MAA

MATHEMATICAL ASSOCIATION OF AMERICA

Prizes and Awards Ceremony • MathFest 2012 •

Madison, Wisconsin

11:30-11:50 a.m.

August 3, 2012

Program for the MAA Prize Session

Opening and Closing Remarks
Paul Zorn, 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.

P. Mark Kayll

"Integrals Don't Have Anything to Do with Discrete Math, Do They?," *Mathematics Magazine*, 84:2 (2011), p. 108-119.

Mathematical work is often so highly specialized that mathematicians in one field can find it difficult to understand research in other areas. These divisions are frequently reflected in mathematics education where courses such as "Discrete Mathematics" suggest the compartmentalization of discrete and continuous topics. However, there are many examples of contemporary problems that combine disparate mathematical fields—such as algebra, geometry, topology, and combinatorics—or that connect mathematics to seemingly unrelated disciplines, such as biology. It is in this context that Mark Kayll enthusiastically reminds us that integrals do have something to do with discrete mathematics.

The beauty of Kayll's article lies in its exposition of some not-so-well known integral formulas for the number of perfect matchings in a graph. Deftly alternating between discrete and continuous topics, the author expresses the number of perfect matchings in a complete bipartite graph in terms of the gamma function. After this initial combination of the discrete and continuous, he expands his collection of improper integrals with the introduction of rook polynomials and derangements. This development of topics continues to a final full refutation of the author's title, a proof that the number of perfect matchings in a complete graph on n vertices is the nth moment of a standard normal random variable.

Kayll's well-written article provides us with engaging examples in which discrete and continuous mathematics come together. It reminds us that elements such as the gamma function are interesting in their own right, and it elegantly illustrates some of the ways in which continuous mathematics can be used to study discrete concepts. Enough details are included for the reader to follow the story, and comprehensive references are provided for those who want to learn more. Readers will finish the article with an increased appreciation of how surprising connections can exist between the discrete and the continuous, and of how the teaching of these subjects as distinct entities can be misleading to students.

Response from Mark Kayll

Thanks first to the citation author(s), whose kind words suggest that my goals in writing the article were in some measure achieved.

We've all heard the phrase 'it takes a village,' and my experiences with this paper bear this out. The considered, constructive, and generous advice from both referees contributed substantively to improving the manuscript. A few colleagues, particularly Karel Stroethoff, also volunteered helpful and insightful input. *Mathematics Magazine* editor Walter Stromquist masterfully guided me in further polishing the piece. It was a privilege to work with these fine scholars—anonymous and otherwise—who selflessly shared their wisdom.

Finally, thank you to the MAA for valuing expository writing and to the selection committee for finding the article worthy of merit. I feel both honored and delighted to receive the Allendoerfer Award, especially since the paper began as an experiment. (In a burst of eccentricity, I had even chosen a pseudonym, 'Kal M. Karply'.) To see it through to its final incarnation has been rewarding and humbling.

Biographical Note

Mark Kayll grew up in North Vancouver, British Columbia. After earning mathematics degrees from Simon Fraser University (B.Sc. 1987) and Rutgers University (Ph.D. 1994), he joined the faculty at the University of Montana in Missoula. He's enjoyed sabbaticals in Slovenia (University of Ljubljana, 2001–02) and Canada (Université de Montréal, 2008–09).

His publications fall in the discrete realm and have touched on combinatorics, graph theory, number theory, and probability. Mark's musical interests, such as playing the banjo, have motivated him in recent years to develop a general education course on mathematics and music for non-math majors.

He lives in Missoula with his wife, Jennifer (an excellent editor), and two beautiful children, Samuel and Leah.

John A. Adam

"Blood Vessel Branching: Beyond the Standard Calculus Problem," *Mathematics Magazine*, 84:3 (2011), p. 196-207.

What optimality principles determine the structure of the arteries, veins, and capillaries that comprise the human circulatory system? How reasonable are estimates that the total length of all the blood vessels within the body is on the order of 50,000 miles? This insightful and intellectually rich article offers an approach to these questions by studying the flow, branching, and maintenance of this important biological tree. To carry out his analysis, the author considers a sequence of increasingly sophisticated models. The first of these models employs only standard calculus tools to determine the optimal branching from a straight blood vessel to a nearby point. Later models use techniques from the calculus of variations to optimize a configuration for a combination of flow and volume.

The author first lays the groundwork by discussing the underlying biological setting, specifying his simplifying assumptions, and introducing some necessary equations from fluid dynamics. He then develops a sequence of models for blood vessel branching based upon a series of ever more comprehensive "cost functionals." The most sophisticated of these models implies certain empirical laws for vascular branching proposed by Wilhelm Roux in 1878, and also yields estimates for the total length of the vascular system.

This well-written article provides an excellent example of mathematical modeling in a context that is accessible and of obvious importance. It clearly shows the interaction of appropriate mathematical techniques with relevant scientific principles and illustrates the complexity of the modeling process. The reader is left with a deeper understanding of the power of mathematics to shed light on natural phenomena.

