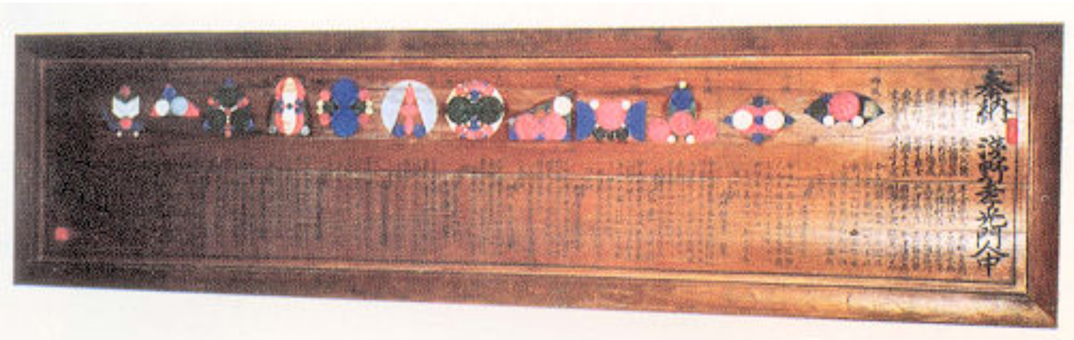
Sacred Geometry

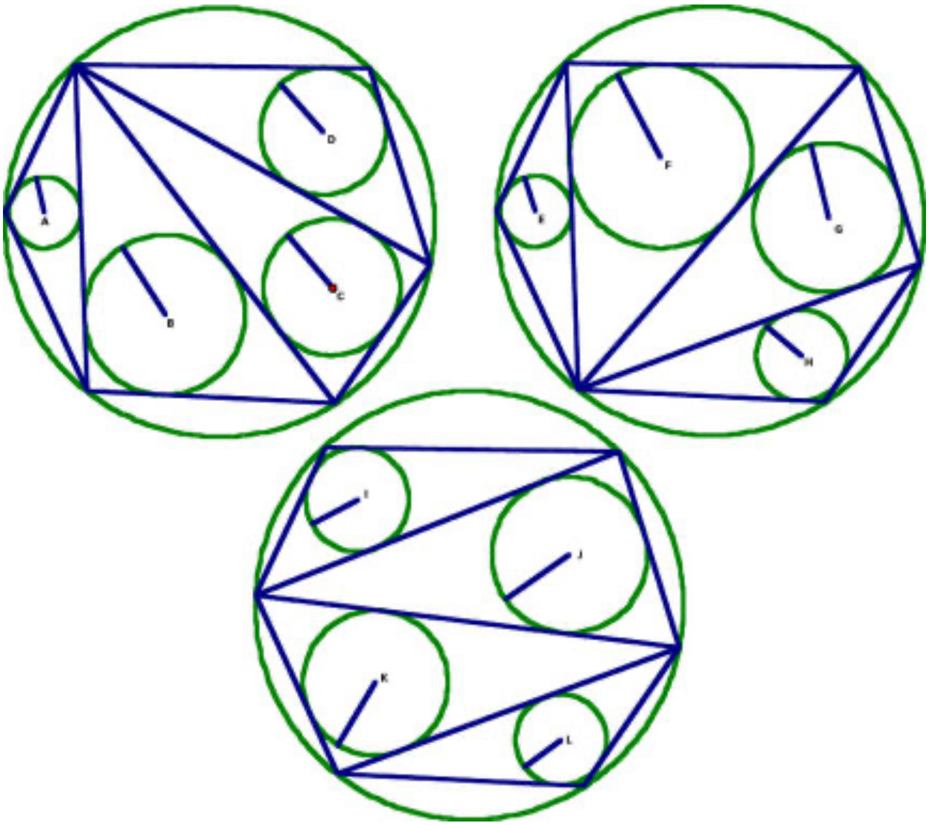
sciencenews.org (https://www.sciencenews.org/article/sacred-geometry) · by Bethany Brookshire

Hundreds of years ago in Japan, people offered thanks to the gods by sacrificing a horse or a pig. Horses and pigs, however, were valuable and expensive, so poor folks had a hard time expressing their gratitude. So they came up with a solution: Rather than sacrificing a horse, they would simply draw a painting of a horse on a wooden tablet and hang it in the temple.



