MathFest 2008

PRIZES and AWARDS

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Program

Opening and Closing Remarks
Joseph A. Gallian, 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.

Eugene Boman, Richard Brazier and Derek Seiple

"Mom! There's an Asteroid in My Closet!"
Mathematics Magazine, vol. 80, no. 2, April 2007, pp. 104-111.

If you have a cramped living space, your closet may have a bifold door; such a door requires less floor space. Few people ask, "How much less?" One morning a student dressing for school thought of it, asked two of his college professors, and the result is this elegant paper that connects modeling, calculus, the Trammel of Archimedes, and envelopes of families of ellipses. The authors investigate and solve the original problem, showing that the outer envelope of the area traced out by the closing door is bounded by two curves. One of the curves is the arc of a circle, but the other is the asteroid, a curve with parametric representation

$$\left(x(\theta), y(\theta)\right) = \left(r\cos^3(\theta), r\sin^3(\theta)\right).$$

The authors solve extensions of the problem to doors with n folds with panels of varying lengths, and show that the asteroid keeps turning up. It is a curve that lives in many closets.

Biographical Notes

Eugene Boman received his B.A. from Reed College in 1984, his M.A. and Ph.D. from the University of Connecticut in 1986 and 1993, respectively. He has been at The Pennsylvania State University (first at the DuBois campus and currently at the Harrisburg campus) since 1996.

Richard Brazier received a B.Sc. Honors degree in mathematics from Bath University England in 1991, his M.S. in 1994 and his Ph.D. in 1997 in applied mathematics from the University of Arizona. He is currently an associate professor of mathematics and geology at The Pennsylvania State University, DuBois campus and Chair of the DuBois campus Earth Science Program.

Derek Seiple received his B.A. from The Pennsylvania State University in 2007. He is currently working towards his Ph.D. at the University of Arizona.

Response from Eugene Boman, Richard Brazier, and Derek Seiple

Naturally, the true reward was finding an interesting problem, working on it, and eventually solving it. However, we are truly surprised, amazed, humbled and grateful that so many others seem to have found the problem and our solution of it interesting as well.

Chris Christensen

"Polish Mathematicians Finding Patterns in Enigma Messages"
***Mathematics Magazine*, vol. 80, no. 4, October 2007, pp. 247-273.**

This article is a well-crafted and carefully written historical paper about Enigma coding and how a little elementary mathematics can go a long way. The Enigma device was a cipher machine used by the Germans before and during World War II. The article describes the history, design, and workings of the device, as well as an account of the breaking of Enigma - a spectacular application of elementary mathematics. This occurred in the 1930s, when a team of Polish codebreakers, chiefly Marian Rejewski, found patterns in German Enigma messages. Their work was made possible by the fact that because of radio noise, each message setting was double-enciphered. This error, together with five elementary theorems about the cycle structure of permutations, allowed the Polish cryptographers to reduce the number of Enigma keys to be tested from seven quadrillion to about one hundred thousand. The result was a simplified model of Enigma that, with hard work and luck, allowed them to determine the internal settings of the machine.

In a book review in the *Notices of the AMS*, Jim Reeds has stated, "if ever there was a real-world story problem handed to mathematics teachers on a silver platter, this would be it." This article puts a shine on that platter.

Biographical Note

Chris Christensen is a professor of mathematics at Northern Kentucky University. His mathematical genealogy is a long line of algebraic geometers; he is a student of Professor S. S. Abhyankar. He became hooked on cryptology when, after running out of (good) Tom Clancy books, he read the novel *Enigma* by Robert Harris – a story set among the World War II British codebreakers at Bletchley Park.

Response from Chris Christensen

I am deeply honored to receive an Allendoerfer Award. I enjoy exploring the impact of mathematicians and mathematics on cryptology, and I appreciate the MAA's encouragement of expository and historical writing by its publishing such papers in *Mathematics Magazine*. I would like to thank Professor Abhyankar, who has encouraged my writing style; Northern Kentucky University's Department of Mathematics, which has encouraged my cryptological exploration; and my wife Nancy, who has been willing to accompany me on (many) trips to Bletchley Park, the National Cryptological Museum, etc., and who has put up with my cryptological obsessions.

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.

William Dunham

"Euler's Amicable Numbers,"
***Math Horizons*, November 2007, pp. 5–7.**

Some of the problems from number theory are accessible to sixth graders and yet their solutions have challenged the greatest mathematicians that ever lived. Euler is one such mathematician and his fundamental contributions to number theory moved it from a side attraction to center stage. William Dunham beautifully captures Euler's thoughts and achievements on an aspect of number theory whose very name captivates even those averse to mathematics. In the article, "Euler's Amicable Numbers," William Dunham highlights one of Euler's significant contributions to number theory in an engaging style that gives the reader insights into the history and lays bare the technique. Dunham provides the reader with ample opportunities to create or complete Euler's method for creating amicable numbers. At the same time his narrative propels the reader to a wonderful result. Amicable numbers *naturally* lead to the sum of the divisors function, relatively prime numbers, multiplicative functions, and the extraordinary power of simple algebraic techniques. Well, as William Dunham points out, all of this was natural to Euler. The rest of us get to marvel at another example of Euler's genius presented in this entertaining article.

