MathFest 2005

PRIZES and AWARDS

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Program

Opening and Closing Remarks

Carl C. Cowen, President
Mathematical Association of America

Carl B. Allendoerfer Awards

The Carl B. Allendoerfer Awards, established in 1976, are made to authors of expository articles published in *Mathematics Magazine*. The Awards are named for Carl B. Allendoerfer, a distinguished mathematician at the University of Washington and President of the Mathematical Association of America, 1959-60.

Roger B. Eggleton and William P. Galvin

"Upper Bounds on the Sum of Principal Divisors of an Integer,"
***Mathematics Magazine*, vol. 77, no. 3, June 2004, pp. 190-200.**

If the prime p divides the positive integer n then the highest power of p dividing n is called a principal divisor of n. Consider an odd integer greater than 15 that is not a prime power. This integer – like all other integers – is equal to the product of its distinct principal divisors. But can you prove that such an integer is also greater than twice the sum of its principal divisors? Motivated by this problem, the authors masterfully tell a wonderful story of mathematics that is both old and new. They give elegant solutions to the original problem, they develop new mathematics to put the introductory problem in a bigger context, and they do much more. A seamless historical connection to Greek mathematics and to classic questions in number theory (perfect numbers, the aliquot sequence, the series of the reciprocals of primes) is combined with a nice balance of rigorous proofs and intuitive arguments. They always have the reader in mind as they discuss ways to generalize the original concrete problem and, in the process, they give the novice reader a good idea of how mathematical research progresses. The exposition is first rate and keeps the reader engaged to the end. An ambitious undergraduate student would gain much from tackling this paper.

Biographical Note

Roger Benjamin Eggleton is an Australian-born mathematician whose main fields of interest are combinatorics, graph theory and number theory. His research and teaching career encompasses universities in five countries – Australia (1963-70), Canada (1970-73), Israel (1973-74), USA (1974-76), Australia (1976-88), Brunei (1989-92), and USA (1993-present). He obtained his Ph.D. in Calgary (1973), under Richard Guy. He has published over 60 research papers, and regards his collaborations with many joint authors, including several papers with Paul Erdös, as one of the main pleasures of his career. He published four joint papers with William Galvin (2000-04).

Biographical Note

William P. Galvin was born in Sydney, Australia on February 5, 1938. His professional career began as a high school mathematics and science teacher, transforming by 1970 into teacher training. Always a dedicated student, he completed four degrees while working full-time: B.A. (Sydney, 1962), M. Ed. (Newcastle, 1974), M. Math. (Newcastle, 1977), M. Eng. Sc. (Newcastle, 1982), all three masters degrees being research degrees. By 1989 Bill was head of the department responsible for teaching mathematics, computing and mathematics education at the Hunter Institute of Higher Education – subsequently amalgamated with University of Newcastle, where Bill continued training mathematics teachers until he retired in 1997. After retirement his research and other mathematical involvements continued unabated, despite growing ill health. Soon after completing a three-year term as coeditor of the Australian Mathematical Society's *Gazette* (2001-03), he died of cancer on December 12, 2003. The next issue fittingly published his obituary, see Australian Mathematical Society's *Gazette*, 31 (2004), pp. 4-5.

Response from Roger Eggleton (and on behalf of William Galvin)

On behalf of my co-author Bill Galvin and myself, it is with pleasure and humility that I accept the 2005 Allendoerfer Award for our paper on principal divisors of integers. After a long and strong-spirited battle with cancer, Bill passed away a few days after we received the welcome news that our paper was to be published in *Mathematics Magazine*. This was the last of four joint papers we wrote during 2000-2003. Each of them gave us the pleasures of shared mathematical adventure -- exploration, discovery, and wonder at the unfolding beauty of mathematics. When much else had begun to recede in relevance for Bill, he continued to find great satisfaction in the pursuit of the timeless beauty of mathematics. He would have been delighted with this recognition of our work. For myself, joining the distinguished list of recipients of the Allendoerfer Award is a wonderful endorsement of the conviction that we should continually strive to communicate the beauty of mathematics as transparently and seamlessly as possible.

Trevor Evans Awards

The Trevor Evans Awards, established by the Board of Governors in 1992 and first awarded in 1996, are made to authors of expository articles that are accessible to undergraduates and are published in *Math Horizons*. The Awards are named for Trevor Evans, a distinguished mathematician, teacher, and writer at Emory University.

Robert L. Devaney

"Chaos Rules!" *Math Horizons*, November, 2004, pp. 11-14.

Most mathematics students have seen various fractals such as the Sierpinski triangle and carpet, and many will know how to construct them. In "Chaos Rules" however, Robert Devaney shows how to deconstruct as well as construct them. This entertaining and enlightening article presents the probabilistic construction of fractals and fractal movies through the "chaos game." This approach is a winner from both the mathematical and pedagogical point of view. The writing is clear and concise as well as fluid and enjoyable, and encourages readers to seek out more information and experiment for themselves.

Biographical Note

Robert Devaney received his B.A. from Holy Cross College and the Ph.D. from the University of California at Berkeley. He taught at Northwestern and Tufts before coming to Boston University in 1980. His area of research is in complex dynamical systems, primarily the chaotic behavior of such systems. He is the author or coauthor of over one hundred research papers in this field and a dozen books about dynamical systems aimed at readers that range from high school students to researchers in the field. He has delivered over 1,200 lectures on dynamics in all fifty states as well as thirty countries worldwide. In 1995 he received the Deborah and Franklin Tepper

Haimo Award for Distinguished University Teaching from the MAA and in 2002 he received the NSF Director's Award for Distinguished Teaching Scholars.

