

FOCUS

Volume 13, Number 4

The Newsletter of the Mathematical Association of America

August 1993

x Fermat's Last *$\neq z^n$*
Theorem
when $n > 2$
Proved!!!

See Page 3

Section
Distinguished
Teaching Awards

See Page 6



FOCUS is published by The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385, six times a year: February, April, June, August, October, and December.

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The FOCUS subscription price to individual members of the Association is \$6.00, included in the annual dues. (Annual dues for regular members, exclusive of annual subscription prices for MAA journals, are \$68.00. Student and unemployed members receive a 66 percent discount; emeritus members receive a 50 percent discount; new members receive a 40 percent discount for the first two membership years.)

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Second-class postage paid at Washington, DC and additional mailing offices. Postmaster: Send address changes to the Membership and Subscriptions Department, The Mathematical Association of America, 1529 Eighteenth Street Northwest, Washington, DC 20036-1385.

ISSN: 0731-2040

Printed in the United States of America.
Printed on recycled paper

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Fermat's Last Theorem, a Theorem at Last

Keith Devlin, Fernando Gouvêa, and Andrew Granville

After defying all attempts at a solution for 350 years, Fermat's Last Theorem finally took its place among the known theorems of mathematics in June of this year.

On June 23, during the third of a series of lectures at a conference held at the Newton Institute in Cambridge, British mathematician Dr Andrew Wiles, of Princeton University, sketched a proof the Shimura-Taniyama-Weil conjecture for semi-stable elliptic curves. As Kenneth Ribet, of the University of California at Berkeley, showed some years ago, Fermat's Last Theorem is a corollary of this result.

In the years since Fermat made his famous marginal note in his copy of Diophantus' *Arithmetica*, asserting, without proof, that equations of the form

$$x^n + y^n = z^n$$

have no integer solutions for values of the exponent n greater than 2, many mathematicians, professionals and amateurs alike, have tried to find a proof. Every few years, the newspapers report yet another purported solution, which is subsequently found to be lacking in some way.

To understand why Wiles has succeeded where so many before him have failed, one needs to know something of the recent history of the problem.

To number theorists, until the last decade the question seemed completely unassailable, despite a number of significant advances that had been made as a result of attempts to solve it, among them the 19th century work of Kummer on cyclotomic fields and ideal theory.

More recently, there was Gerd Faltings' 1983 proof of the Mordell Conjecture, which implied that for each exponent, the Fermat equation could have at most a finite number of solutions. But, despite much simpler proofs of Vojta and Bombieri, it seems unlikely that such methods can be modified to show that there really are no solutions.

Wiles' approach comes from a somewhat

different direction, and rests on an amazing connection, established during the last decade, between the Last Theorem and the theory of elliptic curves, that is, curves determined by equations of the form

$$y^2 = x^3 + ax + b,$$

where a and b are integers.

The path that led to the June 23 announcement began in 1955, when the Japanese mathematician Yutaka Taniyama proposed that there should be a connection between elliptic curves and another well-understood class of curves, known as modular curves. One should be able to establish a connection between any given elliptic curve and a modular curve, and this connection would "control" many of the properties of the initial curve.

Taniyama's conjecture was made more precise in 1968 by Andre Weil, who showed how to determine the exact modular curve that should be connected to a given elliptic curve.

In 1971 the first significant evidence in favor of this abstract understanding of equations was given by Goro Shimura, a Japanese mathematician at Princeton University, who showed that it works for a very special class of equations. As a result, Taniyama's proposal eventually became known as the Shimura-Taniyama-Weil conjecture.

Additional evidence in support of the conjecture came from the fact that its nature allowed for a substantial amount of numerical testing by computer: all curves that were examined seemed to be modular.

But so far, no one knew of any connection between this very abstract conjecture and Fermat's Last Theorem. Things changed dramatically in 1986, when Gerhard Frey, from Saarbrücken, discovered a most surprising and innovative link between the two.

What he realized was that if $c^n = a^n + b^n$, then it seemed unlikely that one could understand the elliptic curve given by the equation

$$y^2 = x(x - a^n)(x + b^n)$$

in the way proposed by Taniyama. Following an appropriate re-formulation by Jean-Pierre Serre in Paris, Kenneth Ribet in Berkeley strengthened Frey's original concept to the point where it was possible to prove that the existence of a counterexample to the Last Theorem would lead to the existence of an elliptic curve which could not be modular, and hence would contradict the Shimura-Taniyama-Weil conjecture.

This is the point where Wiles entered the picture. Using and developing powerful new methods of Barry Mazur (Harvard), Matthias Flach (Heidelberg), Victor Kolyvagin (Steklov Institute), and others, Wiles eventually succeeded in establishing the Shimura-Taniyama-Weil conjecture for an important class of elliptic curves (those with square-free "conductors"), which includes those relevant to proving Fermat's Last Theorem.

For the Cambridge conference, Wiles had announced his lectures, a series of three given on successive days, with the highly unspecific title "Modular Forms, Elliptic Curves, and Galois Representations." Prior to his lectures, he refused to give a hint as to what they might contain. Even though, by the third talk, many in the audience had guessed he might have cracked Fermat's Last Theorem, few dreamt that he could have proved so much more, and there was an audible gasp as he wrote the final result on the blackboard.

Given the history of attempts to prove the Last Theorem, readers will doubtless view this latest announcement with some initial skepticism. But it should be stressed that Wiles' work is not a chain of reasoning as strong as its weakest link. Instead it is a bedrock of ideas, solid and rigid, a rich and profound theory that will hold up even if a few details need altering. Considering the enormous complexity of this work it will, of course, take time to be absolutely certain that there are no hidden flaws, but the experts feel confident that even any necessary changes will be possible. Many of these experts were attending Wiles' talks, and from what he said and the way he said it, they were satisfied that the techniques are, in essence, sound.

The situation is a bit like building a bridge across a chasm. Most attempts to solve the

Please see *Fermat* on page 4



Fermat from page 3

Last Theorem made by amateurs are like a single span consisting of many short pieces of wire tied together. One small flaw and the entire structure collapses. Wiles' solution is much more like a solid concrete and steel bridge, erected on firm foundations laid down by many others. It may contain many small cracks, but the bridge itself still stands, and the road crew can come along later to fill in the cracks. Of course, even solidly built bridges do fall down occasionally, but the nature of Wiles' work, which involves many appreciable, profound new ideas, suggests that this is not such a bridge.

Taking the bridge metaphor a step further, one might ask what is to be found on the other side? Well, it is likely that the proof of the whole of the Shimura-Taniyama-Weil conjecture is at hand, and the consequences are breathtaking. The face of number theory will be altered in a way that we cannot even guess right now.

The story of Fermat's Last Theorem is one of the most delightful in mathematics, and if it had to finally be resolved then perhaps it was best to be as the motivation for such a startling result.

Certainly, the method used to obtain the solution is of far more importance to mathematics than the Last Theorem itself. Indeed, had it not entered the mathematical world the way it had, as a cryptic note by one of the most powerful number theorists the world has ever seen, and had it not resisted all attempts at a solution for so many years, the Last Theorem would have merited little more than a footnote to textbook accounts of Pythagoras' Theorem. But the Wiles result, and the work of the many other mathematicians that paved the way, is sure to have enormous impact in many parts of mathematics.

The next issue of FOCUS will include a much more detailed account of Wiles' new proof.

Dr Andrew Granville, of the University of Georgia, spent the last six months at the Newton Institute at Cambridge, and attended the lectures at which Wiles sketched his new proof. Dr Fernando Gouvêa, a collaborator with, and former student of, Mazur, is on the faculty at Colby College. Dr Keith Devlin is the Dean of Science at Saint Mary's College of California, and the editor of FOCUS.

The Technical Details

Shortly after Wiles finished his lecture, Dr Kenneth Ribet, of the University of California at Berkeley, who was in the audience, sent out the following summary of the proof to colleagues at Berkeley, where the excitement it created led to its rapid appearance on the Internet. The message is reproduced here with his permission.

I imagine that many of you have heard rumors about Wiles's announcement a few hours ago that he can prove Taniyama's conjecture for semistable elliptic curves over Q . This case of the Taniyama conjecture implies Fermat's Last Theorem, in view of the result that I proved a few years ago. (I proved that the "Frey elliptic curve" constructed from a possible solution to Fermat's equation cannot be modular, i.e., satisfy Taniyama's Conjecture. On the other hand, it is easy to see that it is semistable.)

The method of Wiles borrows results and techniques from lots and lots of people. To mention a few: Mazur, Hida, Flach, Kolyvagin, yours truly, Wiles himself (older papers by Wiles), Rubin... The way he does it is roughly as follows. Start with a mod p representation of the Galois group of Q which is known to be modular. You want to prove that all its lifts with a certain property are modular. This means that the canonical map from Mazur's universal deformation ring to its "maximal Hecke algebra" quotient is an isomorphism. To prove a map like this is an isomorphism, you can give some sufficient conditions based on commutative algebra. Most notably, you have to bound the order of a cohomology group which looks like a Selmer group for Sym^2 of the representation attached to a modular form. The techniques for doing this come from Flach; you also have to use Euler systems a la Kolyvagin, except in some new geometric guise.

If you take an elliptic curve over Q , you can look at the representation of Gal on the 3-division points of the curve. If you're lucky, this will be known to be modular, because of results of Jerry Tunnell (on base change). Thus, if you're lucky, the problem I described above can be solved (there are most definitely some hypotheses to check), and then the curve is modular. Basically, being lucky means that the image of the representation of Galois on 3-division points is $GL(2, \mathbb{Z}/3\mathbb{Z})$.

Suppose that you are unlucky, i.e., that your curve E has a rational subgroup of order 3. Basically by inspection, you can prove that if it has a rational subgroup of order 5 as well, then it can't be semistable. (You look at the four non-cuspidal rational points of $X_0(15)$.) So you can assume that $E[5]$ is "nice." Then the idea is to find an E' with the same 5-division structure, for which $E'[3]$ is modular. (Then E' is modular, so $E'[5] = E[5]$ is modular.) You consider the modular curve X which parametrizes elliptic curves whose 5-division points look like $E[5]$. This is a "twist" of $X(5)$. It is therefore of genus 0, and it has a rational point (namely, E), so it is a projective line. Over that you look at the irreducible covering which corresponds to some desired 3-division structure. You use Hilbert irreducibility and the Chebotarev density theorem (in some way that hasn't yet sunk in) to produce a non-cuspidal rational point of X over which the covering remains irreducible. You take E' to be the curve corresponding to this chosen rational point of X .

- Ken Ribet, June 23, 1993, Cambridge, England.

Marginal Interest?

With Fermat's Last Theorem no longer around as "the most famous unsolved problem in mathematics," what else can science journalists and writers of popular books on mathematics use to spice up their writing? FOCUS invites readers to submit their own "marginal comment," and the best ones received will be published in a future issue. To qualify, your problem should be short, simple for the layperson to understand, but should appear to defy solution by "elementary" methods—except, of course, for the truly marvellous proof that will not fit into the margin of FOCUS, which you may keep to yourself. Send your suggestions to: Keith Devlin, Editor, FOCUS, School of Science, Saint Mary's College, Moraga, California 94575, email devlin@stmarys-ca.edu.



Twenty-second USA Mathematical Olympiad Winners Honored

Lisa Kolbe
USAMO Organizer

Winners of the Twenty-second USA Mathematical Olympiad were honored at a two day celebration in Washington on June 6 and 7. Members of the mathematical sciences community, the federal government, and private industry recognized their extraordinary achievement and extended their congratulations to the winners. They were:

Wei-Hwa Huang, First Place,
Potomac, Maryland

Robert D. Kleinberg, First Place,
Wales Center, New York

Lenhard Ng, Third Place,
Chapel Hill, North Carolina

Jeremy D. Bem, Fourth Place,
Ithaca, New York

Andrew O. Dittmer, Fifth Place,
Vienna, Virginia

Timothy Chklovski, Fifth Place,
Hopkins, Minnesota

Jonathan L. Weinstein, Seventh Place,
Lexington, Massachusetts

Joseph A. Hundley, Eighth Place,
Chicago, Illinois

The festivities began with the Sponsors' Reception at the Dolciani Mathematical Center, where MAA officers, representatives from sponsoring organizations, and the USAMO Subcommittee, greeted the winners and their parents.

The sponsoring societies' representatives presented gifts, praising them for their outstanding achievement.

Daniel Marino, District Sales Manager, from the Hewlett-Packard Company, presented the winners



J. Thomas Ratchford, Consultant to Director of White House Office of Science and Technology Policy.

with HP 49SX calculators. Hewlett-Packard has been a long-standing contributor to the USAMO Awards Ceremonies.

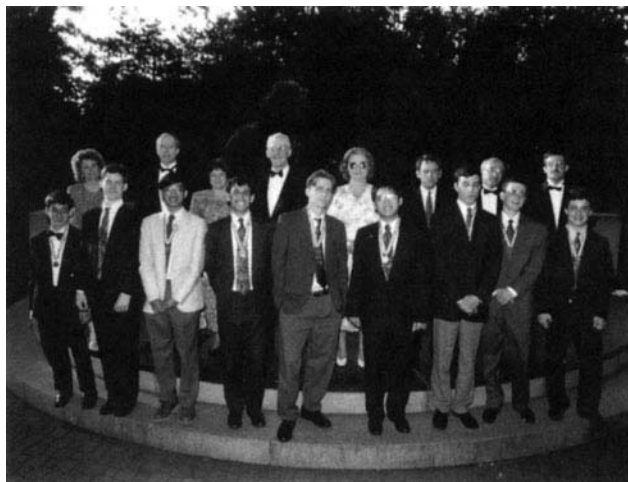
On Monday morning, the winners, their parents, and members of the mathematical sciences community were invited to attend a series of lectures by National Science Foundation mathematicians. Dr. Fred Wan, Director, Division of the Mathematical Sciences, and Dr. Judith Sunley, Executive Officer of the Mathematical and Physical Sciences Directorate, welcomed the winners on behalf of the NSF. Dr. Keith Crank spoke

on Probability and Computers, Dr. Roubon Rastamian address was titled, "How to Build a Poker Table: A Mathematician's Approach," and Dr. William Velez spoke on Number Problems in Elementary Number Theory.

