



Math Graphics: A Review of Two Books

Judith Roitman

***The Thrilling Adventures of Lovelace and Babbage:
The (Mostly) True Story of the First Computer***

Sydney Padua
Pantheon, 2015
US\$19.68, 320 pages
ISBN-13: 978-0307908278

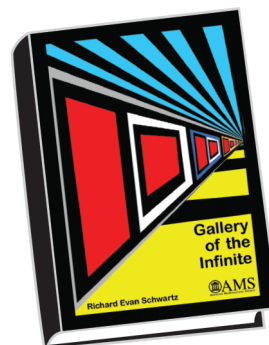
Gallery of the Infinite

Richard Evan Schwartz
American Mathematical Society, 2016
US\$29.00, 187 pages
ISBN-13: 978-1-4704-255-79

Way back in 2010 in these pages I had the pleasure of reviewing the graphic historical novel of early twentieth-century logic and set theory *Logicomix: An Epic Search for Truth* by Apostolos Doxiadis and Christos H. Papadimitriou (writers) and Alexos Papadatos and Annie Di Donna (artists).¹ Now we have Sydney Padua's graphic fantasy *The Thrilling Adventures of Lovelace and Babbage* and Richard Evan Schwartz's graphic exposition of cardinality and uncountability, *Gallery of the Infinite*.

All three of these books escape the overmuscle art that dominates the comic mass market, but their art is otherwise quite different. *Logicomix* is quasi-realistic in a highly two-dimensional way. *Lovelace and Babbage* consists of exuberant black and white semi-caricature. *Gallery of the Infinite*, created via Inkscape (described on its webpage as "a professional vector graphics editor"), is made of severely flattened somewhat abstract shapes in colors that when not black can best be described as strident.

Lovelace and Babbage began life as a web comic, which you can find at sydneypadua.com. I stumbled across it



some time ago and was delighted to hear that it had turned into a book. The website contains links to things like primary sources and animations of Babbage's analytical engine. The book is replete with extensive and highly informative footnotes and endnotes (some of which themselves have footnotes). Padua's writing exuberantly brings the Victorian age alive. For example, Lovelace's family background (her father was Lord Byron) is concisely described: "It's not easy being the daughter of a celebrity mad genius deviant sex god."

Padua's first chapter is a fifteen-page introduction to the historical Lady Ada Lovelace and the historical Charles Babbage, with a quick summary of Babbage's difference engine (gears and steam would have made it run if it ever had been built) and two panels that get to

*Short, somewhat
steampunk
science fiction
vignettes*

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¹The review appeared in the December 2010 Notices.

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²Some explanation of this equation would have been useful.

³It was published as notes to her translation of L. F. Menabrea's "Sketch of the Analytical Engine invented by Charles Babbage Esq." in Taylor's Scientific Memoirs; you can find a link at the website findingada.com/about/ada-lovelace-links.



These two pages from *The Thrilling Adventures of Lovelace and Babbage* capture the exuberant style of the book. Here Ada Lovelace suddenly realizes that logic itself is mathematical and therefore subject to mathematical analysis and investigation. The author, Sydney Padua, does a remarkable job of making intellectual intensity palpable.

its mathematical heart: Lovelace exclaims in one panel, “It can tabulate accurately and to an **unlimited extent** all *series* whose general term is comprised by the formula $\Delta^7 U_x = 0$!!!!”² and in the next continues, “Indeed, **all** other series which are capable of tabulation by the **method of differences!!**,” to which Babbage replies, “**Exactly!**” Then we get to the analytical engine, which would have been programmed with punch cards (similar to the Jacquard loom); Lovelace writes what

The drawings are very much alive.

would have been a seminal paper³ if anyone had paid attention; and there are two wonderful pages in which while writing this paper she realizes, ten years before George Boole’s *Foundational Laws of Thought*, that logic was itself mathematical, i.e.,

that mathematics “might act upon other things besides *number*... The **engine** could analyze **all subjects in the universe!** A new, a vast, and a powerful **language** is developed for the future use of analysis, in which to wield its **truths!**”

Padua then proceeds to invent the two-dimensional Pocket Universe, in which time is circular and in which the rest of the book takes place as a series of short, somewhat