Biographical Note

William Dunham is the Truman Koehler Professor of Mathematics at Muhlenberg College. He holds a B.S. (1969) from the University of Pittsburgh and M.S. (1970) and Ph.D. (1974) from The Ohio State University.

Dunham has written four books – *Journey Through Genius: The Great Theorems of Mathematics* (Wiley, 1990), *The Mathematical Universe* (Wiley, 1994), *Euler: The Master of Us All* (MAA, 1999), and *The Calculus Gallery: Masterpieces from Newton to Lebesgue* (Princeton, 2005) – and has edited *The Genius of Euler: Reflections on His Life and Work* (MAA, 2007) as part of the Euler tercentenary celebration. He previously received MAA's George Pólya Award (1992), Trevor Evans Award (1997), Lester R. Ford Award (2006), and Beckenbach Book Prize (2008). The Association of American Publishers designated *The Mathematical Universe* as the Best Mathematics Book of 1994.

Response from William Dunham

I am thrilled to receive the Trevor Evans Award for my article about Euler's amicable numbers, in part because of the great honor and in part because I had such fun writing it. It was many years ago that I read about Euler single-handedly increasing the world's supply of amicable pairs from three to sixty (!), and I vowed that someday I would look into how he did it. When I finally got around to this task, I found (as so often happens with Euler) an argument at once simple yet jaw-droppingly clever. With the help of Art Benjamin at the editor's desk, my investigations led to a *Math Horizons* article and now – happy to say – to the Trevor Evans Award.

Robert K. Moniot

"The Taxman Game,"

***Math Horizons*, vol. 14, February 2007, pp. 18-20.**

The Taxman game is an easy to understand, yet intriguing, game and as the article shows, all the usual issues of game theory are encountered when analyzing the game. Is it zero-sum? What is an optimal strategy? What are the expected winnings? Because the game is sequential and does not end after a single, simultaneous choice of strategies by the players, an additional tension arises, stemming from the playoff between optimal play in the long run versus an optimal move for the current state of the game. On the other hand, how often does one encounter a game where the Chebyshev theorem on the existence of a prime between n and 2n plays a role in deciding the optimal first move? On reflection, it is not all that surprising that a theorem on prime distributions would be involved; after all, the rules for moving (as well as the scoring) involve divisors of numbers. This short, pleasant and well-written article is a wonderful introduction to this unusual game that connects game theory, algorithms and number theory. The open questions at the end of the article leave readers eager to explore the game on their own.

Biographical Note

Robert K. Moniot holds a joint appointment in the Departments of Computer & Information Sciences and Physics at Fordham University, where he has taught for 26 years. He is currently serving Fordham University as associate dean of Fordham College at Lincoln Center. He received his B.S. degree in physics from the State University of New York at Fredonia and his Ph.D. degree in physics from the University of California, Berkeley, where his dissertation was on the topic of noble gas isotopic patterns in meteorites. He subsequently received the M.S. degree in computer science from

New York University. His main research interest currently is in developing numerical methods for data analysis.

Recently he has begun teaching a "values seminar" exploring the social and ethical issues raised by the use of communication and information technology, and he has published some articles on these topics. In his spare time he volunteers at an outreach center for high school boys in the South Bronx, using computer programming (HTML/JavaScript or the Alice system) to help motivate them to study and stay in school.

Response from Robert Moniot

I am very honored to receive the Trevor Evans prize. I would like to give credit to a Fordham alumna, Carmela Zaccaria, who did her senior thesis under my direction (quite a few years ago now), implementing the tree-search algorithm that finds optimal plays and helping develop the heuristic described in the article. I must also thank my colleague at Fordham, Professor Leonard Nissim, for pointing me to Bertrand's postulate (a.k.a. the Chebyshev theorem) that is key to the proof of the optimal first pick.

My aim in the article was to use the Taxman game to illustrate some basic concepts from game theory, and as an example of how computer scientists develop heuristics when no algorithm for solving a problem exists. I also listed a set of open questions, to show how some difficult and interesting problems can arise out of a very simple game, and to invite the readers to continue the investigations.

One of the open questions has already been answered, at least in principle -- Norman Perlmutter (then a student at Grinnell and now at CUNY) has found an asymptotically winning strategy. That is, although his strategy is not guaranteed to win for all pot sizes, it can be proven to win for all pot sizes larger than some as-yet undetermined value. It's good to know we can (almost) always beat the taxman, in this game if not in real life!

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 M. Apostol and Mamikon A. Mnatsakanian

"Unwrapping Curves from Cylinders and Cones," *The American Mathematical Monthly*, vol. 114, no. 5, May 2007, pp. 388–416.

Taking the simple idea of wrapping a piece of paper around a candle, cutting it obliquely with a knife, and unwrapping the paper to see what shape curve results, the authors take the readers on an interesting journey finding the analytic equations describing the curves. Generalizing the question by looking at the inverse problem—describe what you see when you wrap the graph of your favorite function around a cylinder—and by investigating what happens when you wrap around a cone rather than a cylinder, we are treated to a charming collection of results.

