Putting maths on the map

A new look at how vital mathematics is to map-making is an engaging exploration of a fascinating subject, finds Sarah Hart

Book

Mapmatics
Paulina Rowińska
Picador (UK); Belknap Press (US, out 17 September)

MATHEMATICS helps us understand the world, and in Paulina Rowińska’s Mapmatics: How we navigate the world through numbers, the focus is on its indispensability in the making of visual representations of that world – maps.

As a mathematician, I already knew some of the theory, but it was a pleasant surprise to find this book full of fascinating examples and facts that I didn’t know, including real-world implications of ideas that might be assumed to lie squarely in the realm of the theoretical. Things like it being impossible to determine the exact length of a coastline because it keeps growing with the increasing precision of your measurements (or as Rowińska puts it, if an ant and an elephant agree to meet for a drink 300 miles along the coast, they will almost certainly not end up in the same pub).

Like most mathematicians, I was aware of this curious fractal quality of coastlines, but what I didn’t know is that legislators have come up against this as a genuine problem, in managing treaties that specify distance from the coast.

The book opens by looking at the challenge presented by Carl Friedrich Gauss’s Theorema Egregium (or Remarkable Theorem), which Rowińska explains through the medium of pizza. This wonderful piece of maths gives us a kind of Heisenberg’s uncertainty principle of maps: a flat map of the spherical(ish) Earth can represent areas accurately, or distances accurately, but not both.

Maths can tell us what is possible and help us to achieve the goals of making maps. It is impossible to find a coastline’s exact length, as it grows with the rising precision of measurements on our map. There are many excellent illustrations in the book, so it may be churlish to wish for more, but it would have been helpful to see the Gall-Peters projection, which accurately shows the relative areas of continents, but distorts their shapes, alongside the Mercator projection, which does the opposite. Rowińska does a good job with her choice of topics, which provide a gateway to many intriguing ideas and offer several entertaining diversions. When talking about distance, for example, there is a discussion of Hamming codes, which are designed to detect errors when messages are transmitted across noisy channels. This doesn’t have much to do with maps, but I was willing to go along for the ride.

There were one or two curious omissions, however. Given the book’s cover features contour lines, it is strange they aren’t discussed, especially as the concept of isolines more generally is so powerful. I was also surprised that, though the book is strong on the inherent biases wrapped up in the historical choice of map design, there wasn’t much discussion of the longitude problem or why 0° longitude ended up running through Greenwich, London.

Mapmatics is entertaining throughout, with illuminating examples of a huge range of maps and their uses. On top of navigation, it covers how mathematical analysis of maps showing incidence of disease or crime has been used to stop outbreaks and catch criminals, as well as the uses and abuses of maps for political ends. A bureaucratic decision over boundaries can affect everything from how much funding your child’s school receives to who wins the next election. Mathematics can help detect bias in such decisions.

The chapters are loosely grouped around themes like scale and connectedness. Each is full of interesting applications of maths to related challenges, like the use of space-filling curves to make food deliveries more efficient. The writing style is appealing – playful but with a serious message – and Rowińska clearly has a deep knowledge, both of maps and the maths behind them. An engaging look at a fascinating subject.

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Lately, I have been in the mood for puzzles. Helping me scratch that itch has been a book called S, by Doug Dorst and J. J. Abrams. When you unbox it, you find a novel called Ship of Theseus by V. M. Straka, a character who we learn either disappeared or died under mysterious circumstances. But the real story here is in the marginalia, where two readers who have taken the book out of a library try to solve the mystery. Involving flyers, postcards and a decoder ring, it takes a little practice to learn how to read this story, but it is wonderfully immersive.

Another puzzle I have been loving is the video game Animal Well (pictured above). At first, it seems simple: you navigate as a blob through a pixel-art world. But once the game is “done”, there are more secrets to figure out, including some that require collaboration among players in the real world in an online forum. Weeks later, I haven’t finished this one either, but I am delighted there are still puzzles to solve.