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FOCUS

INSIDE:

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FOCUS

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Inside

On the cover: the hand-cut lead crystal icosahedron that was presented to each member of the Icosahedron Society. Cover photo by Bob Sullivan.

FOCUS Deadlines

	January	February	March
Editorial Copy	November 15	December 15	January 19
Display Ads	December 4	January 4	February 4
Employment Ads	November 17	December 19	January 26

Three Mathematicians Win National Teaching Awards for 2000

Edward Burger, Leonard F. Klosinski, and Evelyn Silvia will be awarded the Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics at the Joint Prize Session and Reception to be held on Thursday January 11, 2001, during the Joint Mathematics Meetings in New Orleans. Each of the winners will speak at a special session to be held on Friday January 12, 2001 from 3:30 to 5:00, giving everyone at the Joint Meetings a chance to get to know the winners and their teaching styles.

Edward Burger

Edward Burger of Williams College is passionate about teaching. He inspires his students with his enthusiasm for mathematics and with his ability to make it fun and interesting. As one of his colleagues puts it, Burger "enthralls, entices, goads, cajoles, fans sparks of curiosity, and converts math phobes into math fans by the hundreds." Burger's energy and dedication are apparent to everyone. He often drops by in the evenings on groups of students working on his assignments to see what they have done and to offer suggestions.

Burger is also noted for innovative courses. At Williams, he has offered an innovative seminar on algebraic number theory, and he has also developed a successful course, *The Spirit of Math*, for students who usually avoid mathematics.

Burger is also a lively speaker who has given numerous talks on a wide variety of subjects outside Williams College. These include conference addresses, talks, lectures at other institutions, and appearances on radio and television. His talks are successful because of his ability to engage and entertain his listeners while still dealing seriously with the mathematics. Because of his ability to capture the interest of diverse audiences, the president of Williams College has dubbed Ed Burger the "ambassador of mathematics."

Leonard Klosinski

Leonard Klosinski of Santa Clara University is perhaps best known for his work on the William Lowell Putnam Mathematical Competition. For the last 25 years he has served first as Associate Director and then as Director of the Putnam Competition. Under his leadership the number of contestants has remained constant or increased slightly despite the declining number of mathematics majors nationally. In recent years, more contestants than ever have been recognized for outstanding achievement on the Putnam. His dedication and organizational skills have ensured that the contest runs smoothly each year.

In addition to being a leader on competitions, Professor Klosinski is a popular teacher, known for giving challenging courses to students who recognize their value. In front of a class he is "lively, outgoing, theatrical, and seemingly spontaneous." He has a loyal following of students who credit to him much of their development as professionals in computer science, mathematics, and various branches of science and engineering.

Evelyn Silvia

Evelyn Silvia is active in teaching at all levels, from grade school to graduate school. She has taught several courses (including supplemental mathematics for deaf children, fifth grade special math, pre-algebra 1, and geometry) in the public schools, without compensation. From 1994 to 1999 she was the Director of the Northern California Mathematics Project whose mission is to improve the quality of mathematics teaching in the schools through professional development programs. She also has played a major role in her department helping graduate students and new faculty with their teaching. She is a role model for high school teachers, for those aspiring to be teachers, and for graduate students.

At the University of California-Davis Professor Silvia has taught a wide variety of subjects successfully. The extra materials that she provides to assist the students are notable. Besides self help handouts and packets of supplementary notes, she has also written a series of popular companion notes for courses where students find the textbook difficult. They are called "Working Excursions," and cover abstract algebra, advanced calculus, and complex variables.

Professor Silvia has served as a mentor in an NSF-sponsored program "Minority Undergraduate Research Participation in the Physical and Mathematical Sciences." Finally, in addition to her teaching and outreach activities, she continues to be a well-respected researcher in functions of one complex variable. ■

Special Session at the Joint Mathematics Meetings in New Orleans

Friday January 12, 2001
from 3:30 to 5:00

Creating a Meaningful Piece of the Human Mosaic
Edward B. Burger

Teaching Through Problems and the Putnam Competition
Leonard F. Klosinski

Reflections on Teaching and Learning
Evelyn Silvia

Teacher Preparation: the Discussion Continues

How to improve the quality of American mathematics and science teaching continues to be an issue of national concern. In September, the National Research Council issued a report called Educating Teachers of Science, Mathematics, and Technology: New Practices for the New Millennium.

The report, which can be obtained from the National Academy Press at http://www.nap.edu, emphasizes that teacher education is a better category than teacher preparation, since the education of teachers must in fact continue throughout their professional life. "Teacher education should...be a seamless continuum that begins well before prospective teachers enter college and that supports them throughout their professional careers." Therefore, the report asks that the responsibility for educating teachers be broadened beyond schools of education to include academics, school districts, and society as a whole.

The National Academy of Sciences established a Committee on Science and Mathematics Teacher Preparation in 1998 to make recommendations about teacher preparation based on the available research data. The report is the result of two years of work by the committee. In addition to its focus on professional development of teachers, it notes that for teaching to improve it is essential that teachers be accorded the same level of respect as other professionals. It describes the education of teachers as a "top national priority," and calls for changes in the rewards, incentives, and expectations for teachers that will reflect this priority. Finally, the report emphasizes the need for cooperation between schools and the higher education community in order to achieve the goal of delivering the best mathematics and science teaching in our schools.

As FOCUS went to press, a second report on the subject was expected for early October, this time from the National Commission on Mathematics and Science Teaching for the 21st Century, usually referred to as the "Glenn Commission" because it is chaired by former senator John Glenn. Preliminary reports in the September 1 issue of *Science* indicated that there would be large areas of agreement between the two reports. The Glenn Commission report should be available on the web at http://www.ed.gov/americacounts/glenn/toc.html. ■

Fermat's Last Theorem: The Musical

Mathematics will show up on stage once again in November, this in a musical called *Fermat's Last Tango*, which will premiere Off Broadway at the York Theater Company in New York City. The musical, written by the husband-and-wife team of Joanne Sydney Lessner and Joshua Rosenblum, is inspired by the story of Andrew Wiles' proof of Fermat's Last Theorem, as made public by the PBS film "The Proof" and the book *Fermat's Enigma*, by Simon Singh.

Standing, left to right: are Chris Thompson (Professor Keane), Joshua Rosenblum (music and lyrics), and Jonathan Rabb (Fermat). In front, Joanne Sydney Lessner (book and lyrics).

The musical tells the story of Professor Daniel Keane, who comes up with a proof that Fermat couldn't possibly understand, finds a flaw in the proof, and then fixes the flaw under the watchful eye of Fermat and other dead mathematicians (who now all reside in the "AfterMath," of course). Fermat, Pythagoras, Euclid, Newton, and Gauss all feature in the show. The tone is lighthearted and whimsical.

Towards the end of the story Fermat is shown running a nightmarish game show called "Prove My Theorem!" in which Professor Keane finds himself a contestant. The other great mathematicians end up getting tired of Fermat's antics, and decide to help the professor fix his proof. The music combines operetta, blues, pop, and, of course, tango. The performance is almost completely sung through, with very little spoken dialogue.

Both of the play's authors were music majors at Yale. Joshua Rosenblum says he briefly considered a mathematics minor, but in the end didn't get much beyond calculus, though he continues to nurture a recreational interest in mathematics. Both became fascinated by the story of the proof of Fermat's Last Theorem, and decided to write a musical on the subject. The show contains little mathematics, but what it does include it tries to get right. The authors have also included some references they hope will resonate with mathematicians. For example, one of the obstacles Fermat puts before Professor Keane in his game show is the fact that mathematics is a "young man's game."

Performances of *Fermat's Last Tango* will begin on November 21 and run through December 31, Tuesday through Saturday. The York Theatre Company is located at the Theatre at St. Peter's, Citicorp Center, 619 Lexington Avenue (at 54th Street), New York, NY 10022. For tickets, call 212-239-6200. ■

The Icosahedron Society

The icosahedron was chosen as the logo of the MAA at the time of its founding in 1915. The newly formed Icosahedron Society recognizes those individuals who have been the Association's most generous contributors.

The choice of the symbol of the Association for the name of this very special group of people signifies their very great importance to the MAA. Their generosity and dedication to the Association make it possible for the MAA to better serve our members and fulfill our mission "to advance the mathematical sciences, especially at the collegiate level," for many years to come.

The Hannah Carter Japanese Garden of the University of California at Los Angeles was the setting for the induction of the first charter members of the Icosahedron Society. The event took place this past summer during MAA's Mathfest, held on the campus of UCLA.

Pictured above are the first four charter members of the Icosahedron Society, along with Don Albers, MAA Associate Executive Director, Ken and Ruth Ross, Tom Banchoff, MAA President, and Tina Straley, MAA Executive Director. Standing from left to right: Edward Brinn and Edith Ross Brinn, Henry Alder, Deborah Tepper Haimo, Mary Alice and Marvin Shaefer, Don Albers, Ruth and Ken Ross, Tom Banchoff and Tina Straley.

President Tom Banchoff unveiled the magnificent hand-cut lead crystal icosahedron presented to each member of the Society as a gift of gratitude and appreciation. A picture of this beautiful sculpture graces the front cover of this issue.

The reception at the Japanese Garden was followed by the President's Dinner for the charter members of the Icosahedron Society. The charter members are listed in the display box on this page.

The icosahedron, one of the five Platonic solids, represents water according to Plato. Water is the sustenance of life. Thus, the icosahedron is a fitting symbol for our sustaining members, whose contributions will ensure a long life for our Association and the fulfilling of our goals to:

Stimulate effective teaching, learning, and assessment in the mathematical sciences.

Foster scholarship, professional development, and a spirit of association among mathematical scientists.

Enhance the interests, talents, and achievements of all individuals in the mathematical sciences, especially of members of underrepresented groups.

Influence institutional and public policy through effective advocacy for the importance, uses, and needs of the mathematical sciences.

The icosahedron is not a space filling solid. In one sense it stands alone and in another it requires others to complete the whole picture.

Each of our Icosahedron Society members stands alone in extraordinary support of the MAA through contributions of their time, dedication through their deeds, and contributions to support the work of the Association. These shining stars add luster to the whole organization, of which they are a part.

On behalf of the President, the Executive Officers, and all members of the Association, we thank these individuals for all of their support of the MAA.

Lisa Kolbe, newly appointed Development Specialist, can be reached at MAA Headquarters for information on the Icosahedron Society and other development efforts. Call 202-387-5200 or email lkolbe@maa.org. ■

Charter Members of the Icosahedron Society

Henry L. Alder
of Davis, California

Edith Ross Brinn
and Edward Brinn
of Salt Lake City, Utah

Deborah Tepper Haimo
of La Jolla, California

Mary Alice
and Marvin Schaefer
of Woodbine, Maryland.

The Curriculum Foundations Project

By William Barker

The stereotype of the mathematics community as aloof—perhaps even a tad condescending—towards other disciplines and their mathematical needs is not uncommon among our science and social science colleagues. Fortunately a major MAA effort that is underway challenges this stereotype: a series of disciplinary workshops known as the Curriculum Foundations Project.

The CF Project is part of a major MAA review of the undergraduate programs in mathematics. The MAA's Committee on the Undergraduate Program in Mathematics (CUPM) is currently studying the undergraduate curriculum, taking into account the views of a broad segment of the mathematics community and its partner disciplines. The goal is a document that will assist mathematics departments as they plan their programs through the first decade of the 21st century. Past CUPM recommendations have strongly influenced undergraduate mathematics instruction. Future recommendations should have similar influence.

Given the impact of mathematics instruction—especially instruction during the first two years—on the sciences and quantitative social sciences, there is a need for significant input from these partner disciplines. Hence the CUPM Subcommittee on Calculus Reform And the First Two Years (CRAFTY) is gathering the necessary information through a series of eleven disciplinary workshops.

These workshops, listed in the accompanying display box, comprise the heart of the Curriculum Foundations Project. They contribute to the foundational materials from which recommendations for the first two years of college mathematics will be constructed.

Each workshop is focused on a particular partner discipline such as physics or computer science, or on a group of related disciplines such as the health-related life sciences. The goal of each workshop is to obtain a clear, concise statement of what students in that area need to learn in their first two years of college mathematics.

The workshops are not intended to be dialogues between mathematics and the partner disciplines. Instead, each workshop is a dialogue between representatives of the discipline under consideration, with mathematicians present merely to listen to the discussions and to provide information on current curriculum trends in mathematics. For this reason, the majority of the twenty to thirty individuals invited to participate in each workshop are from the partner disciplines.

The major product of a CF workshop is a ten-page report summarizing the recommendations and conclusions of the workshop. It is written by the representatives of the partner discipline, directed towards the mathematics community, and addresses a series of questions formulated by CRAFTY. Uniformity of style is achieved across the reports by using essentially the same set of questions for each workshop. Having a common list of questions also aids in comparing the reports of different workshops.

The documents so produced will be widely circulated within the specific disciplines as well as the mathematics community in order to solicit a broad range of comments. After such circulation, the reports will be published and used in the formulation of the ultimate CUPM curriculum recommendations. The reports will also be the focus of a Curriculum Foundations Workshop to be held during 2001 at the U.S. Military Academy at West Point.

In addition to their role in the CUPM review, the reports can serve as valuable resources for initiating discussions between mathematics departments and their partner disciplines. Working from electronic versions of the reports currently available, some mathematics departments have already begun using the reports to stimulate interdepartmental discussions of their curriculum. Promoting and supporting informed discussions with the partner disciplines may ultimately be considered the most important outcome of the Curriculum Foundations Project.

The workshops have generated much good will between mathematics and the partner disciplines. In particular, our colleagues from the other disciplines have been extremely grateful—and perhaps a little surprised! —to be invited by mathematicians to state their views about mathematics education and to realize that their opinions are taken seriously.

Another pleasant surprise concerns the funding of the CF Project. Although the NSF supplied at least partial support for several of the workshops, the vast majority of the events have been funded entirely by the local hosting institutions. Since travel and lodging expenses are covered for all workshop participants, the host institutions have contributed serious money to the project. We are sincerely grateful for their generosity.

As reported in the January, 2000 issue of FOCUS, the first two workshops were held last Fall at Bowdoin College (Physics and Computer Science) and at West Point (interdisciplinary instruction related to Physics and Engineering). The workshops received some attention from the national media, mostly notably in an article by Mark Clayton of the *Christian Science Monitor*, This article is still available on the *Monitor's* web page at http://csmonitor.com/durable/1999/11/09/fp13s1-csm.shtml. Two other workshops have been held since then, with several still to come (see the box on the next page). The project will conclude with an event at the Mathematical Sciences Research Institute in Berkeley, CA. This final workshop will focus on the preparation of mathematics majors.

The Joint Meetings of the MAA and AMS in New Orleans this January will feature

a number of events centered on the Curriculum Foundations Project. In addition to presentations and panel discussions by participants in the workshops, a series of small focus groups will be organized by the CUPM to discuss the CF workshop reports.

Each focus group, comprised of individuals invited in advance, will discuss and analyze the implications of a single CF report. Each report will be considered by at least one focus group, and the insights generated by these discussions will be further input for the CUPM curriculum review.

If you are interested in participating in a focus group, please contact Bill Haver (Virginia CommonwealthUniversity) by email at whaver@atlas.vcu.edu and indicate the reports in which you are interested.