The authors exhibit a wonderful combination of technical ability and inquisitiveness, finding natural and effective ways to analyze their problem and clearly communicate to the reader their insights. Combining an attractive problem understandable by children, an approach to the problem that requires little more than plane trigonometry, and new results that are both surprising and pleasing, this article's clear exposition and helpful illustrations invite us to both follow the author's investigations and to continue to investigate further on our own.

Biographical Note

Tom M. Apostol joined the Caltech faculty in 1950 and is now professor of mathematics, emeritus. He is internationally known for his textbooks on calculus, analysis, and analytic number theory, (translated into five languages), and for the creation of *Project Mathematics!* a series of videos that bring mathematics to life with computer animation, live action, music, and special effects. The videos won first-place honors at a dozen international festivals, and were translated into Hebrew, Portuguese, French, and Spanish. He has published 100 research papers, has written two chapters for the Digital Library of Mathematical Functions (to appear in 2008), and is coauthor of three physics texts for the telecourse, *The Mechanical Universe…and Beyond*.

He has received several awards for his research and teaching. In 1978 he was a visiting professor at the University of Patras in Greece, and in 2000 was elected a Corresponding Member of the Academy of Athens.

Response from Tom Apostol

Lester R. Ford impacted my career in many ways. His 1929 book on automorphic functions and his earlier 1915 monograph strongly influenced 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 another Ford Prize with my colleague Mamikon Mnatsakanian, whose remarkable geometric insights led to joint publication of 25 papers during the past decade.

Biographical Note

Mamikon Mnatsakanian is a former Soviet doctor of sciences in theoretical and mathematical physics and astrophysics, and professor at Yerevan State University in Armenia.

As a student he invented 'Cake-u-lus' - a simple, visual and dynamic approach for solving advanced calculus problems without formulas or equations. He has developed 'Generalized General Theory of Relativity with Variable Gravitational Constant' and 'New Apparatus of Radiation Transfer Theory' and created hundreds educational games and puzzles. He is author/co-author of 80 scientific and popular articles, inventor of the "Mamikon Spinner" and "Logo-Puzzles."

After the 1988 devastating earthquake in Armenia he began seismic safety investigations in cooperation with Californian specialists. His works found true appreciation by his new friends and colleagues in the USA. In 1996 he met his dream colleague, Professor Tom Apostol, and since then works at Caltech's *Project Mathematics!*

Response from Mamikon Mnatsakanian

The Ford Prize is a great honor for me and an encouragement for:
Students - to easily paint their classroom walls with various exact sinusoidal waves and floral designs, by dipping cylindrical or conical paint rollers at an angle in a bucket of paint (but not to cut a wrapped candle by a knife);

Constructors and metal sheet workers - to cut and fold gutters or pipes of any profile to perfectly fit in their connections with cylindrical/conical water or gas lines, chimney or air-ventilation tubes, in every possible manner;

Computer graphic designers - to use our transformations in 2D-programs, instead of 3D, to perfectly demonstrate such intersections being rotated in space;

Mathematicians - to re-evaluate the hard work done by all of the above, who use their hand and visualization skills, and to be inspired by a child's natural (deeply mathematical) excitement over bikes, rollers and a slinky.

David Auckly

"Solving the Quartic with a Pencil," *The American Mathematical Monthly,* vol. 114, no. 1, January 2007, pp. 29–39.

In a discussion that sets off to explain a procedure for solving quartic polynomial equations, Auckly leads a tour of some of the most mathematically rich and variegated native lands of the algebraic geometers. The main attractions along his tour are pencils of curves, which he ultimately employs as the chief tools for illustrating how one solves the general quartic, exemplified here by the consideration of the equation $x^4 - 7x^2 + 6x = 0$. This quartic is turned into the pencil of conics

$$y^2 - 7y + 6x + \lambda(y - x^2) = 0,\ y = x^2,$$

whose four base points provide the solutions to the original quartic.

Along the way to the solution, the author, like the best tour guides, takes us along pathways that lead deep into the mathematical countryside, hinting at what we can learn if we choose to dally longer. At a number of points along the way, he stops and opens the doors of the bus to allow his passengers to disembark and probe a bit further with the call, "Talk about this with the mathematically adept or. . . read all about it at your library."

From the safety of the motorcoach our host points to how the landscape has been developed by algebraic geometers over the centuries via the construction of rather sophisticated machinery: algebraic closure and the complexification of curves followed by projectivization, linear systems and pencils. Even more exotic notions follow on later in the tour: rational elliptic surfaces, birational equivalence, symplectic manifolds, and Lefschetz fibrations.

Auckly's travelogue engages readers with a familiar problem and keeps them interested through an exposition of some deep and significant notions in algebraic geometry. After completing his tour, we realize the need to keep our pencils sharpened!

Biographical Note

David Auckly earned his Ph.D. at the University of Michigan and then held a postdoctorial position at University of Texas Austin followed by an NSF postdoc at Berkeley. He is now a professor at Kansas State University. His research interests cover a broad range of geometry/topology and overlap with PDE, mathematical physics, and algebraic geometry.

He has been very involved in many special educational programs. For example, he helped incorporate mathematics into a residential college at the University of Michigan, and created a unique `Brainstorming and Barnstorming' program at KSU.