Response from John A. Adam

I am delighted and honored to receive the Allendoerfer Award. After undergoing open-heart surgery in 1996, it is perhaps not surprising that I started to develop an interest in the biophysics of the blood circulatory system! However, it was not until more than a decade later that I returned to review my old notes on the subject. In almost every calculus textbook these days there is an optimization problem about vascular branching, and as a result of devoting some class time to this topic, my appetite was further whetted to see if more sophisticated (and accurate) models of branching and bifurcation existed. Apart from a passing reference to empirical 'laws' of branching (proposed by Roux in 1878), cited by D'Arcy Thompson in his 1942 book *On Growth and Form* (Dover edition 1992), I could find only a brief but valuable summary by Rosen (1967). Consequently, I determined to try and reproduce the stated results, and re-develop them in the more pedagogic context of 'mathematical modeling'.

I must point out that the paper in its final form owes much to the valiant 'word-smithing' efforts of past *Mathematics Magazine* editor, Frank Farris, and current editor, Walter Stromquist. The paper was in pre-press status during the transition from Frank's editorship to that of Walter, so it was very thoroughly vetted by each one! I am very grateful for their guidance and assistance.

Biographical Note

John Adam is Professor of Mathematics at Old Dominion University. He received his Ph.D. in theoretical astrophysics from the University of London in 1975. He is author of approximately 100 papers in several areas of applied mathematics and mathematical modeling. His first book, *Mathematics in Nature: Modeling Patterns in the Natural World*, was published in 2003 by Princeton University Press (paperback in 2006). He enjoys spending time with his family, especially his (thus far) five grandchildren, walking, nature photography, and is a frequent contributor to the *Earth Science Picture of the Day* (EPOD: http://epod.usra.edu/).

In 2007 he was a recipient of the State Council of Higher Education of Virginia's Outstanding Faculty Award. He co-authored *Guesstimation: Solving the World's Problems on the Back of a Cocktail Napkin*, published by Princeton University Press in 2008. More recently he has authored *A Mathematical Nature Walk* (2009, paperback version in 2011) and *X and the City: Modeling Aspects of Urban Life* (2012), both published by Princeton.

Trevor Evans Award

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

Nathan Carter and Dan Kalman

"Harvey Plotter and the Circle of Irrationality," *Math Horizons,* vol. 19:2 (2011), p. 10-13.

Nathan Carter and Dan Kalman bring to life the rich mathematics behind the simple question of finding rational points on the circle by telling a creative mathematical story, using puns and characters from the Harry Potter franchise. The evil Lord Voldemorphism is trying to find the rational points on the unit circle. Harvey Plotter and his faithful companions, Hymernie and Rong, must try to determine the rational points before Lord Voldemorphism. Rong mentions that a line between two rational points always has a rational slope. He suggests they begin with (0, -1) and draw a line with rational slope; then the other point will be rational. Hymernie knows Rong is confusing the converse with the contrapositive. With some work they prove Rong's conjecture. They begin finding one rational point at a time, but they need all the rational points. A friendly suggestion by Professor Alphas Jumblemore reminds them to use a general p/q for the rational slope. Once done they realize that the rational points are Pythagorean Triples.

Response from Nathan Carter and Dan Kalman

We thank the MAA for their generous recognition with this award. Much of the credit should go to the editors and production staff of *Math Horizons* who arranged for the stunning artwork that decorates the article. The authors also wish to clear up a misunderstanding. Some seem to think that the inspiration for this "fictional account" stemmed from Manjul Bhargava's Hendricks Lectures on elliptic curves at MathFest 2011. Although Professor Bhargava's lectures were excellent, our inspiration comes from a fortunate encounter with Harvey and his friends in person, on Platform 9 3/4 in the London Underground. Not only did the illustrious trio share their story and grant us permission to retell it, but they corrected us on a common tourist blunder: it seems that referring to the platform number as 39/4 is "improper." All issues of propriety aside, we had great fun collaborating on this paper. Thanks to the MAA for publishing *Math Horizons*, to the editors for encouraging us, and to the award committee for honoring our work in this way.

Biographical Notes

Nathan Carter uses computer science to advance mathematics. He studied both subjects at the University of Scranton and at Indiana University, earning a Ph.D. in mathematical logic in 2004. He then joined the faculty of Bentley University and has worked in logic, written the book *Visual Group Theory,* and dabbled in social network analysis. He writes open source mathematics software, including *Group Explorer* for group theory visualization, and *Lurch,* a general validation environment for mathematical reasoning.

Dan Kalman has been a member of the mathematics faculty at American University, Washington, DC since 1993. Prior to that he worked for eight years in the aerospace industry and taught at the University of Wisconsin, Green Bay. Kalman has a B.S. from Harvey Mudd College and a Ph.D. from University of Wisconsin, Madison. He has been a frequent contributor to all of the MAA journals, has published two books with the MAA, and has served on the editorial boards of both MAA book series and journals. Kalman has served the national and regional MAA in several capacities, including a term as associate executive director for programs, as the current governor for the MD-DC-VA Section, and as a cast member of both productions of 'MAA: the Musical'.

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.

David A. Cox

"Why Eisenstein Proved the Eisenstein Criterion and Why Schönemann Discovered It First," *American Mathematical Monthly,* 118:1 (2011), p. 3-21.

We all recall Eisenstein's criterion mostly for its application to show that the cyclotomic polynomial for prime *p* is irreducible and perhaps we wonder why a name is attached to this, seemingly minor, auxiliary result. In this fascinating paper David Cox not only tells us that Eisenstein was scooped by Theodor Schönemann but, much more interestingly and importantly, he explains why both men were led to the result.

