Our Days Are Numbered: How Mathematics Orders Our Lives

The Big Questions: Mathematics

Reviewed by Paul Zorn

**Our Days Are Numbered: How Mathematics
Orders Our lives**

Jason Brown

Emblem Editions

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The Big Questions: Mathematics

Tony Crilly

Quercus

US\$8.50, 208 pages

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Neither of these two good books is—if Amazon popularity rankings are any guide—a big seller. Both rank in the vicinity of *Framley Parsonage* (1861), fourth in Anthony Trollope's six-novel series on Barsestshire life. Countless novels of zombie "life", for that matter, lead our books by wide margins. Both of these books deserve better.

These are refreshingly sunny-minded books. Both authors write in a friendly, easygoing style, emphasizing not just mathematics' usefulness but also its intrinsic interest. And neither author has

mathematical or educational axes to grind. Both are more in love with mathematics than angry at Philistines who may dislike or ignore the subject. There is no railing against "innumeracy", poor mathematical pedagogy, unreadable textbooks, or the iniquities of those who would prescribe (or proscribe) technology in mathematics education. Both books are, in quite different ways, about "pure" mathematics: its importance, its usefulness, its interest, its hypnotic allure to "us", and its downright coolness. "Isn't this interesting? Let me show you (a little) more" is the unspoken but constant authorial aside.

Readers are neither assumed to have much mathematical background nor expected to work unduly hard to read either of these books. Few if any calculations are "left to the reader". Mathspeak—"clearly", "it can be shown", "*mutatis mutandis*"—is wholly eschewed. What *is* assumed, especially by Crilly, is some intellectual curiosity, not just about what mathematics does but about what it is.

On the face of it the books address, and will probably attract, nonspecialist but quite different audiences. Brown begins, for instance, with the arithmetic of recipe-scaling, while Crilly gets quickly to Babylonian and Egyptian number systems. But both books make similar intellectual demands on the casual reader, and both contain things completely new or at least unfamiliar—if

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this reviewer is typical—even to grizzled veterans. Most of us veterans, after all, have served in only a few mathematical campaigns on a much broader front.

I've "always known", for instance, some basics concerning Euclid's parallel postulate, various doomed efforts to deduce it from simpler axioms, and where Bolyai, Lobachevsky, and Riemann took these ideas. But I learned reading Crilly that it was John Playfair in 1795 who reformulated Euclid's 5th postulate more directly in terms of parallel lines and that Giovanni Saccheri's early eighteenth-century experiments with non-Euclidean thinking began almost a century earlier. And I learned from Brown about Stein's paradox in statistics, which asserts that three or more parameters, say, long-term batting averages of several players, are better estimated together than separately. Other readers, of course, may know these particular things well but learn something else.

The Big Questions: Mathematics

Tony Crilly is Emeritus Reader in Mathematical Sciences at Middlesex University in England. His book is one in a series of volumes titled *The Big Questions: X*, where *X* may denote, among other choices, Mathematics, Philosophy, Physics, God, and (biggest of all) The Universe.

Every chapter title is one of the advertised big questions. Here are a few of the twenty: What is mathematics for? Is it true? Where do parallel lines meet? What is the mathematics of the universe? What shape is the universe? Can we create an unbreakable code? Is there anything left to solve? Winnowing the "big" from the "small" in any field is inherently controversial—and interesting. One can certainly quibble with some of Crilly's particular choices. I would have expected, for instance, to see more "big questions" arising from biology and from electronic computing and communication, but neither "genomics" nor "Internet" appears in the index. Nevertheless, all of the questions Crilly does raise seem to me defensibly "big", and I find his exposition invariably inviting, readable, and (a pleasant but unusual combination) at once serious and informal. Crilly's discussion is also broadly

learned, ranging well beyond mathematics and its history. Samuel Taylor Coleridge, Alexander Pope, and Mark Twain all appear in the index, for instance, as do Braque, Cezanne, and Picasso.