Response from Robert Devaney

I am extremely grateful to everyone here at MAA for offering me the Trevor Evans Award. It is indeed an honor to be recognized for writing this article. I would especially like to thank Art Benjamin for both pushing me to write this article for *Math Horizons* and also for his many fine comments on an earlier version of the paper. And I would also like to applaud the MAA for their continued emphasis on the importance of having mathematicians communicate their research interests to undergraduates, both in the classroom and in such publications as *Math Horizons*.

Lester R. Ford Awards

The Lester R. Ford Awards, established in 1964, are made to authors of expository articles published in *The American Mathematical Monthly*. The Awards are named for Lester R. Ford, Sr., a distinguished mathematician, editor of *The American Mathematical Monthly*, 1942-46, and President of the Mathematical Association of America, 1947-48.

Tom Apostol and Mamikon Mnatsakanian

"Isoperimetric and Isoparametric Problems," ***The American Mathematical Monthly*****, v. 111, no. 2, February 2004, pp. 118-136.**

"A Fresh Look at the Method of Archimedes," ***The American Mathematical Monthly*****, v. 111, no. 6, June/July 2004, pp. 496-508.**

"Figures Circumscribing Circles," ***The American Mathematical Monthly*****, v. 111, no. 10, December 2004, pp. 853-863.**

Classical geometry with a modern twist. Modern geometry with a classical twist. New and surprising results in areas that have been mined for centuries. The three papers by Tom Apostol and Mamikon Mnatsakanian are models of the succinct and the elegant and a rich mix of the new and the classical.

"Traditional isoperimetric problems ask for the region of maximal area among all plane regions having equal perimeters. The first paper deals instead with plane regions that have equal perimeters and equal areas. "

"The second paper introduces Archimedean globes, a family of solids that circumscribe a sphere. Cross sections of each globe by planes parallel to the equatorial plane are disks bounded by similar polygons that circumscribe the circular cross sections of the sphere. Like the sphere, which is a limiting case, an Archimedean globe has both volume and surface area two-thirds that of its circumscribing prismatic container."

"The centroid of the interior of an arbitrary triangle need not be at the same point as the centroid of its boundary. But we have discovered that the two centroids are always collinear with the center of the inscribed circle, at distances in the ratio 2:3 from the center. The third paper generalizes this elegant and surprising result to any polygon that circumscribes a circle."

Any three of the joint papers by Tom Apostol and Mamikon Mnatsakanian are worthy contenders for the Ford Award. The obvious solution is to recognize all three and award the prize for the collection.

Biographical Note

Tom M. Apostol joined Caltech in 1950 and is now Professor of Mathematics, Emeritus. His textbooks on calculus, analysis, and number theory have been translated into five languages and have influenced an entire generation of mathematicians. He created and produced *Project MATHEMATICS!*, a series of ten videotapes that bring mathematics to life with computer animation, live action, music, and special effects. They have won first-place honors at a dozen international festivals, and have been translated into Hebrew, Portuguese, French, and Spanish. His list of publications includes 55 books and 90 research papers, 40 of them published since becoming Emeritus in 1992, 20 of which are joint work with Mamikon Mnatsakanian. In 1978 he was a visiting professor at the University of Patras in Greece, and in 2001 was elected a Corresponding Member of the Academy of Athens, where he delivered his inaugural lecture in Greek.

Response from Tom Apostol

Lester R. Ford has touched my career in many ways. His 1929 book on automorphic functions and his earlier 1915 monograph had a strong influence on my choice of analytic number theory as a field of research. His superb 1929 text on differential equations helped me greatly in my early teaching at Caltech. And his 1938 *Monthly* paper on circles associated with Farey fractions (which I later called Ford Circles) made it possible to simplify the derivation of Rademacher's historic convergent series for the partition function. I consider it a special honor to share a Ford Prize with my colleague Mamikon Mnatsakanian, whose remarkable geometric insights led to joint publication of a score of papers during the past decade.

Biographical Note

Mamikon Mnatsakanian is a former Soviet scientist in Theoretical Physics, Astrophysics, and Mathematics. He was Director of the Mathematical Modeling Center of Physical Processes at Byurakan Observatory and Professor at Yerevan State University, in Armenia. As a student he developed "cake-ulus" (vs. calc-ulus) - a simple, visual, dynamic approach to solving calculus problems with no formulas or equations. He has taught it successfully to students at all levels. He has created and developed: "Generalized General Theory of Relativity with Variable Gravitational Constant" to resolve observational controversies in cosmology; "New Apparatus of Radiation Transfer Theory" with simple and general methods and analytic solutions; "New Methods in Stellar Statistics and Dynamics," one of which represents a simple effective geometric solution to the famous tomography problem, which precedes medical CAT-scans; a thousand problems for California State Department of Education and UC Davis projects, and hundreds of mathematical educational games and puzzles (some computer-interactive). He is author of 80 scientific and popular articles. After the 1988 devastating earthquake in Armenia, he began seismic safety investigations of Armenian nuclear power plants, and residential and kindergarten buildings in cooperation with the State and specialists of California. This brought him to California. Eventually, he met his dream-colleague and ideal patron, Tom Apostol, and in 1997 he moved from UC Davis to work at Caltech's *Project MATHEMATICS!*