An afternoon tea was the setting for the first USAMO winners' reunion. It was a particularly poignant occasion because 1993 winners and alumni honored Professor Emeritus Nura D. Turner, whose work and dedication to the USAMO ceremonies is unsur-

passed. The MAA presented Professor Turner with an engraved crystal bowl.

Professor Donald Kreider, President of the MAA, presided at the Awards Ceremony. It was held in the Lecture Room of the National Academy of Sciences, where the USAMO medal, honoring Gerhard C. Arenstorff, twice a winner of the USAMO and a member of the first USA team in the International Mathematical Olympiad, was



Back row: Carol Westfall, AMATYC; Ron Graham, AMS; Mary Lindquist, NCTM; Donald Krieder, MAA; Carol McGill, Mu Alpha Theta; Glenn Walker, CAS; Bryan Hearsey, SA; Frank Rhodes, SA.

Front Row: Jonathan Weinstein, Andrew Schultz (1992 winner), Lenny Ng, Robert Kleinberg, Joseph Hundley, Wei-Hwa Huang, Andrew Dittmer, Timothy Chklovski, Jeremy Bem.

presented. Engraved silver trays were given to the winners by IBM representative Dr. James Wynne. The 1993 guest speaker was Dr. Joseph A. Gallian, University of Minne-

Please see Olympiad on page 33

THE WHITE HOUSE
WASHINGTON
June 2, 1993

I am delighted to extend my congratulations to the winners of the 1993 United States Mathematical Olympiad. I commend you for the hard work and dedication that have earned you this special honor. For those who will participate in the International Mathematical Olympiad, I am confident that you will represent our country with pride and distinction.

The study of mathematics is an admirable and worthwhile pursuit, yielding personal as well as academic fulfillment. It cultivates logical thinking skills, which will prove invaluable throughout your lives. In conjunction with fields such as chemistry, physics, and engineering, mathematics is an essential element in technological innovation and discovery. It underlies the scientific advancements that are helping to protect the environment, improve health care, revolutionize information systems, and spur economic growth. Our nation has a rich tradition of innovation, design, and discovery, and we will look to outstanding young people like you to continue this legacy.

Your superlative achievements in mathematics reflect the tradition of excellence upon which this country was founded. I send my best wishes for your future success.

Bill Clinton

Section Awards for 1

Henry Alder

A highlight of most section meetings this spring was their Awards for Distinguished College or University Teaching of Mathematics.

The Committee on Awards for Distinguished College or University Teaching of Mathematics is now in the process of nominating at most three of these distinguished teachers for the national awards. The Board of Governors will act on these nominations at its meeting on August 14, 1993 in Vancouver. The national awardees will be honored and make presentations at the Annual Meeting in January 1994 in Cincinnati. For the names of the recipients of the first national awards, together with their pictures, please see the April 1993 FOCUS, pp. 6-7. Three of them will make their presentations at the Vancouver meeting on August 15 from 2:30 p.m. to 5:30 p.m. (for details, see the April FOCUS, p. 27).

The nomination of national awardees from the above list by the national committee has turned out to be a most delightful experience as well as an almost impossible task; delightful because of the extraordinary high quality of teaching of the section awardees, almost impossible because it is exceedingly difficult to differentiate among these truly outstanding and dedicated teachers. Reviewing the nomination files of the section awardees has convinced the Committee that it can never do justice to the large number of superb and devoted college teachers of mathematics in the MAA and that being a section recipient of this Award should be considered an outstanding achievement. As one member of the national committee wrote after receiving this year's files, "The candidates are all very, very impressive; overall this group is as strong as last year's," and another writes, "it's wonderful to see excellence in all dimensions of mathematics instruction, ranging from remedial and introductory courses to mentorship at the graduate level."

A great deal of the credit for selecting such outstanding candidates belongs to the sections who have so energetically and effectively established procedures for



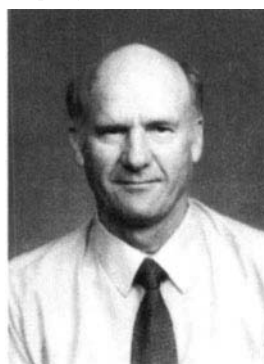
George E. Andrews
*Pennsylvania State University
 Allegheny Mountain Section*



James R. Boone
*Texas A&M University
 Texas Section*



Robert Bringham
*University of Central Florida
 Florida Section*



Kay William Dundas
*Hutchinson Community College
 Kansas Section*



Paul R. Halmos
*Santa Clara University
 Northern California Section*



I. Martin Isaacs
*University of Wisconsin
 Wisconsin Section*



Doug Nance
*Central Michigan University
 Michigan Section*



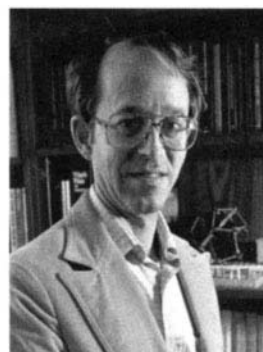
David Pengelly
*New Mexico State University
 Southwestern Section*



Eileen L. Poiani
*St. Peter's College
 New Jersey Section*



Mel Thornton
*University of Nebraska
 Nebraska Section*



Alan Tucker
*SUNY - Stony Brook
 Metropolitan New York Section*



Stephen West
*SUNY - Geneseo
 Seaway Section*

Distinguished Teaching



James N. Cannon
Brigham Young University
Intermountain Section



Allan Cochran
University of Arkansas
Oklahoma-Arkansas Section



Gerald Diaz
United States Air Force Academy
Rocky Mountain Section



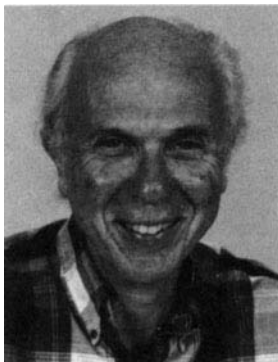
Genevieve Knight
Coppin State University
Maryland-DC-Virginia Section



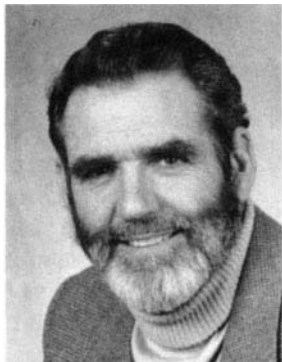
Thomas Moore
Grinnell College
Northeastern Section



Dale Mugler
University of Akron
Ohio Section



J. J. Price
Purdue University
Indiana Section



Jack M. Robertson
Washington State University
Pacific Northwest Section



David Sprows
Villanova University
Eastern Pennsylvania and
Delaware Section

*Photos were not available from
the following Award Winners:*

Robert Bryant
Duke University
Southeastern Section

David Cohen
University of California -
Los Angeles
Southern California Section

Martha Watson
Georgetown College
Kentucky Section

**Congratulations to all the Section Distinguished
Teaching Award Recipients**

identifying and honoring their most deserving college teachers of mathematics.

Establishment of these awards has not only made it possible to identify and honor the most distinguished college teachers of mathematics, but also to emphasize the importance of excellence in teaching college mathematics. The following quotation from the Secretary-Treasurer of the Indiana Section, when transmitting the nomination folder of the awardee of that section, is typical, "On behalf of the Indiana Section, let me once again express the enthusiasm we have felt since the initiation of the Distinguished Teaching Awards."

On September 25, 1993, Section Secretaries will be sent information on the nominations for the third (1994) Section Awards. These guidelines will be essentially the same for the 1993 Awards; in particular, there will be no change in the nomination form. Watch for details in your section newsletter.

Some sections have been concerned that, while the candidates who were nominated were outstanding, the number of nominations has been smaller than they would have liked. They therefore have devised strategies to increase the number of nominations. For example, the Northeastern Section sent out a flyer in March urging any member of the section to "send a one page letter in support of an outstanding teacher and the Section Committee will ask the candidate's department chair to complete the nomination form."

The national committee urges all members of the Association to think of worthy candidates for these awards and nominate them to the appropriate section committee. Even if your candidate should not be selected as a recipient of the award, remember that the nomination by itself is a distinct honor and also that the candidate can be nominated again if not selected the first time. The more outstanding candidates are nominated, the easier it is to maintain the high quality of the awards, so successfully established by the first two sets of awardees.

Henry L. Alder, University of California at Davis, is Chair of the Committee on Awards for Distinguished College or University Teaching of Mathematics



A National Science Foundation Conference on Statistics Education

George W. Cobb
Mount Holyoke College

"In industry, teaching quality control excites people. In high school, teaching statistics gets people interested and excited. In college, it puts people to sleep. Something's wrong." These words were spoken by Richard Scheaffer, of the University of Florida, at an NSF-sponsored conference held in Washington, DC on June 28-29, 1992. The three dozen statisticians and NSF officers who were in attendance are among the many who are currently trying to "fix what's wrong." Most of those present are Principal Investigators or co-PIs for the dozen NSF-funded projects listed in this report. The conference also included a dozen teachers of statistics, each the inventor of an unusual course or distinctive approach. The conference was organized by Joan Garfield, University of Minnesota, and myself, Mount Holyoke College, with assistance from Nell Sedransk and William Haver, who were at the time both Program Officers of the National Science Foundation. Support was provided by the NSF under Grant No. USE-9255396.

The main purpose of the conference might be described by borrowing the Bayesian phrase, "borrowing strength," in this case the strength that comes from exchanging ideas, resources, and experiences. To maximize the chance for genuine exchange, the conference schedule included few formal presentations, but many small-group discussions. These discussions were planned as variations on a sequence of four main themes:

- (1) Seeing new curricular possibilities
- (2) Anticipating resistances to change
- (3) Assessment of student learning
- (4) Total Quality Management (TQM)

Conference Themes

Possibilities and Resistances: Most beginning statistics courses still sit at the same old local minimum in curricular space. The set of topics, and their sequence, is well worn, and most classes, small as well as large, still gravitate leadenly to the default format, "I talk, you listen." There are various ways to push a course away from these inertial patterns. One is to identify underlying assumptions and question them, e.g., "Most

courses are built from a list of topics, with examples chosen to serve as illustrations. In statistical practice, the priority is reversed: we start with a problem, and choose methods we think will help solve it. How closely can a beginning course be modeled on the priorities of actual practice?" Another way to rethink curriculum starts by identifying obstacles to change, then looking for ways to get round the obstacles. For an easy example: to the extent that suitable examples are hard for teachers to find, they will continue to rely on data.

Yet another way to rethink our courses is to think about assessment and TQM.

Assessment: Why is assessment so important? Psychologist Lauren Resnick has given the best short answer I know: "We get what we assess, and if we don't assess it, we won't get it." Or, from an eloquent essay by Grant Wiggins, "One of my definitions of authentic assessment is that 'it is composed of tasks that we value.' It is not a proxy. It is not an efficient system to shake out a grade. Rather, the test should reveal something not only about the student, but about the tasks and virtues at the very heart of the subject — its standards." ("Towards an Assessment Worthy of the Liberal Arts," in Lynn Steen, ed., *Heeding the Call for Change*, MAA 1992.) I suggest that the harder we think about what tasks we truly value, the more likely we are to find that our courses change in response.

TQM: Perhaps not surprisingly, this proved to be the most controversial of the conference themes. I'll limit myself here to two observations by David Moore of Purdue University: (1) "Faculty don't think quality management (especially reduction of unplanned variation) applies to them. Neither did auto plant managers. Both are wrong." (2) "The typical college class can be greatly improved by caring about the outcome and by attention to detail," without a major overhaul of the process. (TQM people say this is true of most processes.) More substantial improvement requires a change in the process."

To seek that improvement, we can all rethink our courses from within the TQM frame

of process orientation, relying for data on frequent feedback and authentic assessment.

Common Features of the Projects

Comparing the various projects represented at the conference suggests a number of trends and challenges in statistics education, although here, as with any search for patterns, we must attend to outlying observations. And here, as with any gathering which includes Robert "Boss" Hogg, we can count on him to supply one of the outliers: Unlike all the other projects, which are concerned with particular curricular materials or courses, the Hogg Workshop was a structured discussion of statistics education in general. (For a report of the conference, see Appendix D of "Teaching Statistics" in *Heeding the Call for Change*)

To me the most striking feature of the other eleven projects is that ten of them involve labs, albeit in some cases only implicitly. The prominence of labs among the projects appears to confirm what many have suggested, that statistics has been moving away from mathematical theory, back towards its roots in science. There is a robust variety in the way the projects use labs: for analysis of real-world data sets from an archive (Ikem, Magel, Notz et al., Tichenor, Trumbo); for simulation-based learning (Gilliland, Meeker); and for hands-on production of data for analysis (Nelson, Scheaffer, Spurrier). Each of these three uses has a characteristic advantage. Analyzing archived data gets students to uncover and "tell the statistical story" of a compelling application of obvious import. Simulations provide first-hand experience with variability, focused on a particular concept or method. Hands-on lab activities allow students to create data which feel truly their own, often the best way to guarantee interest. Unfortunately, each of the three uses has disadvantages also, and therein lies a challenge to statistics education. Archived data sets deprive students of a role in data production, and often the analysis must follow a well-worn path. Simulations are at best recreations of a distant reality, and the hands-on measurements a student can make in one afternoon lab will never compete with the Stanford Heart Transplant data for import. Our challenge is to continue to seek new ways to offer students the advantages of all three approaches.



