The New York Times Book of Mathematics

Reviewed by Ian Stewart

The New York Times Book of Mathematics
Edited by Gina Kolata
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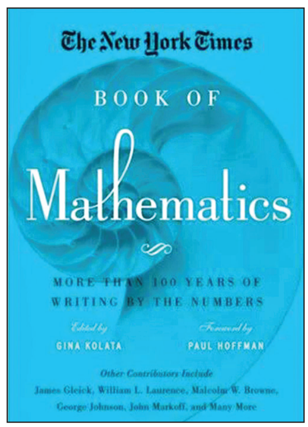
Mathematicians often complain that their subject is neglected in the mass media, although when it does get reported there always seem to be a few of us who find it impossible to resist the urge to complain bitterly about inaccuracies and "hype", which usually seems to mean the promotion of the area concerned instead of their own. As this sumptuous volume demonstrates, neither complaint can sensibly be directed at the *New York Times* [*NYT*]. For more than a century this high-quality newspaper has done sterling work in the service of our profession, the public, and the cause of science journalism.

This collection contains more than a hundred *NYT* articles on mathematics and its applications of all kinds, dating back to 1892 and written by over thirty authors—some journalists, some mathematicians, some neither. Together they provide an unusual overview of our subject and how it is perceived by everyone else. It is an eclectic collection, ranging from an anonymous piece on life insurance at the end of the nineteenth century to Grigori Perelman's proof of the Poincaré Conjecture. The editor has resisted the temptation to place the articles in chronological order, grouping them into seven major areas and then following



an order that helps to tell a story—which is, after all, what journalism is about.

This choice makes the book far more accessible to the general reader, though I'm tempted to photocopy the contents list and shuffle the articles back into the order of publication. Reading them in that order would give a dramatic perception of how our subject has changed over the last 120 years; however, this comes over anyway. Paul Hoffman's foreword and Gina Kolata's introduction provide concise and helpful overviews of such questions, and the first group of topics addresses general issues of what mathematics is and what it's for. That said, this is clearly a book that you can dip into fairly randomly, and I'm going to spend much of this review doing just that. Along the way, I'll say a little about how the selected articles illuminate broader "philosophical" issues—just as the whim takes me.

Roughly speaking, the seven sections deal with the nature of mathematics, chance, famous problems, chaos, cryptography, computers, and biography. Immediately we get a glimpse of which areas of mathematics are deemed newsworthy or, perhaps, just appealed to the editor. Large regions of the mathematical landscape are untouched—only passing reference to Fourier transforms (though the use of wavelets for image compression is mentioned), nothing on symmetry except the E8 "size of Manhattan" calculation. The only mathematical

Ian Stewart is a science writer and professor emeritus of mathematics at the University of Warwick. His email address is `I.N.Stewart@warwick.ac.uk`.

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biology is a short piece on the flocking of birds from 1987. I'm not complaining about what's not been included; just posting a mild warning notice for potential readers. What *has* been included is worthy, valuable, and fascinating, fully justifying the book's existence.

I'll jump in with the third section, on famous problems, solved and unsolved. This covers what by now is familiar ground to most mathematicians: the Poincaré conjecture, the four-color problem, the Goldbach conjecture, Fermat's Last Theorem [FLT], and a flurry of less celebrated but still important questions such as optimal packing of tetrahedra and Steiner trees. In its treatment of Fermat's Last Theorem, the *NYT* offered its readers glimpses of mathematics in the making. "Mathematics expert may soon resolve a 350-year problem…" You'd be justified in assuming this was advance notice of Andrew Wiles's work, but actually the piece is about an abortive attempt by Yoichi Miyaoka in 1988. It reminds us that mathematical research does not consist of triumphs alone; it involves many unsuccessful attempts. The article is suitably cautious: "Nobody has the right to have an opinion yet." The subsequent article, "Fermat's theorem solved? Not this time" provides the dénouement.

A month later, the *NYT* is reporting what experts in number theory had been quietly saying for about a decade: the road to a solution might well be opened up by the theory of elliptic curves. Five years later "At last, shout of Eureka!" told the world of Wiles's Cambridge announcement, confirming that belief. This was followed up by a longer description of what Wiles did—"you use Hilbert irreducibility and the Čebotarev density theorem … to produce a noncuspidal rational point"—well done, James Gleick! Handled so deftly that he gets away with it, while readers gain a subliminal insight that this stuff is difficult and advanced, yet follows some kind of coherent mathematical narrative. Except… "Flaw is found in math proof, but repairs are under way." Then "Fermat's puzzle is still not quite Q.E.D." And finally, "How a gap in the Fermat proof was bridged."

This is what real research is like. A few steps forward, a step or two back. With luck and a following wind, you may actually reach your destination. But should any of this have been reported? Is it "premature" to inform the press of major new developments as they are happening, and before the community has peer-reviewed them? Well, Wiles kept everything secret until he was confident he was right, and his announcement was low-key: nothing terribly wrong there. But, gosh, well… there was a gap. These things happen. Wiles was lucky, Miyaoka not. The plain fact is that, even in the early 1990s, there is no way that the media would *not* have got wind of a possible solution of FLT. The best we can do, as a profession, is to help them tell the story accurately as it unfolds. In every other field of human activity, this kind of thing happens on a daily basis. I've lost count of how many times a cosmologist has announced that dark matter has been detected definitively, only for another one to shoot the whole thing down in flames.