Response from Mamikon Mnatsakanian

It's a delightful and rewarding task - to "twist and mix modern and classical geometry." Armed with advanced knowledge, tools, and led professionally by Tom Apostol, we take exotic and challenging tours back to Archimedes' times for small discoveries overlooked since then. An entire civilization by himself, Archimedes could easily jump 2000 years ahead of his time and invent modern calculus. It took two millennia and two other great geniuses like Newton and Leibniz to realize his ideas. For Archimedes the simple way was no different from the impossible way. He chose the fastest one, the impossible, leaving the simple way for the next time. As his ideas were of the heavens, many earthly mines were left on the ground, still in wait for the next-time exposure, such as: simpler methods to calculus; unknown works of the young Archimedes; the lost and found, lost again, and still missing Archimedes' tombstone.

Henry Cohn

"Projective Geometry over $\mathbf{F}_1$ and the Gaussian Binomial Coefficients," ***The American Mathematical Monthly*****, v. 111, no. 6, June/July 2004, pp. 487-495.**

In the opening sentence Cohn states the nonexistence of a field with one element, then goes on to say there is a well-defined notion of projective geometry over that field. As Cohn remarks, this is a point of view which is well known to experts, but the casual reader's curiosity is certain to be piqued by such an intriguing comment.

The Gaussian binomial coefficients arise as a partial generalization of the binomial theorem to the non-commutative case. Cohn mentions several connections with problems in combinatorics, and gives references where the interested reader can find more. These coefficients also play a role in the structure and representation theory of quantum groups, currently a hot topic in mathematics.

One of the combinatorial connections is to the problem of counting *k*-dimensional subspaces of $\mathbf{F}^n_q$, an *n*-dimensional vector space over the field of *q* elements. By setting $q = 1$, this result suggests a strong analogy between subsets of a set and "subspaces over $\mathbf{F}_1$." This analogy does not yield to investigation as stated, but when re-interpreted as a question about subsets of a projective space (instead of a vector space), Cohn is able to bring the analogy into better focus.

After probing several results which strengthen the analogy, Cohn leaves the reader with an open question – can this analogy be pushed further, say by regarding the alternating groups as a projective special linear group over $\mathbf{F}_1$? Extending the analogy might help streamline the classification of finite simple groups. However, setting $q = 1$ into the formula for the order of the projective special linear group does not quite give the right answer for the order of the alternating group. So it is not (yet!) clear how to make the analogy work in this context.

It has been said that mathematics progresses by a sequence of results that make a vague analogy precise. Reading Cohn's engaging article gives one the feeling of being in the presence of new mathematics at the moment of its birth.

Biographical Note

In high school **Henry Cohn** participated in the PROMYS summer mathematics program at Boston University, which he claims had a tremendous influence on his life and helped him forge connections to a community of mathematicians and of students. After attending college at MIT and graduate school at Harvard (where Noam Elkies was his thesis advisor), he came to the Theory Group at Microsoft Research as a postdoctorate in 2000 and joined the group long term in 2001.

Response from Henry Cohn

I feel honored to receive the Lester R. Ford Award, especially because as I look over the list of papers from previous years, a number of them stand out as having intrigued or inspired me when I've browsed through back issues of the *Monthly*. I hope my paper spurs others to carry this work further, and perhaps resolve the problem discussed in the final section. Many people have contributed to my mathematical education, but I would particularly like to thank Donald Cohn, Noam Elkies, Steven Kleiman, and James Propp for their advice and guidance on mathematical writing, Donald Cohn and Ira Gessel for introducing me to combinatorics, and Robert Kleinberg and Elizabeth Wilmer for their valuable feedback on this paper.

Alan Edelman and Gilbert Strang

"Pascal Matrices," ***The American Mathematical Monthly*****, v. 111, no. 3, March 2004, pp. 361-385.**

Let S be the $n \times n$ symmetric "Pascal" matrix whose entries S_{ij} (starting with row 0 and column 0) are the binomial coefficients $\binom{i+j}{i}$. Likewise, let L be the $n \times n$ lower triangular Pascal matrix with entries $L_{ij} = \binom{i}{j}$ and U the $n \times n$ upper triangular matrix with $U_{ij} = \binom{j}{i}$. Edelman and Strang present four striking and very different proofs that $S = LU$. The first of these involves straightforward matrix multiplication and an elementary combinatorial argument; the second counting glues paths on an up-and-left directed graph; the third is an ingenious recursion via induction and Gaussian elimination; and the fourth is a new and elegant argument involving infinite Pascal matrices and functional equalities.

Although the article focuses on a very specific example, it is one that contains within it a wealth of mathematical ideas, some quite deep and unexpected. The authors are to be commended for collecting this rich array of ideas and bringing them to the reader's attention in such an appealing manner.

Biographical Note

Alan Edelman, a lifelong lover of linear algebra, celebrated his 40th birthday with a cake bought by his wife with icing $Ax=\lambda x$. (See http://math.mit.edu/~edelman/cake40.jpg.) He earned an M.S. and B.S. at Yale University and a Ph.D. at MIT, where he has been teaching almost continuously since 1993. He has also spent over three years at UC Berkeley. Edelman's MIT thesis on random matrices was supervised by Nick Trefethen who is now at Oxford. Random matrices, parallel computing, and numerical linear algebra remain passions. Edelman has shared a Gordon Bell prize for parallel computing, a Householder prize for numerical linear algebra, and many other prizes. He has worked or consulted for Pixar (the linear algebra of colors), Akamai, IBM, and recently started up his own company: Interactive Supercomputing.