Meeting the Challenge: Calculus Renewal

A Live Video Workshop

How can calculus instruction be restructured and reformed? Answers to that question will take place in a live video workshop, sponsored by the National Science Foundation, on Wednesday, October 13, 1993.

The workshop will offer practical insights to alternative curricular approaches and strategies for implementing them. Participants in this workshop will hear from faculty members developing innovative instructional materials—and from their students.

To participate in this video workshop, your institution needs access to a C-Band or Ku-Band satellite down link on the day of the program. In addition you must have a room with a video monitor or a projector and a telephone. The telephone will allow you to ask questions of the participants in the video workshop via an 800 number. Also, consider inviting concerned organizations and schools from your area to join you in viewing and participating in the Workshop.

The registration fee is \$50. Upon receipt of your registration form and fee, you will be sent: A facilitator's guide with technical information on down linking; camera ready copy for local advertising; and a "masters" viewers guide (to copy for all participants), which includes an agenda, instructional objectives, presenter biographies, background notes, department-based audit of undergraduate instruction, and publisher's information for ordering any of the curriculum materials.

MAA Member Receives an "Outstanding Texan" Award

State Representative Garnet Coleman selected MAA member Jacqueline B. Giles for an Outstanding Texan Award, in education.

Giles is a mathematics instructor at Central College in the Houston Community College System, advisor to the Central College Mathematics Club, the Central College Chapter of the Society of Hispanic Professional Engineers, advisor and consultant to OPERATION SMART in District 147, co-founder of YOUTH VICTORY and the Association of African American Mathematics Educators, member of Pleasant Grove Missionary Baptist Church, and organist for Ephesus Missionary Baptist Church, member of the American Mathematical Society, the Joint Policy Board for Mathematics Public Information Resource Committee, and a member of an ad hoc committee to develop the "Archival Records of Minority Mathematics in the United States." She holds a three year appointment to the MAA Committee on Faculty Development.

Giles holds master's degrees from Texas Southern University and Texas A&M University—College Station, with further study at the doctoral level in mathematics and engineering.

Speaking at the ceremony, held in Austin on May 8, Giles said, "All that I am able to accomplish is made possible by those who

love and support me as a person and as a professional educator . . . It has taken a collective effort to get to this level of recognition and it will take that same energy to reach national and international goals for African Americans and all Americans in mathematics education and education in general."

She continued, "I was surprised to get this recognition, but I feel it is timely as I expect to plan more impacting involvement at the national and international levels of education. I already have my mind set to go to an international conference in Vancouver, Canada, and to Russia with a delegation of mathematics educators. A special thanks is extended to my family, Deloyd Parker, Pastor C.L. Jackson, Herbert Hamilton, Representative Garnet Coleman, all of our friends in the Texan Legislative Black Caucus, and many more colleagues and friends. I thank God that this occurred on Mother's Day weekend because this Mother's Day is very special for me. Thanks to the Black Media for allowing me a place to express my views and articles for more than 21 years. I believe the Black Media is our voice in education, politics, and community service. Without it we would have the arduous task of challenging the veracity and content of certain articles, with no alternative channels of expression, extensions, and analyses."

Congratulations to Former MAA President Deborah Tepper Haimo for Receiving the Radcliffe Distinguished Alumna Award in June.



Editorial

If you draw four unit circles centered at the points $(1,1)$, $(1,-1)$, $(-1,1)$, $(-1,-1)$, and then add a fifth, smaller circle, centered at the origin, that just touches each of the other four circles, then this fifth circle is clearly contained in the square around the outer four circles.

Do the analogous thing in three dimensions. Place eight unit spheres with their centers at the points each of whose coordinates is 1 or -1. A ninth sphere, centered at the origin, which just touches the first eight, will lie within the cube that contains the eight.

Likewise in four dimensions, and five, and so on. And it seems obvious that the same will be true for any number of dimensions. But, obvious or not, it isn't true. In nine dimensions, the central hypersphere just touches the bounding hypercube, and for dimension greater than nine it pokes out of the hypercube. If you don't believe me, check it out. All it requires is a straightforward computation of Pythagorean distance.

I cannot recall where or when I first met this marvelous little example of the dangers of "reasoning by dimensional analogy", but I came across it again in the booklet *What's Happening in the Mathematical Sciences*, published recently by the American Mathematical Society. This excellent and beautifully produced collection of "news-paper-level" articles on recent developments in mathematics, written by mathematics journalist Barry Cipra, is available in limited quantity only, free of charge apart from a shipping and handling fee of \$7.00, directly from the AMS (in the USA, phone toll free 1-800-321-4267). It is a "must" for all mathematics department reading and coffee lounges, and the FOCUS editor would like to commend the AMS for bringing out this little gem. It is great publicity for our profession.

We are, after all, in need of as much good publicity as we can get. As mathematicians, we do not need to be told how important mathematics is, and how relevant it can be in many walks of life. But how many citizens, and, more critically, how many lawmakers, have any idea what we do for a living? We are supported, of course, in that most of us manage to earn a living as mathematicians. But for the most part, we do so by teaching, and the expectation is, I am sure, that what we teach is basic arithmetic and algebra skills, topped of with a semester or two of calculus.

A few years ago, when I was working in the British university system, the government embarked on a huge program of cuts in higher education, a system-wide downsizing that continues to this day, incidentally. My own university was faced with having to cut its largely tenured faculty by a factor of about a third within a period of two years. My colleagues and I in the Mathematics Department were concerned that many of our friends in other departments would be forced to leave, and that some departments would have to close altogether. But we knew that our jobs were secure. After all, we said to ourselves, we give all those service courses to the scientists, engineers, economists, business students, and so forth. And besides, mathematics is just plain indispensable.

Well, from a logical point of view, that was all perfectly correct. As society's logical experts, we were right on the ball when it came to evaluating our importance both to the university as a whole and to the world at large. Unfortunately, the crucial decisions were made on political grounds, not logic, and many years of failing to bang the mathematical drum had left us with an administration that regarded us as decidedly dispensable. The department of 18 or so that I joined in 1977 was reduced to 10 or 11

when I left for the United States a decade later. And though my old department does still exist, albeit much reduced in size, in the mid 1980s it was not at all clear that it would survive to see the decade out.

Now, for different reasons, the United States higher education system is under severe financial pressure, and unless administrations faced with making tough decisions are aware of the value of a strong mathematics department, the same can happen at American colleges and universities as happened to me and my colleagues back in Britain.

So, glossy publications such as the one I cited above are to be welcomed, as are any other attempts to convey to the outside world that mathematics is a living, breathing, vibrant discipline, connected to many walks of life. As mathematicians, we must do what our friends in the physical and life sciences have been doing for years: we must learn to bang our own drum—even if, as one of the articles in the new AMS booklet explains, it is not possible to discern the shape of that drum from the sound it makes.

The above are the opinions of the FOCUS editor, and do not necessarily represent the official view of the MAA.

Please note

FOCUS editor Keith Devlin has moved from Colby College in Maine, where he was the Carter Professor of Mathematics and Chair of the Department of Mathematics and Computer Science, to Saint Mary's College of California, in Moraga, California, where he is the Dean of the School of Science.

Personal Opinion

Why Archive?

Albert C. Lewis

The premise might seem uncontroversial: if mathematics is to have a history, resources must be available upon which to base it. But, as I hope to illustrate, historical archiving has not been as straightforwardly automatic as, for example, the archiving of computer files is supposed to be.

When civilization is set back by the destruction of a library, such as the Central University Library at Bucharest in 1989, in modern times most of the loss may consist of printed or machine-readable books and journals which effectively have their backups in other libraries and which can therefore eventually be replaced. But unpublished materials at Bucharest, as at other libraries, are rarely duplicated and distributed and thus they can never be replaced. It is these, usually paper documents—correspondence, personal notebooks, drafts, institutional records, photographs—which the historian, at least, needs. Most mathematicians naturally have a strong historical interest at least to the extent that they regard establishing precedence—who discovered what and when was it discovered—as important.

But is there a need to preserve more than publications today? Gazing upon Gauss's autograph is probably not a source of inspiration for doing mathematics. Students' notes of Hilbert's lectures are probably too out of date for mathematical purposes today. And is it anyone's business anyway to pry into personal correspondence or keep tabs on who was attending whose lectures? Some people may doubt that it is, but many mathematicians share with historians a desire to find out why and how mathematical discoveries are made, received, and taught, and, as good scientists who want the best evidence, are going to make use of whatever such sources of information are available.

Personal archives, like those of Gauss and Hilbert at Göttingen, as well as institutional archives, do exist and continue to be added

to libraries around the world. They are deposited so that they may be looked at. Why is this and how do they get there?

We have had experience during the past thirteen years with American archives since the Mathematical Association of America and the American Mathematical Society investigated the establishment of archives, and committees, such as ours, have tried to aid in the preservation of archival materials. Mathematicians have given a wide range of responses to the notion of archives as the following three examples from my own experience at the University of Texas at Austin illustrate.

RH Bing not long after he returned to Austin became President of the AMS and learned something about archives when a proposal was made to have the Society join the MAA in establishing a joint archives. Everett Pitcher, Secretary of the AMS at the time, has given a diplomatic account of the fate of this proposal in the chapter "Archives" in *A History of the Second Fifty Years*, American Mathematical Society 1939-1988, (AMS, 1988). The AMS chose not to establish an archive at that time (they have since designated Brown University as the repository), but the affair did have the effect of informing some mathematicians about archives, their purpose and functioning. Not long afterwards Bing expressed a concern to me. He had been looking over a file containing drafts of a telegram he had proposed on the occasion of the rather controversial forced retirement of his teacher R. L. Moore from the University of Texas at Austin in 1969. The archival discussions had alerted him to the fact that these drafts might be looked at in the future. He felt that they could be misunderstood and he ought to destroy them. I tried to argue that by doing so he was leaving open the possibility of even more inappropriate speculations about his stand or motives at that time. I also suggested that

he could always add a note of explanation to the file. (I later found that this is what Bertrand Russell did in his own files which are now at McMaster University.) But I agreed that he should do whatever he felt most comfortable with. I believe he did destroy the drafts.

Also during this archival discussion. Alex Rosenberg, then a member of the AMS council, expressed doubts about the desirability of saving anything at all in archives. But when we met at an archival exhibition set up for a council meeting at Texas, he told me that he had changed his mind after convincing himself of the soundness of the following argument. He was himself devoted to algebraic number theory which even many mathematicians regard as a particularly recondite field that is not relevant to much else. Nevertheless, he appreciated that mathematicians respected his interest in the field. By the same token, if there were people whose fields involved archives, the fact that he personally did not have such an interest did not entitle him to destroy archival sources. Boxes of material related to his editorship of *The American Mathematical Monthly* arrived shortly afterwards for addition to the MAA archives.

Soon after the Archives for American Mathematics was established at Texas, its advisory committee was informed that Emil Grosswald was wondering if anyone would be interested in his papers. I did not know Grosswald but I am told that he was a meticulously organized person who did not like loose ends. He sent some material immediately and arranged for the remainder to be bequeathed to the archives in his will. (This did come after his death in 1988.)

I suspect that none of these mathematicians gave much weight, if any, to what motives might be attributed to them in depositing their papers. On the other hand, archives as reminders of our mortality are perhaps, not surprisingly, a subject which some people would prefer to avoid altogether ("Let my family take care of it.") or, on the other, a subject in which some will involve themselves with a view to affecting history. Is handing over one's papers to an archive an egocentric gesture? Is it a creation of an unseemly monument to oneself or a hubristic assumption that one's papers will be of interest to historians? Psychological motives

Please see **Archive** on page 12



Archive from page 11

are, I think, quite irrelevant if a larger view is taken.

For a start, what are "one's own" papers? Considering correspondence with others, shared work, mutual benefits of the teacher-student relationship, and other influences, each mathematician, and especially officers, editors, committee members, referees, and others who participate in the functions of a mathematical society or journal, or in a mathematical department of a school or university or business, is part of a larger network. Perhaps it is more egocentric to unilaterally withdraw the background record of one's part in this enterprise than to assiduously try to preserve it. The important thing seems to me to consider the possibility that archives are more than monuments to the memories of individuals or even individual institutions, and that they help form the living memory of the mathematical experience.

Whether a mathematician saves all or nothing, and, if something in between, then just what, are matters which are probably going to continue to be worked out case by case. Some idea of the sort of things that have been considered worth saving is given by Frederic Burchsted in "Sources for the History of Mathematics in the Archives of American Mathematics," *A Century of Mathematics in America, Part III*, 667-674 (AMS 1988). These can include audio and visual recordings and memorabilia (such as R. L. Moore's typewriter with mathematical symbols) as well as the more common documents mentioned above. There is in general not yet a danger of flooding archives with an excessive amount of material. At this point it seems more important to make

an effort to counterbalance the inevitable losses which have occurred and will occur. Albert W. Tucker has a despairing tale of how a box of important files belonging to one of Princeton's well-known mathematicians was inadvertently left in the corridor outside his office. The next day, when it couldn't be found, it was discovered that the box had been picked up by the night caretaking staff and thrown out. More massive disappearances have been known to occur when a department as a whole has moved to a new building.

