THE SUMERIANS , THE SEXAGESIMAL SYSTEM AND THE BABYLONIAN LEGACY TO ASTRONOMY

by Paul Coffre

The Sexagesimal System

The Sumerians who lived in Mesopotamia (nowadays Iraq) 5000 years ago, developed a sexagesimal computation system. The sexagesimal system is a base 60 computation system.

Why?

Why not base 10 (decimal), base 2 (computers), base 12 (Egyptians), base 20 (Mayans)?

The sexagesimal system is still in use today after 5000 years: Clocks, Coordinates of maps, Trigonometry… Why was the number 60 so valued in Mesopotamia? 60 is countable on the fingers of both hands, 60 is a highly composite number, 60 has an astronomical significance.

Strange enough that 60 is the first number between two prime numbers (59 and 61) For more details go to: https://en.wikipedia.org/wiki/Sexagesimal

If this finger-counting method was the reason for the Mesopotamian sexagesimal system, why was its sub-base 10 instead of 12?

It is inconsistent that the counting system is 12 × 5 = 60, while the decimal notation system is 10 × 6 = 60. Note that Egypt uses this duodecimal finger-counting method (base 12).

The Ancient Egyptians had a decimal system and did not accept a sexagesimal system. They did not need to count to 60, but they divided day and night into 12 hours each and they needed only to count 12.

Therefore we can safely assume that this finger-counting method was originally developed to count 12 and later convert- ed to count 60 and that Sumerians developed the sexagesimal notation independent of this counting method and then was passed on the Babylonians.

Remember that Mesopotamia was the cradle of an agriculture area back in 3000BCE and the Sumerians were also traders with the rest of the region – Egypt, Persia (Iran), Asia Minor (Turkey), Phoenicians, etc...

They had to find a quick way to count the number of sacs or amphorae ready to be shipped, hauled. 60 is a number that can be done using two hands only!

How?

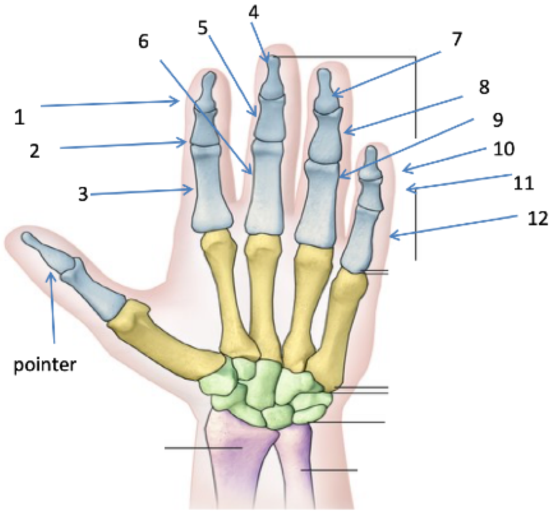
The thumb of one hand is used as a pointer to each of the phalanges (3 per finger) so 4 fingers x 3 phalanges = 12. The fingers of the other hand will count the number of 12 increments therefore: 5X12 = 60.

This was much easier and faster than the ten fingers of both hands!

The sexagesimals system is still in use today: Hours, minutes, seconds or Degree, minutes, seconds

The Sumerian divided the hour in 60 minute (minor) parts that became the minute. The minute was also divided in 60 secondary parts that became the second.

Counting to 12 with one hand >>>



The Babylonian Legacy to Astronomy

It takes somewhat more than twelve lunar months for the Sun to make its yearly trek around the heavens along the ecliptic circle and return to the same place relative to the background stars. One-twelfth of the way around this 360-degree circle should be roughly equal to a month, the time it takes for the Moon to go through a full cycle of its phases.

This amounts to 360° / 12 = 30°, a nice round number in the sexagesimal system (consisting of exactly one half of a unit of sixty parts).

Thus the Sun travels along a 30° arc of the ecliptic circle about once a month, and so, each of these 30° arcs was matched to a corresponding constellation along the zodiacal band.

This was the mechanism whereby the Babylonians used the sky as a calendar. Since their year began at the spring equinox, the Sun would pass through the first of these constellations, Aries the Ram, during the first month of the year, corresponding to the 0° to 30° band along the ecliptic.

The face of an ancient Sumerian

During the second month, the Sun would be in Taurus the Bull (30◦ to 60◦ along the ecliptic), then Gemini the Twins (60° to 90° along the ecliptic), etc. By the end of the following winter, the Sun would complete its journey through the twelfth zodiacal band, for Pisces the Fish (330° to 360° = 0° along the ecliptic), returning to its starting point for the next year's course. (The diagram below sketches how this works, but it is drawn from the modern perspective, showing the Earth orbiting the Sun.)

Reference: Daniel E. Otero, 'Teaching and Learning the Trigonometric Functions through Their Origins' MAA Convergence (March 2020)