Response from Alan Edelman

It is a special pleasure to share this honor with Gil Strang who is the "gold standard" for exposition in mathematics. He has been a friend and mentor for many years. Over the years I have learned that novices may believe that easy-to-read mathematics is trivial, but those with experience know that the opposite is true. We should all strive to emulate those Olympic athletes who take a lifetime of practice in order to make their sport look oh so easy. Our paper looks at Pascal's triangle through a linear algebra "lens."

Linear algebra reveals so much. Whether I am studying differential geometry or hearing a lecture from some area of engineering, I often find myself recasting the subject into the succint language of linear algebra. Indices vanish, the formulation is crisper, $A'A$ quickly is replaced with the SVD, and there is no turning back.

Biographical Note

Gilbert Strang was an undergraduate at MIT and a Rhodes Scholar at Balliol College, Oxford. His Ph.D. was from UCLA and since then he has taught at MIT. He was President of SIAM in 1999-2000 and Chair of the U.S. National Committee on Mathematics in 2003-2004. He can't stop teaching and writing textbooks: *Introduction to Linear Algebra* (1993, 1998, 2003), *Linear Algebra and Its Applications* (1976, 1983, 1988, 2005), *Introduction to Applied Mathematics* (1986), and *Calculus* (1991). The publisher is always Wellesley-Cambridge Press, except Brooks/Cole for the earlier linear algebra book. His other books (with wonderful coauthors) are just linear algebra in disguise: *An Analysis of the Finite Element Method* (1973), *Wavelets and Filter Banks* (1996), and *Linear Algebra, Geodesy, and GPS* (1997). He plans to learn something new soon. He is especially happy to share this Pascal paper with his friend Alan Edelman (who won the MAA's

Chauvenet Prize in 1998).

Response from Gilbert Strang

I am grateful and proud to receive a Ford Prize from the MAA. I think of our society as a group of friends, helping each other. We all try to do a good job of teaching and writing and thinking about mathematics -- and in my case that specially means linear algebra. I just see over and over again how beautiful and how important this subject is. When I realized that a symmetric Pascal matrix is exactly the product of a lower triangular times an upper triangular Pascal matrix -- all with those binomial coefficients -- I just thought once more: How beautiful.

Steven Finch and John Wetzel

"Lost in a Forest," ***The American Mathematical Monthly*****, v. 111, no. 8, October 2004, pp. 645-654.**

This article offers a bird's eye overview of a tantalizing minimization problem, posed as follows almost 50 years ago by R. Bellman: "A hiker is lost in a forest whose shape and dimensions are precisely known to him. What is the best path for him to follow to escape from the forest?"

A forest, for the authors' purposes, is a closed and convex plane region *F* with nonempty interior. An escape path is a curve, parametrized on the closed unit interval, that must leave *F* regardless of its initial point and direction. A "best" escape path, then, is one that is shortest.

Circular forests offer few surprises; an escape path is a straight line, and the escape length is the diameter. Shortest escape paths are diameters also for "fat forests": those that contain a 60-degree rhombus centered on a diameter line. But few other cases are understood---the shortest escape path is unknown even for an equilateral triangle. The difficulty should perhaps not be surprising, given the connection the authors point out to Moser's famous but unsolved "worm problem": to find the convex region of least area that covers every path of unit length.

The article delivers more than its title promises: Readers will emerge not so much lost as amazed, both by the depth of apparently simple forests and by the mathematicians' ingenuity in engineering escapes.

Biographical Note

Steven Finch received his B.A. in mathematics from Oberlin College in 1982 and his M.S. in applied mathematics from the University of Illinois at Urbana-Champaign in 1985. He has worked as a statistical weather forecaster at TASC and at MIT Lincoln Laboratory, technical editor at MathSoft, and adjunct instructor at Salem State College. He presently holds a biostatistics programming position at the Boston University School of Public Health. His book *Mathematical Constants* (Cambridge University Press, 2003) was widely praised. He is honored to have received a Book Fellowship from the Clay Mathematics Institute beginning in 2004. Finch is also a classical pianist and composer. A compact disc recording *An Apple Gathering* features his vocal and choral music.

Response from Steven Finch

I am delighted to receive the Ford award for my article "Lost in a Forest" with Jack Wetzel! This investigation is one of many explorations that are described in my book *Mathematical Constants*. (I remain surprised that no one wrote an encyclopedia of the same breadth and depth before mine. Wasn't the literature gap clear?) Here the geometry of optimal escape paths is very intricate -- mere constants don't convey the full story -- and the logarithmic spiral conjecture mentioned toward the end is still unresolved. Three preprints on the arΠiv describe my continuing research. Also, my INRIA website is full of relevant supplementary materials. Many of the problems we encounter in our sub-specialties can be explained (at least approximately) to non-experts if we try hard enough. The Ford award provides much-appreciated impetus for me to keep writing and trying.