He lights up like the Vegas strip when he talks about mathematics. Dave has directed around 30 undergraduate and graduate level research projects and he has been recognized with several teaching awards. In addition to mathematics, Dave enjoys being silly with his wife and two little children. He also enjoys any time that he can spend in the mountains.

Response from David Auckly

I am very flattered to receive this award. I have never found writing easy, however it is always easier to write about something interesting. The work of Gompf and Donaldsonn on Lefschetz fibrations is beautiful and it formed the motivation for the paper.
I hope the paper will inspire others to study these beautiful ideas.
I owe Bruce Palka and the anonymous referee thanks for their superb editing/refereeing.

Andrew Cohen and Tanya Leise
"Nonlinear Oscillators at Our Fingertips," ***The American Mathematical Monthly*****, vol. 114, no. 1, January 2007, pp. 14–28.**

Hamming is famous for having said "the purpose of computing is insight, not numbers." In this well-crafted paper Tanya Leise and Andrew Cohen present a case study illustrating that the purpose of mathematical modeling, too, is insight not numbers. They employ a nonlinear differential equation model of some moderate complexity to study a real-world dynamical system involving coupled oscillatory neuromuscular behavior, as in the coordination of the simultaneous twiddling back and forth of a person's left and right index fingers. As readers are invited to test for themselves in a simple experiment, this two-finger motion exhibits striking behaviors: as one increases the frequency of the twiddling, a sudden transition from nearly out-of-phase movement to in-phase (or sometimes, anti-phase) oscillation takes place. The authors carefully show how to construct the model, developed by Haken, Kelso, and Bunz, beginning with the familiar mass-spring ODE $m\ddot{x}+kx=0$. Terms are added in turn to take care of long-term periodicity and amplitude damping. A discussion is then presented for how one chooses an appropriate "coupling function" to piece together a pair of model equations for the motion of each of the two fingers. This coupled model is meticulously analyzed, analytically, when convenient (and with the necessary help of a computer algebra package), and also graphically, so as to highlight the key features of the system's behavior and to verify that it reproduces the desired motion.

Although coupled oscillatory neuromuscular motion is a complex phenomenon whose underlying physics is yet to be fully understood, Leise and Cohen are able to uncover a good deal of qualitative information from a careful analysis of a model system of differential equations. Who knew that just twiddling your fingers could lead to such engaging mathematical insight!

Biographical Notes

Tanya Leise, who received her Ph.D. from Texas A&M in 1998, is an assistant professor of mathematics at Amherst College. While her previous research focused on the dynamics of accelerating cracks in elastic and viscoelastic media, she has recently developed an interest in the dynamics of coupled nonlinear oscillators in the contexts of rhythmic motion and chronobiology (the study of biological clocks). She is currently most interested in adjusting the circadian rhythm of her 5-year-old daughter, that is, in getting her up in time to catch the school bus each morning.

Andrew Cohen received a M.Sc. in computer science from Texas A&M University in 1996 and a Ph.D. in psychology and cognitive science from Indiana University in 2002. He is currently an assistant professor of psychology at the University of Massachusetts, Amherst. His research interests lie in using mathematical models to investigate the building blocks, or features, that underlie perception and exploring how multiple features are combined to determine higher-level cognitive decisions in tasks of perceptual classification, recognition memory, judgment, and identification.

Response from Andrew Cohen and Tanya Leise

We are honored to receive the Lester Ford Award for this article, which arose from our discussions bridging mathematics and psychology. Working on this project was great fun, and we have enjoyed encouraging mathematicians to “twiddle” their fingers. We would like to thank Geoffrey Bingham for bringing the Haken-Kelso-Bunz model to our attention and especially J.A.S. Kelso for his help in improving our exposition.

Thomas C. Hales

"The Jordan Curve Theorem, Formally and Informally," ***The American Mathematical Monthly,*** **vol. 114, no. 10, December 2007, pp. 882–894.**

The Jordan Curve Theorem, stating that every simple closed planar curve separates the plane into a bounded interior region and an unbounded exterior region, is familiar to most readers of the *Monthly*. The author brings us to a deeper understanding of the possibly less familiar topic of developing a formal proof of the theorem, where the logical inferences have been generated and checked by a computer.

Professor Hales guides the reader through some of the surprising complexity and equally surprising simplicity of the formal argument, at the same time reminding us of a very pleasing proof of the Theorem published in the Ford Award winning article by Carsten Thomassen (*Amer. Math. Monthly,* 99 (1992), 116–130).

By emphasizing the interplay between the everyday mathematics that most of us practice and the formal deduction that is the core of his work, the author helps the readers appreciate both the attractiveness of the research and the drive of the mathematicians who pursue the challenge of actually formalizing the informal arguments that we call rigorous mathematics.

Biographical Note

Thomas C. Hales received his master's degree from Stanford University in the School of Engineering and his Ph.D. in mathematics from Princeton University in 1986 under Robert Langlands. He has held positions at Harvard University, the University of Chicago, and the University of Michigan. He is currently the Andrew Mellon Professor of Mathematics at the University of Pittsburgh. His honors include the MAA Chauvenet Prize (2003), the R. E. Moore Prize (2004), and the Robbins Prize (2007) of the AMS. His research interests include representation theory, motivic integration, discrete geometry, and formal proof theory.

