An Imaginary Tale: The Story of $\sqrt{-1}$ by Paul J. Nahin
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Parts III and IV are a rag-bag of miscellaneous 'Did you know?' facts, conversion factors and formulae.

Overall, this may be a book for the secondary school library: the author has a breezy, enthusiastic style and his book is very browsable, but don't get too annoyed with occasional lapses and unevenesses of exposition in the mathematical details, nor with the consistent use of imperial units.

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An imaginary tale: the story of $\sqrt{-1}$, by Paul J. Nahin. Pp. 264. £18.95. 1998. ISBN 0 691 02795 1 (Princeton University Press).

As most of us know from personal knowledge, attempting to explain imaginary numbers to a non-mathematician can be a frustrating experience. At the mere definition of the number i, even the most timid math-phobic will lose all inhibitions and indignantly insist that such a thing is an impossibility, since everybody knows that negative numbers cannot have square roots – "a minus times a minus equals a plus!" Of course, they will offer no objection to the epithet of *imaginary number*, but such acceptance will almost inevitably be accompanied by questions ranging from the pragmatic ('What possible use can these numbers have?') to the philosophical ('Aren't all numbers imaginary anyway?').

On such occasions, it would be useful to have a copy of Paul Nahin's excellent book at hand. One could almost imagine that it was written to answer such sceptics: if anyone needed convincing of the validity and utility of complex numbers, this book would either persuade them or put an end to their questions! It comprises a well-written popular account of the properties of i, presented in a historical framework – highly appropriate since it is only comparatively recently that mathematicians themselves have fully accepted the legitimacy of imaginary numbers.

Beginning with a prelude on how ancient Greek mathematicians Heron and Diophantus overlooked imaginary numbers, the main text opens with a discussion of the earliest appearance of such entities in the work of Cardano and Bombelli in sixteenth-century Italy. The story continues via the attempts of seventeenth-century mathematicians, such as Descartes and Wallis, to interpret imaginaries geometrically. We then see how this problem was eventually solved (and new problems posed) by Wessel, Argand, Hamilton and Gauss.

The final two chapters deal mainly with eighteenth- and nineteenth-century developments. The algebraic power of imaginary numbers are brought to the fore in the penultimate chapter, where results by Cotes, Bernoulli and Euler provide illustrations of the variety of relationships between imaginary numbers and trigonometric, exponential and logarithmic functions. The last chapter considers complex variables and, in particular, Cauchy's creation of complex analysis. This is supplemented by three appendices: on the fundamental theorem of algebra, complex roots of a transcendental equation, and the computation of i^i to 135 decimal places.

Between the more historical sections are two chapters on applications. These provide good examples of the use of complex numbers, not just in the solution of mathematical problems, but in more practical fields such as physics, astronomy and electrical engineering. I never imagined I would ever read a book that drew a link between $\sqrt{-1}$ and Walt Disney's *Fantasia*! (It has something to do with the use of complex numbers in solving problems involving electrical circuits.)

Perhaps because its author is an electrical engineer, *An imaginary tale* manages to couple the beauty and brilliance of the results it contains with a sense of wonder and amazement at their profundity. While displaying an appropriate level of respect for mathematical rigour within the constraints of a popular exposition, Nahin is able to convey to his audience the significance, as well as his appreciation, of the results. For example, after showing how Euler proved that

$$\int_0^\infty \sin x^2\,dx = \int_0^\infty \cos x^2\,dx = \tfrac{1}{2}\sqrt{\pi/2},$$

Nahin comments 'What a genius Euler was – but he wasn't through yet!' (p. 180).

Although intended as a popular book, *An imaginary tale* is definitely written for the mathematically literate reader, i.e. mathematics undergraduates and above. Furthermore, as the author tells us in a preliminary note, 'when I need to do an integral, let me assure you I have not fallen to my knees in dumbstruck horror. And neither should you' (p. vii). But it is by no means of interest solely to practising mathematicians. Anyone who has taken first-year undergraduate courses in mathematics would be able to derive both information and enjoyment from this book.

In addition to its mathematical sophistication, the book also exhibits a sound knowledge of the history of the subject, and an awareness of much of the pertinent literature. It also succeeds in avoiding whiggish interpretations of past events, justly criticising E. T. Bell's *Development of mathematics* for failing to do likewise (p. 229). A minor criticism would be that, due to its discursive nature, the story presented is not completely linear, so the narrative tends to jump around a bit chronologically. Similarly, not all quotes and nuggets of information are given references in the endnotes for each chapter. But then, this was not intended as a scholarly tome.

With *An imaginary tale*, Nahin has provided another worthy addition to the field of popular books on mathematical subjects, of which Eli Maor's *e: The story of a number* is perhaps the most comparable. The reader is stimulated with a wealth of fascinating and intriguing information, in addition to which, peppered throughout the text, are stories and anecdotes, which further enliven the reading and give the story a human perspective. The clarity of the writing, together with the author's sense of humour and obvious enthusiasm for the subject, make it a pleasure to read and to recommend.

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The mathemagician and pied puzzler: a collection in tribute to Martin Gardner, edited by Elwyn Berlekamp and Tom Rodgers. Pp. 226. $34/£22. 1999. ISBN 1 56881 075 X (A. K. Peters).

Gardner is well known as a doyen of recreational and puzzle mathematicians, attracting a wide range of enthusiasts, many of them not professional mathematicians. This book is a result of some gatherings of the flock since 1993, with around 40 contributions. Some of them are very short, six to the extent that they would have been better left as communications to the dedicatee. A few, such as B. Cutler on box-packing puzzles (pp. 169-174), will register only for fellow specialists, but most articles show a good sense of comprehensibility, and of fun.

Among arithmetical and algebraic exercises, D. Singmaster contributes a fine survey of various results in number theory, in the historically most informed and best referenced paper in the book (pp. 219-235). One formidable fun-task is presented by two authors: to evaluate the vigintisextic