HISTORY OF MATHS BIBLIOGRAPHY DURHAM 2010

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Time Line Events

Date (Approximate)	Topic	Some Details
3000BCE	Counting in 60s	Babylonian counting system in base 60 found on clay tablets
1550 BCE	Word problems - finding a missing amount.	Problems that may now be solved using algebra in the Ahmes papyrus, written by an Egyptian scribe
1500 BCE	12 hour day	Division of the day into 12 hours - ancient Egypt
1000 BCE	Chinese magic squares "Lo Shu"	The origins of these three by three arrangements is mythical, but they have been recorded continuously since 200 BCE
300 BCE	Defining a point, line and surface	Euclid's Elements, the basis of classical Greek geometry
200 BCE	Calculation of the circumference of the Earth	Eratosthenes' observations of the shadow cast by the sun at different latitudes
200 BCE	Chinese rod numbers for counting on a checkerboard	A system for recording numbers in a base 10 system. Colour coding to identify negative numbers at a later date
100 BCE	Development of "Roman Numerals"	The Roman numerals as we know them developed over a long period of time, and continued to develop into the Middle Ages.
600 CE	Discovery of zero	In India, first as a place holder, then as a number
700 CE	Finger counting in Britain	Bede's publication explaining finger "numerals"
825 CE	Origins of the word "algebra"	From Al-Khowarizme's work, in Baghdad

825 CE	Solution of quadratic equations by a geometrical method	Al-Khowarizme's method of completing a square
1150 CE	Algebra (of Al-Khowarizme) into western Europe	Arabic knowledge reaches western Europe mainly through contact made in the crusades
1202 CE	Current numerals (with zero) introduced to Western Europe	These were introduced by Leonardo of Pisa (Fibonacci) in his book "Liber Abaci"
1478 CE	Lattice method of multiplication	Lattice method (gelosia), first printed description in Treviso - Italy
1500 CE	Knotted strings called Quipu used to record numerical information	This system was used by the Inca civilisation in South America, mainly Peru. May have been used for some time before this date
1557	First appearance of the equals sign	Introduced by Robert Recorde in his book Whetstone of Witte, a book of algebra, published in London, written in English
1580	Introduction of symbolic algebra	Use of symbols, vowels for unknowns, consonants for knowns, in the work of Viete
1585	First appearance of the decimal point	In a book by Simon Stevin (Belgium)
1585	Algebraic form of the formula for solving quadratic equations	Versions of this used by Viete and Stevin
1614	Invention of logarithms	John Napier published his book of logarithms
Soon after 1614	Kepler used logarithms to do calculations of planetary orbits	He was one of the first o benefit from this faster way to do multiplication
1631	First appearance of a quadratic equation being solved by factoring a quadratic expression	This was done by Thomas Harriot. He considered only the positive roots
1637	Coordinate geometry made an appearance	In Descartes' Geometrie, an appendix to his Discours de la methode

1642	First mechanical calculator	Invented by Blaise Pascal (1623-1620) who is also associated with early work on probability
1687	Invention of the calculus published	Published independently by Newton in England and Leibniz in Germany.
1800	Metric system of measurements	The metric system designed during the French revolution
1830	Non-Euclidean geometry	This was part of the beginning of modern mathematics. Lobachevsky (Russia) and Bolyai (Hungary)
1848	Development of Boolean algebra	Created by George Boole in a book describing "a calculus of reasoning". It forms the origins of abstract algebra
1855	Polar Area diagrams for mortality figures	Florence Nightingale created these diagrams which she called coxcombs.These gave graphical representations of mortality figures during the Crimean War
1874	Cantor showed the real numbers cannot be put in a one to one correspondence with the natural numbers	This was published in Crelle's journal
1937	Definition of the decibel	The measure of the intensity of sound was agreed at a meeting
1960	Establishment of the SI units	The international system of units was agreed for use in science and technology
Perhaps one day	Proof of Goldbach's conjecture	So named after being described in a letter written to Euler from Goldbach in 1742

$(r+1)^3 - r^3 = 3r^2+3r+1$ Undo Σ

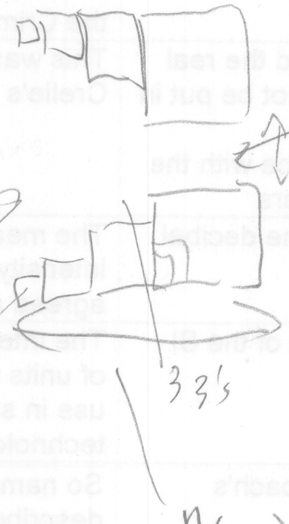
$\sum i^2 = \frac{1}{6}n(n+1)(2n+1)$

induction

method of differences

$\frac{1}{2}n(n+1)$

$1+3+5+\dots+(2n-1) = n^2$



Ancient Greek

filling with exhaustion

$\frac{n}{2}(n+1)$

BABYLONIAN

The civilisation known as the Old Babylonian, in what is now southern Iraq, began around 1800 BC. The writing of this period is cuneiform, a wedge-shaped script. All the Babylonian tablets are written in a language called Akkadian, a Semitic language..

