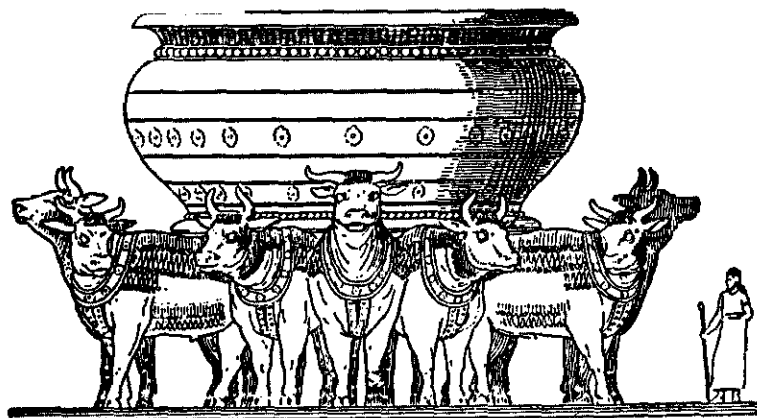# ANCIENT REFERENCES TO PI

T he Greek letter pi (π) is used as the symbol for the ratio of the circumference of a circle to its diameter, which equals 3.14159 . . . . While many mathematics students probably take this ratio for granted, it wasn't always neatly provided in textbooks. On the contrary, the concept of pi has a long history of development and application.

The molten sea.
From A History of π,
©1971 by Petr Beckmann,
St. Martin's Press, Inc.,
New York, NY.

By 1850 B.C., the ancient Egyptians had squared the circle to get $(\frac{4}{3})^4$, or about 3.1605, as a value for π. According to the Bible, some 900 years later **Solomon** built a palace and a building complex, probably using the mathematics developed by the Egyptians to aid in its construction.

> *And he made the molten sea, ten cubits from one brim to the other: it was round all about, and its height was five cubits: and a line of thirty cubits did compass it round about.*
>
> —1 Kings 7:23 (A similar verse appears in 2 Chronicles 4:2.)

The cubit was a unit of measure representing the distance from a man's elbow to the end of his middle finger, about 17 to 22 inches. The molten sea was a high bowl or tank supported by 12 statues of oxen, in which priests washed in preparation for religious ceremonies.

> *Below its brim were ornamental buds encircling it all around, ten to a cubit, all the way around the sea. The ornamental buds were cast in two rows when it was cast. It stood on twelve oxen: three looking toward the north, three looking toward the west, three looking toward the south, and three looking toward the east; the sea was set upon them; and all their parts pointed inward. It was a hand-breadth thick; and its brim was shaped like the brim of a cup, like a lily blossom. It contained two thousand baths.*
>
> —1 Kings 7:24–26

In ancient Greece, **Archimedes** (ca 287–212 B.C.) found π to be between $223\frac{}{71}$ and $22\frac{}{7}$ by circumscribing and inscribing regular polygons about a circle. Six hundred years later, in a set of Indian manuscripts called *Siddhantas* (*Systems of Astronomy*, A.D. 400), the value for $\pi = 3^{177}/_{1250}$, or 3.1416. It's thought that fifth-century Hindu mathematicians used Archimedes' method to find the value of π, but this isn't known for certain.

Chinese mathematicians, who had always used the decimal system, also searched for values of π. In A.D. 718, one Chinese document shows that $\pi = {}^{92}/_{29} = 3.1724$ . . . . **Liu Hui** (ca A.D. 250) definitely used a variation of Archimedes' method, inscribing a polygon of 192 sides to find $3.141024 < \pi \leq 3.142704$. Taking it further, he found $\pi = 3.14159$ by inscribing a polygon of 3,072 sides.

For more on pi, see vignette 80. ★
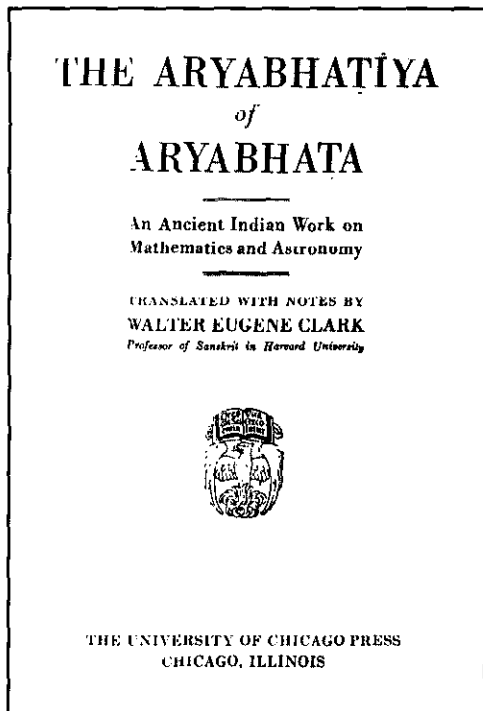
An important description of the Hindu numerical system, the Aryabhatiya *is one of the earliest known publications to use algebra.*

ACTIVITIES

1. Hindu mathematician **Aryabhata** (b A.D. 476) states in his manuscript *Aryabhatiya* (A.D. 499): "Add 4 to 100, multiply by 8, and add 62,000. The result is approximately the circumference of a circle on which the diameter is 20,000." What value of π does this situation yield?

2. The molten sea is described as "round all about," suggesting a circle. What is the length of the circumference of this circle? Of the diameter? Show that these dimensions yield the result $\pi = 3$.

3. A bath was a liquid measure equal to approximately six gallons. How many gallons of water could the molten sea contain? Use the given dimensions to show that priests would have needed ladders or some similar device to bathe in the molten sea. Do your discoveries seem reasonable to you?

4. The ancient Egyptians used the formula $(d - \frac{d}{9})^2$ for the area of a circle with diameter d. What value of π does this formula yield?

5. Modern computers have been used to find π to thousands of decimal places. What algorithms do computers use to compute π?

RELATED READING

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