

# Mechanical Tricks & Puzzles Worldwide During the Edo Era

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## Abstract

Today Japan is a leader in the design, development and sale of innovative new mechanical puzzles. Japan was also a leader in the design of new puzzles during the Edo era. This paper will show examples of the many different types of mechanical puzzles being designed and produced in Japan during the Edo period. The puzzles that are described include six types of mechanical puzzles. For Put together puzzles, where the problem is to assemble a set of given pieces into specified shapes, the Sei Shonagon Wisdom Plate, first published in 1742, was the first puzzle in this category since the Stomachion by Archimedes in 250 B.C. It preceded the first publication of the popular Chinese Tangram by 71 years. Likewise Trick Locks, Cabinets with secret compartments and secret opening boxes are Edo era examples of Japanese Take apart puzzles. Today Akio Kamei and the Karakuri Creation Group in the Hakone area lead the world in innovative new secret opening puzzles. Interlocking burr puzzles were popular in Japan in the 1830s and the Chie-no-ito string puzzle and Chinese rings Disentanglement puzzles were also made in Japan during the Edo period. The Puzzle Vessels created and produced in Japan include the Tantalus Cup, that empties all the liquid before you can drink it if you fill the cup too full, and beautiful examples of Hero's Fountains, that squirt water higher than any water in the fountain. Puzzles that appear impossible, such as Magic Mirrors, were also created during the Edo period in Japan.

Keywords: Puzzle, Karakuri, Trick, Secret Opening Box, Magic Mirror, Trick Lock, Japanese Puzzle History, Edo Era, Edo no Monozukuri

## Puzzle Classification

The 10 classes of mechanical puzzles are shown in Figure 1. The top six classes are more relevant for



Fig. 1. Mechanical Puzzle Classification

the purposes of our theme, so I will discuss them. For this paper I will emphasize the Japanese puzzles that I described in my lecture.

The classes are grouped by the type of problem that you are trying to solve. Many of the puzzles in each category are Karakuri and utilize tricks, as you will see. For example:

The problem to be solved with **Put together** puzzles is to assemble the pieces into a specified pattern in two or three dimensions.

For **Take apart** puzzles, you must take them apart or find a secret compartment.

**Interlocking puzzles** must be disassembled and then reassembled.

Remove a ring from a - string or wire **Disentanglement** puzzle.

Drink water out of a **Puzzle Vessel** without spilling, or fill it up.

Explain how an **Impossible puzzle** was made or why it behaves in a strange way.

## Put together Puzzles

### Sei Shonagon Wisdom Plate

The Japanese puzzle, "Sei Shonagon's Wisdom Plates (Sei Shonagon Chie-no-ita)", first published in 1742, uses seven pieces to form each problem figure. It was the first Put together puzzle published since Archimedes Stomachion in 250 B.C. The second edition, shown in Figure 2, with the original box, pieces and problem book, was published a year

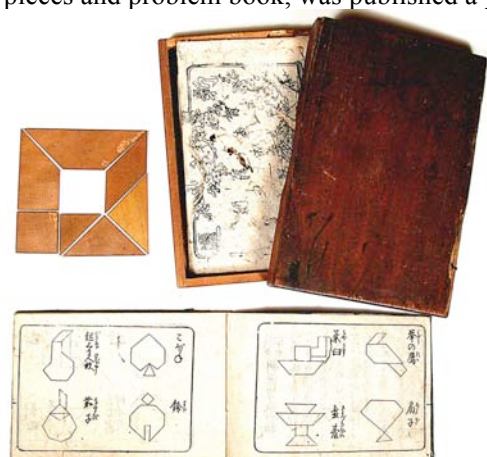
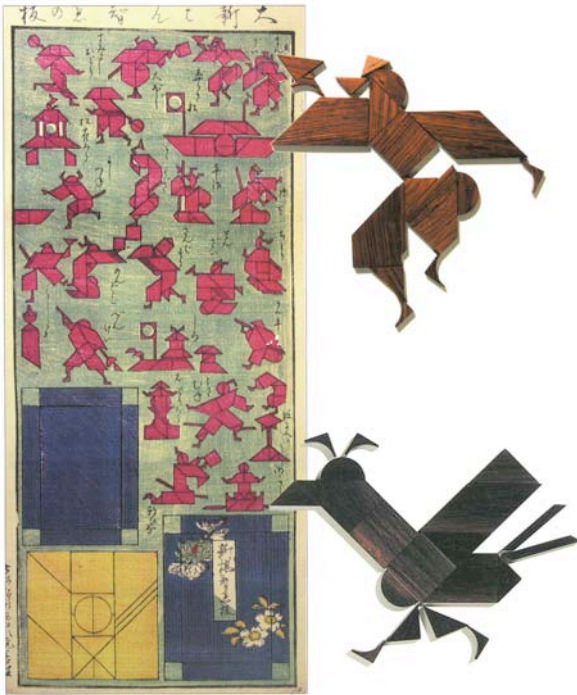