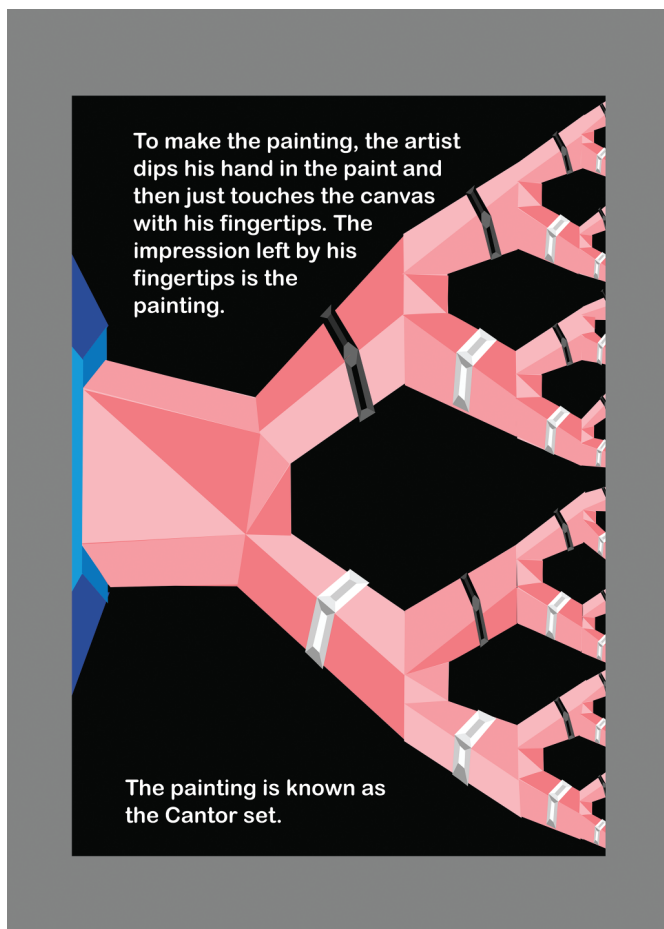
⁴In large part due to the footnotes, endnotes, and footnotes to the endnotes.

steampunk science fiction vignettes: Lovelace appears in disguise to interrupt Coleridge, ruining the poem *Kubla Khan* (the famous Person from Porlock); Lovelace and Babbage use the Engine to produce an Economic Model that runs amok; Luddites attacking the Engine are mollified by tea and a lecture from Babbage; the physical manuscript of George Eliot’s *The Mill on the Floss* is uploaded to the cloud and destroyed in the process; George Boole comes to tea, and takes what later became Boolean algebra so seriously that when offered “coffee or tea” he answers, “Yes”; William Hamilton comes by to discuss quaternions, leading to the discussion of a possible third dimension, which later Lovelace stumbles into while encountering various figures from Alice’s Wonderland—Charles Dodgson appears at the end of this story. There is an appendix that includes many primary documents and an extended explanation of the Analytical Engine. Finally, there is a graphic epilogue.

What is one to make of this? Padua’s day job is as an animator, and the drawings are very much alive, so alive that, despite a relative lack of shading, the notion that this book takes place in a two-dimensional universe seems absurd. A lot of what goes on in the Pocket Universe doesn’t quite make sense (although all of it has connections to our world, as the footnotes and endnotes document), and much of it happens at a kind of fever pitch. We learn a surprising amount about the Victorian intellectual milieu.⁴ Clear portraits are drawn of Babbage as an impractical, somewhat benignly boorish dreamer; of Lovelace as a

driven, extraordinarily sharp genius who, if the day is to be saved, will be the one to save it; and of an enduring intellectual partnership. Padua has created a kind of dream of her own, of Victorian science and mathematics and (remember Ada's father) literature, and of a woman who broke free of convention. Check the website for a taste, and, if you like it, buy the book.

Gallery of the Infinite is a very different book. The back cover claims that it "is suitable for anyone with an interest in the infinite, from advanced middle-school students to inquisitive adults." Having been gobsmacked by Cantor's diagonal argument in seventh grade via George Gamow's



In this picture from *Gallery of the Infinite*, the Cantor tree (the tips of whose infinite branches become the Cantor set) is represented as the hand of an artist with so many fingers that each finger branches into two other fingers, which then branch into two other fingers...and so on.

One, Two, Three...Infinity, I was very happy to be given an opportunity to review this book. Gamow updated! Why not?

