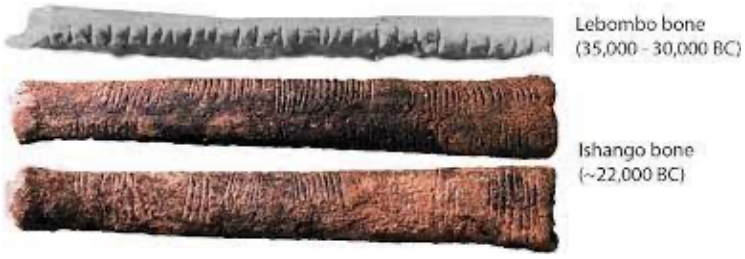
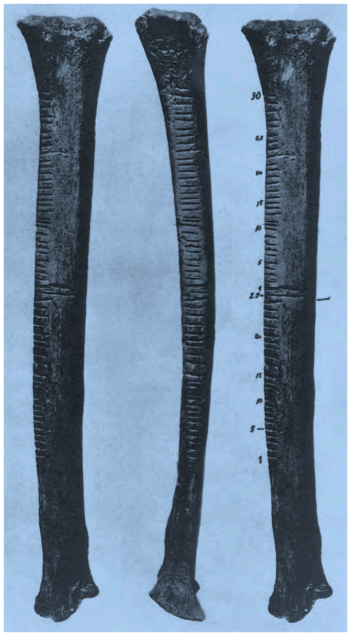
When (and where) did Math begin?

The Origins of Math

1. mathemata - Greek word for ANY subject of study
2. Pythagoreans (600 - 300 BCE)
   a. used the word to describe both arithmetic & geometry
3. Early humans (40,000 - 10,000 BCE) - tally sticks
4. Tally sticks
5.