Fig. 2. Sei Shonagon's Wisdom Plates, 1743

later, and is the oldest known surviving example of a put together puzzle. This puzzle was published 71 years before the famous Chinese Tangram.

## Daishinpan chie-no-ita

The problem sheet for the 19-piece Japanese puzzle shown in Figure 3 was published in 1795.



**Fig. 3. Daishinpan chie-no-ita, 1795**

This puzzle is in Mr. Takashima's collection. The brown, modern, wooden pieces near the top are used to form the red figures on the left. The modern black



**Fig. 4. Utamaro's "Tagasode", 1804**

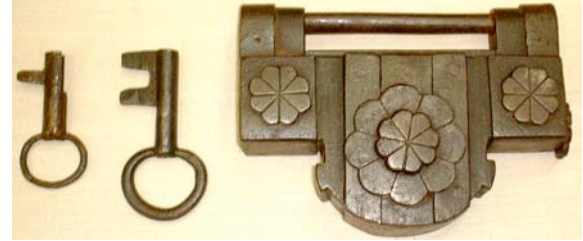
pieces below are from another Japanese puzzle, Shin-hatsumei chie-no-ita, also published in 1795. We believe that this puzzle was used by the famous Japanese artist Utamaro in the woodblock print of 1804, shown in Figure 4, showing Tagasode and her

servant Kamuro trying to solve the put together puzzle.

### Take apart Puzzles

A ring with a secret compartment that contained poison was used by Hannibal in Rome to commit suicide after his defeat in Asia Minor in 183 B.C. The Romans made padlocks between the first and fourth centuries that may have included a trick using a hidden lever to release the face of the lock in order to open it. These may have been the first trick, or puzzle locks.

The Edo era trick lock shown in Figure 5 requires



**Fig. 5. Japanese Trick Lock**

solving three tricks to open it.

Japan has a long history of furniture with secret compartments and secret opening trick boxes of many types. The Edo era Cabinet shown in Figure 6, which has two secret compartments, is part of the



**Fig. 6. Cabinet with two Secret Compartments, 1813-1823**

Jan Cock Blomhoff collection in the National Museum of Ethnology in Leiden, The Netherlands. It was purchased in the Hakone area by Blomhoff, head of the Dutch trading mission in Dejima, Nagasaki, between 1813 and 1823. Phillip von Siebold was a medical doctor who worked for the Netherlands East Indies Army and his job was to study the Japanese culture and society between his arrival in 1823 and his departure in 1829. He collected books, maps, plants and artifacts such as



boxes, dishes and art.

The amazing Four-Direction trick boxes, shown in Figure 7, was made in Hakone during the Edo



**Fig. 7. Hakone Four-Direction Trick Box**

period. The drawer could slide out in 4 directions; to the front, back, left side or right side.

When you pull out one of the drawers of the String Box, shown in Figure 8, the second drawer



**Fig. 8. Hakone Trick Stringbox**

automatically opens at the same time in the opposite direction. One of the drawers was used to hold the strings of a musical instrument similar to a Guitar, called the Shamisen, and the other drawer is used to hold other parts and tools for the instrument. The early Stringboxes opened automatically when a button, hidden in the inlaid wood was pushed.



**Fig. 9. Hakone Trick Springbox, 1819-1829**

Wooden trick boxes, called Springboxes, that were sometimes decorated with straw, contained a drawer which sprang open when a hidden button was pushed. The box shown in Figure 9 is part of the Johan van Overmeer Fisscher collection in the

National Museum of Ethnology, Leiden, The Netherlands.

