problems (perhaps not just mathematical). Seen in this context, the book serves as a lively and fun public ambassador from the world of mathematics to the general public and helps free readers from damaging and pernicious stereotypes.

Addendum

Curious readers may sample the first two chapters of *Math Girls* as free downloads from the publisher's website.[9] Since the content of the book advances quickly in mathematical difficulty, we found them to be a bit unrepresentative of the book; more specifically, we found them to be among the least interesting. Readers who experience difficulty following the math in these samples are unlikely to enjoy the remainder of the text. Unfortunately, a large portion of the recommended supplementary readings were written in Japanese and have not been translated.

[9]Math Girls *homepage, sample section:* `http://bentobooks.com/wp-content/uploads/2011/10/Math-Girls-Sample.pdf`.

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Book Review

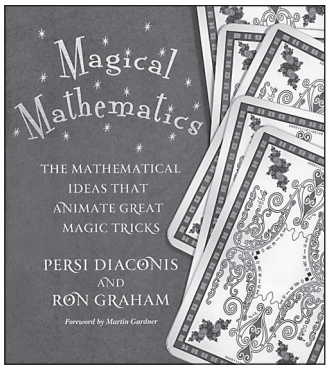
Magical Mathematics

Reviewed by Donovan H. Van Osdol

Magical Mathematics: The Mathematical Ideas that Animate Great Magic Tricks
Persi Diaconis and Ron Graham
Princeton University Press, 2011
US$29.95, 258 pages
ISBN-13: 978-0691151649

When I agreed to review this book for the *Notices*, I did not know that the perfect review had already been written—by Martin Gardner—and that it appeared as the preface to the book itself! In the end, I decided to write up my two cents' worth in hopes of encouraging you to buy *Magical Mathematics* for yourself. Of course, if you want to read the perfect review without buying the book or reading this review, you are likely to be able to read the preface by having a "Look Inside" the book at `Amazon.com`.

To give a vignette of what you can expect to find flowing from the pens of Diaconis and Graham, let me describe a magic trick for you. I'm going to write a word on a piece of paper, fold it into fourths so as to hide the word, and put the paper beneath this brick here on the table before us (we need something really weighty to protect my prediction from being tampered with!). To do your part in



this test of my ability to forecast the future, I want you to pick *any* word (of which there are thirty-six) in the first sentence of the preceding paragraph. Notice that I have no control over your choice: there's nothing up my sleeves! Let's call this word a "key" word.

Now please count the number of alphabetic characters in your key word and move forward in the paragraph that many words to arrive at a new key word. For example, if the initial "to" in that first sentence were your chosen key word, then your next key word would be "this". Got it? Okay, now repeat this process (so that in our example your next key word would be "*Notices*"), over and over, until you can't go any further in the second sentence (which ends with "yourself": always a good place to stop!). There are twenty-three words in that sentence, so there's not a very good chance that I could know your final key word before you started, right? Good, I agree… But wait, there's this piece of paper under this brick here where I wrote a word… Would you pick up the brick, look

Donovan H. Van Osdol is professor of mathematics, emeritus, at the University of New Hampshire. His email address is `dvanosdo@tampabay.rr.com`.

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at my prediction, and then show it to the audience please? Truly a "Magical" prediction, wouldn't you agree??

The playing card version, and origin, of this example is: you pick a "secret" number from one to ten, count down that many cards in a well-shuffled standard deck of cards, use the face value (aces count 1, royal cards count 5) of that card as the new "secret number", and proceed in the same way until the magician tells you to stop. With probability greater than 0.8, the magician has stopped you at the point where your previous secret number would have stopped you anyway. This is called the "Kruskal Count". It was invented by Martin D. Kruskal, winner of the AMS Steele Prize in 2006 and perhaps most well known for the discovery and theory of solitons.

Our version is a variation on a suggestion of John Allen Paulos (see the final paragraph of http://www.math.temple.edu/~paulos/bibhoax.html). As for new mathematics suggested by the Kruskal Count, is there an optimal secret number for the magician to use each time he does the trick? (The answer is "yes".) For this and other interesting matters, see the 2001 paper "The Kruskal Count" by Lagarias, Rains, and Vanderbei (http://arxiv.org/pdf/math/0110143v1.pdf). For a somewhat more relaxed discussion of the Kruskal Count, the mathematics behind it, and alterations thereto, you can consult Colm Mulcahy's column: http://www.ams.org/samplings/feature-column/fcarc-mulcahy6. How does all this play out if one uses a pinochle deck?

Now back to *Magical Mathematics*. After presenting a "trick" together with suggested "patter" in something of the above fashion, most likely together with pictures, Diaconis and Graham then consider, "How does it work?" They also include names of people, some history of the trick, and new mathematics suggested by the trick. Then, perhaps, a new trick suggested by the new mathematics is outlined. Quite a nice circle.

But what else would one expect from Diaconis and Graham? They both started life as entertainers outside of mathematics (card tricks for Diaconis, juggling and trampoline for Graham). As mathematicians, probabilists, combinatorists…, they continue to perform magic within mathematics and mathematics within magic.

Some of the mathematical ideas touched upon in this wonderful book include: de Bruijn sequences, universal cycles, and decoding DNA in chapters 2 through 4; the Gilbreath Principle, the Mandelbrot set, and Penrose tilings in chapter 5; various mathematical properties of card shuffles in chapter 6; modular arithmetic's contribution to nickel, dime, and quarter tricks (going back at least five hundred years—but of course, not in terms of U.S. currency!) in chapter 7; the *I Ching* (Book of Changes) and magic in chapter 8; juggling and how to do simple juggles in chapter 9; and in chapter 10, anecdotes about "Stars" of Mathematical Magic—including Martin Gardner, who knew them all—together with a few of their tricks. Among these is a topological trick involving the inside and outside of a closed loop, and one based upon the game of Rock, Paper, Scissors. The penultimate chapter, "Going Further", gives suggestions for more study, while the final chapter, "On Secrets", talks, among other things, about how to convince someone that you can prove a result without actually giving any details of your proof.

The authors might have called this book *Mathematical Magic*, but I think they chose wisely: magic is the medium, but mathematics is the message. The two subjects are charmingly intertwined and used as the context for Diaconis and Graham to talk about things they dearly love. You'll be richly rewarded by a visit to the world of these contemporary giants of mathematics, magic, and entertainment.

For links to more reviews of books, films, and plays see
http://www.ams.org/media-reviews.