Crilly's exploration of each question is necessarily broad and general. But it's also surprisingly deep in places. Crilly explains, for instance, not only that Grigori Perelman solved the three-dimensional Poincaré conjecture but also something of what the conjecture says, its relationship to the larger problem of classifying three-dimensional manifolds, and the surprising fact that Perelman's solution used techniques from heat diffusion rather than the "usual" topological tools. Crilly's discussion of symmetry, too, goes beyond the usual geometric setting to encompass the algebraic or symbolic symmetry inherent in various forms of duality. In this context I enjoyed learning or relearning the striking dual, or "twin", theorems of Pascal and Brianchon on hexagons with inscribed or circumscribed ellipses.

Among the most admirable features of *Questions* for me is the author's willingness to draw conclusions, sum things up, and sometimes go out on limbs, even beyond the essentially audacious project of the book itself. Crilly speculates, for instance, about what Pythagoras might have thought about this or that. He doesn't hesitate to describe Newton's inverse square law as among the greatest of all formulae or to assert that "the ingenious powers of the human mind can always

surpass the computational capacity of a machine" (p. 190). Readers need not agree with every one of these judgments to find them interesting, useful, and thought-provoking.

Our Days are Numbered

Jason Brown is a professor of mathematics at Dalhousie University in Canada. His project, perhaps less academically ambitious than Crilly's but also nicely executed, is to point to basic mathematics implicit in everyday life and thence to more subtle and more interesting underlying mathematical ideas, methods, and ways of thinking. Most of Brown's topics are standards of the math-is-useful genre: unit conversions, graphical representations, mathematical

games, probability and statistics of everyday risks and decisions, Google's PageRank algorithm, fractals, coding, and Internet security. But Brown treats them all engagingly, in a mildly self-deprecating style, and takes many opportunities to use what mathematical readers might consider common knowledge to point in deeper directions. Stein's paradox, mentioned above, is one example. Others include Benford's law on the predominance of smaller digits in certain data sets and the neat fact—Brown links it to global warming—that the expected number of “records” in a *random* time series of n observations is around $\log n$.

Brown's sprightliest chapters, to this reader's taste, are the last few, on mathematics and music. Both subjects are favorites of the author, a former professional rock guitarist and son of an audiophile. Brown explores, not unexpectedly, the modular arithmetic of rhythms and scales and the numerical problems inherent in instrument tuning. But, unusually, he applies his dual expertise to offer lively mathematical analysis of specific rock music, musicians, and their characteristic tricks, like “tickling”. Who knew, for instance, that the surprising energy of the Beatles' “I Want to Hold Your Hand” derives from a four-note upward shift of a standard chord progression?

My favorite chapter of all is Brown's last, in which he describes applying Fourier methods to a then-unsolved musicological question: Who played what on the famous opening chord (known generally as The Chord; Brown calls it the greatest chord in rock and roll) to the Beatles' “A Hard Day's Night”? Disentangling the chord's harmonics with a discrete Fourier transform revealed to Brown, in 2004, that The Chord involved not only the Beatles' three guitars but also George Martin's grand piano in the Abbey Road studio. NPR, the BBC, and the *Wall Street Journal* all took due notice.

The Big Picture

Few books strike any reader as perfect, and these are no exception, even beyond the debatable choices every author makes. I found the day-in-a-mathematician's-life structure of Brown's book slightly lame in spots, and I noticed a few typos and the odd solecism. Crilly says “multiplication” and “addition” when I think he means “product” and “sum”. But these are minor quibbles, not real defects; both books are nicely written and carefully edited.

Both books deserve better Amazon rankings, longer (nonzombie) lives, and broader audiences than they seem likely to enjoy. In their very different ways, both are readable, engaging, and enthusiastic, and give convincing accounts of mathematics and why everyone should admire, care about, and enjoy our subject.

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