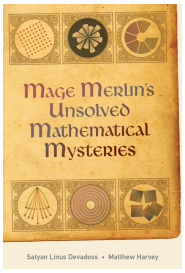
Mage Merlin's Unsolved Mathematical Mysteries by *Satyan Linus Devadoss* and *Matthew Harvey*, MIT Press, 2020 (115 p.), isbn: 9780262044080.

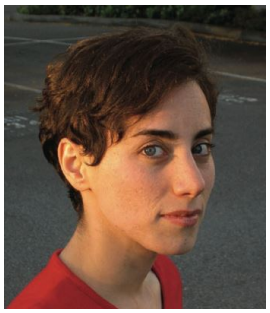




S.L. Devadoss

In their acknowledgements the authors write *"From the moment of this book's conception, we knew that we wanted to create something unusual, something that colored outside the lines of traditional mathematics"* and I confirm wholeheartedly that they succeeded well in this attempt. The title and the cover already suggest that it is some account of mages, princesses, and knights of the round table in a legendary Arthurian time frame, and indeed it is. One would not expect mathematics to be involved, and yet, the essence of the book is to present sixteen unsolved mathematical problems.

This is only possible because the problems have very simple formulations. The Goldbach conjecture is a typical example. The authors start their book by explaining that a typical view of mathematics is like a mountain with simple arithmetic as the wide bottom and moving up to advanced mathematics accessible for fewer and fewer people with at the "icy" top of the mountain the few unsolved problems of mathematics that are left for the mathematical mages. Their own view, of which the present book is an illustration, is the opposite. Mathematics is like an ice cream cone, with arithmetic at the pointy bottom and advanced mathematics at the broad top of the cone. The higher one moves up the cone, the more tools there are to solve problems that can be safely included in the cone, while the many open problems are represented by the delicious ice cream scoop on top. This book presents sixteen samples of these ice cream problems, waiting for a solution.

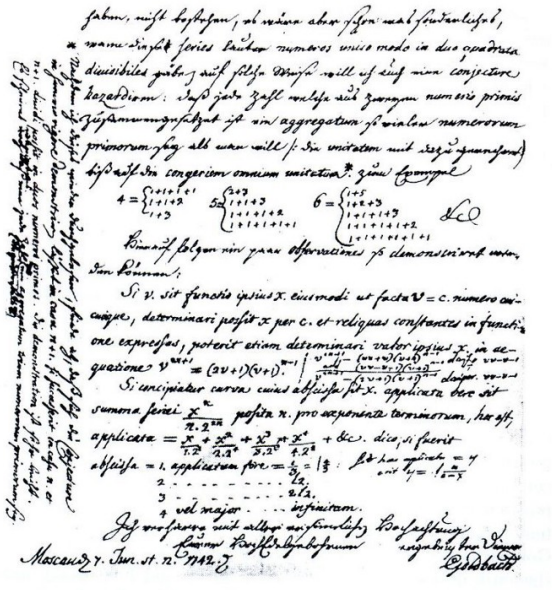


Maryam Mirzakhani

Mathematical problems, easy to formulate, but difficult to solve regularly appear in popular mathematics books and often belong to number theory, graphs, or geometry. They require the least terminology to be formulated. Since they are easy to pose, even without any reference to mathematics, the authors decided to let a fictional character Maryam, a descendent of Merlin the magician, tell us about some of the problems she finds in a book where Merlin wrote down his unsolved Camelot problems. Maryam is the character that translates Merlin's problems formulated in non-mathematical terms, into mathematical language and adds her own comments. The authors chose the name Myriam, by which they want to pay tribute to Maryam Mirzakhani, who is, so far, the only woman who won the Fields Medal, but who untimely passed away in 2017.