The Babylonians wrote on clay tablets which are of a size that fits into the palm of a hand. The earliest tablets were for the purpose of keeping accounts.

The Ancient Mesopotamian number system is sexagesimal - it has a base of 60. Within the 60 it is a decimal system. It is known as a limited place value system since some guesswork, based on the context, is needed to tell the size of a number. The value of each component depends on its position in the number as a whole. There is no symbol for zero.

In modern transliterations of the numbers we use ; to distinguish the whole number from the fractional part.

The basic components are made by pressing a stylus into clay,

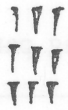
 stands for 1

 stands for 10

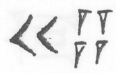
Numbers are built up by repeating these symbols:

 = 1

 = 2

 = 9

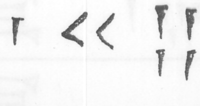
 = 10  = 12

 = 20  = 24

 = 50  = 59

 = 60 (or it could be 1 or 60^2)

Numbers bigger than 60 were written as follows:

84 = 60 + 24 or 1,24 i.e. 

3600 is 60^2 and is written  (which could also be 60 or 1)

$$4000 = 3600 + 360 + 40$$
$$= 60^2 + 6 \times 60 + 40 \quad \text{or} \quad 1,6,40$$

and is written in cuneiform as 

FRACTIONS

Sexagesimal fractions were used for many centuries. Copernicus still used them in the 16th century. We have their legacy in our minutes and seconds. They are written like this:

$\frac{1}{2} = \frac{30}{60}$ i.e. ;30 or  (with no decimal point to give the number an absolute size)

$1\frac{3}{4} = 1\frac{45}{60}$ i.e. 1;45 or 

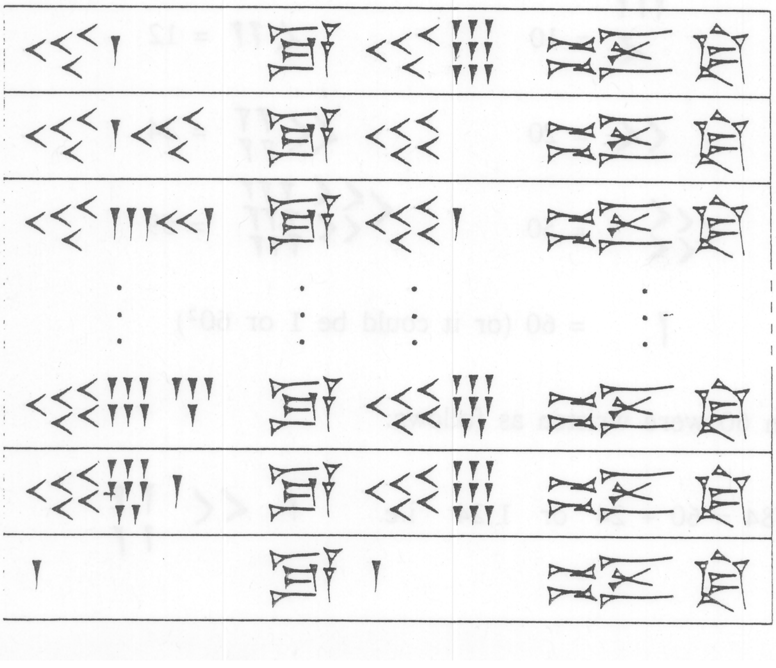
PUPIL EXERCISE

Write the following numbers as the Babylonians might have writen them:

25, 72, 100, 101, 5000, $4\frac{2}{3}$, $61\frac{1}{60}$

Here is a picture of a tablet found in Larsa. Look at the columns of numbers. (The other columns are words.) Try to work out the purpose of this tablet.

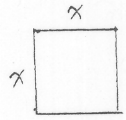
Write the numbers that might once have existed in the missing part of the tablet.



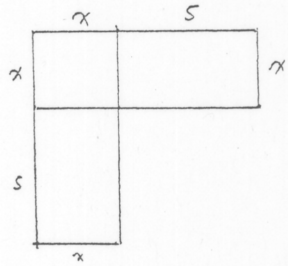
SOLVING QUADRATIC EQUATIONS USING THE METHOD OF AL-KHWARIZMI
AD 780-850 (APPROX)

Solve $x^2+10x=39$

- Draw a square of side x.

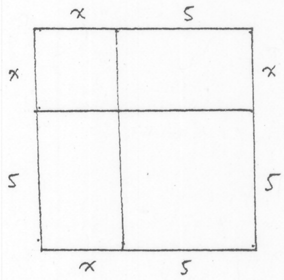


- Add 2 rectangles to the square. Each one has an area of $5x$.



- This L-shape has an area of x^2+10x which is equal to 39.

- Make it into a large square by adding a 5x5 square.