Response from Thomas Hales

It is an honor to be a recipient of the Lester R. Ford Award. It is a pleasure to acknowledge the many researchers who have developed, over a period of decades, the technology that has made it possible to implement projects such as the formal proof of the Jordan Curve Theorem. It filled me with a deep feeling of awe to watch a computer check off every last one of the some 80 million primitive logical inferences in the proof of the Jordan Curve Theorem, showing in an ultimate way how mathematics captures the concept of continuity in a series of discrete logical steps. I wish to thank the MAA for helping to make research on formal proof better understood within the mathematical community.

Katherine Socha

"Circles in Circles: Creating a Mathematical Model of Surface Water Waves," ***The American Mathematical Monthly,*** **vol. 114, no. 3, March 2007, pp. 202–216.**

This article begins with a fascinating picture from World War II: In 1943 an Italian supply ship was torpedoed by a British submarine, which was then nearly bombed by an Italian airplane. A British fighter pilot then took the famous picture showing the interacting water waves caused by the torpedoes, the bombs, and the motion of the damaged Italian ship.

How can the observed patterns of these water waves be explained by mathematics? Katherine Socha shows us in this article the power of partial differential equations to model surface wave motion. The article guides the reader through the process of posing the problem, determining boundary conditions, and translating physical properties into mathematics. The author shows how physical assumptions about factors such as surface tension and gravity are incorporated into the mathematical model.

Along the way, some interesting approximations are needed to find usable solutions. The resulting model provides enough sophistication to explain the different behavior of gravity-dominated water waves and capillarity-dominated water waves. Thus this article can serve as a beautiful introduction to important aspects of partial differential equations.

Biographical Note

Katherine Socha is an assistant professor of mathematics at St. Mary's College of Maryland. She received her B.A. degree from Reed College, her M.S. degree from Portland State University, and her Ph.D. in mathematics from The University of Texas at Austin in 2002. She spent two years as a faculty member of the Lyman Briggs School of Science at Michigan State University before accepting a position at St. Mary's College of Maryland. Dr. Socha is committed to improving access to mathematics for all students. Her two favorite mathematical shapes are the circle and the icosahedron.

Response from Katherine Socha

Thank you for this delightful honor. I am thrilled to join the prestigious list of Ford Award recipients. The wonderful problem in mathematical modeling of surface water waves deserves every accolade, as do the outstanding teachers and expositors whose work influenced me: Tom Dillon presented the problem in a graduate course on fluid dynamics; Andrew Bennett gave wonderful encouragement; Joan Broderick and Susan Goldstine helped me make "writing time" away from my teaching responsibilities; the late, much-missed John Leadley taught me how to write mathematics; and Kevin Foltinek and the anonymous reviewers provided excellent feedback that strengthened the article. I am especially grateful to Bruce Palka, former *Monthly* editor and writer extraordinaire, for writerly encouragement and for urging me to convert my "job talk" into written form.

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.

Roland Minton and Timothy L. Pennings

"Do Dogs Know Bifurcations?" C*ollege Mathematics Journal*, vol. 38, no. 5, November 2007, pp. 356-361.

You don't have to be a dog lover to appreciate this paper, which lends new life to, and extends, a problem first discussed in Johann Bernoulli's lectures to l'Hospital in 1693. While Bernoulli considered a farmer walking along and then into a plowed field, this article considers Pennings' dog, Elvis, who is retrieving a ball thrown into the water some distance away.

Previously, Pennings considered the case where Elvis started on the shore and would apparently solve an optimization problem by running along the beach to an appropriate point, then jumping in and swimming to the ball. In this article, the optimization problem is more complicated, because Elvis is already in the water but down the beach from the ball. Will Elvis always take the seemingly obvious route and swim directly to the ball, or will he take the counterintuitive approach — swim to the shore, run along it for a while, then swim back out?

Minton and Pennings observe that Elvis appears to perceive the bifurcation between swimming straight to the ball when it is reasonably close, and taking advantage of the shoreline when the ball is more distant. This also provides evidence that the dog perceives the global nature of the problem and is not solving a related rates problem, as others have conjectured.

This paper gives an engaging presentation of a nice optimization problem that calculus students can easily visualize and understand. It presents some lovely intuitive arguments that confirm the mathematical conclusions and a limiting case of the problem that gives rise to a pictorial proof of the arithmetic mean-geometric mean inequality. In the end, the authors present data to suggest that Elvis, presumably unable to find derivatives and set them equal to zero in his head, apparently just has good intuition. But the message is clear: Our human students will fare better by doing the calculus, unless they possess a Welsh corgi's instinct for estimating the bifurcation point. As Yogi Berra said, "If you come to a fork in the road, take it."

Biographical Note

Roland Minton is a professor of mathematics at Roanoke College in Salem, Virginia, where he has taught since 1986. He received Ph.D. and M.S. degrees from Clemson University and a B.S. from Virginia Commonwealth.

Minton does research in the mathematics of sports, including golf, tennis and the amphibious activities of Welsh corgis. The products of this work include articles, student independent studies, course projects, calculus labs and many examples and exercises for the calculus books which he co-authors with Bob Smith. A book on the mathematics of golf is in progress.

