The numbers behind Plimpton 322

Anthony Phillips
Mathematics Department, Stony Brook University

September 20, 2011

Abstract
Explanations for the origin of the numbers on the Old Babylonian mathematical tablet Plimpton 322 are surveyed; a new one is proposed. It gives a derivation simpler than those of Price and Friberg; it diverges slightly but significantly from the numbers they include in their hypothetical extension of the table to rows covering the sides and back, and suggests that such an extension is impossible.

1 Introduction
Plimpton 322 is probably the best-known Babylonian mathematical text. It must be one of the most controversial; substantially divergent explanations have been offered by very reputable scholars both for its purpose (why?) and for its generation (how?). This note addresses the “how” question, and proposes a simple and culturally appropriate mechanism generating the 15 rows of the tablet. When this mechanism is used to extrapolate beyond those 15 rows, it gives predictions slightly different from those that have been previously suggested.
2 The tablet; notation

Here is a transcription\[\]

![Table of numerical part of the tablet]

Text in [brackets] is a reconstitution of missing material. The (1)s are implied by the mathematical structure of the data and may have been written ahead of or along the documented break in the tablet. Comparison of this tablet with others of the period suggests strongly that the calculation is carried over from a now missing left-hand companion tablet. The cleanliness of the break suggests that a special, long tablet was fashioned by pushing two standard tablets end to end. Although this joint would have been fragile, the reported traces of modern glue on the join surface suggest that the two halves survived together until modern times.

This transcription includes four corrections of the cuneiform entries. According to [Joyce, 1995]: “In the second row, third column, the original number was 3:12:01 rather than 1:20:25. In the ninth row, second column, the original number was 9:01 instead of 8:01. In the 13th row, second column, the original number was 7:12:01 instead of 2:41. And in the 15th row,

\[\]

1A recent high-quality photograph of the tablet, front and back, is available on the website of the Institute for the Study of the Ancient World:
http://isaw.nyu.edu/exhibitions/before-pythagoras/items/plimpton-322/
third column, the original number was 53 rather than 1:46.” Robson’s transcrip-
tion differs from Joyce’s in that, in row 15, she corrects the 56 to a 28 and leaves the 53. Our analysis will show that this was indeed the correct correction.

The tablet has four columns, which we label here from left to right $A$; $S$, $D$ (following Robson, for Short and Diagonal); and $N$ a row number running from 1 to 15.

The uncontested mathematical properties of the numbers on the tablet are as follows

1. The numbers in column $A$ decrease, fairly regularly, from top to bottom.
2. Each number in column $A$ is a perfect square and one more than a perfect square.
3. In each row, the numbers in column $S$ and column $D$ have no common factors. (One exception: row 11).
4. In each row, $D^2 - S^2$ is a perfect square.
5. In each row, $A = D^2/(D^2 - S^2)$.

For example, the fourth row contains the sexagesimal numbers

\[
A \quad S \quad D \quad N
\]

\[(1) \quad 53 \quad 10 \quad 29 \quad 32 \quad 52 \quad 16 \quad 3 \quad 31 \quad 49 \quad 5 \quad 09 \quad 01 \quad 4
\]

(here $D^2 - S^2 = 3 \quad 45 \quad 00^2$) and $D^2/(D^2 - S^2) = 1 \quad 53 \quad 10 \quad 29 \quad 32 \quad 52 \quad 16 = A$.

It should be kept in mind that the entries on the tablet are written in what we now call “floating point” sexagesimal notation, which is unambiguous for products and reciprocals, but needs some good will for sums and square roots: 1 is a perfect square but 1 00 is not, etc.

\[^2\text{There has been disagreement about the presence or absence of initial 1s in column A; if they are absent, then item 2 below should read “and one less than a perfect square,” and item 5 should read } A = S^2/(D^2 - S^2).\]
3 Summary of existing work on the problem

For ease in comparison, notation has been uniformized in quoting these different authors. Other changes in the same spirit have been set off [in brackets].