Biographical Note

John Wetzel earned his Stanford Ph.D. in 1964 after undergraduate work at Purdue. His entire academic career was spent at the University of Illinois at Urbana-Champaign, from which he retired in 1999 after 38 years of service. He shares a condo in Champaign with his wife Rebecca, a miscellany of hippopotamic objet d'art, and an aggregation of some 61 hippo cookie jars. Always interested in classical geometry, he continues to study covering and fitting problems in the plane and space.

Response from John Wetzel

I am flabbergasted, delighted, and deeply honored to learn that the article, "Lost in a Forest," which I coauthored with Steven Finch, has been awarded an MAA 2005 Lester R. Ford Prize for expository writing. My hope is that our article will encourage others cleverer than I to investigate and perhaps settle some of the many fascinating, frustrating elementary problems about arcs in the plane that stubbornly continue to resist resolution.

Judith Grabiner

"Newton, Maclaurin, and the Authority of Mathematics," ***The American Mathematical Monthly*****, v. 111, no. 10, December 2004, pp. 841-852.**

It can be argued—and is, by Grabiner and others—that the method of creating, successively modifying, and deducing results from rigorous mathematical models began with Isaac Newton and his calculus. This "Newtonian style" perhaps had no better champion than the Scottish mathematician Colin Maclaurin (1698–1746). Grabiner engagingly describes how a 16-year-old Maclaurin attempted (in an unpublished essay) to apply techniques of calculus to ethics, and how the adult Maclaurin employed the Newtonian style to determine the shape of the earth and the precise volumes of molasses barrels, and to conduct actuarial work for the Scottish Ministers' Widows' Fund.

The interesting particulars of some of Maclaurin's work only illustrate Grabiner's main point: that because Newtonianism led to successful solutions to a wide array of problems, it also imparted special authority and prestige to mathematics and mathematicians in general, and lent 18th century mathematics, in particular, an air of objectivity and certainty. This certainty, in turn, gave mathematics trustworthiness in societal and even religious matters. Grabiner's carefully documented article provides a lively account of the broad influence of Newton's work through that of one of his most successful followers. This paper should interest anyone curious about the direct effects of the calculus on all areas of thought.

Biographical Note

Judith V. Grabiner, the Flora Sanborn Pitzer Professor of Mathematics at Pitzer College, received her B.S. in Mathematics from the University of Chicago, and her Ph.D. in the History of Science from Harvard, where her thesis advisors were I. Bernard Cohen and Dirk J. Struik. The author of *The Origins of Cauchy's Rigorous Calculus* (MIT, 1981, Dover reprint, 2005) and *The Calculus as Algebra: J.L. Lagrange*, 1736-1813 (Garland, 1990), she became interested in Maclaurin because Cauchy and Lagrange thought he was so important, and she thought they should know best. She remains fascinated by the relationship between mathematics and society.

Response from Judith Grabiner

Receiving this award for this particular article is a special joy because it gives me the chance to record my debt to I. Bernard Cohen, who helped me understand Newton, and who taught me how to read the mathematics of the past in the context of its own time, and also to Dirk Struik, who taught me that the mathematician remains a social being no matter how abstract his or her researches appear. I also thank the Pitzer family for their generous support, both for my research and my teaching. Finally, I thank the MAA, whose support of mathematics, mathematics teaching, and mathematical exposition are essential to the health of these endeavors, both in the U. S. and in the world.

George Pólya Awards

The George Pólya Awards, established in 1976, are made to authors of expository articles published in the *College Mathematics Journal*. The Awards are named for George Pólya, a distinguished mathematician, well-known author, and professor at Stanford University.

Brian Hopkins and Robin J. Wilson

"The Truth About Königsberg," *College Mathematics Journal*, May 2004, p. 198.

Like a Sunday afternoon stroll through the history of mathematics, this beautifully written article about the historical basis for graph theory draws from the original sources. (What a treat it is to read Euler's own words on the matter.) Hopkins and Wilson take us back to the founding of the city of Königsberg in 1254, then gently help us relive history through their translations set in rich historical context, of the correspondence between Euler and other mathematicians concerning this interesting puzzle. This article would be useful not only in a class where graph theory is being introduced, but also, in the grander scheme of things, what undergraduate math professor should be ignorant of this fascinating little piece of history?

It's natural an article of historical nature be awarded a prize named after Pólya. George Pólya himself drew richly from historical examples and quotations in his books. Pólya uses these examples not only because they are examples of great mathematical thinking, but also because they are examples of mathematics in the making, mathematics in the process of being created. "The Truth About Königsberg" allows readers to be witness to that process of creation. Standing now from the vantage point of understanding the graph theory behind the bridges of Königsberg question, we see that mathematics does not come in final form, and also that notation that is familiar for us was indeed introduced much later. This article wraps up and delivers to us some historical nourishment for the stories we tell along our mathematical meanderings with our students.

Biographical Note

Brian Hopkins is an Assistant Professor at Saint Peter's College, a Jesuit liberal arts college in Jersey City, New Jersey. He received his Ph.D. from the University of Washington for work on algebraic combinatorics related to the representation theory of Lie algebras. Other professional interests include graph theory, combinatorial number theory, undergraduate research, and mathematics education. Currently, he is compiling and editing a discrete mathematics resource guide. He also enjoys choral singing, poetry, and New York City.

Biographical Note

Robin Wilson works in the Pure Mathematics department at the Open University, UK, where he has recently been Head of Department. He is a Fellow of Keble College, Oxford University, and also currently holds the position of Gresham Professor of Geometry, London, the oldest mathematics Chair in England (dating from 1597). He has written and edited nearly thirty books on subjects ranging from graph theory to the history of mathematics, and in 2002 wrote a very successful book on the history and proof of the four-color problem. He is very interested in music, and has recently co-edited a book on music and mathematics.