If keeping the lid on Miyaoka's ideas and Wiles's discovery was difficult two decades ago, it's totally impossible in this age of Twitter and Facebook. We may privately wish the world were otherwise, with discoveries being made public only when they have become definitive—but it's not. Indeed, in most areas outside mathematics something can be definitive for decades and then turn out to be totally wrong. The payoff from this kind of warts-and-all disclosure is almost entirely positive: the public experiences the excitement of serious new mathematics, and sees *new things happening* as they occur. They discover that we are actually *doing things*. It may be "unfortunate" when sometimes the excitement fizzles out, but a week later the only people fretting about it are a few anally retentive specialists. Get a life.

James Gleick features prominently in the book, because he writes so much and so well about our subject, so it is hardly surprising that chaos and related topics get a section to themselves. The area is, actually, rather important. Remarkably, the *NYT* spotted this coming in 1938—in a way. It reported Norbert Wiener's work on Brownian motion, revealing statistical regularities in random movements. But it also mentioned George Birkhoff's approach to chaotic events, which later led Stephen Smale to the horseshoe, a key step in understanding that deterministic chaotic dynamics has its own patterns. This section is an eclectic mix of various topics from nonlinear dynamics—chaos, catastrophes, complexity, stochastics—ending with an obituary of Benoît Mandelbrot and a summary of the development of fractals.

Much of this area was a cause of controversy when the media got hold of it; some still is. "Here is a mathematician's nightmare that I heard in the 1980s," Gleick writes. "[A] mathematician dreamed that Mandelbrot died and God spoke: 'You know, there really was something to that Mandelbrot.'" Today's mathematicians mostly think that God had a point, though a few reckon we are still living the nightmare. Perhaps if they read *Science* and *Nature* regularly they would realize how thoroughly fractals now pervade numerous areas of science.

A third major theme, one that future historians of mathematics will have to come to grips with, is the remarkable interplay between mathematics and computing. Once again the *NYT* is on the case early; once again, the story is not what we might expect. In 1927 it carried a short article on Vannevar Bush's "thinking machine"—more properly, the "product integraph", an analog device for solving differential equations. By 1947 we are hearing of two "giant electronic brains" being established by the National Bureau of Standards, successors to ENIAC and similar beasts. "A third computing machine might be built in the near future to speed up the calculations of the Census Bureau." In the same year, ENIAC is being "converted so that it can handle without resetting all types of mathematical problems… Seventeen per cent of the machine's time is now lost changing the set-up by resetting switches and pulling plugs…the latest change-over [is based on] a new mathematical approach by Dr. John von Neumann."

A huge piece from 1967 describes switching circuits, Boolean algebra, information theory, and the latest high-speed memory device: ferrite cores. By 1997 the story has moved on to Intel's supercomputer with 9,072 Pentium processors. The last item in this section features Vinay Deolalikar's attempt to prove that P does not equal NP—which is left hanging at its unresolved state in 2010. On May 2, 2013, a *New Yorker* blog carried a posting called "A most profound math problem" [`http://www.newyorker.com/online/blogs/elements/2013/05/a-most-profound-math-problem.html`], which told us how "Computer scientists and mathematicians went at Deolalikar's proof with the ferocity of sharks in the presence of blood." That is perhaps a trifle unfair, since there were good reasons all along to be suspicious of the method, even though much of the work was of high quality. At any rate "It wasn't long before Deolalikar's paper was thoroughly discredited." The blog concludes with these wise words: "all of mathematics rests on a fundamental hubris, a belief that we can order what Wallace Stevens calls 'a slovenly wilderness'. It is a necessary confidence, yet we are not always rewarded for it."

Mathematics is not just about theorems and proofs, nor even about methods and uses: it is driven by *people*. One of the less desirable features of newsworthiness is that the most interesting people tend to range from mild eccentrics to the seriously deranged. I doubt I could convince the *NYT* to carry a story about a happily (and long-) married father of two who drives to the office five days a week, does competent but not outstanding research into specialist areas of nonlinear dynamics, has been based at the same university for his entire career, and whose main hobby is reading books. I might *just* get them to feature one about a mathematician who traded his undergraduate lecturing for popular science and broadcasting, writes science fiction, has collaborated with Terry Pratchett (if you've not heard of this guy, he writes humorous fantasy bestsellers, set on a flat world supported by giant elephants on the back of a space-faring turtle, where magic works), appeared in *Nature* wearing a wizard's outfit, and once brought a live tiger into a lecture room full of children.

You'll guess that both of them are the same person—me. Even the second one pales into insignificance compared to the remarkable mathematicians that actually *have* been featured in the *NYT*. Included here: Paul Erdős, Terry Tao, Grigori Perelman, John Horton Conway, Claude Shannon, Srinivasa Ramanujan, Kurt Gödel, Andrew Wiles, and Leonard Adleman—all brilliant and thoroughly deserving of public recognition. I'm not sure exactly what impression nonmathematical readers will get from these articles, and I'm absolutely sure that it won't be the father of two who drives to the office five days a week, but I'm also sure that it will be very interesting indeed. And, in the end, that's what media exposure is for. Not to tell the full story in every detail and complete precision, but rather to show the world that we are committed, innovative, useful—and real people. Thank, you, *New York Times*, for having done just that for more than a hundred years. Thank you, Ms. Kolata, for collecting so much gripping and informative material together and arranging it so well.

Please keep it up.