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(*b*, Fan-yang prefecture [modern Hopeh province], China, *ca*.a.d. 429; *d*, China, *ca*. a.d. 500)

mathematics.

Tsu Ch’ung-chih was in the service of the emperor Hsiao-wu (*r*. 454–464) of the Liu Sung dynasty, first as an officer subordinate to the prefect of Nan-hsü (in modern Kiangsu province), then as an officer on the military staff in the capital city of Chien-k’ang (modern Nanking). During this time he also carried out work in mathematics and astronomy; upon the death of the emperor in 464, he left the imperial service to devote himself entirely to science. His son, Tsu Keng, was also an accomplished mathematician.

Tsu Ch’ung-chih would have known the standard works of Chinese mathematics, the *Chou-pi suan-ching* (“Mathematical Book on the Measurement With the Pole”), the *Hai-tao suan-ching* (“Sea-island Manual”),(“Mathematical Manual in Nine Chapters”), of which Liu Hui had published a new edition, with commentary, in 263. Like his predecessors, Tsu Ch’ung-chih was particularly interested in determining the value of π. This value was given as 3 in the *Chou-pi suan-ching*; as 3.1547 by Liu Hsin (d.23); as or , by Chang Heng (78-139); and as , that is 3.1547 by Wan Fan (219-257).Since the original works of these mathematicians have been lost, it is impossible to determine how these values were obtained, and the earliest extant account of the process is that given by Liu Hui, who reached an approximate value of 3.14. Late in the fourth century, Ho Chēng-tein arrived at an approximate value of , or 3. 1428.

Tsu Ch’ung-chih’s work toward obtaining a more accurate value for π is chronicled in the calendrical chapters (*Lu-li chih*) of the *Sui-shu*, an official history of the Sui dynasty that was compiled in the seventh century by Wei Cheng and others. According to this work.

Tsu ch’ung-chih further devised a precise method. Taking a circle of diameter 100,000,000, which he considered to be equal to one *chang [ten ch’ih*, or Chinese feet, usually slightly greater than English feet], he found the circumference of this circle to be less than 31,415,927 *chang*, but greater than 31,415,926 *chang*,[He deduced from these results] that the accurate value of the circumference must lie between these two values. Therefore the precise value of the ratio of the circumference must lie between theses two values. Therefore the precise value of the ratio of the circumference of a circle to its diameter is a 355 to 113, and the approximate value is as 22 to 7.

The *Sui-shu* historians then mention that Tsu Ch’ung-chih’s work was lost, probably because his methods were so advanced as to be beyond the reach of other mathematicians, and for this reason were not studied or preserved. In his *Chun-suan shih Lung’ung* (“Collected Essays on the History of Chinese Mathematics” [1933]), Li Yen attempted to establish the method by which Tsu Ch’ung-chih determined that the accurate value of π lay between 3.1415926 and 3.1415927, or .

It was his conjecture that

“As , Tsu Ch’ung-chih must have set forth that, by the equality

one can deduce that

x=15.996y, that is that x=16y.

Therefore

For the derivation of

When *a, b, c,* and *d* are positive integers, it is easy to confirm that the inequalities

hold, If these inequalities are taken into consideration, the inequalities

may be derived.

Ch’ien Pao-tsung, in *Chung-kuo shu-hsüeh-shih* (“History of Chinese Mathematics“[1964]), assumed that Tsu Ch’ung-chih used the inequality

$$S_{2n} < S < S_{2n} + (S_{2n} - S_n),$$

Where S_{2n} is the perimeter of a regular polygon of $2n$ sides inscribed within a circle of circumfernce S, while S_n is the perimeter of a regular polygon of n sides inscribed within the same circle. Ch’ien Pao-tsung thus found that

$$S_{12288} = 3.14159251$$

and

$$S_{24576} = 3.14159261$$

resulting in the inequality

$$3.10415926 < \pi < 3.1415927.$$

Of Tsu Ch’ung-chih’s astronomical work, the most important was his attempt to reform the calendar. The Chinese calendar had been based upon a cycle of 235 lunations in nineteen years, but in 462 Tsu Ch’ung-chih suggested a new system, the Ta-ming calendar, based upon a cycle of 4,836 lunations in 391 years. His new calendar also incorporated a value of forty-five years and eleven months a *tu* (365/4 *tu* representing 360°) for the precession of the equinoxes. Although Tsu Ch’ung-chih’s powerful opponent Tai Fa-hsing strongly denounced the new system, the emperor Hsiao-Wu intended to adopt it in the year 464, but he died before his order was put into effect. Since his successor was strongly influenced by Tai Fahsing, the Ta-ming calendar was never put into official use.

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