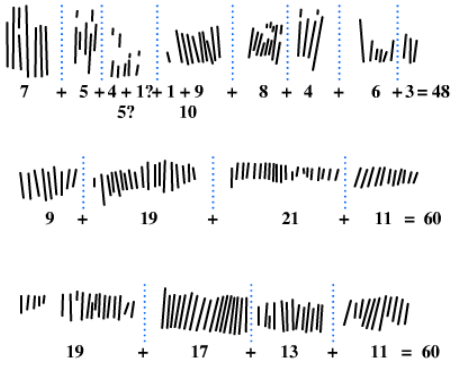


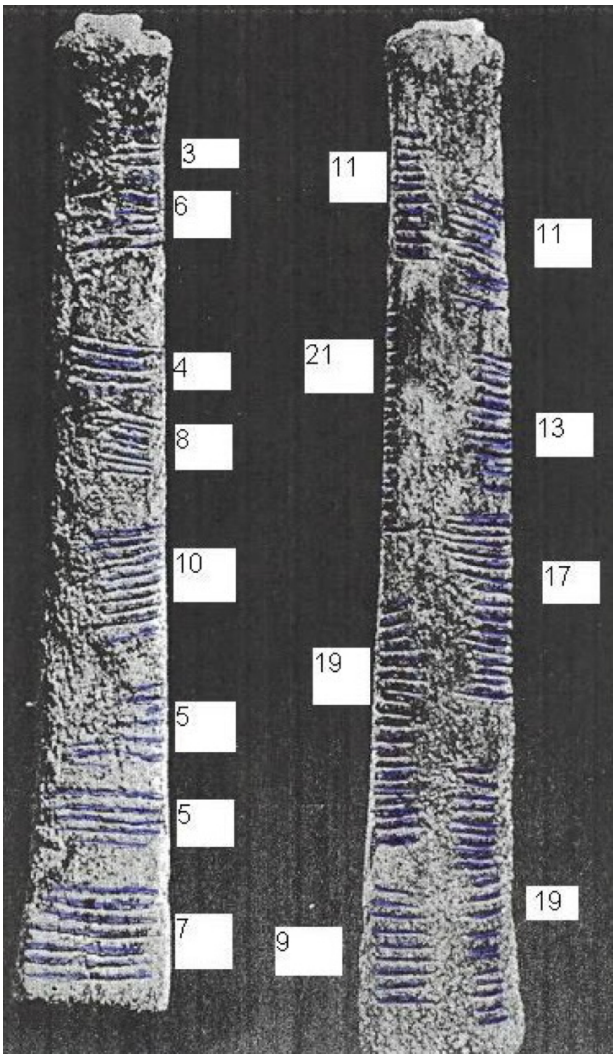


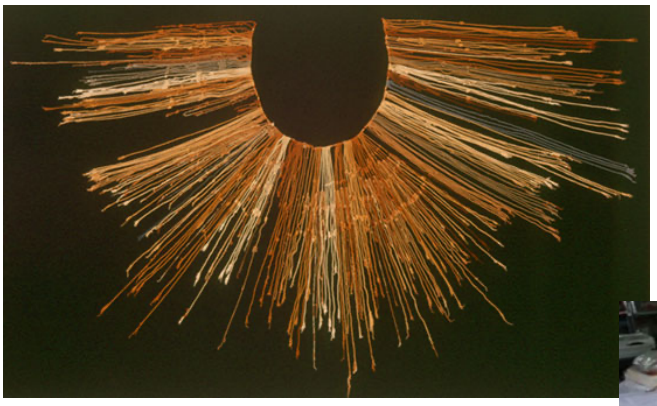
Three views of a Paleolithic wolfbone used for tallying. *(The Illustrated London News Picture Library.)*

Bone artifacts bearing incised markings (tallying sticks) date as far back as 30,000BC

- wolf bone (Czechosloakia (1937) is 7 inches long with 55 deep notes, all equal length
- they could tally hunts or kills, it's likely they tallied time
- Ishango, Egypt - headwaters of Nile - 17,500 BC (12,000 years before agrarian communities)
  3 columns:
  Sums of columns I and III are 60 indicating a reference to time







500 BC – Peru

Quipus

no writing in the Inca empire, so these were a very important record of financial transactions

A *quipu* usually consisted of cotton or camelid fiber strings. The Inca people used them for collecting data and keeping records, monitoring tax obligations, properly collecting census records, calendrical information, and for military organization

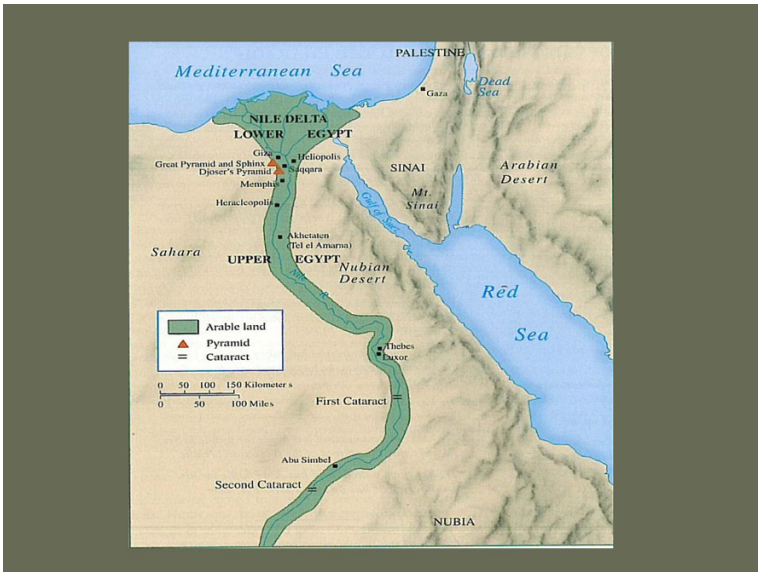
For example, if 4s represents four simple knots, 3L represents a long knot with three turns, E represents a figure-eight knot and X represents a space:

- The number 731 would be represented by 7s, 3s, E.
- The number 804 would be represented by 8s, X, 4L.
- The number 107 followed by the number 51 would be represented by 1s, X, 7L, 5s, E.