It is easier to throw things out than to contact your local archivist (or one of the national archives listed below) just as it is easier not to make backups of computer files. If you or someone you know wishes to consider what to archive, our committee stands ready to help with information, advice, and support.

Albert C. Lewis (Box 57118, Hamilton, Ontario L8P 4W9).

Other members of the AMS-MAA Committee on Archives: Andrew M. Gleason (Harvard University); Karen H. Parshall (University of Virginia); Franklin P. Peterson (MIT); Everett Pitcher (Lehigh University); Sanford L. Segal, Chair (University of Rochester).

Archives of American Mathematics: Frederic F. Burchsted, Archivist, University Archives, SRH 2.109, The University of Texas at Austin Austin, Texas 78713-7330; 512-495-4129.

Archives of Mathematics and Mathematicians: Mark N. Brown, Curator of Manuscripts, The John Hay Library, Brown University, Providence, Rhode Island 02912; 401-863-1512.

Transportation and the Mathematical Sciences

The Board on Mathematical Sciences and the Transportation Research Board of the National Research Council jointly sponsored a symposium in early May on the changing interactions between transportation and the mathematical sciences. Speakers included representatives of the Federal Aviation Administration and the Federal Highway Administration.

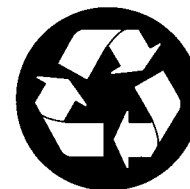
The rapid expansion of the transportation system has slowed, and focus has shifted to optimizing the system's uses. Thus the mathematical sciences have an evolving and more prominent role. Mathematical simulation of traffic flow, for instance, has increasing relevance: while synchronizing traffic lights for normal traffic flow is now routine, designing systems for rush hour is an unsolved problem. Operations research, statistics, mathematical modeling, and the design and analysis of algorithms are areas of increasing usefulness.

To cite another example, the FAA is building a new, more complex air traffic control system, the software for which will contain over a million lines of code.

Contributed Paper Sessions

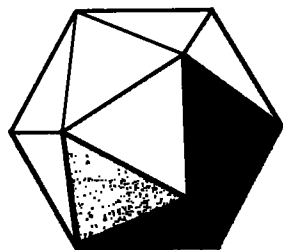
The MAA Committee on Sessions of Contributed Papers selects topics and organizers for contributed paper sessions at national meetings. The Committee would be delighted to hear from MAA members who would like to organize such a session or who have suggestions for topics.

Planning is now underway for the August 1994 summer meetings in Minnesota and the January 1995 winter meeting in San Francisco. The deadline for receipt for proposals for either meeting January 15, 1994. Information should be sent to the chair of the committee: Elizabeth Teles, 11501 Chattily Lane, Mitchellville, Maryland 20721 w(202) 357-7051, h(301) 262-9586, e-mail: eteles@nsf.gov.



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**The
1992
MAA
Annual
Report**



President's Message

Donald L. Kreider

My term as President began at the close of the annual meeting in San Antonio last January, at a session honoring the first recipients of the MAA Awards for Distinguished College or University Teaching of Mathematics. President Haimo, now Past President, handed me a gavel signifying the beginning of my term. I am still hopeful that she will instruct me in its use. Her presidency was an active one, marked by many accomplishments. The MAA Strategic Plan, adoption of the new Council structure, heightened collaboration with our sister mathematical organizations on issues of concern to us all, and the implementation of the Awards for Distinguished Teaching, are some of her legacies. They paint a picture of a strong Association, true to its roots, yet willing to move forward.

In the past several years the MAA, the Mathematical Sciences Education Board (MSEB), and other organizations have published a number of documents that articulate goals and strategies for undergraduate mathematics education. The most recent of these are the MAA Guidelines for Programs and Departments in Undergraduate Mathematical Sciences. Given final approval by the Board of Governors in February, and published in the June issue of FOCUS, the Guidelines will contribute to current efforts at revitalizing undergraduate mathematics.

What actions should follow their publication? Certainly, many departments of mathematics have picked up the challenge, responding to the call for action in creative and exciting ways. The programs of sectional meetings and the national meetings make that clear. But how systemic is the movement, and to what extent is it addressing the main goal of improving undergraduate instruction in mathematics? This question is being pressed upon us ever more strongly by the foundations that support the MAA's projects.

This spring I proposed an initiative to report progress in undergraduate mathematics education. The idea is to gather, organize, and disseminate information about the creative and exciting approaches being taken by mathematics departments in response to the challenge of revitalizing undergraduate mathematics. A centerpiece of the initiative

would be the launching of an electronic database that will facilitate the dissemination of information about successful instructional programs. This would be one of a number of new electronic services that the MAA is preparing to introduce to its members. And it would be accompanied by an effort to coordinate a set of articles in MAA publications and activities at MAA national and Section meetings that will contribute to the database. The ultimate purpose is to enhance communication among departments who are actively trying new things, to make it easier to learn what others are doing, to celebrate successes, and to learn from failures. In May the Executive and Finance Committees approved moving forward with such an initiative, building on MAA efforts already underway, such as the provision of electronic services. The Coordinating Council on Education, CUPM, the Committee on Electronic Services, as well as many other committees and editors of the journals, need to be engaged.

During the spring I had the opportunity to visit meetings of a number of our MAA Sections. This is both enjoyable and a reminder of the vitality of our Association that resides at grassroots levels. Contributed paper sessions, special programs for undergraduate students, invited speakers, panels on current topics or concerns—all these, and much more, are part of rich programs and are embedded in lots of fun and collegial interaction. I might also add that this President, living as he does in Vermont, finds it especially pleasant to visit the southland in late winter and early spring. The Section meetings are important to the Association. They provide an important link between our members, local mathematical activities, and work of the Association at the national level. Indeed many more members attend their Section meetings each year than attend the national meetings.

San Antonio provided a gracious and attractive site for the annual meeting in January. It was well attended, and well enjoyed. The mathematical programs of both MAA and AMS were rich and varied. The many receptions and social engagements added to the fun. And the presence of many undergraduate and graduate students added spice



to the meeting and promised a lively future for our organizations.

A highlight of the San Antonio meeting was the celebration of the *American Mathematical Monthly's* 100th birthday. Part of the program for the meeting was dedicated to this celebration, including inspiring talks by former *Monthly* editors. The *Monthly* banquet itself was one of those rare occasions when nostalgia, reflection, and pride combine in a most natural way to remind us why we love this Association. We all left the celebration, and the meetings as a whole, with a deep feeling of pride in those who nurtured the *Monthly* over all these years, those who gave rise to the MAA itself, and everyone who is carrying on the traditions and activities today.

The San Antonio meeting will also be remembered for marking the first time in our history that the Board of Governors of the MAA and the Council of the AMS met in joint session to resolve an issue of concern to both organizations. The immediate question was the moving of the 1995 joint meeting from Denver to another site, as reported in the April issue of FOCUS. The prevailing effect will be the remembrance of the high level of debate and the strong feeling of collegiality that characterized the joint session. There will be future issues that similarly test the bonds of cooperation between us, and the precedent set in San Antonio shows that we can face such challenges. My congratulations go out to presidents Debbie Haimo and Mike Artin for holding us together and to Henry Alder who demonstrated his consummate skill in parliamentary matters.

Collaboration with other mathematical organizations is essential to reaching MAA's goals. Supporting and revitalizing undergraduate instruction, identifying and encouraging students who can be future mathematicians, encouraging underrepresented groups to continue their study of mathematics and to consider careers in mathematics and science, and improving the education of tomorrow's teachers—all these require a view of mathematics education that transcends the traditional boundaries of school, college, and graduate school. Thus the MAA works closely with the American Mathematical Society and the Society for Industrial and Applied Mathematics under the umbrella of the Joint Policy Board for Mathematics. Here we join hands in matters of government relations, science and education policy, and public awareness of mathematics. We work closely with the National Council of Teachers of Mathematics and the American Mathematical Association for Two Year Colleges under the umbrella of CBAMN (Cooperative Board for AMATYC, MAA, and NCTM). Here we work together on educational matters that cross the lines of schools, two-year and community colleges, and four-year colleges and universities. And finally, we collaborate with the much larger number of mathematical organizations within the Conference Board on the Mathematical Sciences. The mathematical community has gained the reputation nationally of "having its act together". Our solidarity is important in gaining wider support for mathematics.

The MAA is a largely volunteer organization. It carries out its work through individual members, the sections, and its committees and councils. It has some 150 different committees working on as many different programs, and its vitality depends on the diversity of members within this structure. The Committee on Committees makes a very strong effort to bring new people and new ideas into its nominating process each year as it prepares its final recommendations for the President. It delegates to the Council chairs the responsibility for identifying suitable candidates to fill committee vacancies, and the chairs are charged to consult widely. FOCUS has periodically invited members to volunteer for committees that would be of particular interest to them. This has resulted in a very large response, much larger than the number of positions available. All such

expressions of interest are retained by the Committee on Committees, however, so many who are not called immediately can expect to be called upon in the future.

I would like to close this first report with an observation about the MAA that is of utmost significance to me. Throughout its history the MAA has operated with civility and collegiality matched by few other organizations. It has aspired to be an organization open to all who are bound only by an interest in mathematics and mathematics education. This is not to say that its record is unblemished, however, for there have been incidents of discrimination against African American colleagues in the past, and there were periods during which segregation and repression in our society at large affected the ability of African Americans to participate fully within the MAA or to feel fully welcome at its meetings. One would like to say that those days are past. Indeed they are, as measured by the resolve of MAA officers, the Board of Governors, and today's MAA members, that we are and will remain an open and welcoming organization to all. And we will take active steps to carry this policy forward. But past errors cannot be expunged, and only time can slowly heal the deep hurt that many of our minority colleagues feel even today. I report on this matter now because such feelings surfaced strongly within the Southeast Section and in San Antonio at meetings of the MAA Committee on Minority Participation and the National Association of Mathematicians. It is good that they did. It is important that we pay attention. It is essential that we all resolve to redouble our efforts to convince every one of our members that they are valued members of our community and that their full participation is needed if we are to accomplish our goals. I ask all members to join me in this resolve. Were we not an open and welcoming organization I am sure that those voices would not have been raised at the San Antonio meeting. In that I take heart.

The MAA is in the center of efforts to address the critical problems in American mathematics education. It has taken a leadership role, and through its members and Sections it is actively engaged at all levels. The work remaining is daunting. But we continue.

Inside the 1992 Annual Report

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From the Executive Director's Desk

A Nation at Risk

Marcia P. Sward

Ten years ago we were shocked into awareness of the weaknesses of our educational system by the report, "A Nation at Risk," which stated:

"We report to the American people that while we can take justifiable pride in what our schools and colleges have historically accomplished and contributed to the United States and the well-being of its people, the educational foundations of our society are presently being eroded by a rising tide of mediocrity that threatens our very future as a nation and a people."

The MAA and Educational Reform "A Nation at Risk" launched a massive educational reform effort in which the MAA has played an important role, together with its sibling mathematical societies. In the process of shaping this role and looking for the resources to carry it out, MAA leaders began to look with new eyes at the MAA itself — its strengths, weaknesses, existing resources, and potential — and to build toward a stronger organization capable of serving its members well and of providing strong leadership in the educational reform movement.

Much of what they saw was good — outstanding journals and books, attractive national meeting programs, strong Sectional organizations. But not all. There were, for example, a large number of committees (over 100), some of which were long overdue for discharge, some of which had overlapping or even contradictory charges, and few of which had adequately representative memberships.

And there were other problems: the MAA's historic national headquarters buildings were badly in need of renovation; the MAA's computer system was inefficient and out-moded; the MAA had only marginal access to electronic communications; and, while the financial base of the MAA was adequate for

regular member services, it was insufficient to launch and maintain desirable new projects and programs.

MAA Committees During her term as MAA President, Lida K. Barrett undertook to open committee membership to a wider pool of members, thus ensuring broader representation of members' interests in committee deliberations. Deborah Tepper Haimo, after assuming the presidency in January 1991, sought to reduce duplication of effort and increase the effectiveness of committees. With Board of Governors approval, she organized MAA committees in Council groups according to their basic responsibilities, and appointed oversight committees to coordinate and facilitate their work.

Strategic Planning In an effort to develop a clear vision to guide further change within the MAA, President Haimo initiated a strategic planning process in 1991. A draft plan was presented by the Strategic Planning Committee to the MAA Board of Governors in December 1992. The Board reaffirmed the MAA's historic mission, approving a new mission statement and program and operational goals, and asked MAA committees to review the relevant portions of the plan and advise the Board on the programs and projects proposed. (See FOCUS, October 1992, page 3). The strategic planning effort will not come to full closure until January 1994 when, hopefully, the Board of Governors will formally adopt an MAA Strategic Plan.

Progress During 1992 Much progress was made in 1992 in several areas addressed in the draft Strategic Plan:

Electronic Communications

In June 1992 the MAA's 32-member Washington Office staff was linked via a Novelle network, and staff members gained direct access to the Internet. Email quickly became



the favored mode for MAA leaders and staff to communicate. With guidance from the MAA Committee on Electronic Communications, the MAA staff began the process of planning for MAA Electronic Services, to be launched in fall 1993.

Cooperation with Other Mathematical Organizations

Recognition of the magnitude and complexity of educational reform has spurred more interorganizational cooperation than ever before. The long-term collaboration of MAA with the AMS and SIAM on public information and governmental affairs was supplemented in 1992 by a new collaboration among the MAA, NCTM, and AMATYC. Representatives of these organizations met for the first time at the International Congress of Mathematics Education in Quebec last August to begin to shape a common agenda.

A joint ad hoc Committee on AMS/MAA Cooperation, chaired by Donald L. Kreider, reviewed the various joint ventures of the AMS and MAA, and identified various additional areas where collaboration might be useful.