Response from Brian Hopkins and Robin J. Wilson

We are very honored to receive the 2005 George Pólya Prize. Our paper grew out of a coincidence: The 2001 Joint Mathematics Meeting in New Orleans included the session "Mathematics in the Age of Euler." We each independently proposed to speak on Euler's solution to the bridges of Königsberg problem; Robin Wilson on some letters leading up the solution, Brian Hopkins on the details of the solution itself. The organizer of the session, Fred Rickey, put us in touch with each other, and we decided to pool our resources into a forty-minute joint presentation. The success of our talks led us to write the article published in the *College Mathematics Journal*. It was a pleasure to follow Euler's path through this problem and present this piece of mathematical history to a larger audience.

Stephen M. Walk

"Mind Your □s and □s," *The College Mathematics Journal*, November 2004, p. 362.

The joy of mathematical discovery can begin with the simplest question: Stephen Walk's article provides an existence proof. When teaching Linear Algebra for the first time, Walk used a book that stated the vector space axiom "for all u there exists an x such that $u+x=u$" instead of the correct "there exists an x such that for all u, $u+x=u$." Although he trotted out his favorite examples in class of how interchanging these quantifiers matters, he was flummoxed when a student asked him to provide an example of a non-vector space which satisfied all the other [correctly-stated] axioms and this one incorrectly stated one.

This article gives us another pedagogical example in our arsenal to fight the good fight against mis-orderings of quantifiers. Perhaps more importantly, though, reading Walk's playful account of his investigation into this question and the resulting non-vector space he created is delightful and allows us to relish in his exuberance of discovery as it reminds us of our own joy in solving mathematical puzzles both large and small.

Biographical Note

Stephen Walk intended to become a mystery novelist until Raymond Smullyan's puzzle books hooked him on mathematical logic and convinced him that proving guilt beyond a reasonable doubt is not so interesting as proving theorems beyond any doubt whatsoever. At the University of Northern Iowa his interest in logic was nurtured by Dr. Michael Millar, and at the University of Notre Dame he was expertly guided by Dr. Peter Cholak. Along the way, he was encouraged immeasurably by Amy Walk. He has been with the mathematics department at St. Cloud State University in St. Cloud, Minnesota since 1999. His chief non-mathematical interest is spending time with daughters Josephine (4) and Annabel (1).

Response from Stephen Walk

This is truly an honor. Many times I've looked to the *College Mathematics Journal* for classroom material and inspiration, and I never imagined that an article of mine would not only appear in the *CMJ* but also be chosen for a George Pólya Award. My jaw still hurts from hitting the floor when I heard the news! I am grateful to *CMJ* editor Lowell Beineke and the two anonymous referees, all three of whom made excellent suggestions that contributed to the final paper. I also owe special thanks to Blake Hegerle and Mark Renslow, two Linear Algebra students who made me think and kept me honest, and one of whom asked the question that sparked this article. I don't remember which one actually asked, and it doesn't matter, because the other was probably thinking it anyway. Thank you!

Merten M. Hasse Prize

In 1986 an anonymous donor gave the Mathematical Association of America funds sufficient to support a prize honoring inspiring and dedicated teachers. The prize was to be named after Merten M. Hasse, who was a former teacher of the donor, and who exemplified these qualities of a fine teacher. The prize is designed to be an encouragement to younger mathematicians to take up the challenge of exposition and communication. The Merten M. Hasse Prize is for a noteworthy expository paper appearing in an Association publication, at least one of whose authors is a younger mathematician.

Maureen T. Carroll and Steven T. Dougherty

"Tic-Tac-Toe on a Finite Plane," ***Mathematics Magazine*****, Vol. 77, No. 4, October 2004, pp.260--274.**

In this entertaining article, the authors tweak the familiar game of tic-tac-toe by placing it in a new context: the finite affine or projective plane, noting that "with this new twist, the game that grew tiresome for us as children is transformed into an interesting, geometrically motivated game." And indeed it is! Not only does mathematics motivate the game, but the game motivates mathematics -- we are treated to a tour of topics such as Latin squares, axioms for affine planes, and strategy-stealing and weight functions in game theory. These ideas help the authors classify those affine or projective planes on which there is a winning strategy. Throughout the article, the authors invite us to participate in the discoveries, just as they have involved their students. Their choice of topic, friendly exploration, tidy conclusion, and smooth exposition make this article fun and engaging reading.

Biographical Note

Maureen T. Carroll is an Associate Professor at the University of Scranton. She and her coauthor first started their collaborations when they were both graduate students at Lehigh University. Although her dissertation field was functional analysis, she has also published papers in voting theory and game theory. She was a Project NExT fellow (green dot) and participated in the Institute in the History of Mathematics.

Biographical Note

Steven Dougherty received his doctorate from Lehigh University and is now a Professor of Mathematics at the University of Scranton. He has written over 40 papers in coding theory, number theory and combinatorics with 19 coauthors from nine different countries. He has lectured at numerous universities and conferences spanning six countries.