Minton lives in Salem with his wife Jan and avidly follows the exploits of his children Kelly and Greg. His two cats are defiantly disinterested in his research. He enjoys playing golf, reading the works of such diverse souls as Orson Scott Card, Kinky Friedman, and Stephen Jay Gould.

Response from Roland Minton

It is a true honor to receive this award named for George Pólya, the master teacher whom so many of us aspire to emulate. It was a pleasure working with Tim and Elvis. Their first article is a gem, and they received my intrusion with warmth and generosity. I think that Professor Pólya would have enjoyed watching the collaboration. We were able to "solve it" quickly. The process of finalizing the structure of the article and making word choices that most effectively conveyed our sometimes divergent ideas was painstaking. In other words, it was as much (professional) fun as a mathematics teacher can have.

Biographical Note

Timothy Pennings is a professor of mathematics at Hope College in Holland Michigan, where he has been since completing his Ph.D. at Iowa State University and B.S. and M.S. at the University of North Dakota. Pennings enjoys the philosophical side of mathematics, and writes papers (such as "Infinity and the Absolute") that dig into the rich soil at the confluence of mathematics, philosophy, theology and cosmology. His research is in dynamical systems and mathematical modeling. Recent research with undergraduates includes modeling volleyball serves, bicycle dynamics, a neural explanation of the s-shaped learning curve, and finding the relationship between the shadowing property and sensitive dependence. Pennings has directed the NSF-REU Site in Mathematics at Hope College since 1995.

Pennings enjoys kayaking, cross-country skiing, biking, climbing sand dunes and other activities that don't use fossil fuels. Choral music, ultimate frisbee, and racquetball fill out the week. Elvis also enjoys doing research with undergraduates, but is equally fond of chasing squirrels and retrieving sticks.

Response from Timothy Pennings

I am grateful and honored to receive an award bearing the name of George Pólya. Professor Pólya spent his career not only doing mathematics, but also thinking about HOW we do mathematics. Although he suggested a series of useful steps, at its core the creative process is a mystery. A friend of mine once said, "I am not a thinker, but an observer of thoughts." That is, sometimes all we can do is to relax, empty the mind of distractions, and glimpse the "thought spark" that occasionally flashes by. Humans must work at this; Welsh Corgis seem to come by it naturally.

Andrew J. Simoson

"Pursuit Curves for the Man in the Moone," ***College Mathematics Journal*****, vol. 38, no. 5, November 2007, pp. 330-338.**

Imagine harnessing two dozen swans to carry you to the moon and back. Such a flight is the subject of Bishop Francis Godwin's story "The Man in the Moone," written in 1599 but not published for decades. Godwin's swans, who fly toward the moon — so they pursue it instead of intercepting it — need twelve days for the trip there but only eight for the return. In his delightful article, "Pursuit Curves for the Man in the Moone," Andrew Simoson speculates on these numbers. Are they reasonable for a body flying at constant speed under such conditions? The answer is a surprising "Yes!"

For mathematical context, Simoson provides a historical survey of pursuit problems, and then proceeds to model Godwin's moon flight two ways: once without taking the sun into account, once with the sun as center. For literary context, Simoson provides a brief but varied selection of notable earth-moon voyages in fiction, only three of which address the durations of both the moon shot and the return trip. It is nothing short of astonishing that one of these stories offers feasible estimates for a craft (swan-powered or otherwise) that chases the moon—especially a story written by a bishop who lived a century before differential equations were studied in earnest, and who did not publish the tale for fear of controversy over his assumption of a Copernican solar system.

Simoson's paper, with questions for further work in its final section, makes a nice launching point for a project in a differential equations or vector calculus class. Further, it is worth reading for its own sake, both for the rare intersection of mathematical investigation and literary exploration and, ultimately, for the vindication of what was essentially an incredibly good guess on Godwin's part. As mathematicians, we can willfully suspend our disbelief only so far. Sure, a swan flight to the moon is a flight of fancy. Simoson's article shows the numbers do work out.

Biographical Note

Andrew J. Simoson earned a Ph.D. from the University of Wyoming in 1979 under the direction of Leonard Asimow in functional analysis. Since then he has been chairman of the Mathematics Department at a small school in Appalachia, except for two sabbatical year Fulbright appointments at the Universities of Botswana and of Dar es Salaam. He is the author of MAA's Dolciani Series book, *Hesiod's Anvil: Falling and Spinning through Heaven and Earth*, and he had the good fortune to win the 2007 Chauvenet Prize. In exchange for accompanying him to Africa for two years, Andy agreed with his wife Connie to take ballroom dance lessons; now after quite a few lessons and stepped-upon-toes, they---at the behest of the students--regularly teach a college dancing class each spring term.

Response from Andrew Simoson

To those who had a hand in selecting my submission from the many fine articles and notes that regularly appear in *The College Mathematics Journal*, thank you! It is a distinct honor to be on the same list as those singled out in past years. I only wish that I could share this honor with the author of "The Man in the Moone," a bishop of the early seventeenth century, Francis Godwin, who proposed the pursuit problem and a solution which inspired this paper---for once I read his story, the article almost wrote itself. Perhaps if there is a heaven, and I happen to make it there, I can thank him in person.