It's an engrossing tale beginning with Gauss's equal division of the circle, the relation of that work to the analogous problem on a lemniscate, the connection of that problem to the question of solvability by radicals of polynomials, and thence into the wonderlands of Galois theory, finite fields, and elliptic curves. It is an amazingly rich story, beautifully told, not of a priority dispute but of a grand sweeping flow of ideas beginning with Gauss (who partially scooped both Schönemann and Eisenstein) and extending into the beating heart of modern-day mathematics. It is a *tour de force* of mathematical and historical scholarship.

Response from David Cox

I am honored to receive a Lester R. Ford award from the MAA. In 1984, just after receiving tenure, I wrote my first expository paper, which is when I fell in love with the rich sweep of ideas that enabled number theory to flourish and expand in the 18th and 19th centuries. When I began writing my book on Galois theory in 2000, I stumbled upon the wonderful story of Eisenstein and Schönemann and was thrilled to see how it related to the work of Abel on complex multiplication and the lemniscate. Several years later, Ulf Persson, the editor of *Normat* encouraged me to submit an article to *Normat*. I realized that a lecture I had given on Eisenstein and Schönemann had the potential to make a good article; the obvious next step was to submit it to the *Monthly* so that the story could reach a wider audience. I am grateful to Ulf for the role he played in this and also to the Five College Number Theory Seminar, which provided a perfect venue for the lecture that led to the subsequent article.

The history of mathematics is full of great stories. The mathematics involved, even if done several centuries ago, can be surprisingly sophisticated. The challenge is to do justice to the mathematics while not getting bogged down in details, and it is even more fun if we can get a glimpse of the personalities of the key players. Mathematics is an intensely human story that simultaneously touches on universal truths. It is a great combination, one than I encourage others to explore. I thank the MAA for recognizing my contribution to this enterprise.

Biographical Note

David A. Cox went to Rice University and received his Ph.D. from Princeton University in 1975. After teaching at Haverford and Rutgers, he has been at Amherst College since 1979, except for a sabbatical at Oklahoma State University. After more than 30 years, he still loves the combination of teaching and scholarship that is possible at a liberal arts college. His current areas of research include toric varieties and the commutative algebra of curve parametrizations. His earlier work in algebraic geometry includes papers on étale homotopy theory, elliptic surfaces, and infinitesimal variations of Hodge structure, and he also has interests in number theory and the history of mathematics. He is the author of books on number theory, computational algebraic geometry, mirror symmetry, Galois theory, and toric varieties, three of which have been translated into Japanese.

Ravi Vakil

"The Mathematics of Doodling," *American Mathematical Monthly*, 118:2 (2011), p. 116-129.

This article, based on the first of Vakil's Hedrick lectures at the 2009 MathFest, is a wonderful example of expository mathematics. A *doodle* involves starting with a shape (for example a "W") on a piece of paper, and then drawing a curve around it, roughly the set of points within a small constant "distance" from the W. Now repeat the procedure starting with the curve obtained and keep repeating. Do the successive doodles get more and more "circular"? The author began with this simple mathematical question, one that a seventh grader might ask, and "just followed where it took us."

Definitions and questions are made more precise, and eventually lead to reworded precise and satisfying answers. Just following "where it took us" inspires a sequence of natural generalizations and, inevitably, to more sophisticated topics. Vakil touches on the relevance of these investigations to elementary, and not so elementary, well-known and not so well-known problems in geometry. Along the way the reader gets an informal introduction to linear invariants, winding numbers, differential geometry, Hilbert's third problem, and current research in algebraic and hyperbolic geometry. As Vakil concludes: "In some sense our journey is a metaphor for mathematical exploration in general."

Response from Ravi Vakil

I am deeply grateful to the MAA for this honor. I am humbled to see among the previous winners the names of many mathematicians I greatly admire, both for their intellect and mathematical accomplishments, and for their ability to communicate the essence of what we do to a broad audience and not just a small circle of experts. If we truly believe that mathematics is central to human knowledge, providing a subtle and powerful language with which to understand the universe, then we should feel compelled to evangelize. A willingness to speak to others does not contradict valuing work on deep problems that require years of effort even to understand. While we speak to experts in precise language, we should feel comfortable using metaphor when speaking to a broader audience, in the hopes of communicating deeper truths about how mathematics works.

This particular article has been gestating in my head for a long time, beginning with a sense of wonder at the age of five. I learned the marvelous facts therein from friends, students, teachers, colleagues—unfortunately too many to recognize here. A central joy of being a mathematician is being a part of a conversation begun centuries ago.

Biographical Note

Ravi Vakil is a Professor of Mathematics and the Packard University Fellow at Stanford. He is an algebraic geometer, whose work touches on topology, string theory, applied mathematics, combinatorics, number theory, and more. He was a four-time Putnam Fellow while at the University of Toronto. He received his Ph.D. from Harvard, and taught at Princeton and MIT before moving to Stanford. He has received the Dean's Award for Distinguished Teaching, the American Mathematical Society Centennial Fellowship, the Terman fellowship, a Sloan Research Fellowship, the NSF CAREER grant, and the Presidential Early Career Award for Scientists and Engineers. He has also received the Coxeter-James Prize from the Canadian Mathematical Society, and the André-Aisenstadt Prize. He was the the Hedrick Lecturer at MathFest 2009, and is a MAA Pólya Lecturer. He is an informal advisor to the website math*overflow*. He works extensively with talented younger mathematicians at all levels, from high school through recent Ph.D.'s.