Much of what we know of Egypt comes from the “father of history” - Herodotus - whose job it was to “report what people say, not to believe it all”. He calls Egypt, “the gift of the Nile”.

3500 - 3100 BC, the self-sufficient agricultural communities along the Nile had gradually coalesced into two larger kindoms - North and South.

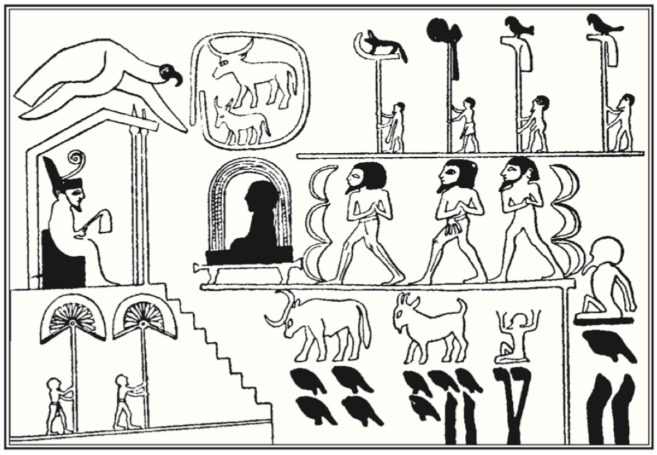
3100 BC these regions were united by military conquest from the south by Menes, the first of 32 dynasties that lasted almost 3000 years.



With Egypt's unification came the need for computation: a census, taxes, an army, etc.

One of the years of the Second Dynasty was named "Year of the Occurrence of the Numbering of all Large and Small Cattle of the North and South"

As early as 3500 BC, the Egyptians had a system that allowed them to count indefinitely.



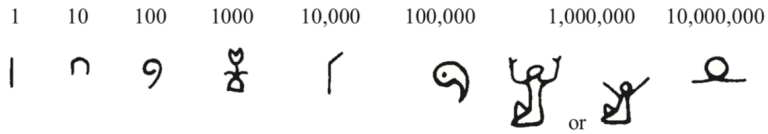
This scene is taken from the great stone macehead of Narmer, which J. E. Quibell discovered at Hierakonpolis in 1898. There is a summary of the spoil taken by Narmer during his wars, namely "cows, 400,000,   goats, 1,422,000,  , and captives, 120,000,  ."

Scene reproduced from the stone macehead of Narmer, giving a summary of the spoil taken by him during his wars. *(From* The Dwellers on the Nile *by E. W. Budge, 1977, Dover Publications, N.Y.)*

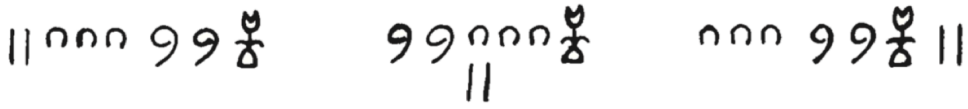
"sacred signs" = hieroglyphics

picture script, each character = concrete object

Egyptian hieroglyphic number symbols



$$1 \cdot 100{,}000 + 4 \cdot 10{,}000 + 2 \cdot 1000 + 1 \cdot 100 + 3 \cdot 10 + 6 \cdot 1 = 142{,}136.$$

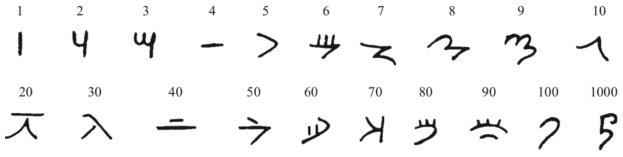


= 1232

Egyptian method was not a “positional numbering system”

The Egyptians wrote on papyrus (strips of a plant, they cut, "glued together" and dried) with brushes. These could be large and were rolled when not in use, and the dry air kept them from molding.

