Historical Figures in Mathematics

In reading about these areas of mathematics that we often take as obvious. it often was, once someone had worked it out beforehand. This series is about some of the lesser-known of those people.

Sir Isaac Newton, the well-known British mathematician is often quoted as saying "If I have seen further it is by standing on the shoulders of Giants".

The Calculation of PI

Zu Chongzhi

Figure 1 In China, Zu Chongzhi (5th century) of the Southern and Northern Dynasties was the first person to calculate the value of π to seven decimal places.

Zu Chongzhi's name is sometimes written as **Tsu Ch'ung Chi**. He came from a famous family who were originally from Hopeh province in northern China. His great grandfather was an official at the court of the Eastern Chin dynasty which had been established at Jiankang (now Nanking). Weakened by court intrigues, the Eastern Chin dynasty was replaced after a revolt by the Liu-Sung dynasty in 420. Zu Chongzhi's grandfather and father both served as officials of the Liu-Sung dynasty which also had its court at Jiankang (now Nanking).

The Zu family was an extremely talented one with successive generations being, in addition to court officials, astronomers with special interests in the calendar. In ancient China there was a belief that an emperor received his right to rule from heaven. Producing a calendar specifically for a new emperor established a link from the heavens to the particular rule. This meant that astronomers had important roles at court for their skills could result in an emperor's successful rule. The Zu family handed their mathematical and astronomical skills down from father to son and, indeed, this was one of the main ways that such skills were transmitted.

Zu Chongzhi, in the family tradition, was taught a variety of skills as he grew up. In particular he was taught mathematics, astronomy and the science of the calendar from his talented father. He learnt mathematics from a number of sources, but mainly from Liu Hui's commentary on the *Nine Chapters on the Mathematical Art*. Zu learnt other skills too for he excelled in engineering and was skilled in literary composition, writing ten novels.

Zu Chongzhi followed in the family tradition of serving the emperors. When Emperor Xiaowu of Liu Song (who ruled from 454 to 464) heard of him, he was sent to an Academy, the Hualin Xuesheng, and later at the Imperial Nanjing University (Zongmingguan) to perform research. He was appointed by the Emperor Xiao-wu first as an officer in Yang-chou, a city in Kiangsu, and then as an officer in the military staff in Jiankang (now Nanking).

During this time Zu worked on mathematics and astronomy. In particular he was working on a new, more accurate calendar. The calendar which had been in use was based on a 19 year cycle with years consisting of 12 months of 29 or 30 days. In seven of the 19 years an extra month was inserted making it a calendar based both on the sun and the moon with 235 months in 19 years. This had been changed in 412 to a calendar based on a 600 year cycle with an extra month inserted in 221 of the years. This calendar was not accurate enough for Zu.

In 462 Zu proposed a new calendar, the Tam-ing Calendar (Calendar of Great Brightness), to the Emperor which was based on a cycle of 391 years. In 144 of the 391 years an extra month was inserted, so there were 4836 months in 391 years. He was able to make a calendar with this degree of accuracy since he had calculated the length of the tropical year (time between two successive occurrences of the vernal equinox) as 365.24281481 days (an error of only 50 seconds from its true value of 365 days 5 hours 48 minutes 46 seconds), and a nodal month for the moon of 27.21233 days (compare the modern value of 27.21222 days).

Zu, however, had an opponent at the court as far as his calendar was concerned. This was Tai Faxin, one of the Emperor's ministers, who declared that Zu was:-

... distorting the truth about heaven and violating the teaching of the classics.

Zu's answer? Next time