Peter Sarnak

"Integral Apollonian Packings," *American Mathematical Monthly*, 118:4 (2011), p. 291-306.

This wonderful paper begins by considering three coins—a nickel, a dime, and a quarter. A theorem of Apollonius says that another coin can be placed in the region that they bound so that all four coins are mutually tangent. Actually, Apollonius's theorem says more: given any three mutually tangent circles, there are two circles tangent to all three. This paper is about the radii of these circles, investigated through the curvature (reciprocal of the radius). Descartes established a beautiful relation among the five curvatures, and his result implies that the radii of all further circles lie in an extension field of the rationals (it is generated by just one square root obtained from the three original radii).

Another consequence of Descartes' result is that when the three original curvatures are all integers and one other elementary condition is satisfied, then all of the subsequent curvatures are integers. This is the point at which this article takes off—it leads to connections with several other areas of mathematics, and what the author does so marvelously is to acquaint the reader with several of these. They include algebra through the Apollonian group, analysis through enumeration and density questions, and number theory through questions on curvatures that are prime.

In his exposition, the author has skillfully combined content, old with new, elementary with advanced. From its humble beginnings of three coins and the results of Apollonius and Descartes through to fascinating recent results and open problems, "Integral Apollonian Packings" is truly an exceptional article.

Response from Peter Sarnak

It is a great surprise and honor for me to be a recipient of one of this year's MAA Ford Awards. My paper on the diophantine analysis of Integral Apollonian Packings owes much to my many collaborators who have worked on different aspects of the subject making it into a theory, which was ripe for a general exposition. Also thanks to Jeff Lagarias, who introduced me to the diophantine features of Apollonian packings and to his insightful joint works on this topic. Finally thanks to the editor and staff of the *American Mathematical Monthly*, whose professional efforts greatly improved the exposition.

Biographical Note

Peter Sarnak is a Professor of Mathematics at Princeton University and the Institute for Advanced Study, Princeton. He received a B.S. degree from the University of Witwatersrand (Johannesburg) and a Ph.D. from Stanford University. His mathematical interests are wide-ranging and his research focuses on problems in number theory, automorphic forms, geometric analysis and related combinatorics, and mathematical physics.

Graham Everest and Thomas Ward

"A Repulsion Motif in Diophantine Equations," *American Mathematical Monthly*, 118:7 (2011), p. 584-598.

Beginning with $y^2 + 2 = x^3$, the authors entice the reader with the distinguished history of this equation along with the surprising sizes of solutions. The authors then lead the reader forward in time, effectively offering a "speed dating" tour of highlights in Diophantine equations, such as the *ABC conjecture*, the Baker-Stark methods, the recent proof of the Catalan conjecture, and the geometry of elliptic curves. They deftly introduce key definitions and themes of Diophantine equations in simple concrete contexts, gently hinting at the complexity that a fully general description would involve. The authors weave several themes throughout the article, such as the interplay of computation/conjecture/theory, or the "familiar refrain" that an effective (bounded) search may still be an impracticable one. This paper exemplifies the *Monthly's* goal to "inform, stimulate, challenge, enlighten, and even entertain" its readers.

Response from Thomas Ward

It is a great honor to be awarded the Lester R. Ford award, and I am most grateful to the Mathematical Association of America for this prize. I know my co-author Graham Everest, who passed away in 2010, would be particularly delighted that this comes from an organization so devoted to mathematics teaching and mathematical exposition. He enjoyed teaching and the great privilege of sharing wonderful mathematics with interested students. Diophantine problems have brought both of us much enjoyment over the years, as their study spans much of the known history of mathematics and involves a wide array of techniques and approaches. We both thank the many students we have encountered for honing our interest in mathematical exposition, and also thank both the editor and an anonymous referee for suggestions concerning the article. The article touches on several topics close to Graham's heart – the history of Diophantine equations, the beautiful link between arithmetic and geometry, rational and integral points on elliptic curves, and the great power of modern Diophantine analysis. It is not clear who we should thank for the fact that the chord-and-tangent method gives the points on an elliptic curve the structure of an Abelian group, but we are certainly grateful for this beautiful property.

Biographical Notes

Tom Ward has worked at the University of East Anglia since 1992, and is currently Pro-Vice-Chancellor (Academic) with responsibility for teaching and learning and the student experience. He attended Waterford-Kamhlaba School in Swaziland, where he encountered several inspirational mathematics and physics teachers who nurtured an interest started by his physicist parents. After studying at the University of Warwick, he worked at College Park and Ohio State University before returning to England. He works in ergodic theory, and enjoyed a long collaboration with Graham Everest, studying dynamical systems from a number-theoretic point of view and number theory from a dynamical point of view. He has written several books, including *Recurrence Sequences* with Everest, Alf van der Poorten, and Igor Shparlinski; *Heights of Polynomials and Entropy in Algebraic Dynamics* with Everest; and *Ergodic Theory with a View Towards Number Theory* with Manfred Einsiedler.

