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Mathematics Over Time

Professor Little

The Final Word on Plimpton 322

The ancient civilization of Babylon in Mesopotamia produced some of the earliest mathematical tablets known in history. The famous and controversial text “Plimpton 322” appeared around 2000 – 1600 B.C.E. in Larsa, which is Southern Iraq today. Like all Babylonian records, this tablet used a base-60 number system. Mathematicians have studied this tablet for years and still very little is known. It is such a controversial text because of the kinds of math that were used and the interpretations of how the Babylonians were able to perform these mathematical functions. The most popular interpretations of Plimpton 322 have been presented by Otto Neugebauer, Peter Rudman, David Joyce, and historian of ancient Mesopotamia Eleanor Robson. Neugebauer suggested that the Babylonians were using an algebraic process to perform the math on the tablet and form Pythagorean triples. Rudman disagreed by saying that they must have used the Pythagorean Theorem or at least have had some understanding of it. Joyce along with some earlier mathematicians thought that it was a table of Pythagorean triples and that it was probably a trigonometric table. All of these theories are indeed mathematically correct. However, it seems that they are not historically correct. Eleanor Robson gives her unique take on the tablet in her article “Words and Pictures: New Light on Plimpton 322” in the *American Mathematical Monthly*.

Eleanor Robson begins her work by expressing the belief that historical documents and artifacts can only be understood when they are studied in their historical context. Studying ancient mathematics is indeed different form merely researching modern mathematics. She criticizes other work on Plimpton 322 and other similar artifacts because she says that some historians are like detectives that study the documents like they are trying to solve a murder mystery or a puzzle. They end up reading too much into the document and not realize the real historical significance of the artifact. Oftentimes it is an amateur historian who then feels a sense of accomplishment for outwitting a professional historian. These historians are missing the point as they are avoiding the historical context. Mathematics tends to be seen as something free from culture that is waiting to be discovered. This is not the case, however. Mathematical investigators need to understand the language, history, archaeology, social context, and the mathematical concepts that were known at the time.

Robson disagrees with David Joyce’s theory that Plimpton 322 is a sort of trigonometric table. She says that if it is, there should be other evidence of angle measurements somewhere in Mesopotamia. The people in ancient Mesopotamia thought about triangles very differently from the way we do. The major difference involves their understanding of plane geometry. Their calculations of circles were very different than our own as the math involved using the circumference as opposed to the radius to determine the area of the circle. Since plane figures were conceptualized, named, and defined from the inside out, the center of the circle and the concept of the rotating radius would have been irrelevant in Mesopotamia. Also, because the rotating radius was not included in their idea of a circle, they had not set the foundations for angle measurement and trigonometry. Therefore, Plimpton 322 could not possibly have been a trigonometric table of any sort because the relevant types of math and concepts had not yet been conceived.

Robson also disagrees with Otto Neugebauer’s suggestion that Plimpton 322 was primarily a number-theoretic investigation of Pythagorean triples along the algebraic lines. Numerous cuneiform tablets were uncovered at Larsa in Southern Iraq. Upon comparing the tablets, Plimpton 322 does not strongly resemble the other mathematical tablets and is more similar to the administrative tables. She compares it to the tablet YBC 4721. This tablet, like Plimpton 322, was written in what is known as landscape form with headings above each column. The entries in the first column are listed in descending numerical order. All of the calculations that take place on the artifact occur from left to right across the table. It contains some Sumerian writing and is dated in the last column to have come from around 1822- 1784 B.C.E. Due to the similar setup, she assumes that Plimpton 322 must have come from around the same time period. She also suggests that it must have been written by someone familiar with temple administration. Since it follows these formatting rules, Neugebauer’s theory can be dismissed. Had the missing columns on the left side of the tablet listed *p* and *q*, they would not have been in descending numerical order as this would have gone against the specific formatting rules. Therefore, it could not possibly be a number-theoretic investigation of Pythagorean triples along the algebraic lines.

After dismissing the theories of David Joyce and Otto Neugebauer, Eleanor Robson expresses her interpretation of Plimpton 322. She says that we can recognize reciprocal pairs as something that played a large role in mathematics of Ancient Mesopotamia. Records and problem sets from scribal schools present the best evidence of the importance of reciprocal pairs. Students at these schools needed to learn their sexigesimal multiplication tables by heart. None of the numbers on the tablet are more than four places long. The mathematical tablet YBC 6967 from the same time period as Plimpton 322 in Larsa helps to aid the understanding of this concept. This tablet contains the instructions on how to solve school problems that deal with reciprocal pairs. The mathematician Jens Hoyrup interpreted the mathematics contained on this tablet not as being evident of algebra, but instead as demonstrating the idea of cut and paste geometry. Upon following these instructions, the Pythagorean triples that Neugebauer suggested present themselves. However, the Pythagorean triples were reached through the usage of geometry as opposed to algebra as Neugebauer had thought. Robson feels as though the most accurate description of Plimpton 322, historically, culturally, and linguistically, is that it is a list of reciprocal pairs written in descending order used to find the short sides and diagonal sides of triangles with the long side equal to one by the method of completing the square. She feels that the only question that now remains regarding this important artifact is who wrote it and for what purpose.

I am convinced by Eleanor Robson’s arguments on understanding Plimpton 322. Unlike the mathematicians David Joyce and Otto Neugebauer, Robson takes a look at the cultural and historical aspects behind the artifact to better understand its meaning. Strictly from a mathematical viewpoint, it could be seen as a table of Pythagorean triples or a trigonometric table. However, when viewed in its appropriate context, it makes sense that the mathematics on Plimpton 322 are a generalized version of another important Mesopotamian artifact, YBC 6967, and was probably produced by a math teacher as a source of problems for his students. However, I also agree with the theory presented by Peter Rudman in his work *The Babylonian Theorem*. Rudman suggests that based on the math shown on the tablet, the Babylonians probably had some understanding of the Pythagorean Theorem. I agree that if they were performing this kind of math, it is very likely that they must have realized the relationship in the sides of a triangle, if they were in fact looking at geometry when working on this math. Robson does not make reference to Rudman’s thoughts and therefore does not disprove them.

In sum, the Mesopotamian tablet Plimpton 322 remains a famous and controversial text. Many mathematicians have studied this tablet and have come up with several different ways of interpreting it. Otto Neugebauer believed that it dealt with algebra and Pythagorean triples, David Joyce and other mathematicians felt that it is a table of Pythagorean triples as well as a trigonometric table. Peter Rudman thought that the Babylonians must have had some understanding of the Pythagorean Theorem. While all of these ideas are certainly mathematically correct, it is unlikely that they are historically correct. In her work, “Words and Pictures: New Light on Plimpton 322,” Eleanor Robson investigates the historical and cultural context of the time and place where Plimpton 322 was discovered. She reaches the conclusion that the artifact instead was probably a problem set for students that dealt with reciprocal pairs. While its true meaning and purpose may never be known or understood, Robson puts forth an excellent argument for her historical and cultural understanding of this famous and controversial artifact.

Bibliography

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2. Rudman, Peter S. The Babylonian Theorem: The Mathematical Journey to Pythagoras and Euclid. Amherst, NY: Prometheus Books, 2010.