The Mathematical Sciences Education Board (MSEB) hosted a five-organization joint planning session in October 1992. Presidents and Executive Directors of the MAA, AMS, SIAM, NCTM, and AMATYC re-

viewed the strategic plans of the organizations, looking for common interests and concerns.

The Conference Board of the Mathematical Sciences (CBMS) undertook a joint Career Information Program, initiated by the MAA.

Student Activity

As President Donald Kreider recently noted in an interview in FOCUS (June 1993), "mathematicians have rediscovered students." It has been gratifying to see the MAA continually build its student membership and student participation. The year 1992 saw continued increases in participation of students in sectional and national meetings, and growth in MAA Student Chapters. Fund raising for a new undergraduate magazine, Math Horizons, was also successful. This new MAA publication will be launched in fall 1993, and will be disseminated in bulk to all U.S. colleges and universities.

Mathematical Center Fund

The resources needed to pay for badly needed renovation of the Washington Headquarters were obtained from generous members and friends of the MAA. A three-year \$600,000 campaign was successfully completed, with contributions now topping \$630,000. At a gala reception at the San Antonio meeting, donors were honored and thanked. Seventeen rooms in the MAA's National Headquarters have been named in honor of friends, family, mathematicians of renown, and mathematics textbook authors.

Conclusion

These are just a few highlights of MAA activity in 1992, but may serve as an indication of progress made during the year on a variety of fronts. Much has transpired during the first six months of the current year, and it is now clear that 1993 will be another banner year for the MAA. As Executive Director, I am extremely pleased to be able to report that the MAA is in sound fiscal condition, is planning carefully for the future, and is tackling the issues of the day with vigor and enthusiasm.

Committee on Visiting Lecturers

The Association's Visiting Lecturers Program serves departments of mathematics across the country. Its objectives include stimulating and expanding the mathematics programs in two-year colleges and in those four-year colleges not offering a PhD in mathematics; affording staff and students at such colleges with opportunities to meet and converse with creative mathematical scientists; communicating new and relevant applications of mathematics and computer science to not only the physical sciences and engineering, but also the biological and social sciences; and strengthening the rapport among mathematicians working for government, industry, and educational institutions.

The program's 1992—1993 Information Booklet includes the names of participating lecturers. These lecturers agree to remain in the program for four years, after which they must take at least a two-year hiatus before the Committee invites them to participate again. MAA Visiting Lecturers not only deliver formal presentations but also meet with students and faculty informally. They will happily discuss opportunities for graduate study and employment with students, and they will cooperate with departments to further the aims of their mathematics programs.

The Committee encourages departments to establish departmental colloquiums with an appointed chair. Such colloquiums will foster faculty dialogues and presentations

and increase participation in the Visiting Lecturers Program. Consequently, the Committee addressed its Information Booklets to "Colloquium Chairperson" at each department of mathematics in the United States and Canada with the hope that, if no such person exists, the department would appoint one!

Interested departments should arrange for a visit directly with the desired lecturer; at that time, they should agree upon expenses. Some lecturers' home institutions have indicated a willingness to subsidize some visiting lecturers' expenses (asterisks distinguish these listings in the booklet). Some institutions maintain faculty development funds. To assist you, the 1992–1993 Information Booklet discusses guidelines for financial considerations.

Members of the Committee on Visiting Lecturers urge departments to take advantage of the opportunities this program provides. Furthermore, the Committee welcomes suggestions and comments to improve the program; you may contact any Committee member at the appropriate address provided inside the Information Booklet. The Committee also solicits names of potential lecturers, particularly from states and provinces currently without representation. If you have heard an outstanding speaker whom you think might further the programs objectives as stated above, or, if you wish to receive additional information on the program, contact: James G. Ware, Chair, MAA Committee on Visiting Lecturers, Department of Mathematics, University of Tennessee, Chattanooga, TN 37403-2598; (615) 755-4545.

CRAFTY

CRAFTY met at both the January 1992 meetings in Baltimore and the January 1993 meetings in San Antonio. In Baltimore CRAFTY organized a contributed paper session on innovative first-two-year course sequences. CRAFTY also cosponsored two panel sessions: one on site-testing of calculus reform projects and another on the College Board's Advanced Placement Calculus Program.

In San Antonio the committee cosponsored a poster session on calculus reform projects

and a panel on calculus reform and the AP Calculus Program.

A series of NSF-supported summer workshops, directed by Don Small (a member of CRAFTY) through discussions at committee meetings and another NSF grant for a program of visiting, single department workshops, is also being developed in the committee with Martin Flashman as director.

At the end of the San Antonio meeting, Wayne Roberts replaced Thomas Tucker as chair of CRAFTY.



1992 MAA Financial Report

Gerald J. Porter, Treasurer

This is my first year as Treasurer. I succeed Don Kreider who served as Treasurer from 1986 to 1992. During Don's tenure the MAA made remarkable strides toward putting both its financial and physical houses in order. The Association has moved from years of unbalanced budgets to balanced budgets, has repaired and renovated our buildings, and is currently completing installation of a new computer system. The Executive team of Marcia Sward, Rhoda Goldstein and Donald Albers provide sound administrative management for the Association at the same time as they initiate innovative new programs. Particular praise is due to Don Albers for the growth of the publications program. Revenues have increased more than 50% over the past two years, and an all time high of 18 new titles were published in 1992. In addition, the MAA has taken over responsibility for publishing UME Trends and plans are well underway for the publication of Math Horizons, our new student publication.

The strategic plan for the MAA is nearing completion and will provide a map for the future of the Association. As we implement this plan we are always constrained by limited resources — more than half of our unrestricted income comes from members' dues. Grants are an important means of starting programs, but the challenge that we face is in institutionalizing these programs when the grants are finished.

The outcomes in 1992

There are several measures of the Association's fiscal health. These include our general operating budget, grant activity, our real estate holding, and our investment fund. We discuss each of these separately.

General Fund: The General Fund is the MAA's unrestricted operating Fund. Income to the General Fund comes from the member's dues, publication sales, interest on working capital and contributions. Expenses include publications, management, supplies, non-externally funded program support, allocated building expense and support of sections. It is the goal of the Finance Committee that the General Fund will

be in balance. During 1992, the General Fund showed a surplus of \$100,700 compared to a surplus of \$52,200 in 1991 on a total budget of \$3.7 million.

Restricted Funds: The restricted fund includes externally funded projects and the American Mathematical Competitions (AMC). Grant revenues during 1992 totaled \$1,176,000. This includes new grants to support, among others, SUMMA, Math



1992 Revenues and Expenditures with 1991 for Comparison

Revenues

	1991	1992
Dues	\$1,964,000	\$2,115,000
Subscriptions	445,000	507,000
Book Sales and Advertising	661,000	835,000
Interest, Dividends, and Capital Gains	268,000	155,000
Contributions	233,000	224,000
Grants and Indirect Cost Reimbursement	945,000	1,176,000
Contest Fees and Sales	725,000	774,000
Space Rental	101,000	78,000
Miscellaneous	172,000	183,000

TOTAL REVENUES **\$5,514,000** **\$6,047,000**

Expenditures

Journals and FOCUS	\$1,422,000	\$1,525,000
Membership	475,000	424,000
Books	723,000	1,049,000
Sections, Meetings and Joint Programs	232,000	214,000
Development	59,000	58,000
Grant Supported Programs	1,095,000	1,312,000
Mathematical Competitions	610,000	724,000
Building Operations	146,000	141,000
Miscellaneous Programs	225,000	216,000

TOTAL EXPENDITURES **\$4,987,000** **\$5,663,000**

Horizons, and the IMTP Project, as well as the continuation of other projects. The AMC is responsible for operating the high school and junior high school mathematics contests as well as the Math Olympiad. During 1992 restricted income totaled \$2,058,917 while expenses totaled \$2,034,768.

Building Fund: Several years ago, the Finance Committee made the decision to separate the Building Fund from the General Fund, so that the expenses associated with renovation of our building would be isolated from the day-to-day operating budget of the Association. Space costs are allocated to the general fund as a fixed yearly charge. This allocation with rental income from our other tenants and contributions constitute income to the Building Fund. Expenses include operating expenses, debt service, capital improvements and principal payments on our mortgages. Because of the recent renovations on our building, there is a cumulative deficit in the Building Fund. As our mortgages are reduced and interest costs decline, that income will be used to reduce and eventually eliminate this deficit. During 1992, our mortgage indebtedness declined from \$448,714 to \$393,903 while our accumulated deficit in the cash building fund increased from \$150,402 to \$179,914.

Investment Fund: The MAA Investment Fund includes both restricted and unrestricted endowment funds. The earnings and capital gains from our investments are retained with the exception of funds that are intended to support special activities such as the Sliffe Awards to high school teachers. During 1992, the investment fund increased from \$1,409,248 to \$1,461,980 after taking account of a transfer of \$42,000 to support designated programs.

Summary: I am pleased to report that the MAA has the financial strength and capable management required to support the leadership position that we have assumed in collegiate mathematics. Balance sheets can, however, only begin to measure the strength of the Association. The most important asset that the MAA has is our members. Their involvement in the many MAA activities at both the section and national levels provides the energy for the organization and the foundation for its activities.

Consolidated MAA Balance Sheet

Assets

	December 31, 1991	December 31, 1992
<i>Current Assets</i>		
Cash	\$126,541	\$132,495
Liquid Assets	1,449,788	1,233,202
Accounts Receivable	512,577	818,545
Publications Inventory	243,828	273,938
Prepaid Expense	241,571	254,320
TOTAL CURRENT ASSETS	\$2,574,305	\$2,712,500
<i>Non-current Assets</i>		
Investments (at cost)	\$1,009,595	\$921,305
Furniture and Equipment	655,431	862,890
Building (at cost)	816,456	816,456
Building Improvements (at cost)	897,310	930,369
Accumulated Depreciation	(693,509)	(809,354)
Deferred Development Costs	134,364	199,434
TOTAL NON-CURRENT ASSETS	\$2,819,647	\$2,921,100
TOTAL ASSETS	\$5,393,952	\$5,633,600

Liabilities and Fund Balances

<i>Current Liabilities</i>		
Accounts Payable	\$259,028	\$208,967
Accrued Royalties	32,247	41,482
Other Accrued Liabilities	235,975	162,877
Prepaid Dues and Subscriptions	1,963,391	1,959,807
TOTAL CURRENT LIABILITIES	\$2,490,641	\$2,373,133
<i>Long Term Liabilities</i>		
Mortgage Payable	\$448,714	\$393,902
Unexpended Grant Receipts	336,421	364,937
TOTAL LIABILITIES	\$785,135	\$758,839
<i>Fund Balances</i>		
Unrestricted Fund Balances	\$784,833	\$943,889
Restricted Fund Balances	842,947	977,701
Endowment	490,396	580,038
TOTAL FUND BALANCES	\$2,118,176	\$2,501,628
TOTAL LIABILITIES AND FUND BALANCES	\$5,393,952	\$5,633,600

SUMMA 1992—a Year in Review

William Hawkins

The Strengthening Underrepresented Minority Mathematics Achievement (SUMMA) Program of the MAA is a national effort focused on increasing minority participation in mathematics at every level, from elementary through graduate school and beyond. The goals of SUMMA are to increase the representation of minorities in the fields of mathematics, science and engineering and to improve the mathematics education of minorities. Oversight of the SUMMA Program is provided by Marcia Sward, the MAA Executive Director, and the MAA Committee on Minority Participation in Mathematics, co-chaired by Manuel Berriozábal of the University of Texas at San Antonio and Sylvia Bozeman of Spelman College.

SUMMA collaborates directly with a variety of mathematics-related organizations such as the American Indian Science and Engineering Society (AISES), the American Mathematical Association of Two-Year Colleges, the Alliance to Involve Minorities in Mathematics of the Mathematical Sciences Education Board, the Benjamin Banneker Association, the National Association of Mathematicians, and the Society for the Advancement of Chicanos and Native Americans in Science. Members of the SUMMA staff have attended and/or participated in the ICME-7 Conference, the annual meeting of the Hispanic Association of Colleges and Universities, the annual meeting of AISES and the ongoing Brownbag Discussions of the Quality Education for Minorities Network as part of outreach activities to various groups. Several NSF or U.S. Department of Education conferences have been attended also.

Minority Participation in the MAA

In the North Central Section, efforts are being planned to increase minority participation by involving tribal colleges in their meetings and activities, building on the model of the Pacific Northwest Section. The SUMMA staff receives requests daily from inside and outside the mathematics community for information about minority participation in mathematics.

A second minority member of the Association, Dr. David Sanchez of Los Alamos National Laboratory, was elected to the MAA Board of Governors in January 1993 as a Governor At-Large. A third minority member, Bettye Forte of Ft. Worth, was elected to represent high school teachers. These momentous events occurred at a time of increasing minority attendance at the Joint Meetings as evidenced by the number of minority presenters. The list of minority presentations at Baltimore filled four pages. More than 70 committee and/or council positions are held by minority members of the MAA; the MAA leadership continues to work with SUMMA staff and CMPM to involve more minorities in committee activities. CMPM is working with a variety of committees to address overall issues of minority participation in the MAA. The campaign for naming a room in the MAA headquarters building in honor of Benjamin Banneker is well underway. A campaign for a room in honor of a prominent Hispanic mathematician is being organized.

Core Support

A request for core support has been submitted to the National Security Agency. Their previous grant of \$12,500 ended in April 1992.