- Neugebauer and Sachs [1945]. This was the first publication of Plimpton 322. “The text deals with ‘Pythagorean triangles’: right triangles whose sides are integers.” They understand that a Pythagorean triple \((L, S, D)\) can be generated from a pair \((P, Q)\) of integers, with \(P > Q\), by the rule

\[
L = 2PQ, \quad S = P^2 - Q^2, \quad D = P^2 + Q^2
\]

and that requiring \(P\) and \(Q\) to be relatively prime, and not both odd, ensures that the similarity class of each triple is produced exactly once.

They list their candidates for generating the triples as follows:

| Row | \(P\) | \(Q\) | Row | \(P\) | \(Q\) | Row | \(P\) | \(Q\) |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1   | 12  | 5   | 6   | 20  | 9   | 11  | 2   | 1   |
| 2   | 1   | 04  | 7   | 54  | 25  | 12  | 48  | 25  |
| 3   | 1   | 15  | 8   | 32  | 15  | 13  | 15  | 8   |
| 4   | 2   | 05  | 9   | 25  | 12  | 14  | 50  | 27  |
| 5   | 9   | 4   | 10  | 1   | 21  | 40  | 15  | 9   |

Table 1.

For example in Row 4, \(D = P^2 - Q^2 = 5 \ 09 \ 01\) as in the table.

They observe that then \(D/L = (P^2 + Q^2)/2PQ = (1/2)(P\bar{Q} + Q\bar{P})\), where \(\bar{Q}\) and \(\bar{P}\) are the reciprocals. In their explanation for the construction of the table they take the “almost linearly” decreasing list of \(D^2/L^2\) values in column \(A\) as the primary given. The tablet is then calculated by “selecting numbers \((P\bar{Q} + Q\bar{P})\) from combined multiplication tables such that \([(1/2)(P\bar{Q} + Q\bar{P})]\) has a value as near as possible to the required values of \(D/L\).”

Neugebauer and Sachs briefly consider, but discard, the idea that the number \(P\bar{Q}\) (with its reciprocal \(Q\bar{P}\)) be used as a single parameter;
they list what this would give for the first four rows:

| Row | $P$ | $Q$ | $PQ$ | $QP$ |
|-----|-----|-----|------|------|
| 1   | 12  | 5   | 24   | 25   |
| 2   | 1   | 04  | 27   | 213  |
| 3   | 1   | 15  | 32   | 220  |
| 4   | 2   | 05  | 54   | 218  |

and conclude that the simpler $P$ and $Q$ must have been “the point of departure.”

- Bruins [1949]. Bruins observes that the one-parameter derivation of the numbers on Plimpton 322, “rejected” by Neugebauer and Sachs, can actually be the starting point for “a much simpler interpretation” in which the “constant decrease” of $D/L$ is “merely accidental.” Bruins establishes a complete list of the four-place reciprocal pairs in the range between $(2.24, 25)$ and $(1.48, 33.20)$, the $(PQ, QP)$ pairs corresponding to rows 1 and 15, respectively, as above; he finds, with six exceptions, that each pair on the list corresponds to one row of the tablet. He devises a rationale for the exclusion of the six: in each of them one element has too many regular factors, in the sense that when it is written as $2^\alpha 3^\beta 5^\gamma$ the exponents satisfy $\alpha + \beta + \gamma > 13$, while its reciprocal satisfies $\gamma > 3$.