Graham Everest, who was elected a member of the London Mathematical Society in 1983, died on 30 July 2010, aged 52.

Thomas Ward writes: Graham's talent for mathematics took him to Bedford College and doctoral study under the supervision of Colin Bushnell at King's College London. He joined the University of East Anglia as a lecturer in 1983, and spent his whole career there.

His research appeared in the form of some 70 research papers and three monographs, and spanned diverse areas of number theory. Three themes informed his research: first, the impact of twentieth-century developments in Diophantine analysis and transcendence theory on counting problems and questions in algebraic number theory; second, the fascinating arithmetic properties of recurrence sequences, including classical questions in the spirit of Mersenne, Lehmer, Zsigmondy, and so on, as well as more modern developments on bilinear sequences and elliptic divisibility sequences; third, Graham had an abiding interest in all aspects of the interaction between number theory and dynamical systems.

As a researcher Graham brought great joy and creativity to his work, and the generosity of his approach to mathematics will be familiar to his thirty co-authors. Graham was a dedicated teacher and supervisor, and many generations of students will remember the energy and enthusiasm of his lectures. His belief in the transforming power of higher education was recognized in the form of a UEA Excellence in Teaching award in 2005.

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, who was a distinguished mathematician, well-known author, and professor at Stanford University.

Leslie A. Cheteyan, Stewart Hengeveld, and Michael A. Jones

"Chutes and Ladders for the Impatient," *College Mathematics Journal, v.* 42:1 (2011), p. 2-8.

Think back to your childhood and the game of *Chutes and Ladders*, in which you used a spinner to try to move your token to exactly square 100 of a 10×10 board before your opponents did. Along the way there were ladders to help you jump ahead, but also chutes to send you back. If you were unlucky, the game could be agonizingly slow. Might there be a better way?

After providing a brief review of the game, Cheteyan, Hengeveld, and Jones extend a Markov chain model that uses the "official" 1:6 spinner to one that uses an arbitrary spinner labeled 1:n in order to understand the relation between spinner range and the expected number of turns for the game. They discover that a spinner with the range 1:15 will provide the impatient player with the shortest game on average (with an expected length of 25.81 turns). Readers are invited to consider additional variations on their own, and to model other childhood board games, aided by modifiable Maple code provided by the authors.

Because the Markov chain for *Chutes and Ladders* has 101 states, the authors cleverly explicate their analysis with a simplified 10-state version of the game, making the article exceptionally clear and very enjoyable to read. Cheteyan, Hengeveld, and Jones are to be congratulated for their innovative and enticing introduction to a classical mathematical topic that all undergraduates should see.

Response from Leslie Cheteyan, Stewart Hengeveld, and Michael Jones

We are grateful, excited, and honored to receive the Pólya Award. Our collaboration evolved from a project for a 2007 Mathematical Modeling course and is a testament to providing research opportunities during the school year. Not all undergraduates are able to participate in summer Research Experiences for Undergraduates. The idea for this work came about from playing *Chutes and Ladders*; we hope to encourage others to write about their use of mathematics to answer questions based on their everyday experiences.

Biographical Notes

Leslie A. Cheteyan received her B.S. in mathematics from Montclair State University in 2008, followed by her M.S. in 2011. From an early age she has had a love for mathematics and its implications. Besides mathematics, Leslie enjoys playing all types of sports, though basketball is her favorite. Her competitive nature helps to fuel her motivation in different areas of mathematics. She now works at Memorial Sloan-Kettering Cancer Center in New York as a research assistant.

Stewart Hengeveld received his B.S. in mathematics from Montclair State University in 2008 and his M.S. in 2012. He has enjoyed spending the last seven years as a mathematics and physics tutor at Bergen Community College, and the last four years as an adjunct professor there. During his time at Montclair, he worked as a fellow in the NSF sponsored GK-12 program. In his spare time, he enjoys astrophotography and playing games of all sorts. He now works for Blue Cross Blue Shield in New Jersey. *Per aspera ad astra*.

Michael A. Jones just completed his 4th year as an Associate Editor at *Mathematical Reviews* in Ann Arbor. Previously he held faculty positions at the U.S. Military Academy at West Point, Loyola University (Chicago), and Montclair State University. He is a graduate of Santa Clara University (B.S., 1989) and Northwestern University (Ph.D. in game theory, 1994). He likes the challenge of examining everyday observations through a mathematical lens and, when appropriate, writing about them. After eight years of living next to a piano teacher in New Jersey, he finally started taking lessons last year.

T. S. Michael

"Guards, Galleries, Fortresses, and the Octoplex," *College Mathematics Journal,* v. 42:3 (2011), p. 191-200.

Beginning with Victor Klee's 1973 art gallery problem—to determine the maximum number of guards needed to protect an art gallery with a simple, closed polygonal floor plan—Michael offers a masterful and beautifully written survey of art-gallery-type results and open problems.