Further reports on the workshops and their results will appear in future issues of FOCUS. Electronic copies of all the reports so far are available at http://academic.bowdoin.edu/math/faculty/barker/dissemination/. ■

William Barker is the chair of CRAFTY, the CUPM Subcommittee on Calculus Reform and the First Two Years. He can be contacted at Department of Mathematics, Bowdoin College, 8600 College Station, Brunswick, ME 04011.

CRAFTY/CUPM Curriculum Foundations Workshops

Contact:William Barker, barker@bowdoin.edu

Completed:

Physics and Computer Science
Bowdoin College, Maine
Oct. 28-31 '99
William Barker, barker@bowdoin.edu

Interdisciplinary (Math, Physics, Engineering)
West Point
Nov. 4-7, '99
Don Small, ad5712@usma.edu

Engineering
Clemson University
May 4-7, '00
Susan Ganter, sganter@clemson.edu

Health-related Life Sciences
Virginia Commonwealth University
May 18-20, '00
William Haver, whaver@atlas.vcu.edu

Upcoming:

Technical Mathematics (at two sites):
Los Angeles Pierce College, California
Oct. 5-8, '00
Bruce Yoshiwara
byoshiwara@hotmail.com

J. Sargeant Reynolds
Community College, Virginia
Oct. 12-15, '00
Susan Wood, swood@jsr.cc.va.us
Mary Ann Hovis, hovisma@ltc.tec.oh.us

Statistics
Grinnell College
Oct. 12-15, '00
Thomas Moore
mooret@math.grin.edu

Business, Finance and Economics
University of Arizona
Oct. 28-29, '00
Deborah Hughes Hallett
dhh@math.arizona.edu
WilliamMcCallum
wmc@math.arizona.edu

Mathematics Education
Michigan State University
Nov. 1-3, '00
Sharon Senk
senk@pilot.msu.edu

Biology and Chemistry
Macalester College
Nov. 2-5, '00
David Bressoud
bressoud@macalester.edu

Mathematics Preparation for the Major
MSRI
Feb 9-11, '01
William McCallum
wmc@math.arizona.edu

MAA Section Meetings November 2000 to March 2001

Eastern PA & Delaware

November 4, 2000—Penn State Abington, Abington, PA

Florida

March 2–3, 2001—Florida Gulf Coast University, Fort Myers, FL

Illinois

March 23–24, 2001—University of Illinois at Urbana- Champaign, Urbana, IL

Indiana

March 23–24, 2001—University of Indianapolis, Indianapolis, IN

Kansas

March 30–31, 2001—Emporia State University, Emporia, KA

Louisiana-Mississippi

March 23–24, 2001—University of Mississippi, Oxford, MS

Md-Dc-Va

November 17–18, 2000—American University, Washington, DC

Northeastern

November 17–18, 2000—Providence College, RI

Northern California

March 3, 2001—Santa Clara University, Santa Clara, CA

Ohio

March 23–24, 2001—Bowling Green State University, Bowling Green, OH

Oklahoma-Arkansas

March 30–31, 2001—Oklahoma Christian University, Oklahoma City, OK

Seaway

November 3–4, 2000 —SUNY at Fredonia, Fredonia, NY

Southeastern

March 30–31, 2001—Huntingdon College, Montgomery, AL

Southern California

March 2001—UC Irvine, Irvine, CA

Texas

March 29–31, 2001—University of Houston-Clear Lake, Houston, TX

For the complete calendar of section meetings visit: http://www.maa.org/sections/schedule.html.

Going Beyond the Big Theorem of Göllnitz:

A Breakthrough in the Theory of Partitions and q-Series

By Krishnaswami Alladi

The theory of partitions and q-series is an exciting area of research that interacts with many fields within and outside of mathematics. A central portion of the theory involves results such as the Rogers-Ramanujan identities, which imply interesting theorems about partition functions. The deep theorem of Göllnitz is a famous example of such a partition theorem. In March 2000, Alexander Berkovich, George Andrews, and I made a breakthrough by obtaining an identity that extends Göllnitz's theorem, solving a problem that had been open since 1971. The consequences of this discovery are likely to be many. In this article I shall outline certain major ideas in the theory of partitions to explain the Göllnitz theorem and describe how the extension was formulated and proved.

The theory of partitions was founded by Euler, who noticed that generating functions could be used to prove elegant partition identities. By a *partition* of a positive integer n we mean a representation of n as a sum of positive integers (called parts), two such representations being considered the same if they differ only in the order of the parts. One of Euler's fundamental results is:

Theorem E: *The number of partitions of an integer into odd parts equals the number of partitions of that integer into distinct parts.*

For example, there are six partitions of 8 into odd parts, namely, 7+1, 5+3, 5+1+1+1, 3+3+1+1, 3+1+1+1+1+1, and 1+1+...+1. There are also six partitions of 8 into distinct parts, namely, 8, 7+1, 6+2, 5+3, 5+2+1, and 4+3+1.

During the beginning of this century, the theory of partitions underwent a glorious transformation under the magic touch of the Indian genius Srinivasa Ramanujan, who discovered a variety of startlingly beautiful results. One of the most beautiful is the following identity (also discovered independently by L. J. Rogers):

(1)

$$\sum_{n=0}^{\infty} \frac{q^{n^2}}{(1-q)(1-q^2)\cdots(1-q^n)} = \prod_{m=0}^{\infty} \frac{1}{(1-q^{5m+1})(1-q^{5m+4})},$$

This is the first of the two Rogers-Ramanujan identities. In the entire theory of partitions and q-series, these two identities are unmatched in simplicity of form, elegance, and depth. MacMahon and Schur showed that one can reinterpret (1) as a partition theorem, as follows:

Theorem R: *The number of partitions of an integer into parts differing by at least 2 equals the number of partitions of that integer into parts which when divided by 5 leave remainder 1 or 4.*

Schur used the combinatorial interpretation to discover the "next level" partition theorem. First, he interpreted Euler's theorem as establishing the equality between partitions where the gap between the parts is at least 1 (distinct parts) and partitions whose parts are $\equiv \pm 1 (mod\ 4)$, (that is, they are odd). Then he reformulated (1) as Theorem R. Naturally, his next step was to study partitions whose parts have gaps at least 3, but then he realized that a certain additional condition was necessary in order to connect these with partitions whose parts satisfy congruence conditions. Here is what he ended up proving in 1926:

Theorem S: *Let $S(n)$ denote the number of partitions of n into distinct parts $\equiv 1$ or $2\ (mod\ 3)$. Let $T(n)$ denote the number of partitions of n into parts whose difference is ≥ 3 with strict inequality when a part is a multiple of 3. Then $S(n) = T(n)$.*

In general, when the gaps increase, additional conditions are required to connect such partitions with those satisfying congruence conditions. One of the deepest examples of such a partition theorem is the Göllnitz Theorem, proved in 1967:

Theorem G: *Let $C(n)$ denote the number of partitions of n into distinct parts congruent to $\equiv 2, 4\ or\ 5 (mod\ 6)$. Let $D(n)$ denote the number of partitions of n in the form $m_1 + m_2 + \ldots + m_v$ such that $m_v \neq 1\ or\ 3$, $m_i - m_{i+1} \geq 6$ with strict inequality if $m_i \equiv 0, 1\ or\ 3\ (mod\ 6)$. Then $C(n) = D(n)$.*

For example, the 7 partitions counted by $C(22)$ are 22, 20+2, 17+5, 16+4+2, 14+8, 11+5+4+2, and 10+8+4, and by $D(22)$ are 22, 20+2, 18+4, 17+5, 16+6, 15+7, and 14+8.

On the congruential side, Schur's theorem deals with partitions into distinct parts in two residue classes (mod 3), while Göllnitz's theorem deals with three residue classes (mod 6). Thus Theorem G may be viewed as a result one level higher than Theorem S.

My former teacher Basil Gordon drew my attention to the Göllnitz theorem. In 1989 Gordon and I had introduced a new technique, *the method of weighted words*, to obtain generalizations of Schur's theorem. Our approach was to consider partitions into integers occurring in two primary colors A and B and to connect these with partitions into parts satisfying certain gap conditions and occurring in colors A, B, as well as in a secondary color AB formed out of it. We cast this in the form of an expansion for a double infinite product:

(2)

$$\prod_{m=1}^{\infty} (1+Aq^m)(1+Bq^m)$$

Schur's theorem follows from this, by replacing the colors A, B, AB by residue classes 1,2 and 3 (mod 3), respectively. Schur's special gap condition for multiples of 3 gets interpreted as a condition attached to parts in the secondary color AB. Gordon and I then extended the method of weighted words to obtain a generalization of the Göllnitz theorem. The idea is to use three primary colors A, B, C and three secondary colors AB, AC, BC formed out of them. The *key identity* is an expansion for the triple product

(3)

$$\prod_{m=1}^{\infty} (1+Aq^m)(1+Bq^m)(1+Cq^m).$$

Göllnitz's theorem follows much as Schur's theorem followed from the previous identity. The colors A, B, and C correspond

to 2, 4, and 5 (mod 6), respectively, and the secondary colors *AB, AC,* and *BC* correspond to the pairwise sums, i.e., to 0, 1, and 3 (mod 6). Once again, our result also explained the strict inequality condition in Göllnitz's theorem as a condition attached to parts in secondary color. Finally, setting $C = 0$ in (3), our result reduced to the identity for the double product (2). Thus this approach via partitions into colored integers allowed us to explain precisely in what sense the Göllnitz theorem was an extension of Schur's theorem. Unfortunately, we did not have a proof for this remarkable identity.

In November 1990, George Andrews arrived at the University of Florida to give a lecture on the "Lost Notebook" of Ramanujan. The key identity caught his attention, and during his brief stay in Florida he thought of nothing else. Before he left, he had produced a proof!

In 1971, George Andrews, who was the first to use computers to search for partition identities, asked whether there exist results beyond the Göllnitz theorem. In the language of partitions into colored integers, the problem may be formulated as follows: *is there a partition result that reduces to the Göllnitz theorem in the same way that the Göllnitz theorem reduces to the Schur theorem?* Andrews, Gordon, and I have been thinking about this for many years. In the spring of 1999, Alexander Berkovich arrived at the University of Florida to conduct research with me. He had previously worked with the Heineman Prize winning physicist Barry McCoy at Stony Brook and had discovered important new Rogers-Ramanujan type identities out of studies in Conformal Field Theory. I drew his attention to the Göllnitz theorem and the unsolved problem concerning results beyond it. In an amazingly short time, Berkovich mastered the techniques necessary to make significant contributions to this problem.

Berkovich and I studied partitions into distinct parts in four primary colors *A, B, C, D.* The difficulty was to connect these in a meaningful way with partitions into parts satisfying difference conditions. It turned out that we had to consider all six secondary colors *AB, AC, AD, BC, BD, CD,* and also the quaternary color *ABCD,* but we had to discard all ternary colors *ABC, ABD, ACD, BCD.* In October 1999, Berkovich and I discovered an incredible four parameter identity (see box). The inclusion of the quaternary color meant that there were conditions that cropped up in four dimensions that were invisible in three dimensions, which was perhaps the reason this identity had remained undiscovered. When any one of the parameters *A, B, C,* or *D* is set equal to 0, the four parameter identity reduced to the key identity for Göllnitz's theorem that Andrews, Gordon and I had proved earlier. To cast the new identity in the form of a Rogers-Ramanujan type partition theorem, we state a special case that comes out of it:

Theorem Y2K: *Let $P(n)$ denote the number of partitions of n into distinct parts congruent to* 7, 11, 13, *or* 14 (mod 15). *Let $G(n)$ denote the number of partitions of n into parts not congruent to* 1, 2, 4, *or* 8 (mod 15) *such that the difference between the non-multiples of* 15 *is* ≥ 15 *with strict inequality if a part is not relatively prime to* 15, *parts which are not relatively prime to* 15 *are* > 15, *the difference between the multiples of* 15 *is* ≥ 60 *and the smallest multiple of* 15 *is* $\geq 30 + 30\tau$ *if* 7 *is a part, and* $\geq 45 + 30\tau$ *if not, where t is the number of non-multiples of* 15 *in the partition. Then $G(n)=P(n)$.*

But just as before, Berkovich and I did not have a proof of the four parameter identity.

As if history was repeating itself, George Andrews arrived in Florida in November 1999 for a conference, and we drew his attention to the new identity. But this time, even Andrews was not able to prove it during his visit. This four parameter identity was much deeper and more intricate than anything he had encountered. Over the next several months the three of us toiled in reformulating the proof of the three parameter key identity for Göllnitz's theorem in many ways hoping that one of these proofs would "lift" to four dimensions. And indeed one such approach worked; the final details in the proof were completed during March 2000, thereby solving the problem Andrews raised nearly thirty years ago.

This breakthrough opens up several exciting avenues of exploration. Using reformulations of the Göllnitz theorem, I had obtained several important applications including new proofs of Jacobi's triple product identity, a fundamental result in the theory of theta functions. Jacobi's identity has only one free parameter, whereas the expansion for the product in (3) has three free parameters, which is why it is so useful. The new identity has four free parameters, and so it definitely will have significant consequences.

Upon hearing the completion of the proof of the new four parameter identity, George Andrews sent the following congratulatory note: "It has been a dream of mine since 1967 that I would someday see a generalization of the Göllnitz theorem. I had rather lost hope after 30 years; so this is an especially delicious moment." ■

Krishnaswami Alladi is Professor of Mathematics at the University of Florida.

$$\sum_{i,j,k,l} A^i B^j C^k D^l \sum_{\text{constraints}} \frac{q^{T_\tau + T_{ab} + \cdots + T_{cd} - bc - bd - cd + 4T_{Q-1} + 3Q + 2Q\tau}}{(q)_a (q)_b (q)_c (q)_d (q)_{ab} \cdots (q)_{cd} (q)_Q} \times \left\{ \left(1 - q^a\right) + q^{a+bc+bd+Q}\left(1 - q^b\right) + q^{a+bc+bd+Q+b+cd} \right\}$$

$$= \prod_{m=1}^{\infty} \left(1 + Aq^m\right)\left(1 + Bq^m\right)\left(1 + Cq^m\right)\left(1 + Dq^m\right),$$

where the constraints are

$$i = a + ab + ac + ad + Q \qquad k = c + ac + bc + cd + Q$$

$$j = b + ab + bc + bd + Q \qquad l = d + ad + bd + cd + Q$$

The Academic Job Search in Mathematics

An Applicant's Perspective

By Darren A. Narayan

I feel it appropriate to begin this article with a "thank you" to all of the people that fought to create jobs in the very tight job market of the 1990's. Because of your efforts we were able to breathe a little easier during our job searches.

Last year I was in the same boat with hundreds of other applicants, searching for an institution whose primary focus was on teaching, but which also valued scholarly research. Perhaps some of what I learned can be helpful to this year's applicants.

The following article is meant to be a source of information that I hope will reduce the stress level for some applicants. Here is what I learned. It is impossible to give perfect advice, so I will just share some things that I wish I knew before I started my search, including some advice from my Mom. Of course, this only covers a few aspects of the process, so I encourage you to talk with faculty members and students and map out a winning strategy.

The Game

Each institution is different and each search committee is different, but in the end they are all looking for the same thing—a good match. They want someone who will mesh well with their students, work well with the faculty, and be a source of new ideas.

Where can I find job postings?

Probably the most useful site is the Employment Information in the Mathematical Sciences (EIMS) at http://www.ams.org/eims on the AMS web site. Other good places include MAA Online at http://www.maa.org and the *Chronicle of Higher Education* Career Network Site at http://jobs.chronicle.com/free/jobs/faculty/scitech/math/links. Advertisements also appear in the AMS *Notices* and in FOCUS.

