Book Reviews

The Best Writing on Mathematics 2012

Mircea Pitici, Editor
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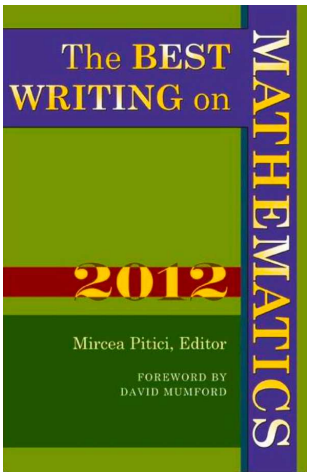
This anthology of popular articles with a mathematical theme is the third in a series edited by Mircea Pitici, who teaches maths and writing at Cornell University. Like its predecessors, the articles were originally published in generalist journals such as *Science*, *Nature*, *New Scientist*, or *Scientific American* or in specialist mathematics, mathematical history, philosophy or education journals or simply in blog posts. They are divided equally among purely mathematical exposition, unusual applications, history of mathematics and mathematics education.



What does good writing on mathematics mean? According to Pitici, it signifies a short, jargon-free article aimed at a lay audience which explains some easily understood mathematical problem.

For example, the scientific journalist Brian Hayes, writing in *The American Scientist*, explains why the volume $V(n)$ of the unit ball in n dimensions increases monotonically with n till $n = 5$ and then decreases monotonically, approaching zero as n increases. A standard mathematics text would accomplish this by defining Lebesgue measure in n-dimensional Euclidean space and calculating $V(n)$ by integration. Instead, Hayes begins with a formula for $V(n)$ found in *Wikipaedia* and points out that the volume given by this formula depends on the ratio of π^n to $n!$ and hence could be expected to increase and then decrease. But Hayes also presents an intuitive geometrical argument for this phenomenon. The ball (or rather a half-sized copy) sits inside a cube of side and hence n-dimensional volume 1, touching all $2n$ facets. So while the region of the cube occupied by the ball is concentrated near the $2n$ facets, the region of the cube not occupied by the ball is concentrated near the 2^n corners. As n increases, this empty region rapidly overwhelms the occupied region, accounting for the short rise and then dramatic decrease in volume.

One of the deepest results in the book is a short chapter by Terry Tao, originally from his blog which has been anthologised elsewhere, on *Structure and Randomness in the Distribution of Primes*. Tao succinctly describes profound theorems by Vinogradov on the lower bound of the set of odd numbers which are the sum of 3 primes, the distribution of primes implied by the Riemann Hypothesis, and his own recent paper with Ben Green on primes in arithmetic progression.

Several articles discuss the 'unreasonable effectiveness of mathematics' in explaining the physical, biological and social world. The foremost is a foreword, written specifically for this volume by David Mumford, on the relation between pure and applied mathematics. Another fine example is an article from *Scientific American* by mathematical physicists John C. Baez and John Huerta explaining how quaternions and octonians are used in string theory and M-theory to describe the interactions of vectors and spinors. Others deal with applications to photography, music and dance.

About a quarter of the articles are about mathematical philosophy and mathematics education, from primary to university level. To my mind, they are the least satisfactory aspects of the book, containing no surprising insights.

More successful are the biographical studies, including G.L. Alexanderson on Jean Bernoulli's researches on the cycloid, Charlotte Simmons on Augustes de Morgan's relationship with Hamilton, Boole and others, F.Q. Gouvea on Cantor's surprising discovery of the equal cardinality of all real vector spaces up to countable dimension, and a historical perspective by G. Bruno, A. Genovese and G. Improta on routing problems from the Königsberg Bridges to the Travelling Salesman.

Popular writing is not as widespread in mathematics as it is in other sciences; for example there are best-sellers by Oliver Sacks in neuroscience, Jared Diamond in anthropology, Steven Hawking in physics and Simon Winchester in geology. This series serves to partially fill this gap.

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