Hieratic script evolved, which was "ciphered", and eventually "demotic" or popular script. - row upon row of commas and dashes distinguish numbers

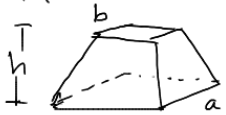


Moscow Math Papyrus : 18' long
1800 BC

1 α	10 ι	100 ρ
2 β	20 κ	200 σ
3 γ	30 λ	300 τ
4 δ	40 μ	400 υ
5 ε	50 ν	500 ϕ
6 ς	60 ξ	600 χ
7 ζ	70 o	700 ψ
8 η	80 π	800 ω
9 θ	90 $\qoppa$	900 λ

- 1878 Thieves found it, sold it to Egyptologist; from there to Mosow – 1912, only in 1930 was it translated.

Inside. $V = \frac{1}{3}h(a^2 + ab + b^2)$



h = actual height

Frustum of Pyramid

- 500 BC, Heron of Alexandria

slant height $h = \sqrt{c^2 - 2\left(\frac{a-b}{2}\right)^2}$

c = actual height

one ex: $a = 28, b = 4, c = 15$

gives a negative radicand

— a complex #

$\sqrt{-168} \xrightarrow{\text{Heron}} \sqrt{168}$

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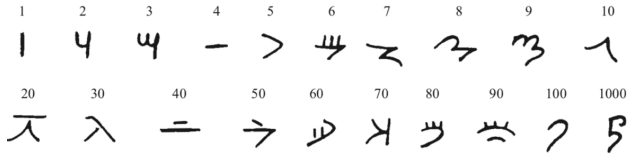

The Greeks (500 BC) developed a ciphered numeral system

1 α	10 ι	100 ρ
2 β	20 κ	200 σ
3 γ	30 λ	300 τ
4 δ	40 μ	400 υ
5 ε	50 ν	500 ϕ
6 ς	60 ξ	600 χ
7 ζ	70 o	700 ψ
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9 θ	90 $\qoppa$	900 $\sampi$

Moscow Math Papyrus - (18’ long) (1800 BC)

1878 thieves stole sold MMP to Egyptologist in 1893 who gave to Musueum in moscow in 1912. Only in 1930 was it translated.

Problem 14. Vol of frustrum of cone:

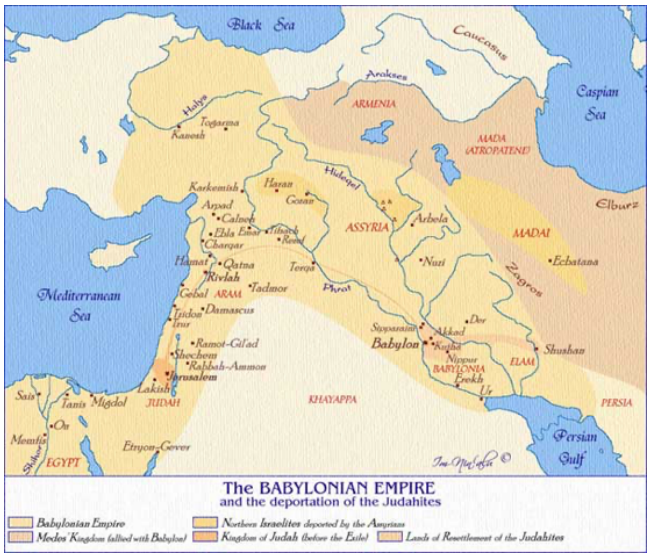
V = 1/3 (h (a^2 + ab + b^2))

but Heron of Alexandria (500 AD)

h = sqrt(c^2 - 2((a-b)/2)^2)

but with a = 28, b = 4, c= 15 Heron solves this but skips sqrt(-1)