- Neugebauer [1957]. Neugebauer does not refer to [Bruins 1949] but only to [Bruins 1955], an attempt to explain some of the errors in Plimpton 322, which he dismisses as containing “incorrect and unfair statements as to the readings of the text.” The $(P, Q)$ analysis from [Neugebauer and Sachs 1945] is repeated; moreover, each row corresponds to a triangle, and “the monotonic decrease of the numbers in column [A] suggests ... that the shape of the triangles varies rather regularly ... .”
Price [1964]. Price follows [Neugebauer 1957] in not referring to [Bruins 1949]. He instead takes up the analysis of Neugebauer and Sachs, reproducing the data in Table 1. He uses their observation that all their numbers $P$ and $Q$ are regular (i.e. have no prime factors different from 2, 3, 5; regular numbers are those with terminating reciprocals, in sexagesimal representation) to explain why the pair (9, 5) is used for row 14 despite violating the “not both odd” rule: the standard pair (7, 2) generating the same similarity class of triples involves the nonregular 7. He then observes that the pairs $(P, Q)$ in Table 1 satisfy the inequalities
\[ 1 < Q < 60 \quad f < P/Q < g \]
“where $f$ is such that $9/5 = 1.48$ is included but $16/9 = 1.4640$ is not, and $g$ is such that $12/5 = 2.24$ is tabulated but $5/2 = 2.30$ is not.” And that every relatively prime pair of regular numbers satisfying those inequalities corresponds in fact to one of the rows of the tablet. For Price the primary given then becomes the set of such pairs of numbers; this allows him to shift focus away from the “regularity of decrease in [column $A$]” which is now “simply the result of the density of such regular numbers among the integers” (here he echoes Bruins’ remark from 15 years before). He goes on to explore the meaning of the bounds $f$ and $g$ on the quotient $P/Q$, in terms of the interpretation of the tablet as a tabulation of triangles. The upper bound $g$ is natural since it “is certainly intended to correspond with the isosceles right-angle triangle.” On the other hand there seems to be no geometric reason for the lower bound $f$. Price suggests that $f = 1$ (which corresponds to $P = Q$ and $S = 0$) would be more natural, and goes on to compute the new pairs $(P, Q)$ satisfying the broader inequality: there are exactly 23 more pairs. He is led to conjecture that “the tablet is an incomplete copy or unfinished work,” offering as supporting evidence the fact that “if the rows were over the edge and on to the reverse there would be almost exactly the right amount of space for the complete array to be

---

3Robson [2001] explains this omission in part by referring to Bruins having published “in a poor print-quality Iraqi journal available in only a few specialist Assyriological libraries.” But [Bruins 1949] appeared, communicated by L. E. J. Brouwer, in the Proceedings of the Royal Netherlands Academy of Sciences, whereas [Bruins 1957] is in The Mathematical Gazette, a publication of the Mathematical Association of America.

425 in the text
given in order.” (He has previously noted that the division of the front of the tablet into columns has been carried over to the blank reverse). Price, like Bruins, argues that the tablet was written and calculated from right to left: the \((P, Q)\) pairs are generated and numbered in order of decreasing ratio \(P/Q\), all offstage; the rows are numbered and the entries \(S = P^2 - Q^2, D = P^2 + Q^2\) and \(A = D^2/(D^2 - S^2)\) filled in. Since \(A\) is monotonic increasing as a function of \(P/Q\) in the range \(P > Q\), the entries in column \(A\) decrease from row to row as a consequence of the construction.

- Schmidt [1980]. Schmidt does not refer to [Price 1964]. He agrees with Bruins’ reciprocal table analysis, although he does not address the problem of the origin of just that set of reciprocal pairs. He argues that Plimpton 322 has nothing to do with triangles, but rather with solving the “normal form of a quadratic equation,” by which he means

\[
x + y = a, \quad x \cdot y = b,
\]

and in the special case \(b = 1\), i.e. what is now referred to as an “igi-igi.bi” problem. He reconstructs the tablet as follows (taking \(T\) and \(\overline{T} = 1/T\) as a pair of reciprocals, \(X = \frac{1}{2}(T - \overline{T}), Y = \frac{1}{2}(T + \overline{T})\)):

\[
T, \overline{T}, X, Y, X^2, Y^2 = A, S, D, N
\]

remarking that since \(X^2 = A - 1\) that column might be superfluous.