Annie and John Selden Prize for Research in Undergraduate Mathematics Education

In January 2005, the MAA Board of Governors established 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.

Marilyn Carlson

Dr. Carlson is professor in the Department of Mathematics and Statistics at Arizona State University. She received her Ph.D. in 1995 from the University of Kansas. Her first publication in collegiate mathematics education was "Obstacles for college algebra students in understanding function: What do high performing students really know?" in the AMATYC Review in 1997. Thus, she fits the qualification on the date of first publication in this field.

Dr. Carlson was nominated for the award by two colleagues, both of whom focused on her important research on the understanding of function and covariation and on mathematical problem solving, and on her role as a leader in establishing the field of research in collegiate mathematics education. She has 23 refereed or invited publications since 1997, in addition to a large number of other publications and presentations, primarily in these two areas.

Since 2003 Dr. Carlson has served as director of the Center for Research on Education in Science, Mathematics, Engineering and Technology at Arizona State University. She is currently the PI of Project Pathways, a $12.5 million NSF Math and Science Partnership project, and co-PI of a $4.5 million NSF Teacher Professional Continuum project. She has served as a PI or co-Pi for 13 additional projects, funded primarily by the National Science Foundation. Dr. Carlson led the development of the Ph.D. program in mathematics education in her department, and she has served (or is serving) as major advisor to ten Ph.D. students and on the committee of an additional ten students.

Dr. Carlson has been very active in SIGMAA RUME. She has served as president of RUME, as a senior research mentor for RUME, has chaired three committees for RUME, has presented an invited plenary address at a RUME conference, and has acted as a local host for a RUME conference. Some of her other professional work includes hosting, with Biodesign Institute and Consortium on Science, Policy, and Outcomes, an ASU-wide event for National Science Board members and Commission on 21st Century Education in Science, Technology, Engineering and Mathematics; serving on the National Research Council Panel: The Disciplinary Content Panel on the Advanced Study of Mathematics and Science in U.S. High Schools; participating in the National Governors' Association's advisory discussions on issues in U.S. science and mathematics education; and serving on five NSF review panels.

Dr. Carlson is outstanding in terms of the quality and impact of her work at the early career stage.

Biographical Note

Marilyn Carlson is professor of mathematics education in the Department of Mathematics and Statistics at Arizona State University. She has a B.S. in mathematics, an M.S. in computer science and a Ph.D. in mathematics education. In 1998 she received the prestigious Early Career Award from the National Science Foundation and recently served as director of the Center for Research in Education in Science, Mathematics, Engineering and Technology (CRESMET) at ASU. She has directed first year mathematics at the University of Kansas and Arizona State

University and has led the development of a Ph.D. and Master's program in mathematics education from which seven Ph.D. and 12 Master's students graduated under her advisement. Her research focuses on student thinking about central ideas of precalculus and beginning calculus, and the development of mathematical thinking. More recently, she has engaged in investigations of knowledge and practices for teaching mathematics. Carlson served as the coordinator for SIGMAA RUME, during which time she initiated and co-edited *Making the Connection: Research and Practice in Undergraduate Mathematics Education*. Carlson also led the development of the Precalculus Concept Assessment (PCA) instrument and has written curriculum for courses in precalculus and beginning calculus.

Response from Marilyn Carlson

I am highly honored to receive this prestigious award. I am also grateful to Annie Selden, John Selden and Ed Dubinsky for their leadership in building the field of undergraduate mathematics education research. I am also grateful for the mentorship of Uri Treisman and Josef Dorfmiester, two outstanding individuals, who generously shared their time and talents to co-advise my dissertation study and support my intellectual development at a critical point of my academic pursuits. I am also grateful to my parents, Paul and Clariece Carlson, who nurtured my curiosities and valued my educational pursuits, and to my children, Tim and Joni, for sharing my journey. I want to also acknowledge the work of many outstanding mathematicians for creating a collaborative environment for me, and my research colleagues at ASU. Thanks to Mike Oehrtman, my colleague and friend, who pushes my thinking daily. To my students who continue to teach me and to my intellectual sole mate, and now my companion, Pat Thompson, thank you for continuing with me on my intellectual journey.

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.

David Brown

David Brown of Ithaca College receives uniformly excellent evaluations from students about his teaching. His colleagues enthusiastically note that he has transformed their curriculum for the undergraduate mathematics major by introducing a highly successful two-semester sequence of courses—Junior Seminar followed by Research Experience in Mathematics. He also developed an inquiry-based freshman course that aims to provide a "sustained experience for students in the process of creating mathematics." Besides directing independent studies and honors work and teaching his regular classes, he has supervised research projects for 30 students on 15 different projects. He has six articles published with students and has made numerous presentations on student work. In the summers 2004-2007 he co-directed with an Ithaca College computer science faculty member an NSF sponsored REU. In the broader mathematics community he has advocated integrating research in mathematics in the undergraduate mathematics curriculum through regional, national, and international presentations. These include a joint presentation with colleague O. Yurekli at a meeting organized by MER, a presentation at a *Compass Points* network conference, and a presentation at an international mathematics education conference in Turkey. He continues to do his own research. For all these accomplishments and more, David Brown is a worthy recipient of an Alder Award.

