

On The Number Trail

“Finding Zero”, by Amir D. Aczel, pg. 244, St. Martin’s Griffin, distributed in India by Pan Macmillan. (2015).

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It all began in the famous Casino de Monte Carlo, the playground of the rich and famous, in the principality of Monaco. A young lad, who had been surreptitiously smuggled in by a ship captain’s steward witnessed the game of Roulette and developed a life-long fascination for numbers and their origins.

The youngster was Amir D. Aczel and the steward was Laci who was Aczel’s father’s steward. The senior Aczel was the captain of a cruise ship which took wealthy Israeli tourists from Haifa in Israel to various destinations in the Mediterranean. Laci, as it turned out was a very colourful character- he had been a brilliant graduate student in mathematics at the prestigious Moscow State University, once considered one of the top places in the world for physics and mathematics. Later, he defected to the newly established state of Israel with a military airplane. He was also a smuggler as Aczel finds out much later.

With Laci, the precocious Aczel travelled to various Mediterranean destinations like Athens and Pompeii and was given an education in the beauty of numbers- the golden ratio and Fibonacci numbers at the Acropolis, prime numbers and Roman numerals at Pompeii etc. In addition, Aczel also learnt about the mystery of numbers. Numbers are everywhere, but there is something mysterious about them. Actually, as Aczel says, “...there are really two mysteries. One was where the first numerals originated.....” Here of course Aczel is referring to the nine numerals and zero, which is the decimal notation that essentially rules the whole world. The second mystery is deeper and more subtle- how did our ancestors abstract the concept of numbers? How did they realize that there is an idea of, for instance *fiveness* shared by all things that are five in number?

It is the quest to solve the first mystery about the origin of our number system that is the subject of this book. Aczel went on to become a professor of mathematics and wrote books and papers in his field. However, his real passion was to find out the origins of our numbers especially zero. And so began a journey which took him, among other places, to the temples of India and the jungles of Cambodia.

Of course, numbers, as a concept, have a long history. The earliest known physical artefact with some evidence of counting is a shin bone of a baboon from the jungles of Congo. Dated to about 20,000 years ago, it has three sets of identical notches with tally marks. Similar bones have been found in Palaeolithic digs in Europe too. And then there are numerous

examples of Neolithic megaliths arranged in particular sequences and groupings, like the circular arrangement at Stonehenge or the linear arrangement in prime numbers at Carnac in France.

However, these tallying systems have no concept of a place value. Place value is the method of representing numbers where the same symbols can be used to denote different orders of magnitude. This allows for an easy representation of arbitrary large numbers. For instance in our decimal system, the same set of 10 numerals can denote different things depending on their position- in 450, the 4 in the hundreds place denotes four hundred while in 4536, it is in the thousands position and so denotes four thousand.

The base of a number system is the other important determinant. Our decimal system is of course base 10 that is we need 10 unique numbers to represent any number. A computer uses a binary system where any number can be represented by 0 and 1. Historically, several systems have been tried, like for instance the base 60 or sexagesimal system of the ancient Sumerians whose vestiges we still see in our counting of time and angles.

The most common and obvious base to use for counting would of course be 10 because we have ten fingers. In fact, the first use of base 10 counting was around 3000 BC in ancient Egypt. Zero as a number also has a long history and its use has been documented in different sites in the ancient world, including Egypt, Babylon and India. The Buddhist concept of *shunayata* or emptiness or nothingness, for instance refers to zero. However, its use as a placeholder in a place value system is what makes it so useful. It is widely believed that this happened during the Gupta period and was due to the work of great mathematicians like Aryabhata (around 500 CE) and later Brahmagupta (7th century CE) though earlier references to it are found in some Jain texts too.

The decimal system travelled from India to the Middle East from where in the 12th century, Fibonacci introduced it to Europe. The numerals were called Hindu-Arabic numerals. This and some etymological connections to the names of numbers led some scholars to question the Indian roots of the system and instead claim that the origin was Arabic. This was especially true of zero since the Latin word for it, *zephirium* derives from the Arabic word *sifr*. It didn't help that the earliest inscription where 0 is used as a numeral in a place value system is a temple in Gwalior dated to 876 CE. This made it plausible that it had come from the Arabs to India. In the 1930s, a French archaeologist reported seeing an inscription in Cambodia with the date 608 Caka or 683 CE, but this inscription had since disappeared. If discovered, this would unambiguously place the origin of 0 in India since this date predates the Arab Empire. And it was this inscription that Aczel was after.

The book is an intellectual and personal quest where Aczel first educates himself about Hinduism, Buddhism and Jainism. He helpfully gives us a one page summary of Hinduism which seems like a caricature with gems like, "...Lakshmi wakes him [Vishnu] up by massaging his legs as he lies in eternal slumber on top of the sea serpent, Ananta- which

means infinity". Or when he talks about Shiva- " For a dangerous god, he seems rather benevolent: His chief interest, as evident from much of the art in which he appears, seems to be sex". One just hopes Mr. Dinanath Batra does not see this book! Elsewhere he talks about the big bird Garuda being Shiva's mount instead of Nandi bull.

After becoming acquainted with the philosophies and religions of the East, Aczel travels to Gwalior and Jaipur and then to Bangkok, Laos and Cambodia in search of the physical evidence of the earliest use of zero as a place holder. In a Jain temple at Khajuraho, in a doorway, "framed by erotic statues", he finds a 4x4 magic square while in a temple in the Gwalior fort he marvels at the 9th century inscription with 0. It seems that it is not just Aczel's knowledge of the scriptures that is shaky but even his history seems a bit odd. Thus, about the Jantar Mantar at Jaipur, he tells us that " These devices [the sophisticated instruments] predated telescopes and so no lenses were used.....". This is amazing- a cursory glance at Wikipedia would have told him that the Jantar Mantar was completed in 1734 CE a good 125 years after Galileo used a telescope to view the Jovian moons!

The quest for the Holy Grail, the Cambodian inscription is intended to read like a thriller. However, here too Aczel fails to keep the reader's interest by too many pointless diversions and personal accounts. And it does get a bit melodramatic sometimes. At one point, after several dead ends in his search, having just finished a nice meal of curried rice (the curry was better than Indian curry he informs us helpfully) and a dessert of crème brulee, Aczel's wife Debra asks him " What would you do if the K-127 (the Cambodian inscription) doesn't exist anymore?" He thinks for a moment and then says, " I will find it... even if I have to spend the rest of my life here in Southeast Asia." Salim Javed couldn't have done better!

For a book by a mathematician and the celebrated author of the bestselling "Fermat's Last Theorem" this book has little mathematics. And even that is not particularly easy to understand by the lay reader. Thus, his short digression to explain Euclid's proof of the infinitude of primes is not at all clear if you don't already know it already. Even Wikipedia does a better job.

This is not the book to learn Eastern thought, or mathematics or history of numbers. Indeed it is not even a thriller. However, the one thing that can be said about it is that it does bring out Aczel's passion for his search. And as it turns out, he does find the inscription in the end though not before encountering some academic double crossing etc.

It was fortuitous that Aczel was successful in his quest for K-127, the holy grail of the history of zero, since he passed away in November 2015 soon after the publication of this book.

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