This tablet was hung in the Kinshouzan shrine in the Gifu Prefecture in 1865. It shows 12 different geometric problems. The third problem from the right was presented by a 16-year-old girl. Fukagawa

This tablet was created in 1814, but it was only discovered in 1994 when the temple it was in was about to be destroyed. Fukagawa



One sangaku shows that the sum of the radii of the small circles in the top two drawings, but not the bottom one, will be the same.

The Kaizu Tenma Shrine in the Shiga prefecture has a sangaku under the right eave which contains 30 problems. It's 10 inches high and 17 feet long. Fukagawa

Then someone, most likely an impoverished samurai, realized that horses and pigs were hardly the only thing that could be drawn on a tablet. He had the idea of painting something original, something beautiful, something creative. He offered mathematics.

Thank you for signing up!

There was a problem signing you up.

Hundreds of beautifully painted, multi-colored wooden tablets showing problems and theorems of geometry have adorned Japanese temples. They are called "sangakus," which simply means mathematical tablets. The text on the tablets is written in an ancient form of Chinese, which was the language of scholars, much like Latin in the West. Only in the past couple of decades have these tablets been translated into modern languages in significant numbers.

A Japanese mathematics teacher, Hidetoshi Fukagawa, has been finding, translating, and researching the tablets. This spring, Fukagawa and Tony Rothman of Princeton University will publish a complete history of sangaku, including photographs of many sangakus that have never before been seen outside of Japan.

"Sangakus are exceptional," Rothman says. "They're not only exceptionally beautiful, but the problems are often exceptionally difficult. And the solutions can be very clever. Some of the things they do to solve these problems would never have occurred to me."

The sangakus were made during a period when Japan was mostly isolated from the outside world. The shogun leaders expelled all the foreign missionaries and forbade Japanese from leaving the country on pain of death in the early 1600s. The result was a kind of renaissance in Japan, with a flowering of unique cultural traditions like tea ceremonies, puppet theater, and woodblock prints.

At the same time, the shoguns persuaded the samurai warriors to lay down their weapons and become government functionaries. The pay, however, was low, so the samurai often moonlighted with other jobs. One of these outside jobs was to teach mathematics in the schools.

Isolated from the development of calculus taking place in the West, these mathematicians and their students created a kind of home-grown geometry with a uniquely Japanese character. Many of the problems were based on origami or folding fans, for example.

Here is an example of a sangaku problem. Take a circle and draw a polygon inside it, with each corner of the polygon on the circle. Choose one of the vertices of the polygon and connect lines from it to all the other vertices, dividing the polygon up into triangles. Within each one of those triangles, draw a circle that just touches each side of the triangle. The sum of the radii of those circles will be constant, no matter which vertex you chose.

Most sangakus simply state the theorem and provide a diagram, but they don't provide a proof, and this one is no exception. The most straightforward way to prove it relies on Carnot's Theorem, which wasn't proven in the West until 100 years after the sangaku was created.

Rothman believes that sangakus were not just religious offerings, but "acts of bravado and challenges to other people to solve the problem." For example, one sangaku proclaims, "'This answer is correct to 15 decimal places,'" Rothman says. "It's kind of like, 'top that if you can!'"

Starting around 1800, several collections of sangaku problems were made into books, including the solutions, so researchers know the original methods for many of the problems. But a couple of sangakus are unsolved to this day. "One of them results in an equation of the 1024th degree," Rothman says. "A mathematician later got very famous for reducing it to a problem of the 10th degree, but that's still way too big to solve. We have no idea how they did it."

If you would like to comment on this article, please see the blog version (http://blog.sciencenews.org/mathtrek/2008/03/sacred_geometry.html).

sciencenews.org (https://www.sciencenews.org/article/sacred-geometry) · by Bethany Brookshire