Mathematics-Based Projects for Minority Students

The purpose of this SUMMA activity is to encourage college and university mathematics faculty to initiate or replicate intervention projects for minority middle and high school students. The Carnegie Corporation of New York has awarded the MAA a second two-year grant for this project in the amount of \$350,000. (See the article in the April 1993 FOCUS for more details.) This renews a two-year grant awarded in May 1991. In 1993, 12 faculty were awarded \$50,000 in small planning grants up to \$5,000.

SUMMA has encouraged 29 projects in the last two years and has 18 more being planned. The goal is to have every mathematics department sponsor a project each summer for underrepresented minorities. By early 1993,

the original Carnegie funds had leveraged an additional \$2.7 million from both public and private sources. Another \$50,000 in Small Grants will be awarded in early 1994. (Please watch for the announcement in FOCUS later this year.)

SUMMA Consortium (SUMMAC) of Intervention Projects

SUMMA is now in the second year of a NSF grant of \$703,000 for three years to network existing mathematics-based intervention projects and those it has been assisting. This SUMMA Consortium (SUMMAC) held its inaugural conference in Washington, D.C. in November 1992 for mathematicians directing intervention projects. Seventy-five directors attended this exciting event where they discussed mutual concerns and received copies of the Project Director's Handbook and the Directory of Intervention Projects which lists 67 mathematics-based intervention projects around the country. A second national meeting of the SUMMAC members is planned for November 1993 for 100-125 participants.

SUMMAC funding currently supports workshops at mathematics meetings. Section workshops are continuing. If your Section has not had a SUMMA Workshop, please contact the SUMMA office. Presentations about successful projects will take place in Vancouver, British Columbia in August 1993 and in Cincinnati in January 1994. A quarterly newsletter, the SUMMAC Forum, is now being published.

Attracting Minorities into Teaching Mathematics (AMIT)

The National Science Foundation provided funding for one year through 1993 for the AMIT project. The purpose of the project was to study the characteristics of undergraduate programs successful in attracting minority students into teaching mathematics at the secondary level. Special emphasis was placed on two-year colleges and articulation concerns because of the large number of minorities attending these institutions.

The study results will be published by the MAA in the late summer or early fall of 1993. The publication will include invited papers from faculty at minority and majority institutions, a commissioned survey of

16 states and 57 colleges of education, and recommendations from a blue ribbon panel for suggested actions by government, the mathematics/education community, the business community and the public.

Mainstreaming Projects for College Students

This proposed project will assist mathematics departments at majority institutions in reexamining their programs, setting goals for minority participation, and establishing mechanisms to reach these goals. The focus will be on two-year colleges. The project presently provides technical support to the Charles A. Dana Center for Mathematics and Science Education, University of Texas at Austin, for a research summer school for minority students funded by NSF. The SUMMA Program assists with the recruitment of minority faculty and students and facilitates meetings between Dana staff and faculty at minority institutions.

SUMMA also facilitates the participation of minority mathematicians in the MAA Visiting Lecturers and Consultants Programs. This will enable minority and majority mathematics students to see minority mathematicians in a positive setting. Plans for this component of SUMMA include the establishment of a database of minority mathematics students at various levels.

Organization for Mathematics Departments at Minority Institutions

The SUMMA Program proposes to develop a new national collaborative focused on the needs, concerns, and strengths of mathematics departments at 52 selected minority colleges and universities because these departments have the record for nurturing minority mathematical talent. Planning will be undertaken by SUMMA in cooperation with key individuals from minority institutions and with representatives of minority professional organizations in mathematics-based fields.

Mentoring Minorities in Mathematics Project

The Mentoring Minorities in Mathematics Project (MMMP), part of a larger national project, is seeking funding for a pilot in Washington, D.C. and in Baltimore. The proposed project is centered on mentoring 100 minority students in schools in the two cities on a one-to-one basis. Mentors will be local minority professionals such as doctors, dentists, architects, engineers, mathematicians and scientists whose background includes strong mathematics preparation. The purpose of MMMP is to encourage the students to pursue appropriate mathematics and science courses throughout their pre-college education.

Archival Record of Minority PhDs in Mathematics or Mathematics Education

Now that there is interest in minorities who hold such doctorates, it has proven to be a daunting task to identify them. To date, more than 300 names of minority PhDs in mathematics or mathematics education have been found for the Archival Record. The SUMMA Program is collecting pictures as well. It is hoped that details will be found about the educational accomplishments of all minorities who were U.S. citizens at the time they received doctorates in the mathematical sciences or mathematics education.

Conclusion

SUMMA continues to have a major impact on the members and structures of the MAA and discussions are beginning about the institutionalization of SUMMA. The work of increasing minority participation in mathematics cannot be limited to the activities of SUMMA. As our foreign competitors grow more powerful and as we become more diverse, we Americans must use our diversity as a strength. High wage jobs will be accessible only to those well versed in mathematics, "the language of the 21st century." The entire mathematical community is needed to ensure that minorities and all other citizens speak this language.

William Hawkins is the Director of the MAA Office of Minority Participation

Committee on Sections renew their commitment

The Association has charged the Committee on Sections with providing assistance to the sections, encouraging communication amongst them, acting as liaison between the sections and the Association's national headquarters, representing the sections to various constituencies and acting as a forum for the discussion of concerns of the various sections. The Chair of the Committee serves on the Executive Committee of the Association to insure an avenue of communication among all levels.

The Committee on Sections continues to review its service to the 29 sections of the Association meeting in both the annual (winter) and summer meetings of the Association. The Committee also hosts the Section Officers meeting at these two conferences, with one officer from each section receiving a travel subsidy from the Association for only the summer meeting. However, many officers attend both meetings and a lively discussion is almost always guaranteed on topics of concern to the sections.

Section officers will next meet on Sunday August 15, in Vancouver, immediately before the Joint Meetings of the Association and the American Mathematical Society with the Canadian Mathematical Society.

The Committee encourages officers to forward agenda items to the chair before the meeting. Past meetings have been devoted to Department Guidelines, Mathematical Reform, Pólya Lecturers, Guidelines for Fund to Aid Sections, the new Math Horizons, and subconventions for sections. We look forward to assisting the sections with their endeavors. Section officers and members — how may we help you?

MAA Board of Governors

Prior to conclusion of the MAA Business Meeting in San Antonio, January 1993

- | | |
|-------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Donald J. Albers, <i>The Mathematical Association of America and Menlo College</i> | Rebecca Hill, <i>Rochester Institute of Technology</i> |
| Gerald L. Alexanderson, <i>Santa Clara University</i> | Shirley A. Hill, <i>University of Missouri at Kansas City</i> |
| John E. Allen, <i>University of North Texas</i> | John H. Hodges, <i>University of Colorado at Boulder</i> |
| Lee H. Armstrong, <i>University of Central Florida</i> | John M. Holte, <i>Gustavus Adolphus College</i> |
| David R. Arterburn, <i>New Mexico Institute of Mining & Technology</i> | Johnny L. Houston, <i>Elizabeth City State University (North Carolina)</i> |
| Donald M. Bardwell, <i>Nicholls State University</i> | John W. Kenelly, <i>Clemson University</i> |
| Lowell W. Beineke, <i>Indiana University-Purdue University at Fort Wayne</i> | Donald L. Kreider, <i>Dartmouth College</i> |
| Marvin L. Brubaker, <i>Messiah College</i> | Bennie R. Lane, <i>Eastern Kentucky University</i> |
| Lawrence O. Cannon, <i>Utah State University</i> | Dennis M. Luciano, <i>Western New England College</i> |
| Lily E. Christ, <i>CUNY, John Jay College of Criminal Justice</i> | Richard F. McDermot, <i>Allegheny College</i> |
| Curtis N. Cooper, <i>Central Missouri State University</i> | Alexander Mehaffey, Jr., <i>University of South Dakota</i> |
| Larry A. Curnutt, <i>Bellevue Community College</i> | Hugh L. Montgomery, <i>University of Michigan</i> |
| William W. Durand, <i>Henderson State University</i> | S. Brent Morris, <i>National Security Agency</i> |
| John H. Ewing, <i>Indiana University at Bloomington</i> | Eric R. Muller, <i>Brock University</i> |
| Barbara T. Faires, <i>Westminster College</i> | John D. Neff, <i>Georgia Institute of Technology</i> |
| Susan L. Forman, <i>Mathematical Sciences Education Board and CUNY, Bronx Community College</i> | Mary M. Neff, <i>Emory University</i> |
| Bettye D. Forte, <i>Fort Worth Independent School District</i> | Ruth D. O'Dell, <i>County College of Morris</i> |
| James O. Friel, <i>California State University at Fullerton</i> | Lynn J. Olson, <i>Wartburg College</i> |
| Leonard Gillman, <i>University of Texas at Austin</i> | Albert D. Otto, <i>Illinois State University</i> |
| Kendall O. Griggs, <i>Hutchinson Community College</i> | Gerald J. Porter, <i>University of Pennsylvania</i> |
| Deborah Tepper Haimo, <i>University of Missouri at St. Louis</i> | Kenneth A. Ross, <i>University of Oregon</i> |
| John G. Harvey, <i>University of Wisconsin at Madison</i> | Sharon C. Ross, <i>Dekalb College</i> |
| | David A. Sanchez, <i>Los Alamos National Lab</i> |
| | Martha J. Siegel, <i>Towson State University</i> |
| | Olaf P. Stackelberg, <i>Kent State University</i> |
| | Elizabeth J. Teles, <i>Montgomery College</i> |
| | Ann E. Watkins, <i>California State University at Northridge</i> |

Committee on Testing

The Committee on Testing (COT) is concerned with mathematics testing and assessment for grades eleven and twelve and the undergraduate level. It maintains and routinely improves the MAA's Placement Testing Program. In addition, COT initiates and oversees externally funded projects relevant to its mission, develops position statements on issues in mathematics testing and assessment and cooperates with other MAA committees with related missions (e.g., the Committee on the Undergraduate Program in Mathematics' (CUPM) Subcommittee on Assessment).

MAA Placement Testing Program
Since the PTP's inception in 1977, COT has overseen its activities. In March 1993, more than 300 postsecondary institutions subscribed to the program. The PTP Program test packet contains twelve tests including calculator-based versions of its *Aithmetic and Skills*, *Basic Algebra*, *Algebra*, and *Calculus Readiness* tests. Subscribers also receive a newsletter which is published twice a year. The Committee is currently developing a new *Basic Algebra* test, a calculator-based version of the *Advanced Algebra* and *Trigonometry* and *Elementary Functions* tests, and three calculator-based prognostic tests. In spring 1993, the PTP began offering custom-designed tests to program subscribers.

Funded Projects

COT continues to oversee three externally funded projects for the MAA: the Calculator-Based Placement Test Program (CBPTP) Project, the Computer-Generated Placement Test (CGPT) Project, and Teaching Mathematics with Calculators: A National Workshop (TMC).

Grants from Texas Instruments fund the CBPTP Project. This project develops calculator-based placement tests and prognostic tests for the PTP test packet. When this project is completed, the PTP will feature six calculator-based placement tests and three calculator-based prognostic tests.

The Fund for the Improvement of Postsecondary Education (FIPSE) funds the CGPT Project. This project uses item-generating functions to produce software that,

Please see COT on page 23

Committee on Student Chapters

While continuing to encourage the formation of new chapters and hence to increase the number of student members of the MAA, the Committee shifted its focus to appropriate programming and activities for these new members. For most students, participating in a section or national meeting is an exciting experience. Students enjoy the invigorating contact with other students of like interests, the challenge of new problems and the thrill of meeting mathematicians whose names they know from their books. Nineteen ninety-two was a landmark year, providing students with such opportunities.

In August, 1992, Miami University of Oxford, Ohio, hosted the Pi Mu Epsilon/MAA Student Chapters Joint Conference — the first-ever national mathematics conference entirely for students. It was extremely successful, with 29 student papers presented in the MAA sessions. Peter J. Hilton of SUNY at Binghamton, gave the MAA invited address on “Another Look at Fibonacci and Lucas Numbers.” There were three minicourses — “Tilings” presented by Doris W. Schattschneider of Moravian College, “Variations on a Spiral” presented by David Kullman of Miami University, and “Environmental Modeling” presented by B. A. Fusaro of Salisbury State University; a Careers Panel Discussion with panelists from government and industry; and Pi Mu Epsilon’s annual J. Sutherland Frame Lecture, presented this year by Underwood Dudley of DePauw University, on “Angle Trisectors.” The program was not lacking in opportunities for social interaction, what with a pizza party, an MAA reception, the Pi Mu Epsilon banquet, a trip to King’s Island, and the popular MAA Hospitality Center, where students congregated to work puzzles and problems, set up dinner groups and chat!

The Exxon Education Foundation provided its third grant to the MAA’s Student Chapters. The money was used, in part, to support student speakers at the summer meeting. A fourth Exxon grant has been awarded for use in 1993. The Committee on Student Chapters gratefully acknowledges this continued support from Exxon’s Education Foundation.

The Committee’s structure changed drasti-

cally at the end of 1992. The terms of Howard Anton of Drexel University and Milton D. Cox of Miami University ended, as did the term of Charles A. Cable of Allegheny College, who was the first person to strongly promote the idea of MAA Student Chapters. All three of these members were with the committee since its inception. Their efforts to start and sustain Student Chapters is behind much of the success of this activity.