Schwartz goes through the basics: cardinality via bijection; the countability of whole numbers, integers, rationals; Schroeder-Bernstein; Cantor's diagonal argu-

⁵He denied the existence not only of infinite sets but of very, very large ones.

ment... . And also some nonbasics: the mathematical universe based on the empty set ("from this point of view, numbers are just organized emptiness"); brief mention of the axioms of ZF; and speculation about how maybe none of this makes sense because there might be a flaw in the axiom system (accompanied by a wild-eyed figure looking a little like a beardless Esenin-Volpin⁵ (the resemblance might just be my imagination)). But this is a *graphic* book, where the text essentially accompanies the pictures and not vice versa. Do the pictures support the text? And does the text accomplish its purpose?

My first impression was that the art was jarring and the presentation creepy: to explain why various sets are countable (the integers, the rationals,...), we are given sharks and chickens—chickens!—with infinitely many teeth in various configurations (the poor chicken wears braces). After a straightforward presentation of Cantor's diagonal argument, we have an artist with so many fingers that each finger branches into two other fingers (the Cantor tree). There is a set of playing cards with staring baboons, more chickens, and what looks like eyes surrounded by buzzsaws. There is a cat with fangs. There is an eye that turns into a Sierpinski carpet. If I were reading this back in seventh grade I might have been having nightmares. Or I might have thought it was really cool. Speaking as an old lady set-theorist, I thought some of the explanations unnecessarily complicated and some of the more general comments without enough context to be understood by a beginner. But what do I know? My artistic preference is elsewhere, and intellectually I know too much to know if this book works.

So I decided I needed some assistance. Why not ask some of the folks for whom the book actually is written what they thought of it? I enlisted a smart houseguest who doesn't know much math and some high school math club members and their friends. I gave them a questionnaire asking about the art, the text, and whether the art supported the text.

The kids all claimed to understand everything; the houseguest gave up at the notion of different sizes of infinity. The art got mixed reviews: it got in the way; it didn't get in the way; it helped a lot; it helped with bijection, but in other places was distracting. A particularly intriguing comment was that "there is so much black that it darkens the tone, giving learning about math a negative connotation." After which the same commentator said, "Well done throughout." All the commentators wanted to know more, although in one case it was despite the book. The kids would all recommend it to a friend; the houseguest would not. One of the kids was creeped out by the branching fingers—"That was not something I wanted to think about"—and thought the art should "just go Cubist, man!" One high school student thought the book was more appropriate for middle school kids. The houseguest thought the tone was somewhat self-indulgent. My

*We are given
sharks and
chickens!*

thirty-six-year-old son also had a quick look at the art, and he immediately said, “Video game graphics!” Of course.

Richard Evan Schwartz has published other children’s books. In 2010 A K Peters put out *You Can Count on Monsters* about prime factorization (the monsters are the prime numbers), whose illustrations, from the online sample, are straightforward diagrams. In 2015 the AMS published his *Really Big Numbers: The First 100 Numbers and Their Characters*, whose pictures, from the online sample, are gentle with light colors. He also has self-published a number of children’s books, including, most intriguingly for me, *The Transporter Problem*, about a serious philosophical problem (if Scottie beams you down from the *Enterprise*, exactly who is it that arrives?) and whose illustrations have the same jagged edginess as those in *Gallery of the Infinite*.

Would I recommend *Gallery of the Infinite*? No. But I would not recommend Pokémon either, which places me in a definite minority. I am an old lady, and in matters like this the culture has passed me by. Will you like it? Maybe. Some of the kids thought it was great. So if you know of or are a smart, young—that is, under forty—person who doesn’t know any set theory, would like to know about it, likes what my generation used to call comics, and likes strange art in garish colors, you might consider this book.

I do have one caveat, which has nothing to do with the text or the art. *Gallery of the Infinite* started to fall apart after six people besides me had read it. Really? AMS is the publisher. I expect better quality control, and so should you.

Note: Valuable assistance in reviewing *Gallery of the Infinite* was received from Nora Agah, Dennis Duermeier, Emmaleigh Hancock, Ben Lombardo, Janet Stefanov, and Jaja Wang.

Credits

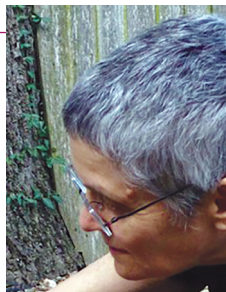
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ABOUT THE REVIEWER

Judith Roitman tends to lead several lives simultaneously. Relevant to this review are: her life doing set theory in the guise of general topology and Boolean algebra, and her life as a poet. She has absolutely no ability to create visual art (“how do you even start a painting/sculpture/drawing?” she asks her artist friends) but finds it deeply satisfying to look at.



Judith Roitman

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