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Marcel Danesi**,** *Pythagoras' Legacy*, Oxford University Press, 2020, pp. 167, £25, (Hardcover)

This slim volume laid out in ten chapters aims to encourage interest in mathematics by merging mathematical ideas with their history. It is aimed at the popular market and derives from lectures given to undergraduates over a number of years at the university of Toronto (where the author is a professor of Linguistic Anthropology attached to the Fields Institute of Mathematical Research). It does not demand a mathematical background of its readers. The enthusiasm of the writer is apparent as he lays out his mathematical plums.

Given its intended market, and judging from the set exercises at the end of each chapter, the author has kept to his aim of not assuming prior knowledge. We cannot judge such a book by scholastic standards—it is aimed at enthusing. This should suggest the judgmental criterion to be adopted. Does it succeed in this aim?

We should not expect historical references at every turn or difficult technical expositions. For such a book the reader is placed in the position of having to taking the exposition on trust. This is just what mathematicians are trained not to do, and this attitude is inculcated in the training of historians too. Mathematicians require proof and historians require sources. There are few proofs in this book and the sources quoted are for the most part secondary (but modern and interesting) sources.

The chosen topics would find their way into most top tens, and they are fairly standard fare. These are presented in a broadly chronological order. Starting with the irrational numbers and the 'Pythagorean Brotherhood' we end with notions of Undecidability and Computability associated with such as Kurt Gödel and Alan Turing. Each chapter is structured in a Prologue, Content, Epilogue, and Explorations format. The prologue is the overview while the epilogues wrap things up. All the illustrative examples are within the range of the target audience. The explorations are the set problems with answers and explanations given at the back of the book. These are based on their chapters and are not too difficult.

In the past few years there has been a profusion of books on popularizing mathematics—and this is to be applauded. There are whole books, and highly successful ones, on single 'numbers' as 0, π e and i and ∞. In this book these have their individual chapters.

Pythagoras's theorem is a wise choice from which to spin the web. It has so many departures leading to core ideas in mathematics, both ancient and modern. The book begins with the 'Pythagorean Brotherhood', the society which included women who were encouraged to enter the group Pythagoras founded in southern Italy around 500 BCE. The book is about their legacy and very ably takes us through the theorem, the $\sqrt{2}$ example (with the standard proof of its irrationality), which in turn raises the notion of mathematical proof. It also raises the philosophical question of whether mathematics is discovered or invented. The first chapter is an excellent introduction.

Much can be done in explaining prime numbers to a general audience and this is the second plum (Chapter 2). Because the book covers a wide range there is bound to be some superficiality in the detail. Reading closer, I was left with a doubt on the wording of the definition of a Germaine prime and their relevance. How did Sophie Germaine use them, for instance? The Riemann Hypothesis gets a mention but there the author holds up his hands and admits (as most authors of popular books are forced to do) that it is 'much too technical to discuss in any meaningful way here.' Gödel's theorem (Chapter 10) is treated this way too.

Chapter 4 is on π. The author introduces it as the ratio of the circumference to the diameter and notes (without proof) that the value is independent of the size of the circle. With a little extra work it could have been shown an equally surprising property, that π also appears in the area formula. Instead, the author jumps to this formula and uses it to estimate π by comparing areas though the novice may wonder why an estimate could not be obtained by comparing lengths (Figure 4.1 p. 58). Obvious errors seem to have escaped the proof-reader's eye:

Lindemann proved π was transcendental in 1882 (not 1832). The language tends to be informal in places: pointing out that π was not an isolated example of a transcendental number but 'part of a rule' —but what rule? And that numbers such as $\sqrt{2}$ and π have cropped up 'essentially by happenstance', or 'Discoveries emerge by happenstance through contemplation', or the claim that 'the manifestations and scientific uses of π are literally innumerable'.

The version of Euclid's Fifth Postulate would raise questions on the meaning of parallel: 'If two straight lines are parallel to each other, they will never meet.' The statement that 'no solution to the quintic [equation] has ever emerged' misrepresents the solubility of the quintic question.

The coverage being so wide means that important ideas get only a sentence or two, such as occurred in the mention of a quantum algorithm. I found the nod towards the topic of N and NP and Turing's halting problem, just too brief to be useful. Brouwer's Intuitionism is absent in the chapter on Foundations (Chapter 9).

The book is admirable on introducing people not usually found in a mathematics books, for example Carl Jung and his notion of *synchronicity* as a characteristic of mathematical discovery and Carl Sagan on *Serendipity*. There is a Bibliography and an Index.

In a crowded marketplace for popular books, is this book value for money? It certainly enthuses and I found it an enjoyable to handle and to read. It is beautifully produced and evidently this is the reason for the high price.

Tony Crilly