- Buck [1980]. “We start with the class of all pairs \((P, Q)\) of relatively prime numbers such that \(Q < P < 100\) and each integer \(P\) and \(Q\) is ‘nice,’ factorable into powers of 2, 3, and 5. It is then easy to find the terminating Babylonian representation for both \(T = P/Q\) and \(\overline{T} = Q/P\). Make a table of these, arranged with \(T\) decreasing. Impose one further restriction:

\[
\sqrt{3} < T < 1 + \sqrt{2}.
\]

Then the \((P, Q)\) pairs that are left correspond to those in Table 1. above (with three exceptions).

Buck cites an unpublished article by D. L. Voils, where it is observed that the \(A\) entry in each row is a key step in the algorithm (as set
out, for example in YBC 6967 [Robson 2001]) for solving the igi-igi.bi problem when the solution is $T$ and $\overline{T}$.

- Friberg [1981]. Friberg continues in the spirit of Price ("It is my belief that the purpose of the author of Plimpton 322 was to write a ‘teacher’s aid’ for setting up and solving right triangles") and with the consideration of pairs $(P, Q)$ of relatively prime regular integers in a certain range. He observes that the inequalities

$$\sqrt{2} - 1 < \frac{Q}{P} \leq \frac{5}{9} = 33\,\text{20}\,\text{1} \leq \frac{Q}{P} < 1\,\text{00}$$

(equivalent to those in Price) correspond to the 15 rows of Plimpton 322, but he draws attention to the reciprocal pairs $t = \frac{Q}{P}$, $\overline{t} = \frac{P}{Q}$ that also characterize each row, taking up the direction dropped by Neugebauer and Sachs. (Note that he takes $t = \frac{Q}{P}$ as the primary element, guaranteeing a Babylonian-style increasing first column in his reconstruction of the missing part of the tablet). He follows Price in extending the range of the inequalities to $\frac{Q}{P} < 1$ and in numbering from 16 to 38 the new rows thus produced. He goes beyond Price in allowing the parameter $t = \frac{Q}{P}$ to go beyond the isosceles case and down to 00 15, producing an additional 22 rows, which he numbers from $-1$ to $-22$. His explanation of the algorithm used to generate the tablet begins as follows: "First a list was made, one way or another, of admissible $t$ values $\leq \sqrt{2} - 1$, which were then ordered in an increasing sequence and labeled by the index $N$." Then the quantities $X = (1/2)(\overline{t} - t)$ and $Y = (1/2)(\overline{t} + t)$ are calculated. Since any common factor of $X$ and $Y$ must be a common factor of $t$ and $\overline{t}$ and hence a regular number, the reduced forms $S$ and $D$ may be calculated by systematically eliminating common regular factors. This then allows a simpler calculation of $Y^2 = A$ (squaring the reduced form and then multiplying twice by each of the common regular factors). Friberg presents it all as the outcome of a "single series of computations" by positing that first $X^2$ and $Y^2$ are calculated by the factorization method, i.e., as above, so as to check that the Pythagorean equation $Y^2 = 1 + X^2$ is satisfied; and that then the reduced forms $S$ and $D$ are retrieved.

\footnote{but “It is also conceivable that a secondary purpose of the Plimpton table may have been to facilitate the setting up and solving of [igi-igi.bi problems].” Friberg was probably unaware of [Schmidt 1980] and [Buck 1980]; neither is cited in [Friberg 2007].}
as by-products of that computation. (A virtue of Friberg’s analysis is that he keeps in mind the difficulty of carrying out large multiplications with “some kind of ‘abacus’ which would set a restriction on the number of sexagesimal places in the numbers of the computation.” The Neugebauer-Sachs calculation can involve squaring a 5-digit number (row 10), but in Friberg’s every multiplication has at least one factor of sexagesimal length no greater than 3.)