The San Antonio meetings in January 1993 provided many activities for students, supported by the Exxon Education Foundation grant. Joseph A. Gallian of the University of Minnesota-Duluth gave the Student Chapters Lecture on “Touring a Torus,” followed by the popular make-your-own-sundae reception. A student workshop on “Mathematics via Hands-on Experimentation” was presented by Herbert R. Bailey of Rose-Hulman Institute of Technology. A Joint (with Pi Mu Epsilon) Advisors Breakfast was followed by a paper session featuring talks by student chapter advisors and section coordinators. This session will be an ongoing feature of the winter meetings. It is organized by Karen J. Schroeder of Bentley College. Approximately 300 students attended the Second Annual Career Fair at which 21 companies, laboratories, and associations discussed opportunities for mathematical scientists. Arthur T. Benjamin of Harvey Mudd College demonstrated his amazing mental calculations.

The Committee on Student Chapters hosts a Student Hospitality Center at each national meeting. Richard S. Neal of The University of Oklahoma runs this center, providing puzzles, contests and information, a place to gather and a friendly respite from the bustle of the formal program. At each winter meeting, a list of NSF-supported REUs and other summer research / internship opportunities is made available.

Deborah A. Frantz of Kutztown University of Pennsylvania continued editing Chapter News which is published twice a year. It is a newsletter for Student Chapter Advisors.

The year 1993 holds even more in store for Student Chapters. The activities of the Committee at the summer meetings in Vancouver will have a Canadian flavor. The Student Chapters Lecture will be given by Richard K. Guy of the University of Calgary, and the student workshop “Using MAPLE to do mathematics” will be presented by Stan

Devitt of the University of Waterloo. As usual, the student paper sessions will be run by Ronald F. Barnes of the University of Houston - Downtown, and there will be some travel money available for student speakers, courtesy of the Exxon grant.

Part of the Exxon grant will fund awards to Sections which plan student programs on contemporary problems of society. Another use of the Exxon grant will be to increase chapter membership for underrepresented minorities. W. Howard Jones of the University of the District of Columbia is overseeing this effort with help from CPM and SUMMA.

A set of guidelines for Section Coordinators is being prepared and will be sent to all the Sections to help them plan appropriate programming for the growing number of student members.

Increased collaboration with other mathematics organizations, such as the AMS, is expected.

For additional information on the MAA Committee on Student Chapters, contact: Aparna W. Higgins, Department of Mathematics, University of Dayton, Dayton, OH 45469-2316; telephone: (513) 229-2103; e-mail: higgins@dayton.bitnet; fax: (513) 229-4000.

COT from page 22

with monitoring, will generate PTP tests. COT has conducted research on the statistical parallelism of PTP test items and has adjusted parameters associated with each item-generating function to produce the desired parallelism. The software facilitates customization of PTP tests.

Outreach and Training

In 1993 the Committee developed two position statements: *The Use of Graphing Calculators on Placement Tests* and *Appropriate Use of Placement Tests*. COT members continue to address mathematics and assessment testing issues at national meetings; during the past year COT members have delivered talks at the annual meetings of the American Mathematics Association of Two-year Colleges (AMATYC) and at the MAA’s Joint Mathematics Meeting in San Antonio. COT continues to offer its minicourse on placement testing at the Association’s annual meetings.

Publications

In Praise of Editors

1992 was a banner year for MAA Publications, with sales topping the \$700,000 mark, up by more than \$200,000 over 1991. These figures reflect the intense and growing interest of MAA members in a host of topics in mathematics and mathematics education.

The growth of MAA books is due in the main to our talented and hard-working series editors who work with Jim Daniel, Chair of the Committee on Publications. They, series editorial board members, and our remarkable collection of authors are responsible for the books published in 1992. Thanks to Jim Daniel and the MAA book editors for their great work.

Twenty new books were published in 1992, including the best-selling, five-volume *Resources for Calculus Collection*. The first printing of 3000 sets sold out in less than six months. RCC was described in a recent *Mathematics Magazine* review as "a treasure trove for the instructor who wants to ease into 'calculus reform,' or for one who wants to plunge in with both feet."

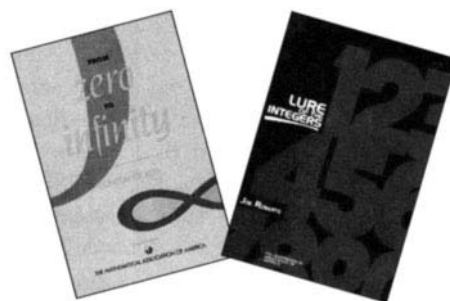
According to our all-member survey, students seem to be more important than ever to MAA members. Survey respondents strongly endorsed two new publications projects for students — Math Horizons, the new magazine for students, scheduled to premier late this fall; and *Classroom Resources Materials*, our newest book series. We are very excited about these new student-oriented projects for 1993.



-Don Albers
Director of
Publications

1992 MAA Titles

- A Century of Calculus: Part I*, T.M. Apostol, H.E. Chrestenson, C.S. Ogilvy, D.E. Richmond, N.J. Schoonmaker
- A Century of Calculus: Part II*, T. M. Apostol, D. H. Mugler, D.R. Scott, A. Sterrett, Jr., A.E. Watkins
- Excursions in Calculus*, Robert M. Young
- From Zero to Infinity*, Constance Reid
- Heeding the Call for Change*, Lynn Arthur Steen
- Library Recommendations for Undergraduate Mathematics*, Lynn Arthur Steen
- Lure of the Integers*, Joe Roberts
- Mathematical Circus*, Martin Gardner
- Mathematical Cranks*, Underwood Dudley
- Mathematics Book Recommendations for High School and Public Libraries*, Lynn Arthur Steen
- Resources for Calculus Collection**
 - *Applications of Calculus*, Philip Straffin, Jr.
 - *Calculus Problems for a New Century*, Robert Fraga
 - *Learning by Discovery*, Anita Solow
 - *Problems for Student Investigation*, Michael B. Jackson, John R. Ramsay
 - *Readings for Calculus*, Underwood Dudley
 - Statistical Abstract of Undergraduate Programs in the Mathematical Sciences*, Donald J. Albers, Don O. Loftsgaarden, Donald C. Rung, Ann E. Watkins
 - Statistics for the Twenty-First Century*, Sheldon and Florence Gordon
 - Student Research Projects in Calculus*, Marcus Cohen, Edward D. Gaughan, Arthur Knoebel, Douglas S. Kurtz, David Pengelley
 - Symbolic Computation in Undergraduate Mathematics Education*, Zaven Karian
 - The Concept of Function*, Guershon Harel, Ed Dubinsky
 - Two-Year College Mathematics Library Recommendations*, Lynn Arthur Steen



"I'm delighted to have the opportunity to work with a great group of book-series editors to help continue the MAA tradition of publishing important, interesting, and well-written material. Thanks to technology, the publishing world is changing and the MAA publications program is changing with it. I hope that Association members will continue to send us the ideas — and manuscripts — we need in order to grow in new directions."

- Jim Daniel
Chair, Publications Committee



1992 Series Editors



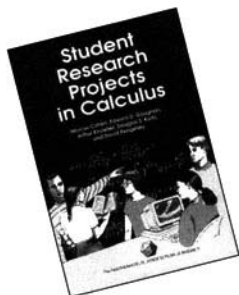
Donald W. Bushaw
Washington State University
MAA Notes and Reports



Marjorie Senechal
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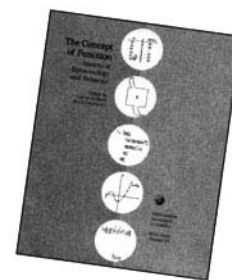
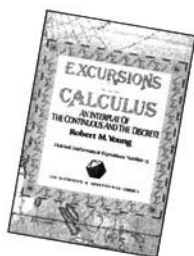
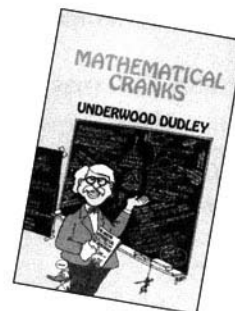
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Also known as John Taine

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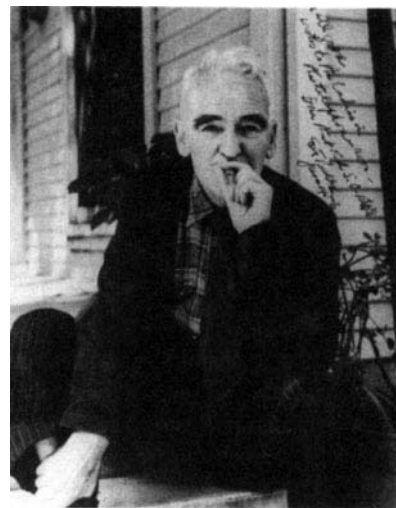
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E. T. Bell

gins with the discovery of an unexpected inscription in an English churchyard and a series of cryptic notations in a boy's schoolbook. Then comes an inadvertent revelation, by Bell himself, in a respected mathematical journal... You will have to read the book to learn the rest.

Originally agreeing to write only a profile of Bell, Constance Reid soon found herself involved in a full-length biography. The discoveries she made in the course of her five years of research will necessitate a fresh evaluation of his extensive mathematical work and his science fiction novels as well as the revision of almost every statement currently in print about his family background and early life.

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384 pp., Hardbound, 1993

ISBN 0-88385-508-9

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Constance Reid— Why I Write About Mathematicians



Constance Reid

There are certain questions that I am often asked in connection with my writing about mathematics and mathematicians. First—are you a mathematician? No. Then—How did it happen that you write about mathematicians?

It happened the following way. In 1952 I was writing short stories, and even considering an novel, when my sister Julia Robinson told me about a program her husband, Raphael, a

mathematics professor at Berkeley, had written for one of the new electronic computers that had been developed during World War II. In one evening the program, which tested the primality of Mersenne numbers beyond $2^{257}-1$, had turned up two previously unknown perfect numbers, the first to be ascertained in seventy-five years, but what I found most interesting was that although the “giant brain” could work with numbers far beyond the ability of human beings and the ordinary calculating machines of the day, it could not answer the simple question that Euclid had asked. How many perfect numbers are there?

I wrote an article about Raphael’s work, which appeared in *Scientific American*. The publisher Robert Crowell read it and asked if I would be interested in writing “a little book about numbers” for him. The result was *From Zero to Infinity*, a fourth edition of which has been issued recently by the MAA. I wrote two more books explaining mathematical ideas to “educated laymen” who had had no more mathematics than I. One of

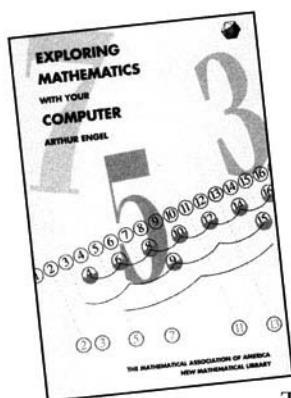
these books, *A Long Way from Euclid*, introduced me to the captivating figure of David Hilbert and the legendary charm he exercised over the young mathematicians of Göttingen. I became obsessed with the idea that the general public should learn about this unique man.

Former students of Hilbert were not encouraging, but ultimately it was the enthusiasm of one of them—Richard Courant—that resulted in my very nontechnical account of Hilbert being published by Springer-Verlag and falling into the hands, not of the general public, but of the scientific community. A life of Courant followed—a natural sequel. I then turned to someone closer to my home in San Francisco—the statistician Jerzy Neyman, who in his eighties was still running the famous “stat lab” he founded at Berkeley.

Today I am being asked still another question in regard to my writing about mathematicians: How did I choose E.T. Bell?

I did not really choose Bell. In 1988 I agreed to write a dedicatory profile of him for the sequel to *Mathematical People*. I already knew from Julia of the inspirational effect of his *Men of Mathematics*. When it appeared in 1937, she was a mathematics major at a small college in Southern California, essentially a “teachers” college. It was through reading Bell’s book that she realized there was something she could do with mathematics besides teach it. She could become a mathematician. So I was not adverse to writing the proposed profile and giving Bell his due as the father of mathematical biography. How and why the profile developed into a full-length biography of a very elusive man—“a cat that cannot be caught,” as Marianne Moore said of T.S. Eliot—is the story of *The Search for E. T. Bell*.

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The Wohascum County Problem Book

George T. Gilbert, Mark Krusemeyer, and Loren C. Larson

If you like problem solving, this book belongs on your shelf. This collection of 130 challenging problems, with carefully worked-out solutions, is presented in the form of "word problems" relating to everyday life in Wohascum County, Minnesota, a rather remote area which is not to be found on any map.

Some knowledge of linear or abstract algebra is needed for a few of the problems, but most require nothing beyond calculus, and many should be accessible to high school students. However, there is a wide range of difficulty, and some problems require considerable mathematical maturity. For most students, few, if any, of the problems will be routine.

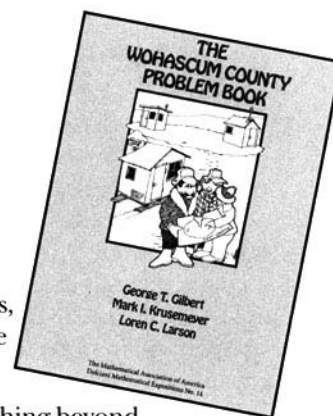
The book centers on solutions which are elegant, instructive, and clear. Often several solutions to the same problem are presented. Some problems have complicated solutions, and many of them are quite long. Sometimes solutions are preceded by "Ideas," which can serve as motivation or as hints, or followed by "Comments," which often put solutions in a broader perspective.

Indices are provided which may be especially helpful to problem solving classes and to teams of individuals preparing for contests such as the Putnam exam.

