Nine Chapters on Mathematical Art

22

Math historians in the Western world recognize Euclid's *Elements* as an ancient classic. In the East, the corresponding classic is a Chinese manuscript called the *Jiuzhang suanshu* (*Nine chapters on the mathematical art*). We don't know who wrote it, but we believe it was written around 200 B.C. Quite sophisticated, the mathematics in the *Jiuzhang* indicated, for instance, that the Chinese knew how to use negative numbers in computations, a concept their Western counterparts had not yet discovered.

Almost a half a century after the *Jiuzhang* was written, the ruler of the Wei dynasty put officials to work revising literary and scientific classics of the past. Because the dynasty considered the mathematics in the *Jiuzhang* essential for the efficient operation of the community and government, they asked mathematician **Liu Hui** (ca A.D. 250) to revise the text. In addition to copying it, Liu strengthened and expanded the text's contents. For example, he developed and used methods of proof to establish the validity of many assertions that had been stated without proof. His extension of the ninth chapter, in which he laid the foundation for the establishment of trigonometric ratios, was eventually distributed as a separate manuscript called the *Haidao suanjing* (*Sea island mathematical manual*). The *Jiuzhang* and the *Haidao suanjing* set the standard for Asian mathematics for hundreds of years after Liu's death.

Liu is also remembered for producing the most accurate estimate of the number pi (π) known to exist in the ancient world. He obtained his value of 3.141024 by tediously inscribing regular polygons in a circle. His value was produced using a regular polygon of 192 sides.

For more on Chinese mathematics, see vignettes 4, 8, 26, 48, 71, and 89. For more on pi, see vignettes 2 and 80. ★

## Other significant early Chinese mathematicians

- **Wang Xiaotong** (ca A.D. 625): Work with cubic equations.
- **Li Ye** (1192–1279): Geometric problems leading to equations of higher degree.
- **Zhu Shijie** (1280–1303): Work with summing series and Pascal's triangle.
- **Guo Shoujing** (1231–1316): Calendar reform and spherical trigonometry.
- **Cheng Dawei** (ca 1590): Wrote oldest surviving work about the *suan pan* (abacus).
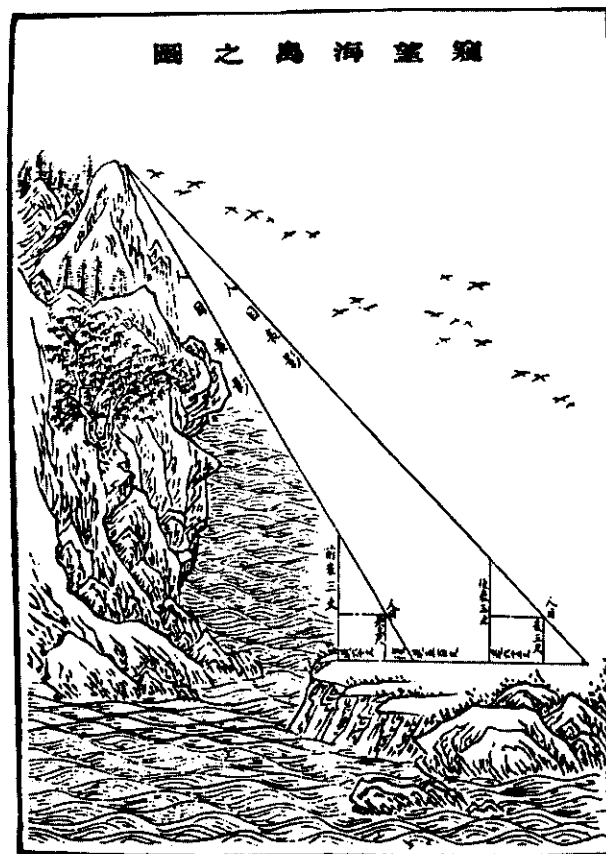
This woodblock print from the encyclopedia **Tu Shu Ji Cheng** *(1726) illustrates a sea island problem.*

Activities

1. Research and solve some of the 246 problems that appear in the *Jiuzhang suanshu.*

2. Some maintain that the early Western world borrowed heavily from ancient Chinese mathematics. Why then is Chinese mathematics relatively unknown in the West?

3. The number 8 is highly esteemed in China. Identify the sets of eight objects given below. Why are they significant?

    a. The eight symbols of Buddhism

    b. The eight emblems of Confucianism

    c. The eight symbols of the immortals in Taoism

4. Chinese burial chambers were similar in shape to the frustum of a pyramid. The *Jiuzhang* provides the formula
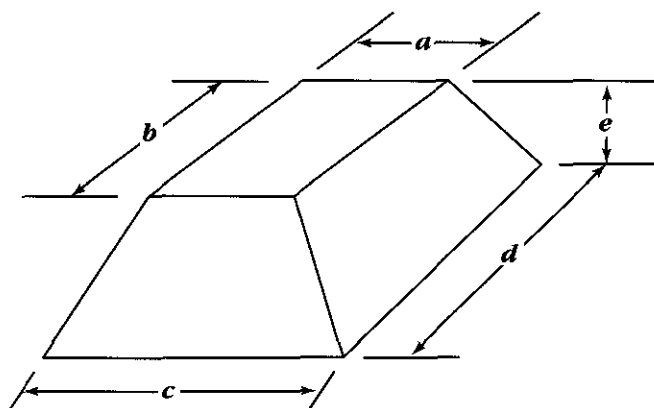
$V = \frac{1}{6}[(2a + c)b + (2c + a)d]e$ for the volume of a chamber such as that shown at left. Is this formula accurate? To help you answer this question, research the formula developed by the Egyptians for the frustum of a pyramid (the theorem of Pappus).

Related Reading

Dunham, William. *The Mathematical Universe: An Alphabetical Journey Through the Great Proofs, Problems, and Personalities.* New York: John Wiley, 1994.

Joseph, George Gheverghese. *The Crest of the Peacock: Non-European Roots of Mathematics.* London: I.B. Tauris, 1991.

Kline, Morris. *Mathematics: A Cultural Approach.* Reading, MA: Addison-Wesley, 1962.

Li, Yan, and Du Shiran. *Chinese Mathematics: A Concise History.* New York: Clarendon Press, 1987.

Needham, M. *Science and Civilization in China,* Vol III. Cambridge, MA: Cambridge University Press, 1959.

Swetz, Frank. *The Sea Island Mathematical Manual: Surveying and Mathematics in Ancient China.* University Park, PA: Pennsylvania State University Press, 1992.

Temple, Robert. *The Genius of China.* New York: Simon and Schuster, 1986.