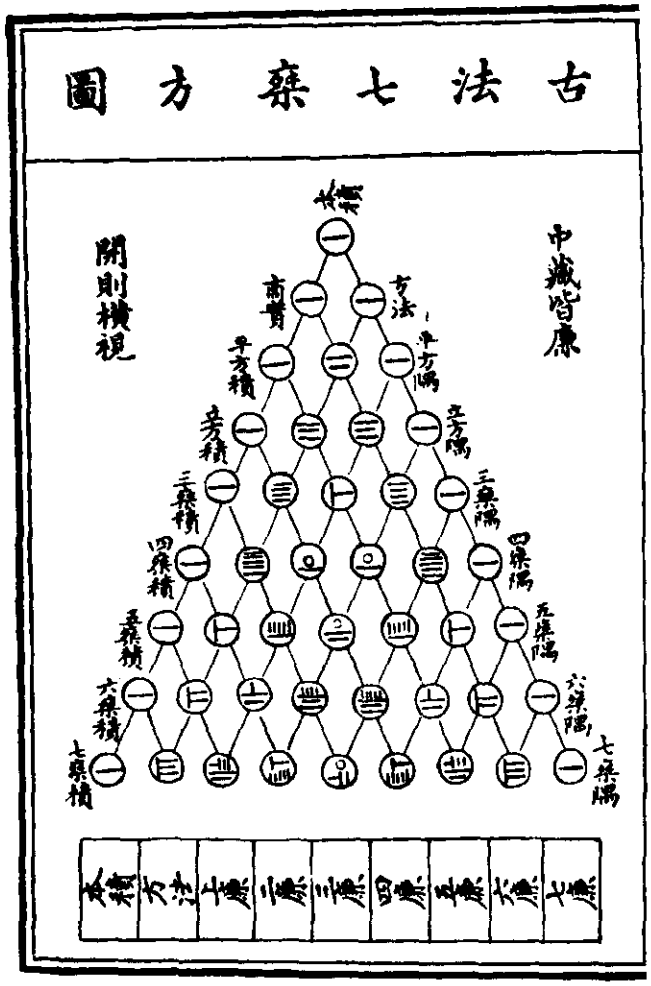
4 Chinese Mathematical Activities



Fourteenth-century Chinese version of Pascal's triangle.

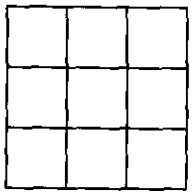
Chinese legend tells of a giant turtle that emerged from the River Luo and showed itself to Emperor Da Yu around 2000 B.C. On the turtle's back appeared a magic square composed of numbers. The Chinese called this diagram the *luo shu*, believing that it contained magical powers. These magic squares, believed to have had their origin in China 4,000 years ago, are still a source of fascination for many people today.

We don't know who first recognized the famous right triangle relationship we call the Pythagorean theorem ($a^2 + b^2 = c^2$), but it's certain that it has traveled the world! Named after the Greek philosopher Pythagoras (572–497 B.C.), the theorem was known to scholars long before he came across it. He very likely learned of it in Babylonia, where he studied and taught with scholars from all around the world. We see the need for its application in this problem from a twelfth-century Chinese manuscript: "There grows in the middle of a circular pond 10 feet in diameter a reed which projects 1 foot out of the water. When it is drawn down it just reaches the edge of the pond. How deep is the water?" In a thirteenth-century manuscript, mathematician **Yang Hui** challenges: "There is a bamboo 10 feet high, the upper end of which being broken reaches the ground 3 feet from the stem. Find the height of the break."

Some four centuries later, we run into one of the most famous triangles in mathematical history, named after French mathematician Blaise Pascal (1623–1662). However, it has been clearly established that Pascal's triangle was known to the Chinese over 300 years before Pascal was born. The Chinese version of the triangle shown above right appeared in *Siyuan yujian* (*Precious mirror of the four elements,* 1303), written by **Zhu Shijie** (1280–1303).

For more on Chinese mathematics, see vignettes 8, 22, 26, 48, 71, and 89. ★

Activities



1. What is "magic" about a magic square? Fill in the *luo shu* numbers that form a magic square in the grid at left. Construct some other three-by-three magic squares.

2. The Chinese version of Pascal's triangle (see the illustration in this vignette) displays the binomial coefficients in the expansion of $(a + b)^n$ for $n = 0, 1, 2, 3, 4, 5, 6, 7,$ and 8. For instance, $(a + b)^4 = 1a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + 1b^4$. The fifth row of the triangle shows how the Chinese represented 6. Expand $(a + b)^n$ for $n = 5$, 6, 7, and 8 to discover how the Chinese represented other numerical coefficients in the binomial expansion.

3. Use the Pythagorean theorem to solve the problems about the bamboo and the pond referred to in this vignette.

Related Reading

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