The Concept of Zero

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Today we take the number 0 for granted, but did you know that it came into our number system relatively recently? This may have been the result of confusion on the part of early mathematicians about zero's multiple meanings. Even today, the fact that the number 0 must be distinguished from nothing (for example, the temperature 0 degrees is certainly something other than nothing) still confuses some people.

Mathematicians in seventh-century India reasoned that since zero is a number, it follows that number operations can be performed with it. **Brahmagupta** (b A.D. 598), who produced rules for operations with positive and negative numbers, asserted that $0 \div 0 = 1$. He didn't see the logical complications produced by this assertion. However, he did seem aware that the division of a nonzero number by zero was a touchy matter, because he did not offer any comment or possible values for $a \div 0$ when $a \neq 0$.

Many centuries later, **Bhaskara** (1114–1185), the leading Indian mathematician of the twelfth century, was the first to suggest that if $a \neq 0$, then $a/0$ is infinite. The statement below appears in his text *Vija-Ganita* (ca 1150).

> *Statement: Dividend 3. Divisor 0. Quotient the fraction 3/0. This fraction of which the denominator is cipher, is termed an infinite quantity. In this quantity consisting of that which has cipher for a divisor, there is no alteration, though many be inserted or extracted ....*

The statement shows that Bhaskara had a good understanding of this concept, but by asserting that $a/0 \times 0 = a$, we can also see that during his time there was still uncertainty about division and multiplication by zero.

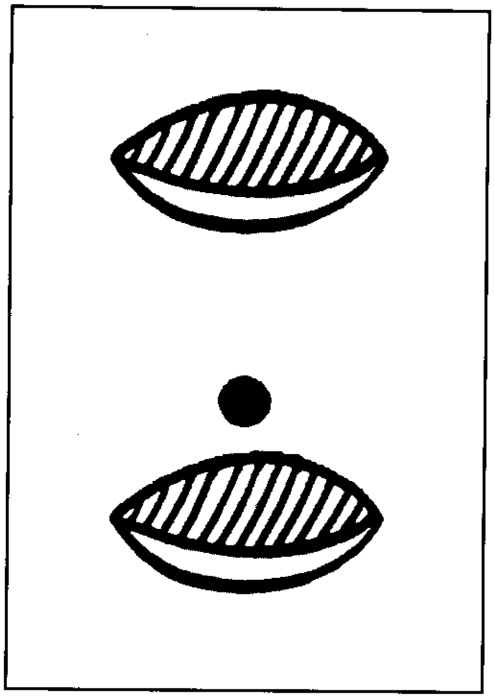
Long after early Mayan and Hindu mathematicians initially began working with the concept of zero, our number system has been structured so that zero and negative numbers have joined positive numbers in a consistent and logical structure.

For more on the history of numbers, see vignettes 1, 12, 14, 21, 29, 37, 52, 64, and 67. ★

The Maya and Zero

It has long been believed that India first introduced the number 0. Now, however, it's known that the Maya of southern Mexico and Guatemala (ca 300 B.C.–A.D. 900) discovered and used zero independently of, and possibly before, the mathematicians of India. One of the Mayan symbols for zero was an empty oyster shell, signifying a hollow. Not only did the Maya use the zero to represent "nothingness," but also to define the value of a number's position. For example, a picture of an oyster shell alone represented the number 0, and an oyster shell shown with a dot above it represented the number 20, or 2 and 0. (See Activities.)

A Mayan glyph (pictograph) for the number zero.



Shown at top is the Mayan "empty oyster shell" zero, called* xok, *meaning "hollow." Shown at bottom is the number 20.

Activities

1. What are some of the logical difficulties that arise when you attempt to define $0/0$ to be 1 or 0?

2. What is the distinction between a line with a slope of zero and a line with no slope?

3. Research the origin of the word *zero.*

4. The Maya had many symbols for zero. What did some of these symbols look like?

Related Reading

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