Questions on the Advertisement

A typical advertisement said to send a cover letter, vita, transcripts, and arrange for three letters of recommendation to be sent to the search committee. However I ran into some ambiguities.

Transcripts: The advertisement said to send "transcripts". I was not sure exactly what kind of transcripts the school would like. Did they want official or unofficial transcripts? Are photocopies acceptable? Do they want my undergraduate transcripts too? How about the summer course I took at a completely different school? I finally decided to send photocopies of transcripts from every school I attended and stated that official transcripts could be sent upon request. When all was said and done I applied to about 70 schools and none of them asked for official transcripts.

Preferred Research Area: Many advertisements said that they are accepting applications in all areas of mathematics with preference given to applicants that were in particular areas of mathematics. In some cases my area of research expertise was not among the preferred areas mentioned, so I was not sure if I should apply. I asked several faculty members, and the consensus was that my chances would be slim. However they did mention that there is always a chance that the advertisement was written by one faculty member, or that the advertisement is outdated and the needs of the department have recently changed. What I did was to ask the search committee chair, but if it was a school I really liked I figured it could not hurt to apply.

Deadlines: Many advertisements said something like "The review of applications will begin on December 10, but applications will be reviewed until the position is filled." I did everything to meet the first mentioned deadline, but if a deadline passed and I saw it was a place I would like to go I did not hesitate to apply and kept my fingers crossed.

The Cover Letter

After asking many members of search committees, I concluded that the most important part of the application was undoubtedly the cover letter. Many applicants sent out cover letters beginning with "Dear Search Committee, I am applying for a position in your College/University" In most cases this letter is viewed much differently from "Dear Professor Crawford, I am very interested in teaching at Mount Allison University".

I typically spent about 30–45 minutes combing through a department's web site looking to see if the school was a good match for me. If it was, I wrote the cover letter emphasizing particularities that I liked about the school.

One thing that can turn search committees off is a poorly written cover letter. Be sure to proofread it carefully. However if you catch a typographical error after you sent the letter out, don't stress about it. Many search committees will be more concerned with a good match than a simple typographical error. However no typos is the best situation, so time spent proof reading is time well spent.

The Joint Meetings of the AMS and MAA in New Orleans

The first thing to say is that it is to your advantage to go to the Joint Meetings! They provide a chance to meet people, be interviewed, and to give a talk.

Interviews: On your interviews one piece of advice is to be energetic. In many cases the department has just gotten a position approved and they are looking forward to some "new blood" entering the department. They want someone who will be enthusiastic whether it is in teaching, research or service.

I also found it useful to have a complete list of questions. This is the time to ask about the expectations for the position such as teaching load, research expectations, availability of research grants, amount of committee work etc. In addition to these, I would ask about the department's future goals, and how the new faculty member might play a role.

Give a talk

I would greatly encourage you to give a talk at the New Orleans Meeting. Many search committees will be interested in seeing an applicant's presentation style.

You can give a talk in an AMS special session or an AMS contributed paper session. Although you are limited to one AMS talk, you can give a second talk in an MAA session and double your chances of being seen.

My Mom's sixth sense: Bring a bottle of water to the interviews because you will be doing a lot of talking. I found it useful to keep snacks and beverages in my hotel room. Lunch breaks at the last meeting were very short and the lines for restaurants were very long. It was great to run to my hotel room and grab a quick lunch without missing a beat.

The on-campus interview

Most likely you will have a very busy schedule, including meetings with the Department Chair, other members of the department, and possibly the President, Provost or Dean. You may be asked to give a 45-minute colloquium talk or to teach a class.

It is a good idea to find out all information regarding these talks. For example for the colloquium talk find out who the audience is. If you don't have a clear idea of what "junior mathematics majors" (say) would know, find out! If you are asked to teach a class, ask about the class, textbook and assigning homework etc.

My Mom's sixth sense: Don't forget your interview clothes. I left mine at home. No comment!

Some final words

If your job search is successful, congratulations! However you might second-guess yourself, because your job is most likely not perfect. You might be searching for your dream school, with the perfect size and a balance of teaching and research that is perfect for you and also at a great location where you can live happily ever after. Chances are this school does not exist. However, you may succeed in finding a match that, while not perfect, is "within epsilon". And who knows, over time that epsilon might just go to zero.

Darren A. Narayan recently completed a job search and is an Assistant Professor of Mathematics at the Rochester Institute of Technology. He is also a fellow of Project NExT, a program of the Mathematical Association of America supported in part by the ExxonMobil Foundation. A longer version of his article can be found on MAA Online at http://www.maa.org/features/narayan.html.

Student Paper Sessions at Mathfest 2000

Student papers are an important part of the MAA national meeting. Student paper sessions were held at the Los Angeles Mathfest on August 3 and 4 (For more about Mathfest, see the article by MAA President Tom Banchoff on page 13.)

There were 32 talks involving 35 students from 26 colleges and universities and two high schools. Six presentations were chosen as outstanding, and received awards of $150 each.

The winners, who were announced at the Pi Mu Epsilon banquet on August 4, were:

Scaling multiwavelets to map integers to integers
by Alison Leuthard and Meghan O'Brien
University of St. Thomas

From left to right: Alison Leuthard, Meghan O'Brien, Irma M. E. T. Servatius, Charles Diminnie (Picture by Ron Barnes, University of Houston-Downtown)

Random perfect matchings
by Deborah Sinclair
University of Redlands

Pseudoprimes, Carmichael and sigma-phi numbers
by Kevin Weis
College of New Jersey

Who has my hat?
by Wendy Corp
Benedictine University

Continuous motion of a non-singular matrix in Rn into the identity
by Rebecca Torrey and
Keith McCarron
American University

Mall Time
Irma M. E. T. Servatius
Massachusetts Academy of Mathematics and Science

For more information on student paper sessions, contact Charles Diminnie at charles.diminnie@angelo.edu. ■

Letters to the Editor

On Post-Tenure Review

On the Post-Tenure Review opinions: both are right. The reviews are here to stay, and they're a lousy idea. Both articles skirt one of the real issues—student evaluations. Students must respect their teachers, but they don't have to like them. True, happy students don't transfer or drop out, but trying to keep TV-bred students entertained is a perversion of education.

Victor Meyers
Retired MAA member

Still the millennium

Although I enjoyed most of the article, "Dionysius, Zero and the Millennium," I was put off by Christian Taisbak's insistence that new Millennium and new century will only begin on Jan 1, 2001. I would not like to allow this popular canard to go once again unchallenged.

Even the most logical of us were a little uneasy about the passage from 1999 to 2000. Our particular calendar system is of course arbitrary, but there's something uncanny about seeing so many nines become zeroes. It was natural to feel a bit of Millennium Anxiety.

Led by the media, the public responded to this unsettling event with two kinds of psychological defense mechanism. The first defense mechanism was displacement: our disturbingly irrational fears of the Millennium were displaced to become technological concerns about the Y2K Bug. The second defense mechanism against Millennium Anxiety was denial: even though the year changes from 1999 to 2000, this supposedly is not a new Millennium.

But to say that this means we are not yet in a new Millennium flies in the face of ordinary linguistic usage. If something happened in 1900, we say it happened in the 20th Century. I'm writing the date 2000 on my checks, and I should be allowed to say I'm in the 21st Century. To say otherwise is to sacrifice intelligibility for a tendentious (though logical) act of denial. It's the kind of thing that gives mathematicians a bad name!

As part of the debate about when the new Millennium begins, we might well ask 2000 years since what? Professor Taisbak shows us just how arbitrary was Dionysius's choice of the date for the Year One of our Western system. Perhaps we can agree that Jan 1, 2000, marked two thousand years since the year 1 BC, which is a date in fact a bit closer to Christ's birth than is the start of the year 1 AD!

In any case, the real world solution to our problem is coming soon. As of Jan 1, 2001, the haggling can end and we'll all be in the 21st Century, free and clear.

Rudy Rucker
San Jose State University

In a letter written in 1957, Dorothy L. Sayers said: "I can just remember the terrific spate of argument and correspondence in the papers... when we moved into the 20th century, some maintaining the 1900 was the last year of the old century and others that it was the first of the new. Every conceivable authority was invoked, from Sacred Common Sense to Astronomy and the Pope. I can't recollect who won, but I know that, as the Song of Roland says, 'Fierce was the battle, and marvellous, and dread'." (From The Letters of Dorothy Sayers, volume 4, page 403).

More on teacher preparation

Articles in the August/September FOCUS discussed proposed new standards and performance measures for prospective teachers. But in mathematics, where teacher shortages are already developing, another emphasis is also needed: to get better math teaching, we need to attract better math students to teaching in the first place.

At the same time that some politicians are bashing teachers, we are considering adding even more "hoops" and "multiple assessments." Would-be teachers are already faced with having to deal with additional education courses of questionable value, constructing portfolios, mastering technology, meeting community service requirements, facing diversity concerns, etc. All this sounds good, but bright students in mathematics, who have alternate career opportunities, may see this as a deterrent to becoming a teacher. Indeed, teaching is already considered tough enough, with five classes daily, discipline problems, absenteeism, language barriers, parental neglect, special needs accommodations, in-service development requirements, and peers that consider math uncool.

To get good mathematics students to consider teaching, we should also be seeking higher teacher pay (the AFT reports that on average starting pay is $26,639 for teachers, $41,698 for math or statistics graduates), reduced workloads, realistic expectations in today's world, and enhanced professional prestige for teaching mathematics. We need to attract, and protect, our strongest students by ensuring that school committees do not hire and promote somebody's cousin of doubtful competence. Otherwise, just adding more requirements and "standards" will only serve to narrow the pool of good applicants and increase the need for even more emergency hiring of less qualified candidates.

Barry Schiller
Rhode Island College

See page 4 for more on the preparation of teachers.

Letters to the editor should be addressed to: Fernando Gouvêa, Colby College, Department of Mathematics, Waterville, ME 044901; email: fqgouvea@colby.edu.

Mathfest 2000

By Tom Banchoff

What a good time we had at the Mathfest at UCLA this August! Talk to anyone who participated and you will learn about the highlight that person experienced. If you have never been to a Mathfest, it will make you want to come, and to join the growing number of MAA members who plan to attend every year. The last two summer meetings, in Providence and Los Angeles, set a standard for the future, with well over 900 registrants at each one. We can all look forward to another success in Madison, Wisconsin next August.

There were three plenary presentations that made a great impression on me, partly at least because they treated topics not included in traditional collegiate mathematics offerings. At the risk of not reporting on the other plenary sessions that I also enjoyed, I would like to reflect on what these three meant to me, and on what they say about the MAA. Such an incomplete account can, I hope, still give an impression of the wide range of activities and interests of our Association, as exemplified at this Mathfest that so many of us enjoyed at UCLA.

Li Ping Ma was the first speaker, and from the beginning description of her early days as a graduate student fresh from China, she endeared herself to the receptive audience. She presented idea-provoking illustrations and examples from her Ph.D. thesis on the differences between Chinese and American approaches to pre-service and inservice training for teachers of mathematics in elementary schools.

What factors in China help young teachers to become masters of their subjects, with profound understanding of fundamental concepts, while the same transformation takes place less frequently in the US? The responsiveness of the audience to this question was something that impressed me. I'm not sure that even a few years ago there would have been so much interest at a national MAA meeting in issues related to elementary education and teacher training, but it certainly was an active issue at UCLA.

Ed Catmull, the Chief Technical Officer at PIXAR Animation Studios, had one of the best-attended talks, on "The Mathematics of Toy Story II". A member of the MAA for many years, he spoke about early mathematics courses that influenced his later work in computer graphics. He described his ongoing interest in visualization, in mathematics books as well as on the screen.

The latter part of Catmull's presentation

Arlie Petters of Duke University spoke on "Gravitational Lensing". Photo courtesy of Arlie Petters.

featured the award winning animated film "Geri's Game", together with outtakes that revealed the geometric structure of the many-faceted animations. Part of the audience included secondary school students with their teachers. Many of them knew the speaker from what they had seen on the electronic poster for Math Awareness Month April 2000. It was great to see them get the message that computer graphics, and computer animation in particular, rely so heavily on mathematics. We have to keep that message up front.

Mathematical physicist Arlie Petters gave a great presentation on "Gravitational Lensing", illustrated with remarkable photographs from deep space, together with illustrations of the geometric theories behind these visualizations of astronomical phenomena. Singularities in the theory of optics, and critical point theory from multivariable calculus combine to analyze data and to predict the properties of dense stars or black holes on the basis of the way light is deflected as it passes them.

As it happens, I had heard two earlier presentations by Professor Petters on the same subject, and some of his work appears on the Math Awareness Month poster as well. I was very happy to learn about the latest developments in this important field, and those who heard about it for the first time appreciated their introduction to this particular application of mathematics to physics.

The success of these and other main talks is a tribute to the committee that selects our speakers, together with cooperating organizations such as the National Association of Mathematicians (NAM), sponsor of the talk by Arlie Petters. Together with all the staff at the MAA and the meeting organizers from the AMS, they put together a program that truly gives testimony to the vigor of mathematics at the collegiate level, and that is what the MAA is all about. Thanks to all of them.

Just a final word about the UCLA meeting—many of us stayed on for some or all of the six-day conference on *Mathematical Challenges for the Twenty-First Century*, another successful meeting that featured presentations about mathematical research. This meeting, together with Mathfest 2000, provided a wonderful view of the panorama of mathematics, a truly remarkable summer experience.

We congratulate the AMS on organizing this successful conference. Special thanks go to Ron Graham, who provided a transition between the two meetings with his "Presidents' Lecture", co-sponsored by Felix Browder, president of the AMS, and myself. For more on the *Mathematical Challenges* meeting, see page 16.

See you in Madison! ■

Tom Banchoff is President of the Mathematical Association of America.

ICME-9 in Japan: An Overview

By Annie Selden

The ninth International Congress on Mathematical Education (ICME) was held from July 31 to August 6 in Makuhari, Japan—a new conference city thirty minutes east of Tokyo by train (but, due to the ubiquitous traffic, several hours away by car). This ICME, the first in Asia, was somewhat smaller than usual, with just over 2000 participants.

Speakers were selected from a variety of countries. About half of the main lecturers came from Europe and North America, but there were speakers from many other countries. The four plenary lectures and fifty regular lectures included a wide range of topics, both theoretical and practical. From trends in mathematics education research to critical issues in teaching symbolic expressions and the role of politics in the development of mathematics in Africa, there was something for everyone.

Among the participants were mathematicians, mathematics education researchers, K-12 teachers of mathematics, and a variety of administrators, from school principals to ministry of education staff. Some were interested in mathematics education research results, whereas others were more interested in collecting novel ideas for classroom use or in running mathematical olympiads. They came from a wide variety of countries, with Angola, Nepal, New Caledonia, Cayman Islands, and Swaziland having one participant each. The largest numbers came from Japan, with 942, and the U.S., with 222 participants.

The program also included thirteen working groups and twenty-three topic study groups, with participants selecting one of each. Choices included working groups for each level of mathematics education (from pre- and primary school to two-year college, university, and adult education).

