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Book under review. *The language of mathematics: The stories behind the symbols*, by Raúl Rojas, translated by Eduardo Aparicio, Princeton and Oxford, Princeton University Press, 2025, pp. 280, £22.00 (paper), ISBN 978-0-69120-188-7.

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Review. Mathematical symbols have stories to tell. Our 'Indo-Arabic' digits are world-travellers who criss-crossed Asia and sailed the length of the Mediterranean Sea on merchant ships. The 'greater than' sign (>) turns out to be connected to the early days of the British colonial enterprise in North America: Thomas Harriot, who introduced it, may have been one of the first Englishmen to learn a Native American language. Even the humble parentheses reward closer scrutiny. They had a front-row seat to one of the most momentous institutional transformation of mathematics: the emergence of scientific journals. Indeed, it is in no small part because of new rules printed in the 1708 'style guide' of the *Acta Eruditorum* that parentheses eventually displaced other ways of grouping sub-expressions, such as the long-popular 'vinculum' or overline (as in $\overline{a - b} \times c$ for $(a - b) \times c$).

Raúl Rojas aims at offering an introduction to the history of mathematics by tracing the origins of its most routine symbols. Loosely based on courses he taught over the years at the Free University of Berlin, this book was first written in Spanish [RG18] and appears here in a very readable English translation by Eduardo Aparicio. It is made up of bite-sized, self-contained vignettes that are grouped into nine chapters, and claims to cover the history of '95% of the most common mathematical [symbols] used in college mathematical texts' (p. 235).

At their best, Rojas's vignettes start from a workaday sign – one we would usually take for granted – and use it as a hook to give a richly illustrated glimpse into the breadth, depth, and sheer contingency of the history of mathematics. Consider the mundane decimal point (pp. 63–68). Over five brisk and readable pages, Rojas discusses the precise base-60 calculations of Babylonians; displays and comments passages from al-Uqlīdisī, Stevin, and Napier; and ends on the contingencies that led to the coexistence, today, of the point and the comma as ways of separating decimals – thus explaining why the 'floating point' used in computer algorithms becomes a '*Gleitkomma*' ('sliding comma') in German.

I can see such vignettes being quite effective at whetting the curiosity of high school or early university students, and teachers keen to include short historical digressions in their courses are likely to find inspiration here. The book is better informed than many popular expositions of the history of mathematics, and while there are no footnotes or endnotes, a short bibliography pointing to further reading for each section is included at the end. The numerous illustrations taken from primary sources are particularly welcome.

Such a format has its limits, however. The choice to make each vignette short and self-contained causes the book to be somewhat disjointed and repetitive. More importantly, it prevents delving into past mathematics in any depth. Combined with the book's approach, which consists in looking backwards from contemporary notations in search of first occurrences, these constraints tend to flatten the past into a gallery of exotic backdrops and colourful costumes for today's mathematics

– or rudimentary versions of it. Within such a framework, remarks to the effect that ‘the constant of integration is missing’ in Leibniz (p. 109) or that Ludolph van Ceulen ‘ran a fencing academy’ (p. 186) are bound to remain curiosities, yielding little understanding of how the methods and concepts of past mathematicians, and the social worlds they inhabited, differ from our own.

On occasion, the simplifications required by the format become misleading. Consider the section on limits (pp. 138–143). Rojas presents a nice modern picture-proof that $\sum_{n=1}^{\infty} \frac{1}{4^n} = \frac{1}{3}$, then claims that it is ‘an example of the exhaustion method used by Archimedes, which is actually a calculation of the limit’ (p. 139). This erases precisely what is distinctive about the ancient method of exhaustion, namely that, by way of a double proof by contradiction, it avoids any consideration of actually infinite series or processes – to the point that I doubt anything is gained in referring this to Archimedes or calling it ‘exhaustion’ (for a less anachronistic treatment, see [Kat09, p. 108]). Elsewhere, we read that Boole extended ‘the notation he used in his study of logic to set theory’ (p. 172), even though the very distinction between logic and set theory as we draw it today does not make sense in Boole’s work.