After describing the fundamental problem, Michael gives a compelling visual proof, due to Steve Fisk, that a closed polygonal art gallery with n walls requires at most $\lfloor n/3 \rfloor$ guards. Next he considers the more subtle question of right-angled galleries (i.e., where adjacent walls meet orthogonally), for which the corresponding maximum number of guards is $\lfloor n/4 \rfloor$. Then onto fortresses, where the guards are posted outside the perimeter of the polygonal structure and the object is to protect the exterior and a clever inversion argument is needed. Ultimately the author explores the three-dimensional analogue of Klee's original problem and produces a surprising example of a polyhedron—the "octoplex" of the title—where, unlike the two-dimensional situation, posting a guard at every vertex does *not* guarantee that the entire interior is protected. Indeed, relatively little is known in the three-dimensional case and Michael concludes the article with several open questions about three-dimensional fortresses suitable for student exploration.

Michael has provided a wonderful overview of some recent work in combinatorial geometry that is accessible to a wide audience. The article is highly engaging, exciting, and most deserving of the Pólya Award.

Response from T. S. Michael

I thank the prize selection committee for this honor.

My high school math teacher, Joyce Palmer, takes special pleasure in my receiving the Pólya award. She had heard Pólya lecture at Stanford and introduced me to his writings on problem-solving when I was her student years later.

Let me also thank *College Mathematics Journal* editor, Michael Henle, for soliciting an article on art gallery theorems and for greatly improving the submitted manuscript.

Biographical Statement

T. S. Michael received his B.S. from Caltech in 1983 and his Ph.D. from Wisconsin in 1988 under the direction of Richard Brualdi. His research focuses on combinatorics, especially combinatorial problems involving matrices or geometry. He has been on the mathematics faculty at the U.S. Naval Academy since 1990, where he coached the Putnam team for ten years and was the founding coach of the Naval Academy triathlon team. His book, *How to Guard an Art Gallery and Other Discrete Mathematical Adventures*, was published in 2009.

Annie and John Selden Prize for Research in Undergraduate Mathematics Education

In November 2004, the MAA Board of Governors approved the Annie and John Selden Prize for Research in Undergraduate Mathematics Education honoring a researcher who has established a significant record of published research in undergraduate mathematics education and who has been in the field at most ten years.

Lara Alcock

Dr. Alcock is a Senior Lecturer in the Mathematics Education Centre at Loughborough University in the UK. She received her Ph.D. in 2001 from the University of Warwick. Her first published paper in collegiate mathematics education was in 2002: "Definitions: dealing with categories mathematically," published in *For the Learning of Mathematics,* a highly regarded international journal.

Since this first publication, she has had 11 papers in eminent journals such as *Educational Studies in Mathematics, Journal of Mathematical Behavior* and *Research in Collegiate Mathematics Education*; a further two are currently in press, and several of these are co-authored with other leading mathematics educators. As well as this core of papers in top journals, Dr. Alcock has published 6 research papers in other journals, 3 book chapters, and 18 papers in conference proceedings. She has presented work at 16 conferences, and in February 2012 gave a plenary presentation at the 15th Annual Conference on Research in Undergraduate Mathematics Education.

Dr. Alcock has done considerable work in translating research in undergraduate mathematics education for different audiences. With the support of the UK's Higher Education Academy, she has produced a book and a DVD designed to allow mathematicians to engage with research-based ideas. In 2013, Oxford University Press will publish her book *How to Study for a Mathematics Degree*, which aims to use insights from research to inform and support students as they make the transition to advanced mathematics.

Dr. Alcock's work is theoretically-based, product-oriented, and pedagogically sound. She has a deep understanding of mathematical content that is evident in all her writing.

Response from Lara Alcock

I am delighted to receive the Selden Prize and, like many researchers in the field of undergraduate mathematics education, I am indebted to Annie and John Selden for their own thoughtful work in this area and for their personal support and interest over years of conference meetings. I am grateful also to my collaborators; the opportunity to work with them has shaped and much improved my thinking. Finally, thanks to the faculty and students that I have worked with at Warwick, Rutgers, Essex and Loughborough, all of whom have provided me with experience and insights that have shaped my career so far and will continue to inspire new research studies.

Biographical Note

Lara Alcock is a Senior Lecturer in the Mathematics Education Centre at Loughborough University in the UK. She was awarded a B.Sc. with first class honors and an M.Sc. with distinction, both in mathematics, by the University of Warwick, and a Ph.D. in Mathematics Education by the same institution. Prior to her current position, she worked across mathematics and education departments at Rutgers University and the University of Essex. Her current research is on mathematicians' and undergraduate students' construction and comprehension of definitions, theorems and proofs.

The 72nd William Lowell Putnam Mathematical Competition

December 3, 2011

The William Lowell Putnam Mathematical Competition is an annual contest of the Mathematical Association of America for college students established in 1938 in memory of its namesake. Each year on the first Saturday in December, over 2000 students spend six hours (in two sittings) trying to solve twelve problems.