Response from Steven Dougherty and Maureen Carroll

We are thrilled to receive the Merten M. Hasse prize. It is a great honor to be recognized by the Mathematical Association of America for our exposition. As professors, we have dedicated ourselves to guiding students in the path of mathematical discovery. In the paper, our hope was to make interesting results from finite geometry, combinatorics, and game theory accessible to students through the use of our game. We are especially proud to be honored by an organization that dedicates itself to beautiful mathematics, excellence in teaching, and student involvement. In addition to thanking the University of Scranton for its support, we must also thank our students. Not only did they help inspire the idea for the game, they also keep the spirit alive by competing in our annual tic-tac-toe contest.

Chauvenet Prize

The Chauvenet Prize for expository writing, first awarded in 1925 to Gilbert Bliss of the University of Chicago, is given for an outstanding expository article on a mathematical topic by a member of the Association. The prize is named for William Chauvenet, a professor of mathematics at the United States Naval Academy. It was established through a gift in 1925 from J.L. Coolidge, then MAA President.

John Stillwell

"The Story of the 120-Cell," ***Notices of the AMS*****, January 2001, pp. 17-24.**

Like its subject, John Stillwell's paper, "The Story of the 120-Cell, " is a mathematical gem. First is its content. The 120-cell lives in three worlds, among the regular polytopes in $\mathbb{R}^4$, in the Poincaré homology sphere S^3 , and in the division ring of quaternions. "And, if this is not enough," says Stillwell, "the 120-cell encodes the symmetry of the icosahedron and the structure of the Poincaré-homology sphere." So, the 120-cell is a gem of many facets.

The 120-cell has a fascinating history, too, originating in the regular polyhedra of antiquity and developing, progressively, through fruitful interactions with the fourth dimension in the 1840s, group theory in the 1850s, and topology around 1900.

And then there are the splendid pictures, some of which go back over a century. As the author states, the story "... can be illustrated better than ever before with the help of computer graphics. Moreover, the new illustrations put the 120-cell in a context of current interest, the geometry of soap bubble configurations, by mapping it in a natural way in $\mathbb{R}^3$."

Beyond its beautiful subject, fascinating history, and gorgeous graphics, this story ultimately succeeds because it is a story well told. John Stillwell's writing is elegant, insightful, and engaging. At the outset he makes us want to learn about the 120-cell, and by story's end we feel satisfied, because we have learned a lot and want to know more. "The Story of the 120-Cell" is a model of superb exposition in mathematics.

Biographical Note

John Stillwell was born in 1942 and raised in Australia, where he was educated at Melbourne High School and the University of Melbourne. In 1965 he first came to the US, to attend graduate school at MIT (Ph.D. 1970). Then he returned to Melbourne, where he taught at Monash University for 31 years. In 2002 he started a new job as professor at the University of San Francisco. He now spends one semester per year there, and the rest of the time in Melbourne. His interests are in geometry, algebra, number theory, and their history. He has translated several of the classics in these fields -- by Poincaré, Dedekind, and Dirichlet for example -- and has written several books, the best-known of which is *Mathematics and Its History* (2nd edition, Springer, 2002).

Response from John Stillwell

It is a great thrill to receive the Chauvenet Prize, because its previous winners include many of the mathematicians whose writings I admire, such as G.H. Hardy and Paul Halmos. I am also proud to have been helped by H.S.M. Coxeter, whose books have inspired me since I was an undergraduate. He provided some historical details, and also expressed pleasure in the topic, so I feel able to say that the paper continues the Coxeter tradition. Others who gave crucial help were Susan Friedlander, who invited me to write something for the *Notices of the AMS*, the Dibner Institute at MIT, for support while I was writing, and Harold Boas -- then editor of the *Notices* -- who tightened up the loose passages in my first draft. Thus it is not only polite, but also historically correct, to say that all of these people deserve some of the credit for the prize.

Henry L. Alder Award for Distinguished Teaching by a Beginning College or University Mathematics Faculty Member

The award was established in January 2003 to honor beginning college or university faculty whose teaching has been extraordinarily successful and whose effectiveness in teaching undergraduate mathematics is shown to have influence beyond their own classrooms. An awardee must have taught full time in a mathematical science in the United States or Canada for at least two, but not more than seven, years since receiving the Ph.D. Henry Alder was MAA President in 1977 and 1978 and served as MAA Secretary from 1960 to 1974.

Matthew DeLong

Matt DeLong is an Associate Professor at Taylor University, Upland, Indiana. He has received strong student evaluations and strong classroom evaluations from his supervisors while teaching a wide variety of courses. He is credited with raising the level of teaching in his department by influencing many faculty to implement his teaching methods. He designs activities for his students in accordance with the belief that students learn mathematics by doing mathematics. His regular methods include uses of technology, writing projects, group homework projects, and student presentations in class. His many involvements with students include summer research experiences, advanced readings courses, and preparation work for the Putnam competition. He has published several articles in *PRIMUS* with co-authors C. Yackel and D. Winter on student-centered instruction, student-learning objectives, and managing the mathematics classroom. As a 1999 Project NExT fellow he has organized sessions for MAA meetings and made presentations at MAA and other professional meetings. He initiated an Educational Issues Seminar at Taylor University for the Division of Natural Sciences and has been involved in setting up a pedagogical study component for a college-wide faculty retreat.