• Robson [2001]. Robson supports the “reciprocal theory,” citing Bruins [1949, 1955], Schmidt [1980], Buck [1980], and Friberg [1981] as predecessors. This analysis is worked out in Table 6 where the columns are (setting $T = P \overline{Q}$, $\overline{T} = Q\overline{P}$):

$$T, \overline{T}, X, Y, Y^2, S, D, L, N$$

Robson explains how the $T$ and $\overline{T}$ parameters can be derived from those in the standard reciprocal table by standard operations, (or appear in the 7 12 multiplication table)\footnote{this may not be necessary; see below}. The range of the $T$ parameter is not discussed, except to remark that since the list seems to have been meant to continue around the back of the tablet, it does not matter. The question of whether all 4-place reciprocal pairs in that range appear in the table is considered at some length. Robson notes six examples:

| Row | $T$   | $\overline{T}$ |
|-----|-------|----------------|
| 4a  | 2 18 14 24 | 26 02 30 |
| 6a  | 2 10 12 30 | 27 38 52 48 |
| 8a  | 2 06 33 45 | 28 06 40 |
| 9a  | 2 02 52 48 | 29 17 48 45 |
| 11a | 1 57 11 15 | 30 43 12 |
| 12a | 1 53 46 40 | 31 38 26 15 |

numbered for where they would be interpolated, which do not appear in the table. These are exactly the six excluded pairs from [Bruins 1949].

• Friberg [2007]. The tablet is presented as “a Table of Parameters for igi-igi.bi Problems.” The reconstruction has four extra columns, and
runs
\[ T, T, X, Y, Y^2, X^2, S, D, N \]
(with respect to [Friberg 1981], the order has been switched to \( P\overline{Q} = \text{igi}, Q\overline{P} = \text{igi.bi} \)); the inequalities have been refined to
\[ 1 \leq Q < 60 \quad Q < P < Q \cdot 2^{25}. \]
This yields exactly 38 \((T, \overline{T})\) pairs which, when ordered by decreasing \(T\), give the 15 rows of Plimpton 322 followed by the 23 “additional” rows for the sides and back of the tablet. Friberg remarks that Robson’s six “missing rows” do not appear in this list since they all would violate the \( Q < 60 \) inequality.

4 An elementary observation

The fifteen \((T, \overline{T})\) pairs listed by Friberg and by Robson (they appear in the table below) have the following property: each element is a multiple of 00 00 00 10. Note that this criterion excludes Robson’s and Bruins’ six missing pairs.

There are exactly 15 such \((T, \overline{T})\) pairs in the range from \((2^{24}, 25)\) to \((1^{48}, 33, 20)\).

Compared to the \((P, Q)\) tradition, this is a simpler accounting for the derivation of the numbers behind Plimpton 322, at least mathematically speaking. With regard to its cultural plausibility:

(a) “... although there are no four-place tables of reciprocals known, it was easily within the abilities of an Old Babylonian scribe to generate regular reciprocal pairs and to sort them in order” ([Robson 2001]). Robson shows how doubling and tripling, and reference to the 7 12 multiplication table, can link our \((T, \overline{T})\) pairs to pairs in the standard table of reciprocals. But the elements in row 4 and row 10 remain unexplained. If we are allowed to use the analogous operations with 5 (for rows 4 and 7), and to combine doubling with tripling (for row 10) then all the links can be economically and directly established.\(^7\) The economicamente” is important, since any two regular numbers can be linked by a sufficiently long chain of products and quotients by 2, 3, and 5.
following table modifies (in rows 4, 7, 10, 12) Table 9 in [Robson 2001].