Other groups devoted themselves to pre- and inservice teacher education, language, assessment, technology, social and political dimensions, history and culture, and research, practice, and theory of mathematics education. Choices of topic groups ranged widely, from the teaching and learning of various subjects—algebra, geometry, calculus, statistics—to distance learning, vocational mathematics, modelling, problem solving, proof, constructivism, creativity, equity, mathematical competitions, entrance examinations, ethno-mathematics, and international comparisons such as TIMSS. In addition, there were commercial and non-commercial exhibits, posters, short presentations, and reports from the various ICME Study Groups that meet annually. The sessions were spread between the Convention Center in Makuhari and the nearby campus of Chiba Institute of Technology, with participants being efficiently shuttled back-and-forth by bus.

Hyman Bass, president of ICMI.

As with previous ICMEs, this interesting but unrelenting succession of lectures, working groups, and topic study groups was broken in mid-week for a day devoted to one's choice of Congress tours. These ranged from visits to local elementary, junior high, or high schools to more touristy trips to historic sites, downtown Tokyo, Disneyland, or the elusive Mt. Fuji, hidden by clouds that lifted for just a few moments.

At international congresses such as this, some of the most interesting and informative exchanges occur informally at the receptions and happy hours or in the halls. From a South African participant, I learned about "sunshine teachers"—so called because they spend their time outside enjoying the warm weather, rather than remaining in the classroom with their students. I was also told that many university departments of education are closing, as South African students now prefer to prepare for more lucrative professions. From a Danish primary teacher, I learned that pupils are taught by groups of three or four teachers who remain with them for several years, providing great stability while allowing the teachers to specialize. It seems that the U.S. might benefit from such a system because some primary teachers tend to avoid mathematics. I also learned that a new Japanese curriculum to be instituted in 2002 will emphasize values and have thirty percent less mathematics.

The smorgasbord, something-for-everyone, program of ICME left two first-time U.S. mathematicians inspired that "there are so many people around the world who care about the quality and future of mathematics education," but they also longed for more interaction with presenters. However, "all in all, we learned a great deal and had much of our recent reading in mathematics education research reinforced." Indeed, according to Mogens Niss, the mathematics education research component of ICME has become much larger over the years. In the early years, Congresses concentrated on good practice, as the research base had not yet been developed. In his plenary address reviewing mathematics education research from the 60's to the present day, Niss characterized this research as having reached the stage of young adulthood.

ICME, which is held every four years, is sponsored by the International Commission on Mathematical Instruction (ICMI), whose president is Hyman Bass, also President Elect of AMS. ICMI is a commission of the International Mathematical Union (IMU), whose congresses

are also quadrennial events that alternate every two years with ICME. The Commission also sponsors studies that usually result in the publication of a study volume; such as *The Role of the History of Mathematics in the Teaching and Learning of Mathematics,* just out from Kluwer.

Annie Selden, with Mt. Fuji as a background.

The next study conference, on "The Future of the Teaching and Learning of Algebra," will be held at the University of Melbourne, December 10–14, 2001. About eighty participants will be invited to participate in this conference; for details, see the website at http://www.edfac.unimelb.edu.au/DSME/icmi-algebra/. For general information on ICMI, check out their website at http://www.mathunion.org/ICMI/.

NCTM has posted reports from recipients of travel grants at http://www.nctm.org/meetings/icme/icme-9/. These include photos of the opening ceremony and classroom visits, as well as personal accounts of plenary and regular lectures, working group discussions, etc. Alex Bogomolny has also given personal report on ICME-9 in his MAA Online columns (http://www.maa.org/news/columns.html). The next congress, ICME-10, will be in Copenhagen, July 4-11, 2004. As details become available, they will be posted at http://www.ICME-10.dk/start.htm.

Written with help from Mark Davis, Shandy Hauk, and John Selden. ■

Annie Selden is Professor of Mathematics at Tennessee Technological University, Coordinator of the Association for Research in Undergraduate Mathematics Education (a Special Interest Group of the MAA), MAA Online Associate Editor for Teaching and Learning, and an Associate Editor of the College Mathematics Journal's Media Highlights.

Short Takes

National Mathematics SAT Scores Are Up

The average score on the mathematics portion of the SAT went up by three points this year, to reach a 30-year high of 514 out of a possible 800. Though everybody's average went up, average scores for minority groups rose more than the average scores for whites. Some experts attribute the higher scores to an increase in mathematics requirements in high schools and to ongoing efforts to reform the school mathematics curriculum. Others seem to feel the change is very small and does not represent a very significant gain. The national average is now 13 points higher than it was in 1990.

Mathematical Art and Fun Web Site Open for Business

Have you ever wanted to get yourself a set of Penrose tiles? You can find one at http://www.mathartfun.com, a new web site dedicated to products related to tesselations, polyhedra, fractals, mathematical art, and other neat stuff. The site, which combines some mathematical content with an online store, was created by Dr. Robert Fathauer, a researcher at NASA's Jet Propulsion Laboratory and designer of tessellation puzzles. On a subpage entitled "Why combine math and art?" Dr. Fathauer argues that linking mathematics and art "is good for your brain" and can help turn people on to mathematics, among other benefits. The site also includes a small gallery of art which is inspired by mathematical ideas.

ExxonMobil supports NCTM Standards

In an op-ed advertisement published in the August 31 issue of the *New York Times,* ExxonMobil made public its support for the NCTM Standards for mathematics education. The "advertorial," entitled "Go figure, with rigor," says that the publication of the new *Principles and Standards for School Mathematics* makes a good idea better, "because the standards have already demonstrated some gains." Quoting the results of the National Assessment of Educational Progress, ExxonMobil argues that the greatest gains have come in Texas, Connecticut, Michigan, and North Carolina, "four states that have been leaders in implementing standards and assessments that reflect the vision of the NCTM standards." The advertisement concludes by calling the other states to accept and implement the standards "and develop more rigorous math programs for their students." The full text of the op-ed advertisement is available on the web at http://www.exxon.mobil.com/opeds/index.html.

Is $\zeta(5)$ irrational?

We still don't know! Interest in the values of the zeta function at integer points goes back several hundred years. Euler proved in the 18th century that $\zeta(2n)$ is a rational multiple of π^{2n}, settling the question for values at the even integers. Values at the odd integers remain mysterious. Apéry proved in the 1970s that $\zeta(3)$ is irrational, but it's still not known whether it is transcendental. In a recent preprint, Tangy Rivoal has announced a proof that infinitely many of the values $\zeta(2n+1)$ are irrational. He shows this by proving that the dimension over Q of the vector space spanned by $\{1, \zeta(3), \zeta(5), \ldots, \zeta(2n+1)\}$ is greater than of equal to a constant times log(n). This gives the first new information about the values of the zeta function at odd integers since Apéry's work. The preprint can be found at http://www.arxiv.org.

A Conference for Undergraduate Women

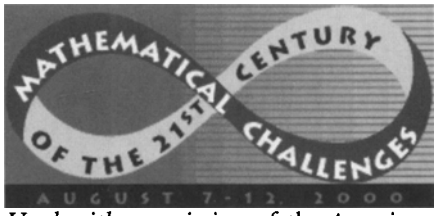
The Third Annual Nebraska Conference for Undergraduate Women in Mathematics will be held in Lincoln, NE February 2-4, 2001. This conference, which brings together talented undergraduate women mathematicians from around the country, will include undergraduate research talks, keynote addresses by mathematicians, and panel discussions. Some funding is available for participants. Those interested in presenting a talk, or just attending, please send email to womenws@math.unl.edu or contact Nebraska Conference for Undergraduate Women in Mathemtics, Department of Mathematics and Statistics, University of Nebraska, Lincoln, NE 68588-0323.

AMS Meeting Explores Mathematical Challenges

One hundred years ago, in his famous speech on mathematical problems, David Hilbert attempted to identify some mathematical questions that were of central importance to mathematics at the turn of the century. This August, the American Mathematical Society brought together some of the world's best mathematicians to attempt to "lift the veil behind which the future lies hidden" and chart a course for mathematics in the 21st century.

The meeting, entitled "Mathematical Challenges of the 21st Century," was held on August 7–12 at the University of California, immediately after the close of Mathfest 2000. A special lecture by Ronald L. Graham on August 6 served as a "bridge" between the two meetings. The following six days included a dense schedule of talks by some of the most creative mathematicians of our time.

Both the list of speakers and the audience included many famous mathematicians. One participant estimated that during one of the plenary lectures "everyone in the Royce Hall auditorium was within 20 feet of a Fields Medalist." From James G. Arthur on "The principle of functoriality" to Shing-Tung Yau on "Geometry and its relation to physics", the talks covered a



Used with permission of the American Mathematical Society

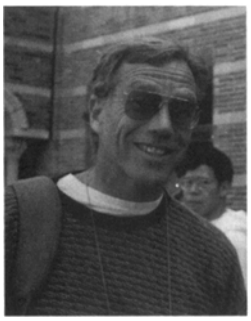
wide range of mathematical subjects, usually at a very high level.

At the beginning of her talk, Karen Uhlenbeck spoke about the paucity of women in university mathematics (and about how they have been and are treated, especially with regards to what is expected of them). Only three of the invited speakers were women, and the percentage of women in attendance was low. A participant in both conferences remarked that at Mathfest, the previous week, there were many more women in attendance than at the Mathematical Challenges meeting. One wonders what causes this difference in the demographics.

With so many high-powered speakers, it is inevitable that some participants felt a little intimidated. Ed Dunne of the AMS reports that Cliff Taubes attempted to relieve this feeling by telling about his days as a graduate student. He paraphrased Taubes as follows. "Taubes was a graduate student in physics at Harvard. He had the impression that everyone knew more than he did at the time. He was feeling depressed about how well he was doing in some class where all the students acted like this was one of the easiest courses in the world. The professor, however, told him that he got one of the highest marks in the class. He was quickly elated. But he soon thought of his classmates: You fakers! You were all just faking the whole time!"

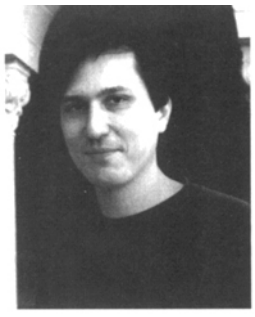
The overall impact of the conference will probably take many years to be felt. Will these talks set the agenda for the next century? Will listening to high-level talks on other areas promote "cross-fertilization" of mathematical ideas? Whatever the case, there is no question that "Mathematical Challenges for the 21st Century" was one of the most important meetings of the last months of the twentieth century.

For more information on the meeting, including a complete list of speakers and titles, visit http://www.ams.org/amsmtgs/mathchall.html. See also the report on the meeting at http://www.ams.org/amsmtgs/mathchall_fini.html. ■



Michael Freedman of Microsoft Research talked about "Quantum Computation and Modular Functions." (Photo by Allyn Jackson, AMS)

Alexander Beilinson of the University of Chicago spoke "On the Geometric Langlands Conjecture." (Photo by Allyn Jackson, AMS)



Maxim Kontsevich of IHES talked about "Operads of Little Disks in Algebra and Topology." (Photo by Allyn Jackson, AMS)

Felix Browder, president of the AMS, had an important role in putting together the "Mathematical Challenges" meeting. (Photo by Allyn Jackson, AMS)

Thoughts on Mathematical Challenges

by Maeve McCarthy

Hilbert gave his famous address to the ICM on August 8, 1900. At their meeting "Mathematical Challenges of the 21st Century", scheduled for the same week a century later, the AMS had a hard act to follow. There were 32 invited addresses from a wide variety of specialties over six days. As an applied mathematician, I was thrilled with the emphasis on partial differential equations and various aspects of computation. As a woman, I was disappointed that there were only three female speakers and that the conference attendance reflected the lack of gender balance in mathematics.

The lack of special sessions ensured that no field was singled out, giving the meeting that sense of unity that mathematics sometimes lacks. If you came hoping to hear or meet the leading specialist in your area, you were probably out of luck. I had the impression that many of the younger mathematicians in attendance were disappointed by this. The conference was a little intimidating at times — especially since most talks were not followed by questions. Even when they were invited, no one asked any. Any discussions had to happen during the breaks and at the receptions.

The AMS provided us with an exhibition of what mathematics is today. I was thrilled at several talks by the amount of mathematics that I learned. Many of the talks were far outside my field, but the speakers made a significant effort to give an overview of their specialty and to pose the problems of the future in terms that could be understood by the audience, regardless of specific background. It was nice to see that, in spite of the wide range of sub-disciplines in mathematics, it is possible to communicate.

There's no doubt that five hour-long talks each day was tiring. I have to confess that, having anticipated "conference burnout," I left on Thursday morning. Those who stayed for the duration must be applauded for their stamina. ■

Maeve McCarthy teaches at Murray State University. She is a member of the Editorial Board of FOCUS and MAA Online.

MAA Announces the Mathematical Sciences Digital Library

When you start to design a new undergraduate mathematics course, don't you wish there was a web site where you could go that would list all the relevant published materials, both books and software, with reviews and user comments? Don't you wish there was a web site that provided a wide range of online learning materials in mathematics–materials of high quality that had been reviewed and selected by editors you trust? Don't you wish there was an online journal that would feature the best online learning materials in the mathematical sciences as well as interactive articles surveying available online materials and others discussing how students learn online? Well the MAA has news for you!

The National Science Foundation has awarded the Mathematical Association of America a two-year grant of almost $900,000 to construct the Mathematical Sciences Digital Library (MATHDL) as a component of the emerging National Science Digital Library. The MATHDL user software will be designed by Math Forum, who will host the library's web pages. MATHDL will consist of three related web-based components. One part of the mathematical library will be an online listing of all types of commercially available learning materials in the mathematical sciences and their applications. A second part will contain free online interactive learning materials in mathematics and its applications. The third part is a new MAA publication, The Journal of Online Mathematics and Its Applications (JOMA).

The listing of all types of commercially available learning materials in mathematics and its applications will be the first place faculty will look when designing a new or revised undergraduate course. The site will provide publication information, a short description of the product, a table of contents (where appropriate), and a link to the publisher's site for more information. Each title will have a site for the reviews and substantive comments by users and authors, a file of users, and a link to a moderated discussion group. There will be links to relevant materials in the library's collection of free, online materials. After the two-year lifetime of the grant, publishers will be charged a fee to have their materials listed. These fees will provide a source of revenue to help support the whole library.

In contrast to the commercially available materials, the library's select collection of online learning materials will be available on the site. These materials will have been tested with students, submitted with peer review, and provided with another review by the library editors. Each unit will have a site for the reviews and substantive comments by users (including students) and authors, a file of users, and a link to a moderated discussion group focused on these particular materials.

JOMA will be the journal of the new library. The standards for submission, review, and editing of materials for JOMA will be the same as for other publications of MAA. The journal will showcase exemplary materials and components, examine mathematics learning in an online environment, discuss creation of pedagogically sound online learning materials, and survey existing materials. The first issue of JOMA will appear in January of 2001. It will feature the results of an earlier NSF grant to Math Forum to locate and publicize the best applets created for online calculus materials.

The principal investigator for the grant and first executive editor of the library is Lang Moore of Duke University. Don Albers, Director of Publications for MAA, and Gene Klotz of Math Forum are co-PIs. The first editor of JOMA is David Smith of Duke University; the first associate editor of JOMA for mathlets is Tom Roby of Hayward State University. ■

Knots In Science

An MAA Short Course at the New Orleans Joint Mathematics Meetings January 8–9, 2001

The MAA will offer a Short Course on Knots in Science at the Joint Mathematics Meetings in New Orleans this January. Organized by DeWitt Sumners of Florida State University, the course will introduce the basic theory of knots and then present a number of fascinating scientific applications.