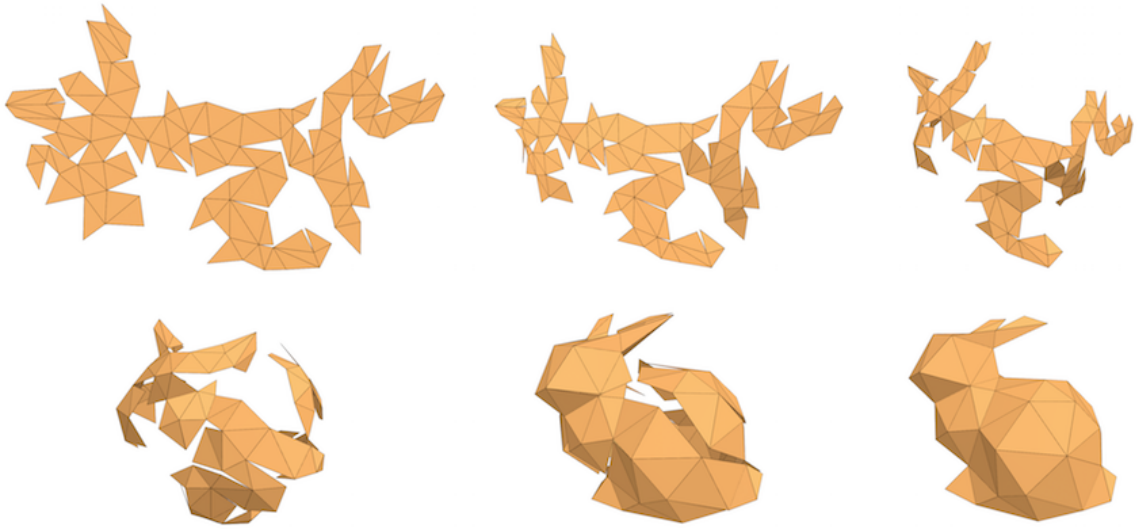
All 16 problems are all discussed in a similar way. First there is a title page with a short paragraph giving a 'modern' introduction to situate the problem. Then there is the story of the problem as Merlin formulated it. It is printed on a nicely illustrated double page with a coloured background, suggesting a reproduction of the parchment pages of Merlin's book. Finally there are two more pages with Myriam's translation into mathematical jargon and her summary of what is currently known about the solution.

The remarkable thing about the formulation of Merlin's problems is that the mathematics are wrapped up in a story about King Arthur's court Camelot. For example the twin prime conjecture is



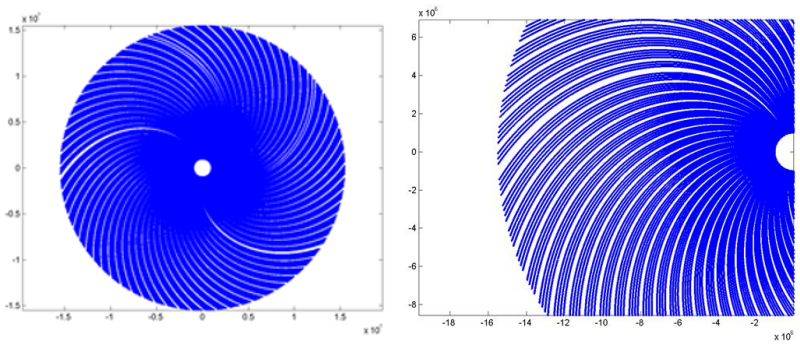
Goldbach's letter

presented as two princesses born on the same day but two years apart. A special celebration takes place on their birthday whenever both their ages are prime. Will this go on forever? Wrapping the birthdy presents is anoter problem that translates into mathematics as asking if every polyhedron can be unfolded in a single (connected) flat surface without overlap, and what if only cuts along the edges are allowed. Proving that there exist infinitely many perfect numbers (numbers equal to the sum of their proper divisors) is presented as a cake cutting problem. Goldbach's conjecture (every even number greater than 2, can be written as a sum of primes) is formulated as a double row of soldiers (even number) that has to split up into two groups. It should be proved that it is always possible to split them such that neither group can be arranged in rows forming a rectangle (have no divisors, i.e. the number of soldiers is prime). Problems from graph theory are formulated as design problems for a maze, a toy, or a tapestry. And similarly, non-mathematical situations are invented for all 16 puzzles.



Unfolding a polyhedron

The amazing fact is that, although all the problems remain unsolved till this day, they are explained with little or no mathematics on a single page or less. Probably not only professionals but also several amateur mathematicians, misled by the simplicity of the formulations, have spent many hours trying to solve some of these problems. Not the solution to these problems is the most important achievement that will change the world, it is the expansion of mathematics, broadening the ice cream cone, that will support more solved problems that is so much more important. Thus if the interest of young mathematicians-to-be can be aroused with booklets like this, we can only be grateful to the authors for writing it.



A bouncer:
For every prime p define a point P with polar coordinates $(r, \theta) = (p, p)$. Plot a blue dot for all these points then you get the remarkable figure on the left (with a detail on the right) for primes between 10^6 and $15 \cdot 10^6$.

Adhemar Bultheel