| Row | T  | \( \overline{T} \) | link to standard table |
|-----|----|-------------------|------------------------|
| 1   | 224| 25                | in table               |
| 2   | 2221320| 251845 | = (104,5615) \cdot (1/27,27) |
| 3   | 2203730| 2536     | = (15,48) \cdot (1/32,32)   |
| 4   | 2185320| 255512  | = (54,10640) \cdot (1/125,125) |
| 5   | 215  | 2640     | = (9,640) \cdot (1/4,4)     |
| 6   | 21320| 27       | in table                 |
| 7   | 20936| 274640  | = (54,10640) \cdot (1/25,25) |
| 8   | 208  | 280730  | = (104,5615) \cdot (2,1/2)   |
| 9   | 205  | 2848     | = (10640,54) \cdot (1/32,32) |
| 10  | 20130| 29374640 | = (121,442640) \cdot (3/2,2/3) |
| 11  | 200  | 3115     | in table                 |
| 12  | 1552 | 3115     | = (54,10640) \cdot (128,1/128) |
| 13  | 15230| 32       | in table                 |
| 14  | 1510640| 3224 | = (1640,336) \cdot (1/9,9)   |
| 15  | 148  | 3320     | = (54,10640) \cdot (2,1/2)   |

(b) Divisibility by 10 must certainly have been a natural criterion for users of Babylonian sexagesimal notation, since in particular 10 had a sign of its own.

5 Predictions for additional rows

If an ordered list of 4-place reciprocal pairs divisible by 10 was in fact the primary given in constructing Plimpton 322, then this tablet may be one of a sequence extending higher and lower. The list of \((T,\overline{T})\) pairs satisfying the “four-place, multiple of 10” criterion used above may be extended in both directions, and can be compared with the hypothetical extensions of the Plimpton list in [Price 1964] and [Friberg 1981]. In both directions there is substantial, but not perfect, agreement. Here is a comparison of the reconstructions; the row numbers given are from the Friberg and Price/Friberg lists.
| No. | $T$   | $\mathcal{T}$ |
|-----|-------|---------------|
| $-21$ | 3 54 22 30 | 15 21 36 0 |
| $i$  | 3 50 24 0  | 15 37 30 0 |
| $-20$ | 3 45 0 0  | 16 0 0 0  |
| $ii$ | 3 42 13 20 | 16 12 0 0 |
| $-19$ | 3 36 0 0  | 16 40 0 0 |
| $-18$ | 3 33 20 0  | 16 52 30 0 |
| $-17$ | 3 28 20 $0^8$ | 17 16 48 0 |
| $-16$ | 3 22 30 0  | 17 46 40 0 |
| $-15$ | 3 20 0 0  | 18 0 0 0  |
| $-14$ | 3 14 24 0  | 18 31 64 0 |
| $-13$ | 3 12 0 0  | 18 45 0 0 |
| $-12$ | 3 07 30 0  | 19 12 0 0 |
| $-11$ | 3 0 0 0  | 20 0 0 0  |
| $-10$ | 2 57 46 40 | 20 15 0 0 |
| $-9$  | 2 52 48 0  | 20 50 0 0 |
| $iii$ | 2 50 40 0  | 21 05 37 30 |
| $-8$  | 2 48 45 0  | 21 20 0 0 |
| $-7$  | 2 46 40 0  | 21 36 0 0 |
| $-6$  | 2 42 0 0  | 22 13 20 0 |
| $-5$  | 2 40 0 0  | 22 30 0 0 |
| $-4$  | 2 36 15 0  | 23 02 24 0 |
| $-3$  | 2 33 36 0  | 23 26 15 0 |
| $-2$  | 2 31 52 30 | 23 42 13 20 |
| $-1$  | 2 30 0 0  | 24 0 0 0  |

$^83$ 29 10 in [Friberg 1981]
The three pairs $i$, $ii$, $iii$ interpolated between the rows corresponding to Friberg’s -1 to -21 are related by doubling and halving to those generating rows 12 and 14 on Plimpton 322, and to Friberg’s No. 25, respectively.