In a first introduction to the history of mathematics, the stories we select and the way we tell them can durably shape students’ perception of the discipline. Approaching mathematics through its symbols allows for a broader array of characters and themes than is usual in traditional general histories of the subject. Rojas sometimes gives pride of place to textbook authors such as Adam Ries or Heinrich Rahn next to expected figures such as Leibniz or Descartes. He also highlights the importance of typesetting throughout, and ends the book with a vignette devoted to the institutional transformations of scientific publishing (pp. 228–233). Nevertheless, it is hard to shake the feeling that Rojas has not been intentional enough about his choices. His vast cast of historical figures, from household names to the obscure, only includes one woman: Sofia Kovalevskaya is all too briefly mentioned, and as a student of Weierstrass rather than for her own work (pp. 53–54).

The treatment of non-European mathematics is also somewhat disappointing. On top of Arabic algebra and arithmetic, the book includes discussions of Mayan and Indian numerals, two brief mentions of the Chinese *Nine Chapters*, and a smattering of allusions to Babylonian and Indian mathematics. There are missed opportunities, however. For instance, the section on the ‘birth of algebra’ that opens the book only mentions Diophantus and al-Khwārizmī, even though accessible introductions to the related methods found in Babylonian, Indian, or Chinese sources are readily available today (e.g., [KP14]). Moreover, the book sometimes repeats damaging *clichés*, for instance asserting that the ‘Arabs rescued Persian, Babylonian, Indian, and even Greek mathematics, which thus survived in “hibernation” during the European Middle Ages’ (p. 36). Most disheartening about such a claim is that it likely does not even reflect a considered opinion. After all, Rojas writes a few pages earlier that ‘[as] the Greek and Roman cultures started to decline, Arab mathematicians took the lead in developing the sciences’ (p. 20), and he offers examples that are hard enough to square with the metaphor of hibernation. Such remarks are undead commonplaces, repeated so often that they continue slipping through unexamined, even when the evidence against them has become overwhelming. Offhand claims that mathematics ‘did not begin with the Greeks, but rigorous mathematics did’ (p. 27; see also pp. 215–216) likewise deserve some nuance nowadays (see, e.g., [Che97], [Che12]).

Finally, it should be said that while the copy-editing has clearly been done with care, the same is not true for the fact-checking. The book contains numerous small but jarring errors and inaccuracies, in excess of what one would expect from a large university press. It is hard to get all details right in a book with such range, but the editorial process ought to correct for this; to my taste, far too many issues have fallen through the cracks. The very beginning of the first chapter confuses al-Khwārizmī's book on algebra with his work on computation with Indian numerals (lost except in Latin versions), incorrectly claiming that the former 'popularized the positional decimal system' (p. 6); the vignette on the decimal point confuses two books by Napier, the *Rabdologiæ* and the *Mirifici Logarithmorum Canonis Constructio*, even attributing the fragment displayed as an illustration to the wrong work (pp. 67–68). Newton's fluents are called 'fluences' (p. 112); Descartes is claimed to have called negative roots 'imaginary' whereas, like earlier authors, he called them 'false' (p. 74) – his 'imaginary' solutions are what we might call the non-real ones; the 1903 second volume of Frege's *Grundgesetze der Arithmetik* (*Basic Laws of Arithmetic*) becomes 'the second edition of his book *The Laws of Arithmetic*' (p. 166); the Chinese *Nine Chapters* are bizarrely referred to as a 'manuscript' and an unfortunate typo slipped into their dating ('CE' instead of 'BCE'; pp. 227–228). When discussing the uptake of Oughtred's cross notation for multiplication, and its competition with the dot championed by Leibniz, the book states that François Viète just 'concatenated the symbols for variables', representing 'the cube for the variable a [. . .] by the sequence aaa' (p. 86). Here Viète, who passed away decades before the publication of Oughtred's *Clavis mathematicæ* and used no such notation, must have been confused with someone else. The sentence is misleading anyway: in the 17th century just as today, mathematicians commonly omitted any multiplication sign between letters, irrespective of which one they otherwise favoured. I can only hope that such issues will be corrected in a future edition, as this book otherwise makes for a fine gift for students discovering mathematics.

References

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