The Five Highest Ranking Individuals

1. Samuel S. Elder, *California Institute of Technology*
2. Brian R. Lawrence, *California Institute of Technology*
3. Seok Hyeong Lee, *Stanford University*
4. Xiaosheng Mu, *Yale University*
5. Evan M. O'Dorney, *Harvard University*

Team Winners

1. Harvard University
   Eric K. Larson, Evan M. O'Dorney, and Alex (Lin) Zhai
2. Carnegie-Mellon University
   Michael T. Druggan, Albert Gu, and Archit U. Kulkarni
3. California Institute of Technology
   Zarathustra E. Brady, Samuel S. Elder, and Brian R. Lawrence
4. Stanford University
   Seok Hyeong Lee, Gyujin Oh, and Lyuboslav N. Panchev
5. Massachusetts Institute of Technology
   Vlad Firoiu, Colin P. Sandon, and Jacob N. Steinhardt

The ***Elizabeth Lowell Putnam Prize***, established in 1992, is awarded periodically to a woman whose performance on the Putnam Exam is deemed particularly meritorious. The prize this year goes to:

Fei Song, *University of Virginia*

The United States of America Mathematical Olympiad

The USAMO (United States of America Mathematics Olympiad) is an annual MAA contest that provides a means of identifying and encouraging the most creative secondary mathematics students in the country. The USAMO is part of a worldwide system of national mathematics competitions, a movement in which both educators and research mathematicians are engaged in recognizing and celebrating the imagination and resourcefulness of our youth. The USAMO is a six-question, two-day, nine-hour essay/proof examination. This year it was held on April 24-25, 2012.

Winners (in alphabetical order)

Andre Arslan, *Hunter College High School, New York, NY*

Joshua Brakensiek, *Homeschooled, Chandler, AZ*

Calvin Deng, *North Carolina School of Science & Mathematics, Durham, NC*

* Xiaoyu He, *Acton-Boxborough Regional HS, Acton, MA*

* Ravi Jagadeesan, *Phillips Exeter Academy, Exeter, NH*

* Mitchell Lee, *Homeschooled, Oakton, VA*

(Alex) Zhuo Qun Song, *Phillips Exeter Academy, Exeter, NH*

* Thomas Swayze, *Canyon Crest Academy, San Diego, CA*

Victor Wang, *Ladue High School, St. Louis, MO*

* David Yang, *Phillips Exeter Academy, Exeter, NH*

Samuel Zbarsky, *Montgomery Blair High School, Silver Spring, MD*

Alex Zhu, *Academy Advancement Science & Technology, Hackensack, NJ*

* An asterisk denotes membership on the 2012 U.S. International Mathematical Olympiad (IMO) team.

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

This 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.

Kathryn Leonard

Kathryn Leonard of California State University Channel Islands (CSUCI) is an outstanding educator who has had significant impact beyond her classroom through undergraduate research, encouragement of underrepresented groups, and cross-disciplinary collaborations. She creatively teaches a wide variety of courses, continually refining them with an intense student-centered focus. Some of her innovations include allowing students to jointly develop course expectations, writing individualized exam problems for each student, and giving students out-of-class Super Fun Activities (typically called midterms). Dr. Leonard has been described as a phenomenal student research mentor, supervising over 20 research students through an academic-year undergraduate research group and an ongoing REU as well as Master's theses. Her mentoring has had a profound impact on many students who have gone on to graduate work, many of whom had few family and community role models for advanced academic work. She seeks out first-generation college students for research positions. Dr. Leonard works with a summer program preparing underrepresented groups for success in college and works to increase scientific and technological success of at-risk girls through links between art and science. She co-founded the CSUCI Critical Friends Group, a multi-disciplinary group of faculty who meet regularly to improve their teaching through dialogue, reflection, and problem solving. She collaborates on projects with the Small Business Institute, the Center for Multicultural Engagement, and the Center for Integrative Studies, and has received multiple grants linking research and teaching of over a quarter million dollars each. She has had a significant impact on her students, the mathematical community and higher education in general.

Response from Kathryn Leonard

Thank you to the MAA for this wonderful and surprising honor, and for the crucial work you do on behalf of the mathematical community. Thank you to my inspiring students who regularly rekindle my passion for teaching and learning. Thank you to my unparalleled colleague, Cindy Wyels, for providing an excellent role model, and to CSU Channel Islands for creating a fertile environment for experimentation and growth. Finally, because my path to mathematics was fairly unconventional, I thank those who took a chance on me along the way: David Mumford, Tom Goodwillie, Jay Epperson, and Carla Wofsy. I wake up every day grateful and amazed to be living the life of the mind, shaping the minds of the future.

Biographical Note

Kathryn Leonard began her mathematical career in her junior year at University of New Mexico as an English major petitioning to waive the mathematics graduation requirement. Petition denied, she enrolled in a Calculus I course that—much to her surprise—led to a double major in Mathematics and English. After a stint writing for Popular Science magazine, she earned a Ph.D. in Mathematics from Brown University under David Mumford's supervision. She received a von Kármán Instructorship at California Institute of Technology, then joined the faculty at California State University Channel Islands. An NSF CAREER award currently supports her research on skeletal shape models with industrial applications to shape recognition. She serves as a Co-Principal Investigator on two additional NSF grants, providing funding for an REU and the Center for Undergraduate Research in Mathematics, and on a W.M. Keck Foundation grant funding interdisciplinary research courses. She still gets no respect from her cats.