As to the pairs interpolated between the rows corresponding to Price and Friberg’s 16 to 38, $v$ is $(9, 1/9)$ times the dual of the pair in Friberg’s No. -21, while rows $iv$, $vi$, $vii$ and $viii$ are related by $(1/2, 2)$ to Friberg’s No. -17, No. -4 and to rows 4, 10 on Plimpton 322, respectively. In particular these pairs, and the rows they generate, seem just as natural as the Price/Friberg
candidates for the “left out” rows; but now there are 28 of them. Fitting
them all on the sides and back of Plimpton 322 does not seem like a realistic
proposition.

In the “floating point” sexagesimal number system there is a finite number
of 4-place, multiple of 10, reciprocal pairs \((T, \overline{T})\), ranging from \((59 33 33 20, 1 00 45 0)\) to \((1 00 45 0, 59 33 33 20)\) when ordered by decreasing \(T\) and
increasing \(\overline{T}\). The way four-place pairs have been related since Neugebauer
and Sachs to entries on Plimpton 322, i.e. through \(X = (1/2)(T - \overline{T})\) and
\(Y = (1/2)(T + \overline{T})\), implies that the \(\overline{T}\) components are to be read as one
sexagesimal place to the right of the \(T\)s (note their notation \((2; 24, 0; 25)\) for
the pair corresponding to Plimpton row 1). With this interpretation, the
condition \(T > \overline{T}\) is automatically satisfied for every pair in the list, and
every element in the list generates a different Pythagorean triple (except
that \((5, 4, 3)\) and \((5, 3, 4)\), etc., will both appear). With this exception,
each similarity class of triples appears no more than once: the calculation of
\((S, D)\) from \((X, Y)\) by the factorization method involves casting out \textit{common}
regular factors; so if \((S', D') = (\lambda S, \lambda D)\) they would have to come from
\((X', Y') = (\mu X, \mu Y)\) and therefore from \((T', \overline{T'}) = (\mu T, \mu \overline{T})\), incompatible
with \(\overline{T'} = 1/T'\) unless \(\mu = 1\).

6 References

Bruins, E. M., On Plimpton 322, Pythagorean numbers in Babylonian Math-
ematics, \textit{Koninklijke Nederlandse Akademie van Wetenschappen. Proceed-
ings} 52 (1949) 629-632.

Bruins, E. M., Pythagorean triads in Babylonian Mathematics. The errors
on Plimpton 322, \textit{Sumer} 11 (1955) 117-121.

Bruins, E. M., Pythagorean triads in Babylonian Mathematics, \textit{Math. Gaz.},
41 (1957) 25-28.

Buck, R. Creighton, Sherlock Holmes in Babylon, \textit{Am. Math. Mon.} 57 (1980)
335-345.

Friberg, Jöran, Methods and Traditions of Babylonian Mathematics: Plimpton
322, Pythagorean triples, and the Babylonian Triangle Parameter Equations,
\textit{Hist, Math.} 8 (1981) 277-318.
Friberg, Jöran, *A Remarkable Collection of Babylonian Mathematical Texts*, Springer, New York, 2007.

Joyce, David E. Plimpton 322 (http://aleph0.clarku.edu/~djoyce/mathhist/plimpnote.html; 1995)

Neugebauer, Otto, *Mathematische Keilschrifttexte, I*, Springer, Berlin, 1935.

Neugebauer, Otto and A. Sachs, *Mathematical Cuneiform Texts*, American Oriental Society, New Haven, 1945.

Neugebauer, Otto, *The Exact Sciences in Antiquity*, Brown University Press, Providence, 1957.

Price, Derek J. de Solla, The Babylonian “Pythagorean Triangle” Tablet, *Centaurus* 10 (1964) 219-231.

Robson, Eleanor, Neither Sherlock Holmes nor Babylon: A Reassessment of Plimpton 322, *Hist. Math.* 28 (2001) 167-206.

Robson, Eleanor, Words and pictures: new light on Plimpton 322, *Amer. Math. Monthly* 109 (2002) 105-120.

Schmidt, Olaf, On Plimpton 322. Pythagorean Numbers in Babylonian Mathematics, *Centaurus* 24 (1980) 4-13.