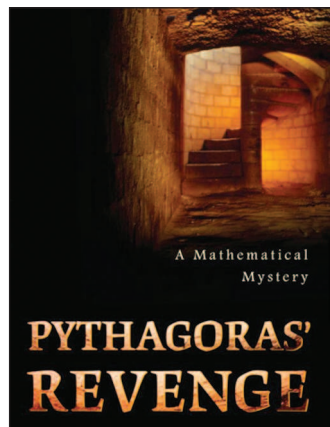# The Full Potential of Storytelling:

Review of *Pythagoras' Revenge: A Mathematical Mystery*

Reviewed by Javier Fresán

Pythagoras' Revenge: A Mathematical Mystery
Arturo Sangalli
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What is the difference between *The Name of the Rose* and *The Da Vinci Code?* Leaving the literary abyss aside, naive readers might find many contact points between two of the most successful historical whodunits ever written. But as soon as they try to go further, they find that Umberto Eco's splendid reconstruction of the labyrinths of scholastic thought turns out to be as important as the murders themselves. By contrast, what underlies the treasure hunt of Professor Robert Langdon is "dust, gloom and nothingness", to give it a more substantial description than it deserves. In the novel under review, neo-Pythagorean sects searching for a reincarnation of their Master coexist with scholars absorbed in the translation of ancient manuscripts. Nevertheless, the author's wish to teach and delight makes the story closer to *The Name of the Rose* than to *The Da Vinci Code.*

Arturo Sangalli received a Ph.D. in mathematics from the Université de Montréal and, for twenty years, conducted research in universal algebra. Then he developed an interest in popularization of science that took the form of many contributions to *New Scientist* before the publication of his first book. With a title partially borrowed from Oscar Wilde, *The Importance of Being Fuzzy: And Other*

Insights from the Border between Math and Computers attempted to illuminate some of the mathematical ideas behind the suggestive terminology of fuzzy logic, neural networks, and genetic algorithms. Initially *Pythagoras' Revenge* was intended to discuss the tyranny of numbers in modern societies in the same style as Sangalli's previous book. But, as if by magic, it became instead a work of fiction.

Few things are certain about Pythagoras' life and teachings, since all preserved sources were written down centuries after his death. According to the earliest chronicles, he was born on the Aegean island of Samos around 570 B.C. and traveled widely during his youth. After many years of apprenticeship—in which, some sources claim, Pythagoras may have met the priests of Egypt, the naked philosophers of India, and the Babylonian astronomers—he settled in the Greek colony of Croton, where he founded a fraternity to share his extensive knowledge with a select minority. In a way, the term "unconventional epicureans", coined for the assassins of Julius Caesar by historian Arnaldo Momigliano, is also valid to describe this ascetic sect whose followers exerted a powerful political influence.

The conviction that "number is the root of all things" played a central role in the doctrine of the Pythagoreans, probably due to their discovery that simple proportions between the length of strings explain musical harmony. Far from being a mere tool in human affairs, integers extended throughout the "music of the spheres" that governed the laws of universe. That is the reason why the emergence of irrational numbers was not celebrated as a step toward a more accurate worldview but rather considered a major threat to the equilibrium of the cosmos. If one trusts the legend, the discoverer of creatures outside the realm of reason, such as the square root of two or the diagonal of the pentagon, would have been drowned at sea after having divulged the secret to people who did not belong to the Order.

Today all is number but for different reasons. As a by-product of the triumph of technology, most of our routines depend heavily on computer systems, decisions based on statistics, or numerical parameters designed to encapsulate chaotic realities. Without the never-ending chains of 0s and 1s—for which Hollywood has over and over again shown a weakness—emails, DVDs, and GPS would just disappear. Even when technology works properly, a measurement mistake may have tragic consequences. A traveler coming from pre-Socratic Greece could think that ours is a "brave new world" in which all mysteries of numbers have been revealed. But after the necessary time to recover from the drastic change, he would realize that a complete comprehension of irrational numbers is still far away.