- We now have $x^2+10x+25=39+25$
  $=64$

- But the side of this square is $x+5$
  $\therefore\ x+5=\sqrt{64}$
  $\therefore\ x+5=8$
  $\therefore\ x=3$

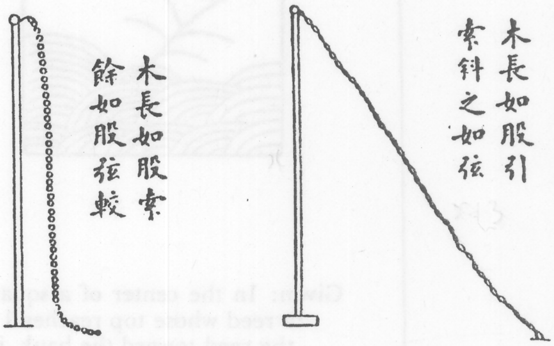
Repeat this for: $x^2+8x=105$ $(x=7)$
$x^2+14x=95$ $(x=5)$
$x^2+5x=66$ $(x=6)$

Possibly try: $x^2+10x=40$ $(x=\sqrt{65}-5)$
and: $x^2+bx=c$ $\left(x=\sqrt{c+\frac{b^2}{4}}-\frac{b}{2}\right)$

ALGORITHM - the word comes from the name of the Arab mathematician who used this method.
ALGEBRA - comes from the Arab word AL-JABR which means "to restore the balance of" i.e. to transpose terms from one side of an equation to the other.

SOME EXAMPLES TAKEN FROM THE CHIU CHANG SUAN SHU
(NINE CHAPTERS ON THE MATHEMATICAL ART)

1



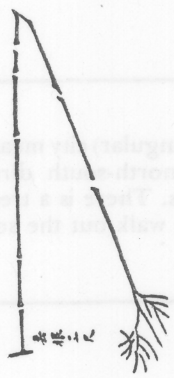
Given: A rope is tied to the top of a pole. The rope is 3 ch'ih longer than the pole. If we pull the rope (taut), the end will just touch the ground 8 ch'ih from the (base of the) pole. What is the length of the rope? (Fig. 2.7*a*)

Land Measures

- li (mile) = 300 pu
- pu (pace) = 5 ch'ih
- chang = 10 ch'ih
- ch'ih (foot) = 10 ts'un
- ts'un (inch) = 3.58 centimeters
- mou (acre) = 240 square pu

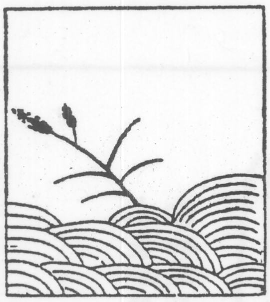
2 Given: The height of a wall is 10 ch'ih. A pole of unknown length leans against the wall so that its top is even with the top of the wall. If the bottom of the pole is moved 1 ch'ih further from the wall, the pole will fall to the ground. What is the length of the pole?

3



Given: A bamboo shoot 10 ch'ih tall has a break near the top. The configuration of the main shoot and its broken portion forms a triangle. The top touches the ground 3 ch'ih from the stem. What is the length of the stem left standing erect? (Fig. 2.13*a*).

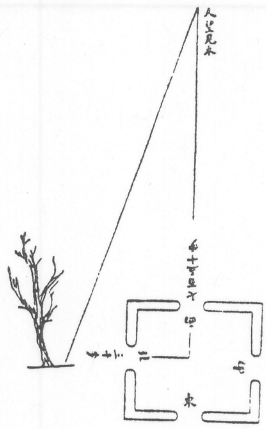
4 引葭赴岸圖 葭出水圖



Given: In the center of a square pond whose side is 10 ch'ih grows a reed whose top reaches 1 ch'ih above the water level. If we pull the reed toward the bank, its top is even with the water's surface. What is the depth of the pond and the length of the plant? (Fig. 2.6*a*)

5 Given: A tree of height 20 ch'ih has a circumference of 3 ch'ih. There is an arrow-root vine[7] which winds seven times around the tree and reaches to the top. What is the length of the vine?

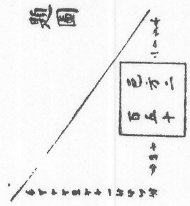
6 Given: A square walled city measures 200 pu on each side. Gates are located at the centers of all sides. If there is a tree 15 pu from the east gate, how far must a person travel out of the south gate to be able to see the tree?



7 Given: A walled (rectangular) city measures 7 li in an east-west direction and 9 li in the north-south direction. There are gates at the centers of all sides. There is a tree 15 li from the east door. How many li must one walk out the south door before he can see the tree?

8

Given: A square walled city of unknown dimensions has four gates, one at the center of each side. A tree stands 20 pu from the north gate. One must walk 14 pu southward from the south gate and then turn west and walk 1775 pu before he can see the tree. What are the dimensions of the city? (Fig. 2.20*a*)



ANSWERS

1 $12\frac{1}{6}$ ch'ih

2 $50\frac{1}{2}$ ch'ih

3 $4\frac{11}{20}$ ch'ih

4 depth is 12 ch'ih, length of plant is 13 ch'ih

5 29 ch'ih

6 $666\frac{2}{3}$ paces

7 315 paces

8 each side is 250 paces

- Plympton 322

Pythagorean triples 1600 BC