Biographical Note

For **Matthew DeLong**, becoming a teacher seemed almost inevitable. His parents, his wife, and his in-laws are/were all teachers. Matt received his B.A. in Mathematics and Economics from Northwestern University (1993), and his M.S. (1996) and Ph.D. (1998) degrees in Mathematics from the University of Michigan. He is an Associate Professor at Taylor University and will be Visiting at the University of Michigan while on sabbatical in 2005-2006. Matt was a Project NExT Fellow (Brown Dot). He co-authored *Learning to Teach and Teaching to Learn Mathematics: Resources for Professional Development*. In addition, he has published research articles in the areas of algebraic number theory and collegiate mathematics education. He is on the board of directors of the Association of Christians in the Mathematical Sciences. In addition to thinking about teaching and mathematics, Matt thoroughly enjoys spending time with his wife and two children (with another on the way), directing his church choir, performing and directing in community theater, playing racquetball with colleagues, and singing in his faculty quartet, Quadrivium.

Response from Matthew DeLong

I know many who would make outstanding recipients of this award. Therefore, I am humbled at being chosen. I thank the MAA for this award, and my department for nominating me. I thank my Taylor colleagues and students for providing a fantastic place to work. The most significant impacts on my teaching were from my dad, who taught me that math is fun and teaching rewarding; Mike Stein of Northwestern, who exemplified excellence in teaching and pointed me to graduate school; Pat Shure (and others) at Michigan, who taught me to teach and allowed me to mentor the teaching of others; Project NExT, which nourished my teaching; and my collaborator Dale Winter, from whom I have learned much. I am indebted to my wife Bonnie, who provides a nurturing home and supports my work, even when I do too much. Lastly, I thank The Truth, for His providence and grace.

Sarah Greenwald

Sarah Greenwald is an Associate Professor at Appalachian State University in Boone, N.C. Her peers and students attest to her effectiveness as a well-prepared, thoughtful, and enthusiastic teacher both inside and outside the classroom. She is a proponent of active learning in the classroom using a variety of teaching methods and technology-enhanced activities. For a number of courses she created materials utilizing appropriate, significant mathematical content in *The Simpsons* cartoon. This work has received media attention, is available on a website for many others to use, and has been published with co-author Andrew Nestler in *PRIMUS* and *Math Horizons*. She has also shared in *PRIMUS* ideas on using writing projects in teaching geometry, and she has written with Holly Hirst an article on current practices in quantitative literacy that is to appear in an upcoming MAA Notes volume. She was a 1999 Project NExT Fellow and a 1999 and 2000 recipient of an NSF Research Opportunity Award.

Biographical Note

Sarah J. Greenwald received her Ph.D. in 1998 from the University of Pennsylvania and her B.S. from Union College in Schenectady, NY in 1991. Her scholarship areas include the Riemannian geometry of orbifolds, popular culture in mathematics, the shape of the universe, and women and minorities in mathematics. She has received NSF ROA Awards and an MAA Tensor grant, and has been heavily involved in MAA service. She recently appeared on NPR's *Science Friday* radio show.

Response from Sarah Greenwald

I'm thrilled to receive this award from the MAA. Thanks to my students at Appalachian for making teaching fun and for their curiosity, their sense of humor, their willingness to learn, and for teaching me all that they have over the last seven years. I greatly appreciate the many people who have helped me make it easier for my students to connect to mathematics and who have influenced and inspired my teaching, articles, and webpages. There are too many people to acknowledge here, but special thanks go to Bill Bauldry, Ann Bies, Holly Hirst, Amy Ksir, Andrew Nestler, Susan Niefield, Arnold Seiken, Karl Zimmermann, and the writers of *The Simpsons* and *Futurama*. I dedicate this award to the memory of my mother, who was also a teacher. She believed in me and encouraged me to do my best, a message I've passed on to my students.

Laura Taalman

Laura Taalman is an Assistant Professor at James Madison University, Harrisonburg, Virginia. Her rave reviews from students and colleagues alike include statements such as "in her first semesters in a senior level algebra course, student demand was two to three times the normal level", even though her courses are known to be very demanding. She developed an integrated calculus/precalculus sequence that had brought a much larger group of students into the mainstream science calculus track and led to the decision by the biology department at James Madison University to move ALL its students into the mainstream track. She has written a text *Integrated Calculus*, used by other faculty at James Madison and some faculty at other colleges, which helps underprepared students succeed in calculus study. As a faculty mentor for an NSF-sponsored REU program, she has directed four women on research in knot theory (soon to be published), and she also continues to do research work in algebraic geometry. As a 2000 Project NExT Fellow, she has organized sessions and made many presentations at national and sectional MAA meetings and elsewhere.

Biographical Note

Laura Taalman grew up in rural Connecticut, was an undergraduate at the University of Chicago, and earned her Ph.D. in mathematics at Duke University in 2000. She is now an Assistant Professor at James Madison University, where she recently published a textbook that combines calculus, precalculus, and algebra into one course. When not teaching or supervising undergraduate research, Laura spends time with her husband and nine-month-old son, reads too many science fiction novels, attempts unreasonable knitting projects, and plays the piano badly.

Response from Laura Taalman

I would like to thank the MAA for supporting the efforts of beginning faculty with this award, and also for sponsoring programs like Project NExT, which helped me immensely as I began my mathematical career. Even more importantly, I would like to thank my colleagues in the Department of Mathematics and Statistics at James Madison University. I am very fortunate to work in a department that is supportive without being controlling, open to debate and even disagreement without being rancorous, and willing to mentor and offer advice without stifling my crazy ideas.

Index of Award Recipients