Babylonian Cuneiform Script

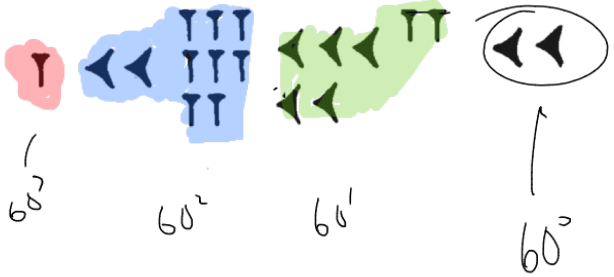


Mesopotania = land between the rivers

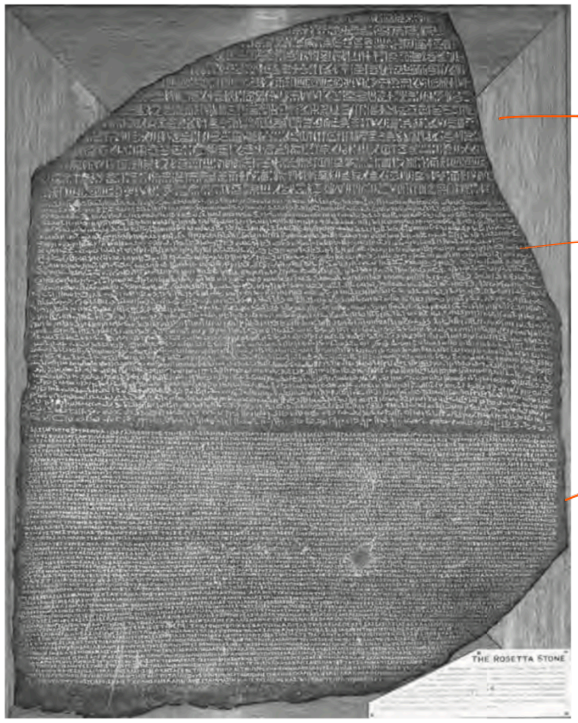
3000 BC: Babylonians developed a form of picture writing, but instead of pen and ink used a stylus to make impressions in clay. (Clay dries quickly but is durable, vs. Chinese writing which was much less durable).

The stylus had a triangular shape with a sharp edge so the combined effect was

Positional numbering system



1 * 60^3 + 28 * 60^2 + 52 * 60+ 20



The Rosetta Stone, bearing the same inscription in hieroglyphics, demotic script, and Greek. *(Copyright British Museum.)*

Found by Napoleon in 1798.

Heirglyphics

Demotic (Popular) Egyptian evolved from hieroglyphics

greek

Plimpton 322 - 1888 BC - Babylonia / Iraq

cuneiform tablet

stylus

line 11

	$\frac{45}{60^2} = \frac{9 \cdot 5}{60 \cdot 60}$ $= \frac{3}{20} \cdot \frac{1}{12}$ $= \frac{1}{80}$
$\frac{33}{60} = \frac{11}{20}$	
$\frac{45}{80} = \frac{9}{16}$	
$1 + \frac{9}{16} = \frac{25}{1}$	

1

Index on Rows

Sexigesimal Number System:

Idea: $3:15 = 3 + \frac{15}{60}$

1st Column: Each is a perfect square:

Ex line 11, $1:33:45 = 1 + \frac{33}{60} + \frac{45}{60^2} = \left(\frac{5}{4}\right)^2$

2nd Column: $\left(\frac{5}{4}\right)^2 - 1 = \frac{25}{16} - \frac{16}{16} = \frac{9}{16} = \left(\frac{3}{4}\right)^2$

3rd Column: $\left(\frac{5}{4}\right)$

Idea: $a^2 + b^2 = c^2$

$$\frac{a^2}{b^2} + 1 = \frac{c^2}{b^2}$$

$$\left(\frac{a}{b}\right)^2 + 1 = \left(\frac{c}{b}\right)^2$$

Col 2 Col 1

ex. $\left(\frac{3}{4}\right)^2 + 1 = \frac{9}{16} + \frac{16}{16} = \left(\frac{5}{4}\right)^2$

col 2 col 1