

Origins of Mathematics

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January 21, 2010

(Rev. 0g, March 29, 2010)

Abstract

Mathematical understanding and practice go back 30,000 years with solid archaeological evidence, and 250,000 years with reasonable supposition but no substantiating artifacts.

Even the earliest man had need of basic mathematical understanding: counting, keeping time, shape and symmetry in craft and art, and the practical matters of numerical communication, building and measuring, even if roughly.

But the capability and likelihood of mathematical cognition, on the other hand, go back much farther: at least 700,000 years ago for the earliest man, and at least 13 million years ago for intelligent primates.

Origins of Mathematics

Mathematics is an ancient area of human knowledge, present in the earliest written records of man, in pre-historic archaeological evidence, and in the cognitive capabilities of both early man and higher animals.

The earliest historical records of mathematical understanding date from 5500 years ago (3500 BCE). These show the numeration systems of the ancient Egyptians, and, before them, the mathematical knowledge of the Babylonians and Sumerians of Iraq. ([Bur], [Kli], [SG37])

Mathematics in Pre-History

Archaeological evidence takes us much farther in time than written records. The earliest archaeological evidence of basic mathematical understanding (tallying by groups) dates from 30,000 BCE, when bone artifacts were discovered that had been used for reckoning time “in sequences of numbers that agree with the number of days included in successive phases of the moon.” ([Bur])

This was the time of the fourth glacial advance (Upper Pleistocene), when Homo Sapiens had emerged and domesticated the dog, dressed and sewed skins,

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were able to live beyond the frost line, had a culture of arts and crafts and a ceremonial society that buried the dead and showed solicitude to the aged and maimed. ([Coo62])

To put this in context: 30,000 BCE is well before the deliberate cultivation of crops, domestication of animals, and formation of settled society around 10,000 years ago (8000 BCE), and before the earliest extant written records of 6000 years ago (4000 BCE). ([Bur]) Indeed, it is just 5% of human history and far less than 1% of the stable history of the modern earth.¹

But surely man had need of basic mathematical understanding before even 30,000 BCE, for counting, keeping time, shape and symmetry in craft, and the practical matters of numerical communication, building and measuring, even if roughly?

Archaeological evidence shows that intelligence, communication, and social living stretch back to 250,000 years ago (Middle Pleistocene), when humans had already evolved into what is essentially their modern form, Homo Erectus, and were using speech, tools, fire for warmth and cooking, were hunting large adult animals, and had diversified into all of the major races.([Coo62])

Presumably, then, there would already have been utility in comparing, for example, the number of men in a hostile encampment with those in the home group, and in communicating this numerical information for group action. Similarly, a builder or toolmaker needing material for a particular purpose would have needed to specify dimensions, even if roughly. An elder needing to know how long a hunting party had been absent before setting off to investigate would have needed to mark time.

The presence of speech is a strong indicator of number sense, since “we know of no language in which the suggestion of number does not appear, and we must admit that the words which give expression to the number sense would be among the early words to be formed in any language.” (Conant, p.3) ([Con96], [Gul97])

It seems likely, then, that the understanding of counting and keeping time far pre-dates the discovered fossil evidence of Homo Sapiens from 30,000 ago, and reaches back at least as far as 250,000 years ago, coincident with speech, fire, and cooperative hunting, traits that that marked the society of Homo Erectus.

Mathematical Cognition: Reaching Farther Back in Time

What came before 250,000 years ago? Archaeological timelines date the Cenozoic epoch of earth’s history, when the earth’s climate was stable, at 25 million years ago. Primates were already living in trees by 13 million years ago, and by the time of the first ice age 700,000 years ago (Early Pleistocene), the early ancestors of man (Australopithecus) had already descended from tree living and were using crude stone tools.

If we broaden our inquiry beyond the evidence for mathematical *understanding and use*, and into the possession of the cognitive precursors for mathematics, we find that both number sense (but not measurement or counting per se) and the perception of shape and change (though perhaps not their description or communication) are not at all unique to the human species.

Investigations have found evidence of number sense in animals (birds, dogs, monkeys, dolphins). Perception of the passage of time, the ability to distinguish one from many (in particular, quantities other than two), and the ability to

¹Counting human history from 700,000 BCE and “modern” history of the earth from 25 million years ago, at the start of stable climate.

distinguish shapes from each other, have all been documented in various animals. ([Con96], [Koe50])

Dating the capability for mathematical cognition then becomes a question of the timeline of intelligent, perceptive life itself. From the evidence at hand of the number sense in animals and primates, it is clear that the first crude-tooled ancestors of man (*Australopithecus*) of 700,000 years ago and the intelligent tree-dwelling primates of 13 million years ago, both had the mental capacity for the cognition of the precursors of mathematics.

Conclusion

The heritage of mathematical practice and mathematical cognition are indeed ancient.

Mathematical understanding and practice go back 30,000 years with solid archaeological evidence, and 250,000 years with reasonable supposition but no substantiating artifacts.

But the capability and likelihood of mathematical cognition, on the other hand, go back much farther: at least 700,000 years ago for the earliest man, and at least 13 million years ago for intelligent primates.

Further Reading

Several of the referenced articles can be found republished in [New56], in particular [Koe50], [Con96], and [SG37].

The rest are available in print: [Bur], [Coo62], [Gul97], [Kli].

Online Resources [New56] and the articles within it are partially available online at Google Books.

An excellent online reference is Number Systems at <http://www.math.wichita.edu/history/topics/num-sys.html>

An online timeline that compares mathematical developments against developments in human history is at <http://www.math.wichita.edu/richardson/timeline.html>

This article is posted, in part, at <http://www.mathscitech.org/articles/mathematics-prehistory>

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