Knot theory had its beginnings in physics, in the work of Gauss, Kelvin and Tait. It quickly became a very active area of research in pure mathematics. Recently new scientific applications in biology, chemistry, fluid mechanics and physics have been developed. Knots are 1-dimensional strings that explore the entanglement complexity possible in 3-dimensional space. Many physical objects are string-like; macromolecules such as polyethylene and DNA exhibit knotting, and the DNA knots are diagnostic of cellular metabolic function. Vortices that form in fluid motion can be long string-like objects, and vortex entanglement has physical ramifications.

The short course will consist of the following lectures:

Introduction to Knots
Colin C. Adams
Department of Mathematics
Williams College

Throughout history, knots have played an important role. They have appeared everywhere from art and literature to seafaring. In more recent times, they have become an integral part of mathematics, with applications from DNA to statistical mechanics. In this talk, we will discuss their past history as well as their future, focusing in particular on the role they play in mathematics. We will introduce various concepts, including Reidemeister moves, crossing number and unknotting number, which will be useful for the subsequent talks. All audience members will have an opportunity to try their hand at making knots.

Knots in Physics
Louis H. Kauffman
Department of Mathematics, Statistics and Computer Science
University of Illinois at Chicago

This talk will give a survey of relationships between knot invariants (particularly the Jones polynomial and its relatives) and methods and ideas from statistical and quantum physics. The talk will begin with a recollection of easily understood invariants such as the linking number, coloring numbers for knots and links, fractions for rational tangles. Then polynomial invariants of knots and links will be discussed and the bracket model of the Jones polynomial will be constructed. The bracket model provides a pivot point for the discussion of more general invariants and the uses of statistical mechanics models and quantum field theory models in the topology. The talk will conclude with a discussion of the role of knots in theories of quantum gravity.

Vortex and Magnetic Knots in Fluid Systems
Renzo L. Ricca
Department of Mathematics
University College, London, England

In this talk we discuss modern developments in topological fluid mechanics and magnetohydrodynamics in the light of recent work done on vortex and magnetic knots. There has been tremendous progress and interaction of mathematics and fluid dynamics and continuing refinement of visualization techniques in experiments and in direct numerical simulation of fluid flows. As a result, we can now develop, apply and test ideas and tools borrowed from knot theory in order to study complex geometries and topologies of fluid systems. Issues of existence and stability of knotted and linked vortex filaments, energy aspects of magnetic braids and measures of structural complexity of vortex tangles are an example of current research programs. We assess the situation by presenting some of the latest results in the field.

Physical Knots
Jonathan Simon
Department of Mathematics
University of Iowa

What happens to knot theory when the knots, traditionally studied as purely one dimensional, completely flexible filaments, are given physical substance — in the form of thickness, rigidity, or some kind of self-repulsion? Researchers have developed several measures of knot complexity, modeled on these kinds of physical "reality." We shall explore these ideas, see relations between different notions of complexity, and compare the "ideal" conformations of knots that arise. We also note that there are strong relations between these measures of complexity and behavior of actual knotted DNA molecules. Audience members will receive a genuine piece of rope and learn about some easy-to-understand unsolved problems.

Ideal Knots
Andrzej Stasiak
Laboratory of Ultrastructural Analysis
University of Lausanne, Switzerland

Ideal geometric representations of knots (ideal knots) are defined as minimal length trajectories of uniform diameter tubes forming a knot of a given type. Ideal knots showed interesting relationships and turned out to be good predictors of certain average properties of randomly distorted knotted polymers. More recently we demonstrated that writhe of ideal knots seems to be quantized, whereby each crossing of the torus type introduces a contribution to the writhe of 10/7 (or -10/7), while each crossing of the twist type introduces a writhe contribution of 4/7 (or -4/7). This observation allowed us to propose a new topological invariant that predicts the writhe of ideal knots or the average writhe of

random knots of a given type just from minimal diagrams of the corresponding knot or link.

Knots in DNA
De Witt L. Sumners
Department of Mathematics
Florida State University

Cellular DNA is a long, thread-like molecule with remarkably complex topology. Enzymes that manipulate the geometry and topology of cellular DNA perform many important cellular processes (including segregation of daughter chromosomes, gene regulation, DNA repair, and generation of antibody diversity). Some enzymes pass DNA through itself via enzyme-bridged transient breaks in the DNA; other enzymes break the DNA apart and reconnect it to different ends. In the topological approach to enzymology, circular DNA is incubated with an enzyme, producing an enzyme signature in the form of DNA knots and links. By observing the changes in DNA geometry (supercoiling) and topology (knotting and linking) due to enzyme action, the enzyme binding and mechanism can often be characterized. This lecture will discuss topological models for DNA strand passage and exchange, and using the spectrum of DNA knots to infer bacteriophage DNA packing in viral capsids.

Knots in Polymers
Stuart G. Whittington
Department of Chemistry
University of Toronto

Polymer molecules in solution or in a melt can be thought of as behaving like a piece of flexible string and, like a piece of string, they can be self-entangled, or mutually entangled with other polymer molecules. The situation can be modeled by randomly embedding a simple closed curve in a three dimensional lattice such as the simple cubic lattice. One can then ask whether the embedding is knotted and, if one repeats the procedure, what the probability will be that the embedding is knotted. We shall discuss a proof that all except exponentially few such embeddings are knotted in the limit when the length of the simple closed curve goes to infinity. One can also ask more delicate questions such as which particular knots are most likely and how badly knotted the embedding is likely to be. Some partial answers will be outlined, and some open questions will be discussed.

As always, there is a separate registration fee for this Short Course. Registration can be done using the form printed in the October issue of FOCUS or on the web at http://www.ams.org/amsmtgs/2025_intro.html. On-site registration fees are $140 for MAA members, $190 for nonmembers, and $60 for students, unemployed, or emeritus members. For more information, contact De Witt Sumners at sumners@math.fsu.edu or by mail: Department of Mathematics, Florida State University, Tallahassee, FL 32306-4510. ■

Statistics Education now has a SIGMAA

By Mary Sullivan and Dex Whittinghill

The Mathematical Association of America, in an effort to better serve its members, has instituted a program of Special Interest Groups, known as SIGMAAs. The latest SIGMAA to be created is devoted to statistics education. It will benefit the many MAA members who teach statistics and who have a strong interest in improving statistics education. The new SIGMAA was chartered with the main goal of continuing the considerable activity in recent years of the Isolated Statisticians and Isolated Teachers of Statistics groups.

The primary purpose of the SIGMAA on Statistics Education is to provide a forum through which MAA members who are interested in statistics education can meet, interact, and exchange ideas; provide support for each other; and foster increased awareness of statistics education. Activities through which the SIGMAA plans to interact with members include sponsoring contributed paper sessions at mathematics meetings, publishing a newsletter and Web page with items of interest to instructors of statistics, and providing an email discussion list to facilitate immediate interaction and exchange of ideas. Other functions are anticipated according to the interests of members.

The MAA has made the process of joining the SIGMAA on statistics education an easy one. MAA members will find a check box on their dues renewal form and interested persons simply indicate their willingness to be a member and include the $10 SIGMAA dues with their MAA renewal. The SIGMAA will meet formally for the first time in January at the Joint Mathematics Meetings in New Orleans. A reception for SIGMAA members will be held in conjunction with the business meeting, which will be on Friday night from 6–8 pm. The officers for the calendar year 2000 , listed below, hope to see you there!

SIGMAA on Statistics Education Officers

Chair: Dex Whittinghill, Rowan University (whittinghill@rowan.edu)
Chair-Elect: Mary Sullivan, Rhode Island College (mmsullivan@ric.edu)
Past-Chair: Allan Rossman, Dickinson College (rossman@dickinson.edu)
Secretary: Ginger Holmes Rowell, Middle Tennessee State University (rowell@mtsu.edu)
Treasurer: K.L.D. Gunawardena, University of Wisconsin-Oshkosh (gunaward@vaxa.cis.uwosh.edu) ■

Treasurer's Report —1999 Financial Year

Gerald J. Porter

I am pleased to report that the Operating Fund had a surplus of $168,464 in 1999. This surplus enabled us to return $175,000 to the Investment Fund (that was withdrawn during 1995 and 1996) without adversely affecting our cash flow. The Board of Governors had approved a balanced budget for 1999 that included a $50,000 contingency fund. Significant differences from that budget were the following:

Income: book and journal income was under budget by $64,000; contributions were under budget by $148,000; interest income exceeded budget by $44,000 and indirect cost recovery by $10,000.

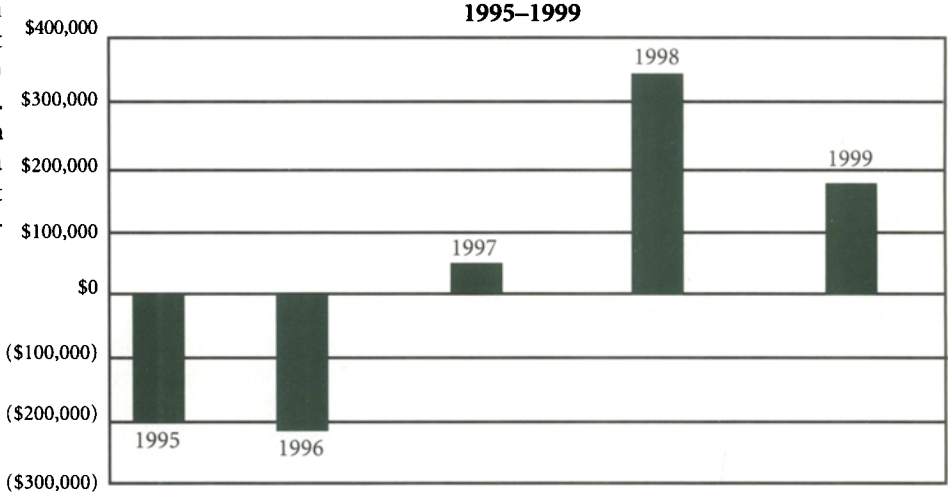
Expense: Salaries and Benefits were under budget by $152,000 because of staff vacancies; Marketing and Communications were under budget by $32,000 and depreciation was under budget by $54,000.

In 2000 and beyond, the MAA will not have the staff vacancies that it had in 1999. As a result, the MAA must work harder to increase income.

The chart on the right gives a quick overview of the performance of the MAA Operating Fund (excluding extraordinary transfers from the Investment Fund) during the last five years. The Operating Fund includes the journal and book programs, meetings, governance, and member services. It does not include grant funded programs, the American Mathematics Competitions, or the operation of the MAA headquarters buildings.

The MAA Endowment Fund[1] increased in value by $117,709 before the normal transfer of $45,330 to the Operating Fund for programs and the extraordinary transfer of $175,000 to the Endowment Fund discussed on page 13. At year end the value of the Endowment Fund was $2,462,739. This includes both restricted and unrestricted funds.

Year End Operating Fund Balance
(excluding extraordinary transfers)
1995–1999



We discuss the operating budget, grant activity, the headquarters building fund, the American Mathematics Competitions and the investment fund individually below. Last but not least, I am glad to acknowledge the assistance of our Director of Finance, Neil Beskin, in preparing this report.

What happened in 1999

• Dues income increased by 3%. This was approximately the amount of the dues increase for 1999. This reverses a decrease in membership that had occurred for the previous few years.

• Contributions (excluding the $37,583 for the Building Fund) decreased by approximately $32,000. In 1998 contributions had decreased by $40,000. This is a disturbing trend. The MAA depends upon member contributions.

• Journal income (other than dues) increased by $85,000. In 1999 Journal income increased by $53,000. This is due to a number of factors including higher subscription charges and inclusion of JSTOR subscriptions; but overall it also represents the recognition of the high quality of our journals.

• Meeting income increased significantly in large part because of the success of the Providence meeting.

• Upon the advice of our auditors we took a charge of $17,981 for slow selling books; in 1998 we wrote off $27,609 of inventory.

• Funds spent on programs and services increased by $137,000. The major factor ($94,000) was an increase in meetings cost because of the successful Providence meeting. We have also transferred $23,000 of project support to this category.

• The change in Administrative costs is due to the inclusion of computer support in 1999. In 1998 this was included in the publications department.

• Part of the increase in journal costs and decrease in publication costs is a reallocation of expenses from one category to the other.

Externally Funded Projects

During 1999 the MAA received external project support of $864,340. This was down from $1,007,533 received in 1998. Indirect cost recovery of administrative expenses was $111,933 down from $128,756 in 1998. We expect that this will increase in 2000 because of new grants.

American Mathematics Competitions

The MAA manages two high school and a junior high school national mathematics competition. These activities are managed from our office in Lincoln, Nebraska. Students who perform well on the high school examination are invited to compete for participation on the U.S. Mathematical Olympiad team. This competition takes place through two additional exams, the AIME and the USAMO. In 1999 the income from these examinations totaled $987,444 while expenses were $932,443.

Building Fund

The Association owns two adjoining townhouses and a "carriage house" at 1527 and 1529 Eighteenth Street NW, Washington, DC. The MAA Washington office occupies 1529, most of the "carriage house," and a small amount of 1527. The remainder of 1527 is rented to other mathematical organizations including the AMS, and CBMS. In 1999 we "charged" ourselves $225,000 for the space we occupied. That amount is included in Building Fund Income.

Building Fund Income:	$345,636
Building Fund Expense:	$341,629

In 1999, depreciation on the building and renovations was $106,055. In 1999, the Building Fund received contributions of $37,583, primarily for the Sward Lobby.

Endowment Fund

The MAA Endowment Fund includes both restricted and unrestricted funds. At the end of 1999 the Endowment was valued at $2,462,739 a 20% increase from the end of 1998. During 1999, $45,330 was transferred from these funds to support prizes and other activities designated by the original donors to the MAA. An additional $26,253 was transferred from the Sliffe Trust. $2,704 was added to the endowment to the James Leitzel Fund.

A extraordinary transfer of $175,000 from the General Fund to the Benefactor's Fund was recorded at the end of 1999. This transfer was made to reverse previous extraordinary transfers that were required by the deficits of 1995 and 1996.

The MAA Endowment Funds are, according to accounting standards, divided into Unrestricted, Temporarily Restricted and Permanently Restricted. The values of these funds at the end of 1998 and 1999 are listed in the box below.

The last will and testament of Edith May Sliffe established a fund (The Sliffe Fund) to fund awards to selected teachers whose teams qualified in the American Mathematics Competitions. The MAA was selected as the Trustee of this fund. On December 31, 1999 the Sliffe Fund had a value of $645,559. The MAA also is the trustee of a trust established by Clinton B. Ford in memory of Walter B. Ford. This trust had a value of $100,908 on December 31, 1999.

The MAA is also the beneficiary of two Charitable Remainder Unitrusts. At the end of 1999 these were carried on our balance sheet at a value of $310,998 in conformance with IRS rules.

General Fund Balance

The General Fund Balance is the cumulative sum of yearly balances in the General Fund. It is a measure of how the Association has done over time. This balance decreased last year by $6,536, which was the surplus in the Operating Fund for the year less the transfer of $175,000 to the Benefactors Fund.