After Cantor's breakthrough, we know that almost all numbers are irrational. However, it is extremely difficult to decide whether a given one is. It is surprising that mankind had to wait until the middle of the eighteenth century to have a proof of the irrationality of π, a ubiquitous constant in Greek mathematics. Or that the values of the zeta function at odd integers remained virgin territory for more than two hundred years. It is still more worrying that almost nothing can be said about numbers that do not admit a simple representation, for instance as the zeros of a well-behaved entire function. In a world where numbers have gained power, we have no definite answer to the most obvious question: what are they? That is one of the possible interpretations of Pythagoras' revenge to which the title of this book alludes.

Two scholars fantasizing about action outside of academia each have information that the other needs. One is a young American mathematician, Jule Davidson, who secretly envies his sister, who works freelance as a consultant in computer security. The closest thing he can afford to her exciting trips around the world is to solve riddles on the Internet. Across the ocean, the Oxford fellow Elmer Galway has not inherited his father's passion for adventure. Instead of following his father's steps as a renowned archaeologist, Galway devotes the little time not taken up by the duties of his classical history chair to help an antiquarian book dealer. The innocent-looking hobbies of Davidson and Galway will lead them to a sect that tries to find a scroll explaining how to recognize the "extraordinarily gifted man" into whom Pythagoras would have reincarnated.

The only point on which all specialists agree is that the first man to call himself a philosopher left no writings, partly for the sake of secrecy and partly because the zeitgeist promoted oral means of transmitting knowledge, as Plato would show later in *Phaedrus*. But what if Pythagoras had compiled his fundamental teachings, foreseeing the downfall of the brotherhood? What if some of his disciples had felt the need of getting the odd circumstances of the Master's death straight? In 1947 a collection of religious and historical scrolls of huge significance

was discovered in the northwest shore of the Dead Sea. Fifty years later, a construction worker found an unknown edition of one of the masterpieces of Spanish literature while knocking down a wall. So it would not be a stretch to imagine that the bowels of a medieval Italian basilica could hide a manuscript referring to the lost original source.

This is the starting point of a thriller that takes the reader from suburban Chicago at the end of the twentieth century to the island of Croton in 445 B.C. None of the ingredients of the plot are very original: there are indeed thousands of novels speculating about sects, lost books, or "beautiful minds". What is new is how the writer masters a manifold of registers to produce a sound story in which culture is not accessory but central. This is evident from the first chapters, where the suspense of a computer countdown helps Sangalli to explain the difficulty of proving that some mathematical problems have no solution. In the meantime, one of the characters discovers, during a seductive conversation with Professor Galway's assistant, that the humanities also have their Achilles' heel: "books full of lies", as Cicero called the work of unscrupulous copyists.

In most cases dialogues allow the author to talk about science in a very natural manner. For instance, the reader hardly notices that he is being taught the basics of philosophy of proof during one of Jule Davidson's encounters with a member of the sect. On another occasion, the excuse to introduce the idea of complexity is a lecture of an internationally famous problem-solver, who claims to have proven that randomness is at the heart of mathematics. At that point, the explanation of the main feature of Pythagoras' revenge is transparent even for those without any scientific background. Sangalli is aware that it is difficult to provide a satisfactory definition for randomness. So it is remarkable how he profits from readers' probable astonishment at this difficulty to guide them through Kolmogorov's notion of complexity and physicists' attempts to generate random numbers from atoms.

Mathematicians probably would have appreciated a more detailed discussion of some of the topics treated in *Pythagoras' Revenge*. For example, the story of the unsolvable Fifteen Puzzle, which in spite of its success was never patented because it was compulsory to submit a "working model", is a great missed metaphor of the meaning of logical consistency. Also conjectures about normal numbers, such as the possibility of compressing Jorge Luis Borges' *Library of Babel* in the digits of π, would have fit in perfectly with the passage in which Alan Turing and Gregory Chaitin go on stage. But it does not matter, for what remains after the end of this page-turner is Sangalli's impressive capacity to communicate mathematics. Let us take this book as a reminder to capitalize on the full potential of scientific storytelling.