244 pp., Paperbound, 1993, ISBN 0-88385-316-7

List: \$26.00 MAA Member: \$19.00

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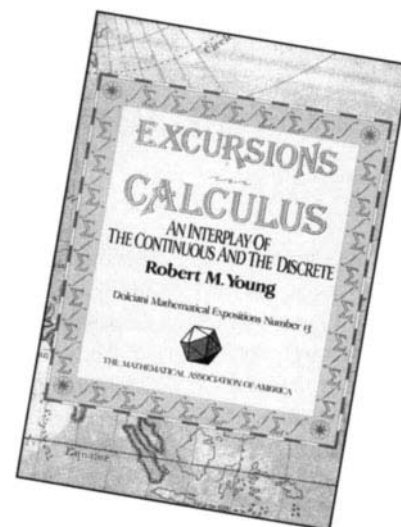


Excursions in Calculus

An Interplay of the
Continuous and the Discrete

Robert M. Young

Printed with eight full-color plates.



Young provides ample material for any student or teacher of calculus to sharpen his or her insight into the surprisingly diverse ways in which the subject impinges on the realm of discrete mathematics...an excellent source of projects for well motivated students. The list of 463 references is a valuable aid for those who wish to dig deeper.

—CHOICE

The purpose of this book is to explore, within the context of elementary calculus, the rich and elegant interplay that exists between the two main currents of mathematics, the continuous and the discrete. Such fundamental notions in discrete mathematics as induction, recursion, combinatorics, number theory, discrete probability, and the algorithmic point of view as a unifying principle are continually explored as they interact with traditional calculus. The interaction enriches both.

The book is addressed primarily to well-trained calculus students and those who teach them, but it can also serve as a supplement in a traditional calculus course for anyone who wants to see more.

The problems taken for the most part from probability, analysis, and number theory, are an integral part of the text. Many point the reader toward further excursions. There are over 400 problems presented in this book.

408 pp., Paperbound, 1992, ISBN 0-88385-317-5

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Starting an Industrial Postdoctoral Program

A handful of postdocs and a few industrial giants are trying to answer the question: "How can I put mathematics to use in real life?" They are part of a fellowship program developed by the Institute for Mathematics and its Applications (IMA) at the University of Minnesota.

The IMA fellowship program connects postdoctoral mathematicians with industry researchers at companies such as Honeywell, 3M, and Siemens. The postdoctoral students apply their skills in advanced mathematics to industry-based, practical problems while working with industry researchers. Now the Institute is proposing to expand the program to other universities nationwide.

The backbone of the IMA program is faculty mentors who must initiate the partnership between university and industry. At a May 22 and 23 meeting, funded by the National Science Foundation, the IMA shared its expertise with prospective faculty mentors in a workshop entitled "How to Start an Industrial Postdoctoral Program."

"The purpose of this meeting is to attract faculty from around the nation who are interested in starting an industrial postdoc program based on the IMA model and to show them how to nurture relationships with industry scientists in their localities," said Willard Miller, associate director of the IMA, which was established by the NSF in 1982 to identify areas in other sciences and industry where mathematical research could be applied.

The faculty mentor must contact industrial scientists, find an industrial project suitable for a mathematical postdoctoral student, and get a commitment for half the money needed to support the postdoc for two years—approximately \$35,000 per year. Faculty mentors apply to NSF for the remainder of the funding. "Most mathematicians have little experience making these contacts," said Miller. "The IMA workshop is designed to alleviate any misgivings and give faculty members practical advice for approaching industry."

At the workshop, Richard Herman, director of the Joint Policy Board for Mathematics (JPBM) in Washington, D.C., discussed how to develop "social contracts" between labs, industry, and universities. The JPBM is an executive action and public policy arm of the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

Avner Friedman, director of the IMA, spoke from personal experience on how the IMA has initiated and nurtured industry contacts. The workshop also provided faculty members with an opportunity to hear from and talk to industrial postdocs and faculty members who have successfully established joint mathematics research projects with industry.

A principal investigator and coordinator of postdocs at Honeywell, J. Allen Cox, provided workshop participants with the industry perspective. "I want to talk about the sensitivities of industry—propriety of data, information exchange—that the faculty mentors often view as unnecessary constraints on research, but industry sees as vital to business," said Cox before the workshop began.

Cox has worked successfully with both Honeywell postdocs, David Dobson and Gang Bao. At the workshop, Dobson described his experience working on problems modeling the behavior of light as it passes through very small optical elements used in lasers, displays, sensors, and other advanced technologies based on lightwaves. Bao is working on the same problem at a more advanced level of technology. Computer simulations of the mathematical models help test how a device will work without actually building a prototype. Honeywell is currently using the computer models in the development of the next generation of cockpit displays for Boeing aircraft.



Richard Herman, Chair, Joint Policy Board for Mathematics; Sam Kramer, Associate Executive Director, National Institute of Standards and Technology; John Simpson, Director, Manufacturing Engineering Laboratory, NIST.

"The tangible gain for Honeywell is a product. The intangible gain is a chance to bring mathematics into Honeywell," said Cox. "We feel that it's a great deal. We certainly get our money's worth."

The idea of industrial postdoctoral fellowships is for both academia and industry to learn from each other through technology transfer. Recent PhDs have access to new mathematical knowledge and industry scientists have access to the most relevant problems facing technology. Furthermore, the fellowships expose young mathematicians to job opportunities beyond the traditional scope of college and university mathematics departments.

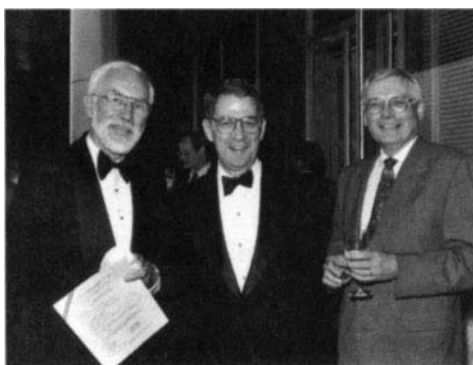
The current IMA program began in 1990 with four 2-year postdoc fellowships—they have six this year and plan for seven next year. The IMA and JPBM are requesting that in 1994 NSF begin a full-fledged industrial postdoctoral program in mathematics based on the IMA pilot program. The proposed NSF program would fund approximately 20 new two-year postdocs each year, with up to 40 funded in any one year by 1995.

Approximately one-tenth of the more than 1,000 new U.S. doctorates in mathematics have access to postdoctoral positions each year. Development of industrial postdoctoral positions could expand the base of mathematics postdoctoral employment and provide the research maturity necessary for developing top-notch professionals.

Olympiad from page 5

sota-Duluth, who captivated the winners and guests with a lecture titled "Touring the Torus."

The day culminated with an elegant reception and dinner in the Diplomatic Reception Rooms of the Department of State. Although unable to attend due to a meeting of a special advisory committee on the Space Station, Dr. John H. Gibbons, Assistant to the President for Science and Technology, was our host. He was represented by Dr. J. Thomas Ratchford, Consultant to the Office of Science and Technology Policy, who read special greetings from President Clinton.



Alfred B. Wilcox, MAA Executive Director Emeritus; David Roselle, President, University of Delaware and former MAA Secretary; and Lynn Arthur Steen, Former MAA President, and Executive Director of the Mathematical Sciences Education Board.

First Place winners Wei-Hwa Huang and Robert Kleinberg were presented with the Samuel L. Greitzer/Murray S. Klamkin Award for Excellence in Mathematics at the conclusion of the dinner. The winners, in addition to other top scorers, went to train at the U.S. Military Academy at West Point from June 8-July 6 for the International Mathematical Olympiad. The international competition held in Istanbul, Turkey July 13-24.

Major contributors to the USAMO Awards



Joseph A. Gallion, University of Minnesota-Duluth, delivers his "Touring the Torus" lecture at the National Academy of Science.



USAMO Alumnus Richard Mifflin, and his wife, Cheryl Bosman on the U.S. State Department balcony with the Lincoln Memorial in the background.

Ceremonies and travel to the IMO are the Microsoft Corporation, The Matilda R. Wilson Fund, The Army Research Office, The Office of Naval Research and the Mathematical Association of America.

The MAA staff who assisted in making the events run smoothly and effortlessly were Mary Mclean Bancroft, Robin Chapman, Elaine Pedreira, and Amy Stephenson.

The eight sponsoring organizations of the American Mathematics Competitions: the



USAMO Alumnus Stephen Modzelewski

American Mathematical Association of Two-Year Colleges, the American Mathematical Society, the American Statistical Association, the Casualty Actuarial Society, the Mathematical Association of America, Mu Alpha Theta, the National Council of Teachers of Mathematics, and the Society of Actuaries.

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MAA President Testifies before Senate Panel in NSF Budget Request

Donald Kreider, President of the Mathematical Association of America, testified before the Senate VA-HUD Appropriations Subcommittee in late May.

Kreider, acting on behalf of the Joint Policy Board for Mathematics, submitted a written statement calling for full support of the NSF budget, in particular for the Division of Mathematical Sciences and the Division of Undergraduate Education. At the hearing, he spoke about the important connection between teaching and research in the mathematical sciences.

The Senate panel will write its version of the VA-HUD spending bill later this summer.

The College Mathematics Journal Special Issue on Differential Equations

The November 1994 issue of the *College Mathematics Journal* will be devoted entirely to teaching the introductory course on differential equations. Recent improvements in graphics software make it possible to shift the focus of the course from analytic methods, which cannot work in all cases, to qualitative methods that can give surprisingly detailed information about the solutions. We are looking for fresh approaches to the subject in this spirit, such as:

- computer demonstrations or student projects
- novel ways to present fundamental concepts
- new applications

The Board of Editors invites submissions to all our regular sections for this special issue: main articles, classroom capsules, student research projects, fallacies, media highlights and quotations or humor. All submissions will be refereed. For information about submitting an article, consult the inside cover of a recent issue of the CMJ or contact the editor: Bart Braden, Mathematics and Computer Science Dept., Northern Kentucky University, Highland Heights, KY 41099.

Papers for this special issue should be in the editor's hands by November 30, 1993.

Mathematics Chair Search

Rose-Hulman Institute of Technology is a school of 1350 strong (mean SAT scores - 680 math, 540 verbal) science, engineering, and mathematics students.

The Department of Mathematics consists of 17 faculty who take teaching seriously. Faculty are active in regional and national professional organizations and are leaders in curricular efforts to use computers in instruction and to teach innovative curriculum combining science, engineering, and mathematics.

We seek a Chair to begin in Fall 1994.

Send request for more information, inquiries, and applications to: Chair Search Committee, Department of Mathematics, Rose-Hulman Institute of Technology, Terre Haute, IN 47803, USA. E-mail: Mathsearch@rose-hulman.edu. Phone (812) 877-8391.

A complete application includes a vita, a statement of mathematical, pedagogical, and administrative philosophy, and three letters of recommendation. Evaluation of applications begins December 15, 1993.

Williams College

Department of Mathematics

Williamstown, Massachusetts 01267

Anticipated tenure-eligible position in statistics, beginning Fall, 1994, probably at the rank

of assistant professor; in exceptional cases, however, more advanced appointments may be considered. Excellence in teaching and statistics, including scholarship and consulting, and doctorate required.

Please have a vita and three letters of recommendation on teaching and statistics sent to Statistics Hiring Committee. Evaluation of applications will begin November 15 and continue until the position is filled. As an EEO/AA employer, Williams especially welcomes applications from women and minority candidates.

Williams College Department of Mathematics Williamstown, Massachusetts 01267

Anticipated visiting position for the 1994-95 year, probably at the rank of assistant professor; in exceptional cases, however, more advanced appointments may be considered. Excellence in teaching, and research and doctorate are expected. Please have a vita and two letters of recommendation on teaching and research sent to Visitor Hiring Committee. Evaluation of applications will begin November 15, and continue until the position is filled. As an EEO/AA employer, Williams especially welcomes applications from women and minority candidates.

Davidson College Department of Mathematics

P.O. Box 1719

Davidson, NC 28036

E-mail: math@apollo.davidson.edu

Applications are invited for an entry level tenure track position in the Mathematics Department beginning August 1994. Completion or near completion of PhD is required. A candidate must be committed to outstanding teaching and continuing scholarly activity. Computer science background is desirable. The teaching load will be 5 courses per year. Davidson is a liberal arts college with a Presbyterian heritage.

A completed application consists of a statement of professional aspirations and goals, resume, graduate and undergraduate transcripts, and 3 letters of reference (at least one about teaching). These should be sent to the attention of Prof. L. R. King, Chair, at the address above. Applications completed by November 27, 1993 will receive first consideration. Davidson College is an Equal Opportunity Employer; women and minorities are encouraged to apply.

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National MAA Meetings

August 15-19, 1993 Sixty-eighth Summer Meeting, Vancouver,
(Board of Governors, August 14, 1993)

January 12-15, 1994 Seventy-seventh Annual Meeting, Cincinnati
(Board of Governors, January 11, 1994)

January 4-7, 1995 Seventy-eight Annual Meeting, San Francisco
(Board of Governors, January 3, 1995)

Sectional MAA Meetings

Eastern PA & Delaware Cedar Crest College, Allentown, November 13.

Indiana Indiana University-Kokomo, October 15-16.

New Jersey Union County College, Elizabeth, NJ, November 13.

Northeastern Westfield State College, Westfall, MA, November 5-6.

Seaway Onondaga Community College, Syracuse, November 5-6.

Other Meetings

October 8-9, 1993 Twenty-first Annual Mathematics and Statistics Conference, Miami University, Oxford, Ohio. Theme: The Teaching and Learning of Undergraduate Mathematics.

April 13-16, 1994 Seventy-second Annual National Council of Teachers of Mathematics Meeting, Indianapolis. For more information, contact: NCTM, 1906 Association Drive, Reston, VA 22091-1593.

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