December 31, 1998	December 31, 1999
$224,187	$217,656

General Fund Balance

Endowment Fund

	December 31, 1998	December 31, 1999
Unrestricted Board designated	$1,490,556	$1,851,620
Temporarily restricted	$431,594	$492,909
Permanently restricted	$118,210	$118,210
	$2,040,360	$2,462,739

Supporting Materials

Supporting materials for this report are available on the World Wide Web. These include the following:

1. Building Fund Report, 1999: http://www.math.upenn.edu/~gjporter/maa/treasurer/1999building.htm.
2. American Mathematics Competitions–1999: http://www.math.upenn.edu/~gjporter/maa/treasurer/1999amc.htm.
3. Income and Expense by Activity: http://www.math.upenn.edu/~gjporter/maa/treasurer/1999income_expense.htm.
4. Grant Income and Expense: http://www.math.upenn.edu/~gjporter/maa/treasurer/1999grants.htm.
5. Investment Fund Report: http://www.math.upenn.edu/~gjporter/maa/treasurer/1999investmentreport.htm.
6. Balance Sheet: http://www.math.upenn.edu/~gjporter/maa/treasurer/1999balance.htm.

Overview: The Operating Budget for 1999

Where the money came from

Total income for 1999 was $4,814,602 up from $4,669,315 in 1998. This was derived as follows:

	1998	1999
Dues	$1,945,975	$2,008,578
Contributions	$186,967	$154,956
Journals (other than from member subscriptions)[2]	$836,332	$921,875
Publications other than journals	$1,070,029	$1,025,461
Allocated Indirect Cost Recovery	$87,705	$88,535
Transfer from Investments	$62,842	$71,582
Indirect Costs on Grants	$128,756	$111,933
Meetings/Minicourses/Shortcourses	$231,086	$295,580
Building Management Fee	$25,000	$25,000
Miscellaneous	$94,623	$111,102
TOTAL	**$4,669,315**	**$4,814,602**

Dues includes member dues, institutional dues, corporate dues, and a payment from the Life Membership Fund for life members.

Contributions include the Greater MAA Fund, the dues supplement and other contributions to the Operating Fund but does not include contributions to the endowment or to the Building Fund.

Journals include non-member subscriptions, sales of back issues and royalties received.

Publications income includes sales of MAA books and reports, placement tests, and video tapes.

Allocated Indirect Cost Recovery is indirect costs recovered from MAA activities that are not included in the Operating budget. This includes Olympiad activities and the American Mathematics Competitions.

Investments are funds that are transferred from Investment Funds to support specified prizes and other activities as well as special transfers. In 1999 there was a special transfer of $175,000 from the General Fund to the Investment Fund to reverse earlier transfers. This transfer does not appear in the Operating Fund Budget presented here.

Indirect Costs on Grants is income on externally funded activities that support MAA administrative activities. Not all funding agencies pay indirect costs.

Meetings and Courses are registration fees from minicourses, shortcourses, and the online courses; net income from the joint meeting and all income from the summer Mathfest.

Where the money went

Expenses[3] totaled $4,646,138 in 1999 compared to $4,294,860 in 1998.

	1998	1999
Journals/Electronic Services	$1,454,784	$1,810,724
Publications	$845,042	$540,379
Inventory Allowance	$27,609	$17,981
General Programs, Services and Projects	$436,783	$574,066
Administration	$850,212	$971,149
Governance	$151,750	$175,140
Membership Processing	$236,479	$275,707
Development	$163,810	$157,710
Miscellaneous	$128,391	$123,282
TOTAL	**$4,294,860**	**$4,646,138**

Journals/Electronic Services include the cost of publishing and distributing the *Monthly, Mathematics Magazine*, the *CMJ*, FOCUS, *Math Horizons*, and our electronic newsletter, MAA Online.

Publications is the cost of our book and video publication program.

General Programs and Services includes the cost of awards, minicourses, MAA portions of the joint meeting, the summer Mathfest, section support, SUMMA, student chapters, project support, and our participation in joint projects and activities such as JPBM.

Administration is the cost of operating the Executive, Finance, Human Resources and Computer Service Departments. These costs are not allocated to other activities.

Governance includes the costs related to the Board of Governors, section officers, executive and finance committees, and the officers.

Membership Processing is the cost of membership recruitment and fulfillment.

Development includes the cost of the Development Department as well as costs related to the Greater MAA Fund. This is an investment in future gifts as well as present contributions.

Miscellaneous includes telephone, copying, postage and office supply expenses.

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[1] We use the name "Endowment Fund" to distinguish these assets from the MAA Investment Fund which consists of Endowment assets plus two trusts that the MAA administers.

[2] Journal income does not include the portion of member dues allocated for journal subscriptions. Those allocations are as follows: *American Mathematical Monthly* $406,445, *Mathematics Magazine* $188,853, *College Mathematics Journal* $180,737, and FOCUS $145,776.

[3] Expenses include direct expenses, allocated building expense, and allocated direct service expense for the publications, marketing, and member services departments. Costs attributable to Governance, the Executive and Finance Departments and the Development Department are not allocated. They appear as Administrative expenses.

EMPLOYMENT OPPORTUNITIES

ARIZONA

ARIZONA STATE UNIVERSITY

The Department of Mathematics at Arizona State University invites applications for a tenure-track position at the Assistant Professor level, beginning in the fall semester of 2001. Applicants are required to have a Ph.D. in Mathematics, or a closely related field with a strong background in Mathematics, and a demonstrated potential for excellence in mathematics education research and teaching at all levels. The successful candidate will be expected to conduct research and publish in the area of mathematics education, provide quality teaching of undergraduate and graduate courses in secondary and undergraduate mathematics education and undergraduate courses in mathematics. Candidates should expect to participate fully in on-campus interdisciplinary mathematics education activities, and appropriate professional service activities.

Applicants must send i) their resume, ii) an AMS Cover Sheet, iii) a personal statement addressing their research agenda, iv) a statement of teaching philosophy, and v) arrange for at least three letters of recommendation to be sent to: R.A. Renaut, Chair, Mathematics Education Search Committee, Department of Mathematics, PO Box 871804, Arizona State University, Tempe, AZ 85287-1804. Review of the applications will begin on December 4, 2000, and will continue weekly until the positions are filled. AA/EOE.

NORTHERN ARIZONA UNIVERSITY

The Department of Mathematics and Statistics of Northern Arizona University invites applications for the following positions:

(1) One tenure-track Assistant Professor in Analysis or a related area.
(2) Two tenure-track Assistant Professors in Mathematics Education, one in Flagstaff, one in Phoenix.
(3) One Lecturer, visiting for the 2001-2002 year but anticipated to become an annually renewable position.

Duties for the tenure-track positions include teaching undergraduate and graduate courses, carrying on an active research program, and service. The visiting lecturer position is primarily a teaching and service position. Applicants should have the experience and commitment needed to work with a diverse population. All four positions start in late August 2001.

Please consult the web site http://odin.math.nau.edu/ or write the appropriate screening committee chair at the address below for detailed qualifications, duties, and application requirements. The searches will remain open until further notice; however, review of applications will begin on December 1, 2000.

Northern Arizona University has a Flagstaff campus enrollment of approximately 15,000. The Department has 24 permanent faculty and offers Bachelor's and Master's degrees with emphases in mathematics, mathematics education and statistics.

Flagstaff is located at an elevation of 7,000 in the cool pine forests of northern Arizona, near high mountains, several spectacular canyons, and numerous other attractions.

NAU IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION INSTITUTION. MINORITIES, PERSONS WITH DISABILITIES, VETERANS, AND WOMEN ARE ENCOURAGED TO APPLY.

Department of Mathematics and Statistics, PO Box 5717, Northern Arizona University, Flagstaff, AZ 86011-5717.

UNIVERSITY OF ARIZONA

The Mathematics Department at the University of Arizona may have tenure track positions in various areas, including Mathematics Education, subject to availability of funding, beginning fall 2001.

We encourage early application. Application re-

view begins November 1, 2000, with applications accepted until December 1, 2000, or as long as positions remain unfilled. Send AMS Coversheet, a letter of interest (specify position), curriculum vitae with a list of publications, and a minimum of three (3) letters of recommendation (enclose or arrange to be sent), to: Personnel Committee, Department of Mathematics, University of Arizona, P.O. Box 210089, Tucson, Arizona 85721-0089.

The AMS form can be downloaded from http://www.ams.org/employment/coversheet-info.html.

The University of Arizona is an EEO/AA Employer. M/W/D/V.

CALIFORNIA

CAL STATE POLYTECH. UNIV., POMONA
Department of Mathematics
Four tenure-track positions
Pure Math and Math Ed. (Asst Prof) Teach major & service courses in secondary teaching/pure option; advise students seeking secondary teaching credential; interact with Center for Education & Equity in Math, Sci. & Tech. (CEEMaST) and College of Ed. (CEIS). Min qual: Ph.D. in pure math with ability to teach geometry, number theory or topology and strong background in math ed. or doctorate in math ed. with ability to teach upper division pure math courses. Initial review of applications 12/15/00.

Math and Math Ed. (Asst Prof) Teach major & service courses in math, applied math, or stat as well as math ed courses; advise students pursuing a secondary teaching credential; interact with CEEMaST and CEIS. Min qual: Ph.D. in math, appl math, or stat and strong background in math ed. or doctorate in math ed. with ability to teach upper division math, appl math, or stat courses. Initial review of applications 1/19/01.

Appl.Math/Stat. (Asst/Assoc Prof) Teach major and service courses in appl math or stat, advise graduate students. Preference will be given to applicants having multiple expertise in the following areas: differential equations, modeling (deterministic and stochastic), random processes, estimation theory, numerical analysis, or operations research. Min qual: Ph.D. in math or stat or related area. Initial review of applications 2/2/01.

Statistics (Asst/Assoc Prof) Teach graduate stat courses, undergraduate and service courses in stat or math; advise graduate students. Preference given to applicants with expertise in one or more of: statistical modeling, multivariate stat, biostat, design of experiment, estimation theory, statistical consulting. Min qual: Ph.D. in stat or math or related area. Initial review of applications 2/2/01.

All positions: Salary dependent on qualifications. Required: evidence of teaching excellence, ability to direct master's theses, potential for conducting scholarly activities. Completion of terminal degree by Sept. '01. Review of applications continues until position is filled or closed. Submit application form (with name of position), curriculum vitae, transcripts, and min. of 3 reference letters to Faculty Search Committee, Math Dept., CSPU Pomona, 3801 W. Temple Ave, Pomona, CA 91768-4007; 909-869-4008; Fax: 909-869-4904; e-mail: lmborchert@csupomona.edu. AA/EEO. See http://www.csupomona.edu/~math.

CALIFORNIA POLYTECHNIC UNIVERSITY, SAN LUIS OBISPO
Mathematics tenure-track position beginning Fall 2001. Assistant professor appointment anticipated. Salary commensurate with qualifications and experience. Excellence in teaching and an active program in research/professional development are expected. Doctorate in mathematics or closely related field is required. Preferred areas of interest are Applied Analysis (numerical and asymptotic analyses, differential equations, modeling), Combinatorics (algebraic and probabilistic combinatorics, partitions, symmetric functions, symbolic computation), and Topology (algebraic and differential topology, fixed point and knot theories, low dimensional manifolds). Submit Cal Poly application form (request via math@calpoly.edu), resume, brief statement of professional goals, three letters of reference (at least one addressing teaching experience), and transcripts (unofficial okay initially) to: Department Chair, Mathematics Department, Cal Poly, San Luis Obispo, CA 93407. All materials must be received by the closing date: 12/1/00. Please indicate Recruitment Code: 13002 on all correspondence. Cal Poly is strongly committed to achieving excellence through cultural diversity. The university actively encourages applications and nominations of women, persons of color, applicants with disabilities, and members of other under-represented groups. AA/EEO.

CALIFORNIA STATE UNIVERSITY, FULLERTON
Mathematics Education The Department of Mathematics at California State University, Fullerton, has an opening for one tenure track position at the assistant or associate professor levels, beginning August 20, 2001. Responsibilities include teaching courses in mathematics and mathematics education; developing the teaching skills of student teachers in mathematics; and being active in research related to Mathematics Education. Doctorate in an area directly related to Mathematics Education or Mathematics awarded by the appointment date, and a Masters Degree in Mathematics or a Bachelors Degree in Mathematics with substantial graduate coursework in Mathematics is required. Rank and salary will be commensurate with experience. The Department has a significant number of faculty who are active in all aspects of teaching and research in Mathematics Education (for the complete job description, please visit us at our web sit at: http://math.fullerton.edu. Send all materials to: Chair, Search Committee in Mathematics Education, Department of Mathematics, California State University, Fullerton, Fullerton, CA 92834. Applications will be reviewed beginning November 15, 2000. For full consideration complete applications must be received no later than January 5, 2001. Cal State Fullerton is an AA/EO/Title IX/ADA Employer.

CALIFORNIA STATE UNIVERSITY, FULLERTON
The Department of Mathematics at California State University, Fullerton has two tenure-track openings at the assistant professor level beginning fall 2001. For candidates with exceptional qualifications, appointment at the rank of associate professor may be considered. Minimum qualifications are a Ph.D. in Mathematics or Applied Mathematics awarded by August 20, 2001, high potential in teaching and research, and excellent communication skills.

The first position is in the fields of geometry or differential geometry. An interest in the history of mathematics would be a plus. The second position is in applied mathematics in the fields of computational mathematics, differential equations (ordinary or partial), or dynamical systems.

Teaching duties include courses at the undergraduate and graduate levels. The successful candidate is expected to be professionally active and to participate in departmental and university affairs. Excellence in teaching and ongoing research activity are essential for promotion and tenure.

Applicants should send a summary of their teaching experience and current and future research plans, a current Curriculum Vita, at least three letters of reference addressing their background and potential in both teaching and research, and transcripts of graduate work to: Chair, Search Committee (specify Pure or Applied), Department of Mathematics, California State University, Fullerton, CA 92834-6850. For full consideration, they must be received by January 12, 2001. Further information regarding CSUF and the mathematics department can be found at http://www.fullerton.edu. Cal State Fullerton is an AA/EO/Title IX./ADA Employer.

SAN JOSE STATE UNIVERSITY
Department of Mathematics and Computer Science
Two tenure track positions in mathematics. At least one will be in the area of statistics. Assis-

tant professor rank is preferred, but appointment to associate professor is possible in exceptional circumstances. To be considered for the position, candidates must have earned their Ph.D. in mathematics by August 2001. Excellence in teaching is of primary importance. Ideal candidate will have an interest in establishing and promoting a pre-actuarial program. Candidates must be sensitive to the educational goals of a multicultural population. Please send a cover letter, vita, graduate transcript(s), and three letters of reference to Dr. Michael Burke, Chair, Department of Mathematics and Computer Science, San José State University, San José, CA 95192-0103. Cover letter should address your approach to teaching and your willingness to live in an area with a high cost of housing. Application deadline is March 1, 2001. EOE/AAE.

CONNECTICUT

SACRED HEART UNIVERSITY
Mathematics

Sacred Heart University, the third-largest Catholic University in New England is a dynamic, independent, coeducational, institution that is committed to excellence in academics and to the Catholic intellectual and liberal arts traditions. The main campus is in suburban Fairfield, one hour north of NYC and three hours south of Boston.

At this time we are anticipating two tenure-track Assistant Professor positions beginning in August 2001. Ph.D. in Mathematics or Math Education required. Specialization in Analysis and/or Statistics preferred. Commitment to teaching and the use of technology in the classroom are essential. Expected to teach major and nonmajor mathematics courses. Candidates with post-doctoral publications and grant writing preferred. Applications must include a complete resume, transcripts, teaching philosophy, and three letters of recommendation.

