

TAKAKAZU SEKI KOWA & AIDA YASUAKI

The most distinguished Japanese mathematician of the Tokugawa Shogunate (1603-1867) era and perhaps of all time was **Takakazu Seki Kowa** (March 1642? – October 24, 1708). **Aida Yasuaki** (February 10, 1747 – October 26, 1817) was one of the most prolific mathematicians of his time. This entry is not only the stories of these two, but also a



Takakazu Seki Kowa



Aida Ysuaki

brief description of the early development of Japanese mathematics. Japan did not begin its intellectual development until Buddhist missionaries arrived from China around A.D. 500. Traditionally it is believed that Japan had a crude system of numeration dating from 600 BCE and that early in its existence it produced or borrowed a system of measures and a calendar.

During the 8th century CE, many of the Chinese mathematical arts were introduced into Japan. Japanese mathematicians imitated the work of Chinese scholars and when a university system was established in Japan, nine Chinese books were made the basis of the mathematical curriculum. Chinese mathematics and Japanese mathematics used the same language, not just the same Chinese characters. Thus if Japanese mathematicians acquired Chinese mathematical books they could have easily understood Chinese mathematical ideas.

During the Tokugawa Shogunate, Japan gradually cut itself off from the western world, with this self-imposed national isolation (*sakoku*) officially decreed in 1639. Citizens were forbidden to leave the Japanese isles, foreign books were banned and foreign missionaries and their converts were persecuted.

Nevertheless, during the late 17th century, the country experienced a cultural renaissance similar to the one that had occurred in the previous century in Europe. This period, known as *genroku*, saw *haiku* poetry develop into a high art form, as did *No* and *Kabuki* theater. Japanese mathematicians created their own mathematical world, and learned people of all classes, from farmers to samurai, produced theorems in Euclidean geometry. Most of the theorems and answers to problems were presented as beautifully colored drawings on wooden panels called *sangaku*, literally meaning “mathematical tablet,” which were hung under the roofs of a shrine or a temple.” The *sangaku*, both mathematics and art, were beautiful in their simplicity. Many of these were lost during the modernization period of the Meiji revolution. However, about nine hundred of these survived and can be seen nowadays in rural Japan.

Many mathematicians contributed significantly to Japanese mathematics in this period. Among these are Mōri Kambei Shigeyoshi and his pupils Yoshida Schichibei Kōyū, also known as Mitsuyoshi, who wrote *Jinkō-ki* (“Small number, large number, treatise”), the first great Japanese arithmetical work and Imamura Chishō, who in his book *Jugai-roku*, devoted to stereometry (the art of determining the dimensions and volumes of solids) and arithmetic, gave the value of π as 3.162.

Takakazu Seki was born to a samurai warrior family at Fujioka in Gunma prefecture, but at an early age a noble family of the name Seki Gorozayemon adopted him. In Eastern Asian countries, adults had several names, including aliases and pennames, used officially, while their real names were used only in the family. Takakazu Seki used the name Seki Kowa when he published books. As his fame developed, Japanese mathematicians knew him only through his works, so Takakazu Seki became known as Seki Kowa.

When he was nine a servant introduced Seki to mathematics and from then on this child prodigy taught

himself mathematics. Seki is known to have collected mathematics books from both the Chinese and Japanese cultures and eventually became so recognized as a mathematical expert that he was called *Sansei* (“The Arithmetical Sage”), a title carved on his tombstone. He is generally considered to be the founder of Japanese mathematics.

Under Seki’s influence a Japanese school of mathematics was created. Because of the secrecy and rivalry among Japanese schools it is difficult to identify all of Seki’s mathematical contributions. It is known that he introduced algebraic notations, invented determinants to solve systems of linear equations and evidently made major discoveries in calculus. He created a new mathematical notation system, which he used to determine many of the theorems and theories that were already known in Western mathematics. Although he anticipated many of the discoveries of Western mathematics, there is no evidence that he was in any way influenced by it. Unfortunately, if the number of manuscripts attributed to Seki Kowa is accurate, then most of these have been lost.

Because he was a descendent of the samurai class, Seki was appointed examiner of accounts for the Lord of Koshu, and when the latter became Shogun, Seki became Shogunate samurai. In 1704 Seki was made the master of ceremonies in the Shogun’s household. Seki is given much credit for the social reform that helped develop the study of mathematics in Japan and make it widely accessible.

Aida Yasuaki produced as many as fifty to sixty works a year, of which nearly 2000 have survived. He was a distinguished teacher of traditional mathematics, which is called “wasan” (old Japanese Mathematics) in order to distinguish it from “yosan” (western mathematics). Yasuaki studied under the mathematician Yasuyuki Okazaki. In 1769, Aida went to Edo (now Tokyo) to work for the shogunate of Tokugawa Ieharu. The shogunate, which lasted from 1192 to 1867, was extremely powerful, controlling the emperor, administering the lands and making foreign policy. Aida was employed as a

civil engineer, but his dream was to become the best mathematician in Japan.

Through a series of unfortunate events Yasuaki earned the animosity of Sadasuke Fujita, one of Japan's leading mathematicians. In 1781, Fujita published a mathematical work *Seiyo sampō*, upon which his reputation rested. Aida wrote *Kaisei sampō*, a work based on that of Fujita, but critical of it, perhaps in retaliation for Fujita pointing out errors in tablets inscribed with mathematical problems that Aida had donated to a religious temple. This fanned the flame of the feud between the two mathematicians, which soon involved many others, who took sides in the dispute.

When the shogun Tokugawa Ieharu died in 1786, to be succeeded by Tokugawa Ienari, Aida lost his position and chose to spend the rest of his life working on his mathematics. In 1788, he compiled a book of geometry problems, called *Sampō tenshi shinan*. In it he explained the use of algebraic expressions and the construction of equations, and contributed to number theory. Aida was the founder of the *Saijō* school, one of the most active groups in the mathematical sciences in the latter half of the Edo period. In 1819, Kazu Watanabe edited and published the mathematical book *Kinsensanpō*, in honor of his master Aida Yasuaki. It included much of the traditional mathematics of the period that involved solving complicated geometrical problems featuring chains of circles.

During the 19th century the *wasan* was gradually supplanted by *yosan*. This transformation introduced hybrid manuscripts, written in *Kambun* with Western mathematical notation. When Commander Perry opened Japan to the West in 1867, closely followed by the collapse of the Tokugawa shogunate, the new government ordered that the study of native mathematics be replaced by *yosan*.

Quotation of the Day: "... the Japanese mathematics did not exist as a science but as art. On that

account everything studied in Japan had borne the character of specialty, lacking in generality. But the Japanese were by no means wanting in the scientific spirit; they were on the contrary endowed strongly with the zealous yearning after truth and knowledge which prevailed throughout the whole history of the Japanese mathematics.” – Yoshio Mikami