Green, Ohio: 5 and 6 April 1991
Oklahoma and Arkansas Cameron University, Lawton, Oklahoma: 29 and 30 March 1991
Pacific Northwest Seattle Pacific University, Seattle, Washington: 20–22 June 1991
Rocky Mountain University of Northern Colorado, Greeley, Colorado: Spring 1991
Seaway State University of New York at Oneonta, Oneonta, New York: Spring 1991

Southeastern University of South Alabama, Mobile, Alabama: 5 and 6 April 1991
Southern California El Camino College, Torrance, California: 2 March 1991
Southwestern New Mexico State University, Las Cruces, New Mexico: 5 and 6 April 1991
Texas Stephen F. Austin State University, Nacogdoches, Texas: 4–6 April 1991
Wisconsin University of Wisconsin, Oshkosh, Wisconsin: 26 and 27 April 1991

Other Meetings

20 January 1991 *Workshop on the Teaching of Calculus,* San Francisco, California. No advance registration necessary. For further information, contact: Gilbert Strang, Room 2-240, MIT, Cambridge, Massachusetts 02139.
28–30 January 1991 *Second ACM-SIAM Symposium on Discrete Algorithms,* Cathedral Hill Hotel, San Francisco, California. Organizer: Alok Aggawal of the IBM T. J. Watson Research Center. For further information, contact: SIAM Conference Coordinator, Dept CC0900, 3600 University City Science Center, Philadelphia, Pennsylvania 19104-2688; (215) 382-9800; siam-confs@wharton.upenn.edu. Fax: (215) 386-7999.
11–15 February 1991 *Twenty-Second Southeastern International Conference on Combinatorics, Graph Theory, and Computing,* Louisiana State University (LSU), Baton Rouge, Louisiana 70803. Invited speakers include: R. Brualdi, P. Erdös, C. Godsil, W. Pulleyblank, and R. Thomas. For further information, contact: J. G. Oxley of the Department of Mathematics at LSU.
25–27 March 1991 *Fifth SIAM Conference on Parallel Processing for Scientific Computing,* the Western Galleria Hotel, Houston, Texas. Organizer: Danny Sorensen of Rice University. For further information, contact the SIAM Conference Coordinator at the address above (28–30 January 1991).
7–9 April 1991 *Fourteenth Annual Symposium of the New York College Learning Skills Association,* Sheraton Inn and Conference Center, Ithaca, New York. Keynote speaker: Joe Clark, educator and subject of the film, *Lean on Me.* For further information, contact: Carl M. Wahlstrom, Genesee Community College, One College Road, Batavia, New York 14020; (716) 343-0055.
12 and 13 April 1991 *Tenth Annual Pi Mu Epsilon Regional Undergraduate Mathematics Conference,* St. John's University, Collegeville, Minnesota 56321. Open to all students, faculty, and those with a love of mathematics. Invited speaker: Raymond Smullyan of Herbert H. Lehman College of the City University of New York. For further information, contact: Shoba Gulati of the Department of Mathematics at St. John's University, (612) 363-3087.
26–28 April 1991 *1991 Annual Meeting of the New York State Mathematics Association of Two-Year Colleges (NYSMATYC),* Buffalo Hilton at the Waterfront, Buffalo, New York. For further information, contact: Leonard T. Malinowski, Department of Mathematics, Community College of the Finger Lakes, Lincoln Hill, Canandaigua, New York 14424.