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Topic 1 - The Final Word on Plimpton 322?

Plimpton 322: Evaluating Theories

Plimpton 322 is a cuneiform tablet written in Larsa, present-day southern Iraq, from approximately 1800 BCE. Written by the Mesopotamians, there are many differing theories as to what is on the tablet, who wrote the tablet, and how the Mesopotamians knew the mathematics on the tablet (either geometric or algebraic). Otto Neugebauer, Paul Rudman, David Joyce (along with others) and, most recently, Eleanor Robson developed different theories of how the numbers on Plimpton 322 came about. Robson rejects theories based on trigonometry and Pythagorean triples with the use of historical context, and she rules that Plimpton 322 is a teaching tablet with a list of reciprocal pairs.

Robson says we must view ancient tablets with a historical view, rather than a mathematical view. She gives an example of how, when asked to draw a triangle, people today would draw one differently, although still a triangle, than those in Babylonian times. How mathematics is viewed can vary between cultures and times, so the best way is to decipher using a historic lens. If we view with a mathematical lens, we would assume Mesopotamians used and viewed math the same way we did, but they did not. For example, they defined the area of a circle by the circumference squared divided by four times pi instead of area equals pi times radius squared as taught today. Yet, Robson says that to evaluate theories on Plimpton 322, a “successful theory should not only be mathematically valid but historically, archaeologically, and linguistically sensitive too.” She states that previously Plimpton 322 was only viewed in a mathematical way, and the theories produced from it would make it seem like it is “millennia ahead of its time.” To evaluate theories of what Plimpton 322 shows, Robson says we must make “new comparisons.”

David Joyce and some other mathematicians believe that Plimpton 322 is a table of Pythagorean triples as well as a trigonometric table. However, Robson rejects this theory by saying it is “anachronistic.” Mesopotamians defined circles by the circumference, not through the use of radii as we now do. It is thus probable that trigonometric ideas were not used often. There is no evidence that Mesopotamians had a way to measure angles, so the theory is probably not historically correct. Robson goes on to say that the concept of a circle rotating around its radius was not used often, and therefore not taught as much. Since Plimpton 322 was most likely used by a student, the teacher would not have used trigonometry. The idea that the radius was a function of angles was slow to be learned and taught. A trigonometric theory depends on too many ideas not taught or often used in 1800 BCE.

Neugebauer believes that the Mesopotamians used an algebraic process to form Pythagorean triples. Robson quickly rejects Neugebauer’s theory with two reasons. First, she says that the table on Plimpton 322 follows the same formatting as other tables found in Larsa and that the variables *p* and *q* Neugebauer identified would “not have been in descending numerical order,” thus breaking the formatting of the time. There is also no reason as to why *p* and *q* were selected out of all possible Pythagorean triples. However, Robson said that Plimpton 322 is unlike any other tablet found, so it is believable that it does not need to follow the formatting rules as other tablets do. Secondly, Robson says there is also no explanation for the numbers in Column I on Plimpton 322 or why they would be necessary to show Pythagorean triples.

Robson believes Plimpton 322 should be viewed as a list of reciprocal pairs. She first points out that reciprocal pairs had been taught to students for a while and were on other tablets as well. Plimpton 322 uses completing the square, a known method, to find the reciprocals. To determine the written headings of the columns she looks to YBC 6967. YBC 6967 is a tablet from the same time and place as Plimpton 322. The mathematics on the tablet uses, as Robson says, cut-and-paste geometry to show reciprocal pairs. Column I would be similar to what is on YBC 6967, because Robson believes both have to do with reciprocal pairs. YBC 6967 “describes the area of the large square, composed of 1 plus the small square.” Thus, Column I says that 1 should be added to each entry in the column. This makes sense because the reciprocals were “used to find the short sides *s* and diagonals *d* of triangles with long sides of length *l* = 1.” Moreover, she believes that the author of Plimpton 322 is a teacher who is writing down exercises, much like on YBC 6967, for a student. She was able to rule that the author is a teacher by determining the person could not be a professional or an amateur, because professional mathematicians did not exist and there would be no time for an amateur to learn as part of the “merchant class.” The tablet is, according to her, “was [not] written for the temple bureaucracy: its organisational structure most closely resembles a class of school mathematics document.”

Although, Robson argued her points well, I believe both Neugebauer and Rudman’s theories still are reasonable. However, I do believe the trigonometric idea is not backed historically. Robson accepts Hoyrup’s idea of cut-and-paste geometry when viewing YBC 6967, but does not look to Rudman’s idea as another way to evaluate YBC 6967. If she were to do so, and if she were to establish that Rudman may be correct, then Rudman’s idea that Plimpton 322 is of Pythagorean triples could also be true, for the use of the Pythagorean theorem is just an extension of his diagram used for YBC 6967. Since the two tablets were written around the same time, it is definitely possible that the Babylonians continued the geometric idea further in Plimpton 322. Even if she disregards Rudman’s idea for YBC 6967, she still believes the Mesopotamians used a geometric approach which is what Rudman believed was used for Plimpton 322. Neugebauer’s theory is still reasonable in that even Robson says Plimpton 322 is unlike any other tablet from Mesopotamia, so it does not have to follow the same order as other tablets. There may be an unknown reason as to why *p* and *q* were chosen, but they still show Pythagorean triples. Even if *p* and *q* were used to show administrative accounts, like YBC 4721, the numbers could be a result of an understanding of the Pythagorean Theorem. I absolutely agree with Robson’s overall idea that when viewing ancient tablets historical context should be included in conclusions, especially if it is true that Plimpton 322’s “format is strikingly similar to administrative tables from the area.” If Plimpton 322 was written for a nonmathematical reason, then it probably did not include math beyond what was taught or what was used for computing administrative works.

Robson’s ideas are flawed in that YBC 6967 is not exactly like Plimpton 322, so her translation of Column I may be wrong. YBC 6967 is one problem set, whereas Plimpton 322 may be multiple problems solved in a way different than YBC 6967. Since Babylonian tables are really common, yet there is not one similar to Plimpton 322, it should not be easily compared to YBC 6967 and other tablets. The only way Robson denies Neugebauer’s Column I translation is through the use of YBC 6967, so it is possible that his translation still stands. Robson also somewhat contradicts herself in saying that Plimpton 322 is very similar to YBC 4721 – it is written similar to an administrative table – yet, she concludes it is written by a teacher for a student. She compares the tablet to two tables, but makes a definite conclusion that it is written by a teacher. Although these are small flaws, they should still be evaluated.

While the definite truth of Plimpton 322 will not be known until another analogous tablet is found, the current theories of the tablet are intriguing. However, Robson is able to deny all theories besides her own through the use of historical facts. Since the Mesopotamians had not invented a way to measure an angle, clearly Plimpton 322 is not a trigonometry table. That is not to say Joyce is completely wrong, for the tablet could still be a table of Pythagorean triples. I also believe that Neugebauer and Rudman’s theories are still rational, if given more tablets to compare to Plimpton 322. The Mesopotamians could have definitely used the image Rudman uses with both YBC 6967 and Plimpton 322. There is nothing safe to say about the tablet for nothing is completely sure, for even the idea that it is a teaching tablet is not for certain.

Bibliography

Robson, Eleanor. “Words and Pictures: New Light on Plimpton 322.” *The Mathematical Association of America* Feb 2002: 105-120. Print