Susan Martonosi

Susan Martonosi of Harvey Mudd College (HMC) is an innovative teacher, particularly in her use of technology, real-world applications and undergraduate research. Her passion for teaching probability, statistics, and operations research (OR) has truly revitalized student interest at HMC in those areas. She brings industrial sponsors into the HMC Mathematics Clinic senior projects course and emphasizes the societal impact of mathematical modeling. Dr. Martonosi is a prolific undergraduate research mentor, having worked with over 30 students on senior theses, clinics, independent studies and summer projects. Moreover, she has influenced the national OR community to embrace undergraduate research, by organizing both a track for undergraduate research talks at the INFORMS conference and a new prize for undergraduate research in OR. Her award-winning case study of airline flight delays, *Flight Delays at RegionEx*, illustrates fundamental data analysis skills and common statistical paradoxes. She has also had international influence outside of mathematics bettering lives through her work supervising the student group Engineers for a Sustainable World, which developed and delivered a solar-powered water pumping system for a Kenyan school. Dr. Martonosi is a passionate and inspiring teacher who has already had a significant impact through her work.

Response from Susan Martonosi

I am deeply honored and thankful to the MAA for giving me the Alder Award. Teaching has always been a passion of mine, and every day I am thankful for the gift of living my dreams. I am truly fortunate to work at a place as special as Harvey Mudd

College, where I have had the opportunity to learn from my colleagues, all of whom are outstanding teachers in myriad ways, and to be challenged by my students, who continue to inspire me. I have had the good fortune to grow as a teacher through their mentorship, and I look forward to continue this growth for years to come. I am thankful for the Project NExT program, which provided valuable professional development early in my tenure track that continues to bear fruit, and for my colleagues in INFORMS who have supported and encouraged my growth as a scholar. I am especially thankful to my parents for appreciating the satisfaction that arises from a life full of learning and for providing me with so many opportunities to develop that same appreciation.

Biographical Note

Susan Martonosi is Associate Professor of Mathematics and Director of the Mathematics Clinic program at Harvey Mudd College in Claremont, CA. She received her B.S. in Operations Research and Industrial Engineering from Cornell University and spent two years teaching high school mathematics in Guinea, West Africa with the Peace Corps. She received her Ph.D. in Operations Research from MIT and has been teaching at Harvey Mudd College since 2005. Her research expertise is in the mathematical modeling of problems in homeland security, and her latest research interest is solving logistics problems pertaining to humanitarian aid. She enjoys involving undergraduates in her research and has mentored over thirty undergraduate research students. She co-founded the INFORMS (Institute for Operations Research and Management Science) Undergraduate Operations Research Prize and is active in the Education Forum of INFORMS. She is also a Project NExT Fellow (Sepia Dot).

Michael Posner

Michael Posner is an innovative and creative teacher whose impact on the teaching of statistics goes far beyond his home institution. His students praise him for his enthusiasm, his passion for statistics, and the open and caring atmosphere he establishes in every classroom. Dr. Posner's use of individual student projects has received rave reviews from the class participants, and his assessment techniques have merged statistical research and pedagogy in a unique way. As a result, his students have submitted projects to a national competition. Outside the classroom, he initiated a university-wide task force investigation into the teaching and use of statistics across the various colleges of the university. Dr. Posner was the sole recipient of the Villanova University 2010 Faculty Award for Innovative Teaching. His involvement in the national statistics education community is both broad and deep, including his service as Chair of MAA's Special Interest Group on Statistics Education and member of the ASA/MAA Joint Committee on Statistics Education. His efforts have resulted in his serving as Co-Principal Investigator of a four-year $2.4 million NSF Discovery Grant concerning innovative assessment techniques for teachers and students in the Greater Philadelphia area schools.

Response from Michael Posner

I am honored to receive this distinguished award from the MAA. There are many people to thank who have guided me along the way. I am appreciative of all my teachers over the years, mostly those who taught me how to teach, but also those who taught me how not to teach. I want to thank those who have exposed me to the scholarship of teaching and learning, for a scientific (both quantitative and qualitative) understanding of how students learn better and who transformed me from a lecturer to a learning facilitator. I want to thank the educators and educational researchers who have illuminated the importance of thinking about pedagogical innovations, assessment techniques, and learning outcomes. I want to thank my department for embracing my scholarly path and especially my chair for his constant support. I want to thank the entire statistics education community, who make following this passion enjoyable and inspirational. Most importantly, I want to thank my dad, who role-modeled the professorial life that led me to here, my mom for her support and time to focus on my family and career, my wife for her collegial, emotional, and spiritual companionship, and my three greatest teachers who inspire me and make it all worthwhile, my kids—Yael, Jonah, and Ari.

Biographical Note

Michael Posner is an Associate Professor of Statistics at Villanova University. He holds a B.A. in Statistics and Economics from the University of Rochester, an M.S. in Statistics from Carnegie Mellon University, and a Ph.D. in Biostatistics from Boston University. His publications and research span the fields of statistics education research, biostatistics, health care research, statistics and the law, educational research, and analysis of observational studies. Dr. Posner serves on a number of national committees on statistics education through both the MAA and the ASA, is a Project NExT fellow (Sepia Dot), and is the Associate Director for Professional Development for the Consortium for the Advancement of Undergraduate Statistics Education (CAUSE). He has taught the MAA mini-course on Teaching Introductory Statistics at the past few Joint Meetings. Outside the classroom, he is a "retired" competitive ballroom dancer who plays ultimate frisbee and volleyball and enjoys spending time with his wife, five year old twins, and newborn.

Index of Award Recipients

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