Please direct applications to Rose Marie Kinik, Chair, Mathematics Department, Sacred Heart University, 5151 Park Avenue, Fairfield, CT 06432. EOE/AA employer. Women and minorities encouraged to apply.

WESLEYAN UNIVERSITY

The Department of Mathematics and Computer Science invites applications for the following positions in Mathematics to begin in the academic year 2001-2002. Candidates for these positions must have a Ph.D. in Mathematics and are expected to have strong records in both research and teaching.

Assistant Professor of Mathematics: We seek candidates for two tenure-track assistant professorships, one in analysis and the other in algebra. These positions are most suitable for candidates with an established research program, typically with some postdoctoral experience. For the analysis position, we are especially interested in probability theory, Lie groups, or geometry with connections to dynamics; for the algebra position, we are especially interested in arithmetic or algebraic geometry, number theory, algebraic groups, commutative algebra, or algebraic combinatorics. Outstanding candidates in any area of mathematics are encouraged to apply.

Teaching duties for each of the above positions are two courses per semester.

Wesleyan University is committed to increasing the diversity of its faculty and is an equal opportunity/affirmative action employer.

Applications must be submitted by January 29, 2001. Applicants should arrange for at least four letters of recommendation, including one which evaluates teaching, to be sent to the address below.

All correspondence and applications should be submitted to:

Mathematics Search Committee
Department of Mathematics and
Computer Science
Wesleyan University
Middletown, CT 06459

E-mail enquiries may be directed to mathjobs@wesleyan.edu; please mention that you are enquiring about the assistant professorships.

More information concerning the Department of Mathematics and Computer Science and about Wesleyan University can be found via http://www.math.wesleyan.edu/.

GEORGIA

GEORGIA COLLEGE & STATE UNIVERSITY

The Department of Mathematics and Computer Science invites applications for a tenure-track position in mathematics at the assistant professor rank. A Ph.D. in mathematics or a closely related discipline is required, as well as a commitment to teaching and scholarship at a public liberal arts university. All specialties are welcome, with special consideration given to candidates who can help develop the department's actuarial science minor. Effective teaching, scholarship and university/community service are requirements for promotion and tenure. Please send a letter of application, CV, unofficial graduate transcripts, and three letters of recommendation to:

Search Chair
Department of Mathematics and Computer Science
CBX 017
Georgia College & State University
Milledgeville, GA 31061

The cover letter should address career goals and views on teaching and scholarship in a liberal arts university. [Final candidates for the position will be required to submit official graduate and undergraduate transcripts.] Please indicate availability for interviews at the January meeting of AMS/MAA.

For additional information on the department and the position, please see the department's web page at http://www.gcsu.edu/acad_affairs/coll_artsci/mathcomp_sci.

GC&SU is an Equal Opportunity/Affirmative Action Employer.

INDIANA

WABASH COLLEGE

Wabash College invites applications and nominations for the position of Chair of the Department of Mathematics and Computer Science. Preferred starting date of July 2001. Wabash, a selective liberal arts College of 850 men, has been nationally ranked for the percentage of its science graduates who go on to successful graduate work and is consistently ranked by *U.S. News and World Report* as one of the best values among liberal arts colleges. The College's endowment, one of the largest nationally per student supports competitive salaries, an engaging teaching and learning environment, a strong program of faculty development, and a good educational value for its students. Wabash is currently in the process of building and renovating science and mathematics facilities. Our new Center for Inquiry into the Liberal Arts will present Wabash faculty with the opportunity to have a major influence on the liberal arts nationally. With teaching and administrative duties, the new chair will have the opportunity to continue the development of the 7-member department in a very supportive environment as the department prepares to move into the new facility. Applicants must have a Ph.D. in mathematics or computer science, a commitment to undergraduate education, demonstrated evidence of excellence in teaching, administrative and leadership skills, and a record of scholarly activity, and should enjoy the broad intellectual community offered by a quality liberal arts college. For additional information please see our web page at http://www.wabash.edu/depart/math/. Applications, including vita, statement of teaching philosophy, description of scholarly interests, names, addresses, and phone numbers of three references who can address issues of teaching and administration, should be sent to Robert L. Foote, Mathematics and Computer Science Chair Search, Wabash College P.O. Box 352

Crawfordsville, IN 47933-0352. Applications will be considered as they arrive, and will be accepted until the position is filled. Nominations and inquiries may be made by phone, mail, or e-mail to Robert L. Foote, Mathematics and Computer Science Chair, 765-361-6429, footer@wabash.edu or to Mauri Ditzler, Dean of the College, 765-361-6224, Ditzlerm@wabash.edu. Wabash College encourages applications from women and minorities. EOE.

KANSAS

BENEDICTINE COLLEGE

Computer Science: Full-time, tenure-track position beginning January or August 2001. Rank and salary negotiable. Includes teaching introductory programming, upper-division CS, some lower-division math. Requires an advanced degree in CS or equivalent course work with an advanced degree in math. Teaching experience desired. Letter of application, vita, and three references to Dr. Jo Ann Fellin, OSB, Chair, Department of Mathematics & Computer Science, Benedictine College, 1020 North 2nd Street, Atchison, Kansas 66002. email: jfellin@benedictine.edu. Applications accepted until position filled. EOE. www.benedictine.edu.

MARYLAND

SALISBURY STATE UNIVERSITY
MATHEMATICAL SCIENCES POSITION

Applications are invited for one or more tenure-track Assistant Professor positions, beginning 15 August 2001. A Master's in mathematics and a doctorate in mathematics or mathematics education are required. Candidates from all areas of mathematics are encouraged to apply, especially those with backgrounds in geometry or teacher preparation. Candidates must have a commitment to excellence in teaching, scholarly development, and service, and must communicate effectively in spoken and written English.

The department offers degrees in mathematics and computer science, and numerous courses to satisfy requirements for degrees in other areas. Successful candidates will demonstrate a commitment to undergraduate education and a willingness to teach a broad range of introductory mathematics courses as well as an ability to contribute to mid and upper-level offerings for majors.

Salisbury State University is committed to employment equity and diversity in the workplace. We especially welcome and encourage qualified minority applicants, women and persons with disabilities to apply. Our employment goals are to create a workforce from a variety of backgrounds and experiences that will strengthen the values of a diverse university community.

For additional information see http://faculty.ssu.edu/~mathcosc/.

Screening of applications will begin on December 11, and will continue until the position is filled. Applicants should submit a cover letter including a statement of their teaching philosophy, a resume, and three letters of recommendation to:

Dr. Homer W. Austin
Search Committee Chair
Department of Mathematics and
Computer Science
Salisbury State University
Salisbury, MD 21801

Salisbury State University is an Affirmative Action/Equal Opportunity Employer.

TOWSON UNIVERSITY

Applications are invited for two entry-level tenure-track positions in mathematics, beginning in Fall 2001. Applicants must have a Ph.D. in mathematics or statistics, and must provide evidence of excellent teaching and an active research program. Preference will be given to applicants in statistics, operations research, or optimization, but all specializations will be considered. Applicants must have a commitment to teaching a variety of courses some of which require the use of technology or mathematics across the disciplines. The teaching assignment is nine contact hours per semester. The salary is commensurate with that for an entry-level position.

The Mathematics Department (www.towson.edu/math/) offers Bachelor's programs in pure mathematics, applied mathematics, applied mathematics with computing, actuarial science, and mathematics education and Master's programs in applied and industrial mathematics, and mathematics education.

Applicants should submit a letter of application, the AMS cover sheet, a resume, a description of research, a statement of teaching experience and philosophy, a copy of the graduate transcript and have three letters of recommendation addressing both teaching and research sent to:

Professor Raouf Boules
Chair, Mathematics Search Committee
Mathematics Department
Towson University
8000 York Road
Baltimore, MD 21252-0001.

Applications or material sent by e-mail will not be considered. Because we will have representatives at the AMS-MAA Joint Meetings in New Orleans, please indicate if you will be attending. Review of applications will begin on December 15, 2000, and will continue until both positions are filled.

Towson University, one of the eleven campuses of the University System of Maryland, and the second largest public institution in the State of Maryland, is a comprehensive university offering Bachelor's and Master's degree programs. Towson University has an enrollment of approximately 16,600 students and nearly 900 full-time equivalent faculty. The campus is situated on 328 acres of beautifully landscaped and wooded grounds just north of Baltimore and within 50 miles of Washington, DC.

Towson University is an equal opportunity/affirmative action employer and has a strong institutional commitment to diversity. Women, minorities, persons with disabilities, and veterans are encouraged to apply.

MASSACHUSETTS

AMHERST COLLEGE

Applications are invited for a tenure-track position in Mathematics at the Assistant Professor level, beginning in August 2001. Amherst College is a private liberal arts college for men and women that emphasizes scholarship and excellence in undergraduate teaching. The College has 1650 students and 165 faculty members. It is located in the valley of the Connecticut River in Western Massachusetts. Our environment is enhanced by our proximity to the nearby University of Massachusetts and Hampshire, Mount Holyoke and Smith Colleges.

Departmental responsibilities include teaching a wide range of undergraduate courses and supervising undergraduate theses. Faculty are expected to maintain vigorous research programs. Professors teach two courses each semester.

Applicants should hold a Ph.D. in mathematics. The Department seeks candidates with broad intellectual interests, a strong commitment to excellence in research and undergraduate teaching, and the ability to develop a research program with opportunities for undergraduate participation. Candidates should submit a current curriculum vita, a list of publications, graduate and undergraduate transcripts, a letter describing plans for teaching and research, and three letters of recommendation. For full consideration, applications should be completed by December 1, 2000.

Amherst College is an Equal Opportunity/Affirmative Action Employer, and encourages women, minorities, and disabled persons to apply.

Reply to:
Prof. David Cox, Chair
Search Committee
Department of Mathematics
and Computer Science
Amherst College
P O Box 5000
Amherst, MA 01002-5000
e-mail queries to: search@math.amherst.edu.

MICHIGAN

MICHIGAN STATE UNIVERSITY
Lyman Briggs School
Assistant/Associate Professor of Mathematics

Michigan State University invites applications for a tenure track, academic year, assistant/associate professorship of mathematics position in the Lyman Briggs School, an undergraduate, residential, liberal arts science program within the College of Natural Science. Candidates must have a Ph.D. in mathematics, mathematics education, or statistics and a research record commensurate with an appointment at the assistant or associate professor rank. Preference will be given to applicants with at least five years experience and who are particularly passionate about teaching mathematics to undergraduates. Duties include teaching two of the four Lyman Briggs mathematics courses offered each semester and supervising undergraduate teaching assistants.

This position offers exciting opportunities to collaborate with faculty in the Department of Mathematics, the Division of Science and Mathematics Education, the College of Education, and the Drew Science Enrichment Program on questions about the teaching and learning of mathematics at the undergraduate level. The Briggs School environment offers additional opportunities for integrating mathematics with the other science courses.

A complete application package consists of a cover letter, curriculum vitae, a representative scholarly paper, a personal teaching philosophy statement, a list of undergraduate mathematics courses taught in the last five years, and the names and addresses of three references, all sent in a single mailing. The material should be sent to the Mathematics Search Committee, Lyman Briggs School, Holmes Hall, Michigan State University, East Lansing, 48825-1107. Complete applications should be received by November 1, 2000; later submissions may be considered if suitable candidates have not yet been identified. Questions should be directed to Ms. Kathie Ellis at the above address or (517) 353-6486 or ellisk@pilot.msu.edu

Michigan State University is an Affirmative Action/Equal Opportunity Institution. Applicants who are not U.S. citizens or permanent residents must provide a document of employment authorization for the U.S. Persons with disabilities have the right to request and receive reasonable accommodation. Women and minorities are strongly encouraged to apply.

See www.msu.edu and www.msu.edu/unit/lbs.

MINNESOTA

MOORHEAD STATE UNIVERSITY
Mathematics Department
Moorhead, MN 56563

Tenure-track position at rank of assistant professor to begin August, 2001. A Ph.D. or Ed.D. in mathematics education is strongly preferred. Substantial progress toward a terminal degree is required. Eligibility for licensure at some level K-12 and good communication skills are required. Preference will be given to candidates with evidence of successful teaching at the K-12 and college level. Interest or experience in teaching a mathematics methods course and evidence of ability to work effectively as a member of a teaching team are desired. Duties include teaching mathematics education methods and content courses and undergraduate mathematics courses. Other responsibilities include advising students, developing in-service workshops, service to the university and maintaining an appropriate level of professional activity. The teaching load is twelve hours per semester, which may include supervising student teachers. Screening of applications will begin January 17, 2001. Applications accepted until filled. Completed applications must include resume, MSU Standard Application Form, graduate and undergraduate transcripts, and three current letters of reference. Apply to Don Mattson, Chair, Mathematics Department, Moorhead State University, Moorhead, MN 56563, (218) 236-2274; fax number: (218) 236-2168; e-mail: matson@mhd1.moorhead.musu.edu. Moorhead State University is an equal opportunity/affirmative action employer and educator. Women, minorities, and persons with disabilities are encouraged to apply.

MOORHEAD STATE UNIVERSITY
Mathematics Department
Moorhead, MN 56563

Tenure-track position at rank of assistant professor to begin August, 2001. A Ph.D. in mathematics or statistics is required. Preference will be given to candidates qualified to teach courses in upper division undergraduate statistics, numerical analysis or mathematical modeling. Preference will also be given to candidates with successful college teaching experience. Duties include teaching undergraduate mathematics courses, advising students, service to the university, and maintaining an appropriate level of professional activity. The teaching load is twelve hours per semester. Screening of applications will begin January 17, 2001. Applications accepted until filled. Completed applications must include resume,(MSU Standard Application Form, graduate and undergraduate transcripts, and three current letters of reference. Apply to Don Mattson, Chair, Mathematics Department, Moorhead State University, Moorhead, MN 56563, (218) 236-2274; fax number: (218) 236-2168.

E-mail: matson@mhd1.moorhead.musu.edu. Moorhead State University is an equal opportunity/affirmative action employer and educator. Women, minorities, and persons with disabilities are encouraged to apply.

COLLEGE OF SAINT BENEDICT
SAINT JOHN'S UNIVERSITY
Mathematics Department-Assistant Professor

The College of Saint Benedict/Saint John's University seeks candidates for a tenure track position in mathematics to begin Fall, 2001. The successful candidate must demonstrate a strong commitment to undergraduate teaching in a liberal arts setting and should be prepared to teach a wide range of mathematics courses to majors, minors, and general education students. A Ph.D. in the mathematical sciences is required. The department has thirteen full-time faculty members, is supported by a separately staffed Mathematics Skills Center, and graduates approximately 20 majors annually.

Saint John's University, a liberal arts college for men, and the College of Saint Benedict, a liberal arts college for women, are located four miles apart in Central Minnesota just outside metropolitan St. Cloud and 70 miles from Minneapolis. Both are Catholic colleges in the Benedictine tradition. Students attend classes on both campuses, selecting courses from a common curriculum with identical degree requirements. Academic departments are joint and the academic program is coordinated by the Provost for Academic Affairs, with the assistance of the undergraduate deans on each campus. This partnership allows each college to offer to its students a co-educational academic experience with expanded educational opportunities, while preserving the single sex character and distinct heritage of each institution. Additional information is posted on our website: http://www.csbsju.edu.

