Overall, there is reference to the work of about 170 mathematicians within five major cultural settings. Such names include Hipparchus of Rhodes, Menelaus of Alexandria, Brahmagupta of India, Islamic mathematicians such as Abu Narr Mansor and Europeans such as Copernicus and Rheticus. Hence, the structure of the book is both chronological and cultural, and its five chapters analyse the work that took place in Babylon and Ancient Greece, Alexandrian Greece, India, Islam and Europe (up to the late 16th century).

Because of the astronomical origins of spherical trigonometry, the preface attempts to provide understanding of fundamental ideas such as the celestial sphere, the ecliptic, precession of the equinoxes, right ascension and sidereal time etc. But many such notions, being three-dimensional concepts, are not easily explained in so few words, and readers may need to access other sources for further clarification.

The mathematical journey traversed by this historical account tells us how trigonometry developed from geometrical constructs, whereby the sine of an angle was represented by the length of a chord in a circle. It proceeds explain the evolution of the more analytic representations via tables of chords and tables of numerical data (sine tables). All of this took place prior to the invention of algebraic notation and well before the concept of function had arisen. However, extracts from original texts are included throughout the book, but the author uses modern notations to illustrate the mathematics contained in these.

But what I particularly like about this book is the author's style of writing. He integrates mathematical explanations with historical and cultural perspectives; and he goes some way to convey the nature of the original mathematical expression. Moreover, although the book covers 'elementary' mathematics and is easy to read, it is nonetheless intellectually challenging. In fact, Van Brummelen's historical analysis is of the highest standard: his bibliography is extensive, and it is hard to imagine that he has failed to mention any relevant work of significance.

This book certainly fills a notable gap in the history of mathematics, and it should appeal to a wide readership – including those interested in the history of science in general and astronomy in particular.

P. N. RUANE
157 Mildmay Road, Chelmsford CM2 0DU
email: *ruane.hp@blueyonder.co.uk*

Decoding reality: the universe as quantum information, by Vlatko Vedral. Pp. 229. £16.99. 2010. ISBN 978-0199237692 (Oxford University Press).

Information is physical. Such is Vedral's central thesis, as he seeks to show that everything in reality is composed of information. What follows is a breathtakingly broad romp through a swathe of disciplines, taking in economics, sociology, quantum cryptography, photosynthesis, and many others besides. Even DNA, it seems, could turn out to be a quantum computer. This a book primarily for the intelligent and inquiring layperson, rather than for a mathematician or scientist who may well find the author's lack of precision off-putting; for example, using the term 'basic heat units' to mean (I think) electron-volts. All the same, the first two-thirds of the book undoubtedly make stimulating reading. In the last third, however, when Vedral argues that the universe itself is a quantum computer requiring no antecedents, and develops a dogmatic atheism reminiscent of Dawkins, he is clearly on shakier ground.

Unfortunately, what detracts so badly in the book is Vedral's sloppy writing and extraordinarily careless manner of expressing himself, leading to some supposed explanations which are quite simply baffling. On page 83, we are told that 'all exponentials are linear to start with,' and even more remarkably, on page 180, that 'as we know from elementary maths, the area of an object is necessarily always smaller than its volume.' Maybe I need to put in some time studying elementary maths before I can really understand his reasoning.

MICHAEL WARD

7 Poplar Tree Drive, Seaton EX12 2TW

Mathematics in India, by Kim Plofker. Pp. 384. $ 39.50. 2009. ISBN: 978-0-691-12067-6 (Princeton University Press).

I have had some appreciation for the achievements of Indian mathematicians ever since I read Joseph's *The crest of the Peacock* [1]. From Joseph's book I learned an Indian 'proof without words' of the formula for the sum of products of two consecutive integers which I found so nice that I explain it to my students using custom-made wooden blocks. To the mathematicians of premodern India this was part of a subject they called 'piles', which dealt with stacks of objects. Despite that, my knowledge of Indian mathematics was very superficial indeed, as Plofker's book has shown me.

In the introductory first chapter Plofker states the aims of her book. As she explains (p. 2), most books present this subject as a series of episodes illustrating how Indian mathematicians discovered several results long before their European counterparts. A case in point is Madhava's series for $\pi/4$ (middle of the fourteenth century), which was later rediscovered by Leibniz. This is what Grattan-Guiness called *heritage*, as opposed to *history*; see [2]. Real history tries to unravel what happened within a certain cultural, social and political context, and this is what this book seeks to do for Indian mathematics.

Given my poor knowledge of Indian mathematics, I was bound to come across many surprises as I got through the book, but they came even earlier than I might have expected. The first concerned how much there is still to do in the study of the Indian mathematics of the past. Difficulties abound, among them the uncertainties of early Indian chronology, the lack of historical and biographical data in Indian scientific works, and the fact that several texts remain unpublished to this day. I also did not know that most Indian works were written in verse, and that even the numbers had to rhyme! In order to accomplish this last feat, numbers were expressed by strings of words, each one of which represented an individual digit or group of digits. The curious thing is that this is a positional decimal number system. Since a Sanskrit text of the third century CE has an example of such a way of representing numbers, we can conclude that positional decimal numbers must be at least as old as that. However, as far as we know, numbers were not written *symbolically* using a decimal place value system before the middle of the first millennium CE.

But with that we have already moved too far into the future. To catch Indian mathematics at its inception we must move back to the second millennium BCE (chapter 2). That was the time when the first *Veda* were composed. These are ancient religious texts written in Sanskrit, from which we learn, for example, that a decimal system of number words had already been established by Early Vedic times. Moreover, these texts mention huge numbers, way beyond anything that would be needed in everyday life, like *parardha*, which means a trillion. Why such numbers were important we do not know for certain.

Most of the mathematics of Vedic times is contained in the *Vedangas*, or 'limbs of the Vedas'. These are commentaries which specify in detail the correct way to perform devotions to the gods. One of these, the *Sulba-Sutra*, contains several rules for using lengths of cord to construct altars with the shapes and dimensions that were considered correct (p. 20ff). This seems to me a lovely topic to discuss when