Biographical Note

David Brown received his B.A. from Ithaca College and M.S. and Ph.D. from Cornell University. He is very excited to be back teaching at his alma mater, sharing the joy of mathematical discovery with all of his students. Whether it is a multidisciplinary first year seminar on cryptology, a calculus class, or a mathematical research course, he loves to teach. He also greatly enjoys collaborating with colleagues at IC in research on special functions while continuing his own scholarship. When not working, David loves spending time with his wife, son and daughter.

Response from David Brown

I thank the MAA for this wonderful award and for its continued insistence on quality mathematical education. I thank the colleagues and students who undertook my nomination. My entire department deserves recognition for giving me the freedom to try new ideas and for being an inspiration for innovative teaching. My students share this award as they have taken each step with me in my growth as an educator. Finally, I thank my wife and children for being a constant source of joy and excitement. I will strive to live up to the honor of this award.

Jacqueline A. Jensen

Jacqueline A. Jensen of Sam Houston State University is lauded by students for her personal interest in them and their learning. She reaches out to students of every level to improve their view and knowledge of mathematics and to improve their lives as well. Her dean credits her with changing her department's approach to recruiting and educating mathematics students, saying that a large portion of the faculty are now involved with student learning outside the classroom and with undergraduate research projects. Jackie broadly promotes mathematics, innovative teaching methods, and recruits women into mathematics. She reactivated the local MAA chapter "while encouraging more than 70 students to attend and present at the MAA sectional meetings, MathFest, and the Joint Mathematics Meetings." She founded a lecture series bringing female mathematicians to campus to present talks for undergraduates, and she founded the Texas Undergraduate Mathematics Conference, which now brings over 100 students to present talks and hear presentations by well-known speakers. She coordinates all the Young Mathematicians Network activities at MathFest and the Joint Meetings. For all these achievements and more, Jacqueline Jensen is a worthy recipient of an Alder Award.

Biographical Note

Since earning her Ph.D. from the University of Oregon in 2002, **Jacqueline Jensen** has been an assistant professor at Sam Houston State University. At SHSU, she serves as the advisor for the Ruth Lane Mathematics Society and through reactivating the MAA student chapter, has encouraged more than 70 students to present their research at MAA sectional meetings, MathFest and the Joint Mathematics Meetings. With funding from the MAA and the Tensor Foundation, she founded the Piney Woods Lecture Series in mathematics, which brings female mathematicians to campus to present talks for undergraduates. She also founded the Texas Undergraduate Mathematics Conference, the third year of which brought together approximately 150 students to present talks, participate in panel discussions, and see presentations by well-known invited speakers. Due to her dedication to students, the Texas Section of the MAA acknowledged her in 2006 with that year's Award for Outstanding Contributions to Students.

Response from Jacqueline Jensen

I am deeply honored to be recognized with a Henry L. Alder Award. To be listed among the Alder Award winners is humbling. I am proud to be recognized for my contributions to students, both in and out of the classroom, and thank all of the students that I have had a chance to interact with at Sam Houston State University (SHSU) for their dedication and enthusiasm. I also thank my many colleagues, both at SHSU and at other institutions, for their words of wisdom, and my friends and mentors from Project NExT for their guidance as I have embarked upon my career.

Katherine Socha

Katherine Socha of St. Mary's College of Maryland is credited with classroom teaching that successfully incorporates in an exceptional manner a wide variety of teaching techniques. She takes the interest of an individual student and develops from those interests an appropriate research project for the student as a senior thesis. Students rave about her classes as interesting and fun! Her accomplishments include: serving as a project co-director for SIAM's *whydomath*, a national program aimed at increasing the number of science students choosing to study mathematics; being a co-director of the WomenMath Poster Project sponsored by AWM; serving as director for St. Mary's Summer REU for first-year and second-year underrepresented students sponsored by MAA's SUMMA office; co-directing MAA PREP workshops on establishing and running an effective Emerging Scholars Program; and establishing a summer science camp for underserved eighth-grade girls. She is also a popular speaker on outreach activities. For all these achievements and more, Katherine Socha is a worthy recipient of an Alder Award.

Biographical Note

Refer to page 18.

Response from Katherine Socha

I am deeply honored to receive the Alder Award, and I am very grateful for the collaborations, encouragement, and support I have received from the mathematics community, from many mentors, and from my colleagues. Thank you to St. Mary's College of Maryland for allowing me the freedom to carve out a slightly non-traditional path. Further thanks: Thomas Wieting and John Leadley encouraged me to persist in mathematics; Joyce O'Halloran taught me how to read mathematics (though she may not have known it!); Dorothy Williams showed me that it is possible to merge your values with your work and do good in the world; Jerry Bona led me to a great area of study; Michael Starbird became a valued collaborator; and Karen Uhlenbeck supported my first steps toward a career in teaching through outreach and communication. Special thanks to my colleagues in the Mathematics & Computer Science Department at SMCM: you enable and value my work, and I am glad to be friends and colleagues with you.

Index of Award Recipients