All applicants must submit a letter of application, statement of teaching philosophy, curriculum vitae, copies of all transcripts, three recent letters of recommendation to:

Saint John's University
Human Resources
Box 7188
Collegeville, MN 56321-5000
*Or via email - asiemers@csbsju.edu

Applications received after December 1, 2000 cannot be guaranteed consideration. Women and people of diverse racial, ethnic, and cultural backgrounds are encouraged to apply. The College of Saint Benedict/Saint John's University are EEO/AA employers.

NEBRASKA

CREIGHTON UNIVERSITY

Creighton University invites applications for the Clare Boothe Luce Professorship within the College of Arts and Sciences. The position is restricted by the Clare Boothe Luce bequest to the Henry Luce Foundation to women who are U.S. citizens. Creighton University is a Jesuit, Catholic institution that encourages applications from qualified individuals of all backgrounds who believe they can contribute to its distinctive educational traditions. The position is for a tenure-track assistant professor in mathematics, statistics or computer science. Candidates must have a Ph.D. prior to chair appointment and a research record commensurate with the expectations of a chair position at this rank. Send letter of application, curriculum vitae, transcripts, statement of research program and goals, statement of teaching philosophy and three letters of recommendation independent of the applicant to Luce Search Committee Chair, Department of Mathematics and Computer Science, Creighton University, Omaha, NE 68178-2090. Review of completed dossiers will begin December 15, 2000 and will continue until a suitable candidate is selected. Creighton University is an Affirmative Action/Equal Opportunity employer. Women and minority candidates are encouraged to apply.

NEW JERSEY

THE COLLEGE OF NEW JERSEY

DEPARTMENT OF MATHEMATICS AND STATISTICS: Applications are invited for a tenure track position in Mathematics Education starting September 2001. The position requires a Ph.D. or Ed.D in Mathematics, Statistics or Mathematics Education, demonstrated record of teaching effectiveness, and strong indications of research potential. Responsibilities include teaching up to 12 hrs./sem, which includes content and methods courses, supervision of student teachers, advising and committee service. Preference for a candidate who can collaborate with the Center for Inquiry and Design Based Learning, which currently has state and federal funding in excess of $3 million for Integrated Science, Mathematics and Technology Initiatives. Experience with in-service teachers preferred. Send vita and three letters of recommendation, addressing teaching and research to: Search Committee, Department of Mathematics & Statistics, The College of New Jersey, PO Box 7718, Ewing, NJ 08628-0718. Application deadline: January 2, 2001. To enrich education through diversity, TCNJ is an AA/EOE. http://www.tcnj.edu/~mathstat/.

NEW YORK

COLLEGE OF SAINT ROSE

Tenure Track Faculty Positions
Computer Information Systems

The College of Saint Rose invites applications for two tenure track faculty positions beginning as early as the Spring, 2001 semester. Applicants with a Ph.D. in Computer Information Systems, Computer Science or a closely related field will be given preference but other applicants, especially those with an M.S. in CS or CIS, will also be considered. Faculty members are sought for several introductory and intermediate undergraduate courses and advanced graduate courses in areas such as computer literacy, programming, data structures, database management, computer architecture, graphics, networking and software engineering. Responsibilities at the college include teaching undergraduate and graduate courses; program development and promotion; student advisement; participation in college activities; and active scholarship.

Applicants must submit a current curriculum vita, three letters of recommendation, and graduate transcripts. Applications should be addressed to Dr. Neal Mazur, Chair, Computer Information Systems Department, The College of Saint Rose, 432 Western Avenue, Albany, NY 12203. Applications will be accepted until the positions are filled. Dr. Mazur may be contacted at mazurn@mail.strose.edu. Additional information about the campus can be found by visiting www.strose.edu. The College of Saint Rose is an Equal Opportunity, Affirmative Action Employer. The College encourages applications from women and members of minority communities.

CORNELL UNIVERSITY

Cornell University Math Department Visitor Position Description: The following positions are for the Academic Year (August - May): 4 half time visiting positions for math professors on sabbatical/other leaves. Send two teaching references, CV, proposal for research and/or study program, and how visit will benefit home institution to Catherine Stevens, 320 Malott Hall, Cornell University, Ithaca, NY 14853-4201. Candidates must possess a Ph.D.; proven excellence in teaching and research. Deadline for Applications: December 1, 2000. For more info about the position or institution/company:

http://www.math.cornell.edu/~math/Job_Opps/Faculty/positions.html. Cornell University is an Affirmative Action/ Equal Opportunity Employer.

DOWLING COLLEGE

Department of Mathematics and Computer Science

Dowling College invites applications for a tenure-track position in Mathematics to begin in September 2001. Applicants should have a Ph.D. or A.B.D. in Mathematics. The teaching load of 12 credits per semester may be reduced through research released time. Salary and benefits are very competitive and will be, with rank, commensurate with experience. The position is dependent upon funding.

Dowling College is an Affirmative Action/Equal Opportunity Employer located on the south shore of Long Island, fifty miles from Manhattan. A detailed vita should be sent to: Math and CSC Search, c/o Human Resources, Dowling College, Idle Hour Blvd., Oakdale, NY 11769-1999. www.dowling.edu.

SUNY FARMINGDALE

Anticipated Vacancy for Tenure Track Position-Fall 2001. The Mathematics Department of SUNY Farmingdale announces anticipated vacancy of tenure track position of Assistant Professor. Minimum qualifications-Ph.D. in Mathematics, Applied Mathematics, Statistics or Operation Research, at least two years of teaching experience on the undergraduate level, strong commitment to teaching of all levels of undergraduate mathematics. Experience in directing Applied Mathematics student research projects is preferable. Salary depending on qualifications. Application deadline: must be postmarked no later than January 15, 2001. Send resumes with a brief statement of your teaching philosophy, and the telephone numbers of three references (no letters of references, please) to Dr. I. Neymotin, Chair of the Search Committee, Department of Mathematics, SUNY-Farmingdale, NY 11735-1021. AA/EOE.

SUNY POTSDAM

Assistant Professor of Mathematics: The State of New York at SUNY Potsdam invites applications for one anticipated full time tenure track position effective September 1, 2001, at the rank of Assistant Professor. Responsibilities of the position include teaching twelve hours per semester of undergraduate and/or first year graduate courses. Required qualifications are Ph.D. in any area of mathematics with a strong interest in and preparation for teaching undergraduate major mathematics courses. Some preference will be given to candidates in Algebra, but candidates from all areas are encouraged to apply. Applications, which must include letter of interest, a statement of the applicant's philosophy of teaching, a resume, three letters of recommendation describing teaching experience and abilities, and a transcript (a copy is acceptable) should be sent to: Dr. Cheryl Chute Miller, Staffing Committee

Chair, Department of Mathematics, SUNY Potsdam, Potsdam, NY 13676 (millercc@potsdam.edu). To ensure full consideration, complete applications must be received by January 15, 2001. SUNY Potsdam is an equal opportunity, affirmative action employer committed to excellence through diversity.

NORTH CAROLINA

MEREDITH COLLEGE
Assistant Professor of Mathematics
Applications are invited for one, possibly two, full-time tenure-track position(s) to begin in August 2001. Applicants must have a Ph.D. in mathematics and demonstrated excellence in teaching. Experience with technology, innovative teaching techniques, and/or undergraduate research is highly desirable. Meredith College is a private comprehensive college of 2600 students offering both liberal arts and professional programs. The College is located near the world-renowned research triangle area in Raleigh, North Carolina. Applications will be reviewed beginning December 15, 2000 and continue until the position is filled. Send letter of application, resume, statements of teaching philosophy and research goals, copies of transcripts, and three letters of support to: Dr. Virginia Knight, Head, Department of Mathematics and Computer Science, Meredith College, 3800 Hillsborough Street, Raleigh, NC 27607-5298. Meredith College seeks to increase diversity among its faculty and staff. Minority candidates are strongly encouraged to apply. Meredith College is an Equal Opportunity Employer.

OKLAHOMA

THE UNIVERSITY OF OKLAHOMA
Applications are invited for one or more full-time, tenure-track position(s) in mathematics beginning 16 August 2001. The position(s) is initially budgeted at the assistant professor level, but an appointment at the associate professor level may be possible for an exceptional candidate with qualifications and experience appropriate to that rank. Normal duties consist of teaching two courses per semester, conducting research, and rendering service to the Department, University, and profession at a level appropriate to the faculty member's experience. The position(s) requires an earned doctorate and research interests that are compatible with those of the existing faculty; preference will be given to applicants with potential or demonstrated excellence in research and prior successful undergraduate teaching experience. Salary and benefits are competitive. For full consideration, applicants should send a completed AMS cover sheet, curriculum vitae, a description of current and planned research, and have three letters of recommendation (at least one of which must address the applicant's teaching experience and proficiency) sent to:

Search Committee
Department of Mathematics
University of Oklahoma
601 Elm, PHSC 423
Norman, OK 73019-0315

Phone: 405-325-6711
FAX: 405-325-7484
e-mail: search@math.ou.edu

Screening of applications will begin on December 15, 2000 and will continue until the position(s) is filled.

The University of Oklahoma is an Equal Opportunity/Affirmative Action Employer. Women and minorities are Encouraged to Apply. OU has a policy of being responsive to the needs of dual-career couples.

OREGON

PORTLAND STATE UNIVERSITY
Department of Mathematical Sciences
Mathematics Education Position
Assistant or associate professor in mathematics education, starting September 16, 2001. Ph.D. in mathematics education with the equivalent of a masters degree in mathematics, demonstrated excellence in teaching, and evidence of outstanding research potential.

Teach mathematics and mathematics education courses, advise students, and direct dissertations in a mathematics education programs including; middle school math graduate certificate; BS/BA; MST/MAT; and Ph.D. in mathematics education. Develop a strong research program in mathematics education that includes the procurement of external funding for research.

See also (http://www.mth.pdx.edu). Application to include (1) a letter of intent, (2) a curriculum vitae, and (3) three letters of recommendation. Send to:

Search Committee
Department of Mathematical Sciences
Portland State University
P.O. Box 751
Portland, OR 97207-0751

Deadline: December 31, 2000. Portland State University is an Affirmative Action/Equal Opportunity Institution.

PORTLAND STATE UNIVERSITY
Applications are solicited for a possible postdoctoral position (max 3 years) as an assistant professor in mathematical sciences, starting September 16, 2001. Applicants must have (or complete by September, 2001) a doctoral degree in pure or applied mathematics or statistics, demonstrated excellence in teaching, and evidence of outstanding research potential. Strong consideration will be given to candidates whose research interests most closely complement existing faculty and support a new professionally based Ph.D. program. Postdoctoral duties include teaching one course per term and being an active participant in the initiation of the new Ph.D. program.

Further program information is available on the department's home page, www.mth.pdx.edu. Qualified applicants are invited to submit an application including (1) a letter of intent including AMS application cover page, (2) a curriculum vitae, and (3) three letters of recommendation.

Send materials to:
Search Committee
Department of Mathematical Sciences
Portland State University
P.O. Box 751
Portland, OR 97207-0751

Review of files will begin February 15, 2001 and continue until the position is filled. Portland State University is an Affirmative Action/Equal Opportunity Institution.

TEXAS

SAM HOUSTON STATE UNIVERSITY
Mathematics Position
Specialty in Mathematics Education
The Dept. of Mathematics, Computer Science, and Statistics seeks applicants in a tenure-track position for a specialist in mathematics education. Rank and salary are negotiable. Applicants should have the equivalent of a masters' degree in mathematics and hold a doctorate in mathematics education or mathematics with an emphasis in mathematics education. Preference will be given to persons having an interest in teaching and developing curricula for prospective teachers. Experience in grant procurement, in-service teacher education, use of technology in the classroom, research and publication are also desirable qualities. Review of applications will begin 1 November 2000 and continue until the position is filled. To apply submit a letter of application, full curriculum vitae, transcripts, and three letters of reference to: Mathematics Education Search Committee, Dept. of Mathematics, Computer Science, and Statistics, Sam Houston State University, Huntsville, TX 77341-2206.

Sam Houston State University is an EEO/AAP employer. For additional information on this and other positions, access our web site at: www.shsu.edu/~hrd www.

TEXAS CHRISTIAN UNIVERSITY
Department of Mathematics
Instructorship beginning August 2001. Ph.D. or master's degree in mathematics or statistics is required, as well as documented excellence in teaching. Instructors typically teach four classes per semester. Position is for one-year, but is renewable indefinitely, provided that the instructor continues to exhibit exceptional abilities in the classroom. A complete application consists of a vita, a statement on teaching experience and philosophy, undergraduate and graduate transcripts, and at least three letters of reference with emphasis on teaching.

Texas Christian University is a major teaching and research university of approximately 7,000 students; it is located in the Dallas-Fort Worth metroplex, a vibrant metropolitan area of 5 million people. TCU does not discriminate in admissions or hiring on the basis of religion. Send correspondence to: Search Committee, Department of Mathematics, TCU Box 298900, Texas Christian University, Fort Worth, TX 76129. Consideration of applications will begin January 15, 2001, and will continue until the position is filled. TCU is an Equal Opportunity/Affirmative Action Employer.

VIRGINIA

EMORY & HENRY COLLEGE
Emory & Henry College invites applications for a tenure-track position in mathematics at the undergraduate level, beginning in August, 2001. Doctorate in mathematics or mathematics education required. Eighteen or more graduate hours in computer science preferred. Possibility of joint Math/CS appointment. A strong commitment to undergraduate teaching is essential. Applicants should be able to teach a wide range of courses leading to a bachelor's degree in mathematics. Emory & Henry College is a small liberal arts college in southwest Virginia, related to the United Methodist church, enrolling 1000 students. Closing date: December 15, 2000. Apply with vita, graduate transcripts, three letters of reference and statement of teaching philosophy to Dr. Paul Blaney, Dean of Faculty, Emory & Henry College, Emory, VA 24327. AA/EOE.

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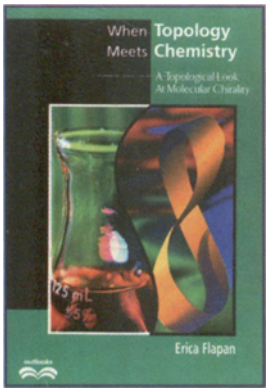
Two New Interdisciplinary Titles From the MAA

When Topology Meets Chemistry

Erica Flapan



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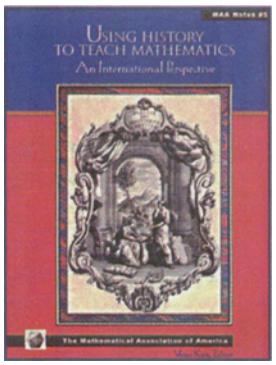

This book is a collection of articles by international specialists in the history of mathematics and its use in teaching, based on presentations given at an international conference in 1996. Although the articles vary in technical or educational level and in the level of generality, they show how and why an understanding of the history of mathematics is necessary for informed teaching of various subjects in the mathematics curriculum, both at secondary and at university levels. Many of the articles can serve teachers directly as the basis of classroom lessons, while others will give teachers plenty to think about in designing courses or entire curricula. For example, there are articles dealing with the teaching of geometry and quadratic equations to high school students, of the notion of pi at various levels, and of linear algebra, combinatorics, and geometry to university students, as well as articles showing how to use historical problems in various courses and one dealing with mathematical anomalies and their classroom use. Although the primary aim of the book is the teaching of mathematics through its history, some of the articles deal more directly with topics in the history of mathematics not usually found in textbooks.

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