The “Chiebako” or *Ingenious Box*, shown in Figure 10, was shown in an 1844 booklet titled, “The



**Fig. 10. Hakone Ingenious Trick Box, 1844**

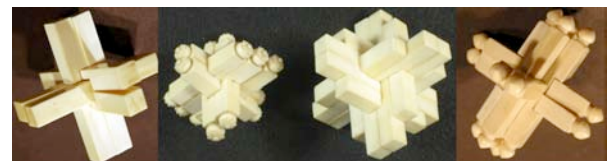
Hakone collection of souvenirs at a hot spa (Onsen-miyage Hakone-gusa).” The large lower drawer is a secret opening box. It is released by pushing the button in the upper back corner of the side of the case.

Today Akio Kamei and the Karakuri Creation Group in the Hakone area lead the world in innovative new secret opening puzzles.

### Interlocking Puzzles

Six piece interlocking puzzles, called burrs because they resemble a cocklebur, were first shown in an engraving by French artist Sebastien Le Clerc in 1699. However there are unverified stories that Japanese interlocking puzzles, called Kumiki, were being made in the seventh century.

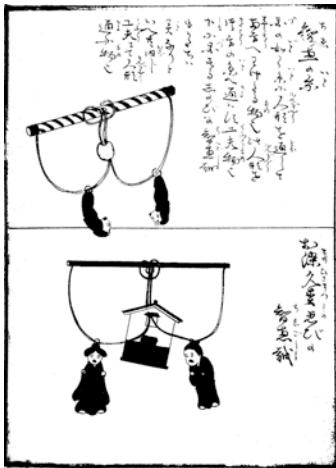
Burrs with 6, 7, 12 and 24 pieces were popular in Japan in 1830 and several of these burrs, shown in Figure 11, were included in Chinese chests of Ivory puzzles from about 1840.



**Fig. 11. Ivory Burrs, c. 1840**

### Disentanglement Puzzles

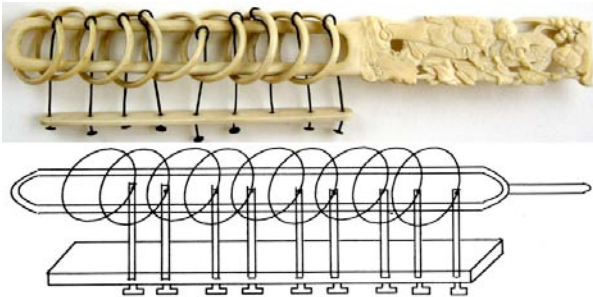
Luca Pacioli, an Italian mathematician and Franciscan friar, described three types of string disentanglement puzzles in his unpublished manuscript written in 1500. These puzzles have been popular ever since and one of them, the charming Japanese “Ingenious String” puzzle shown in Figure 12, was popular in Japan in 1836. The puzzle is to put both people on the same loop of string. The design is patterned after a Kabuki stage scene. In Europe the puzzle is called “Solomon’s Seal”.



**Fig. 12. Chie-no-ito string puzzle, Meiyo Kenbun Zue, 1836**

The puzzle for the Chinese Rings is to remove the handle from the 9 rings. It is quite difficult to solve for such an early puzzle.

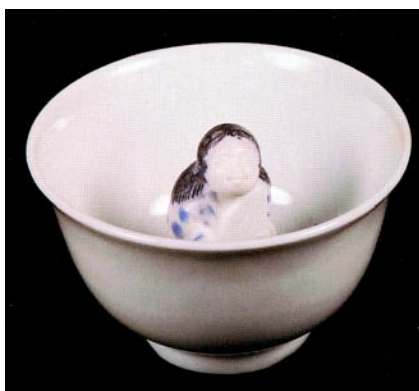
The puzzle, shown in Figure 13, was popular in Japan, China, Europe and India during the Edo period. Yoriyuki Arima, Lord of Kurume in Kyushu, analyzed and solved this puzzle and include it in his book on Japanese mathematics “Shuki Sampoh” in 1769.



**Fig. 13. Chinese Rings Puzzles**

**Puzzle Vessels**

Puzzle vessels are the earliest examples of mechanical puzzles ever found. Both the



**Fig. 14. Japanese Tantalus Cup,** Metropolitan Museum in New York and The Jerusalem Museum in Israel, have examples of puzzle vessels at least 3,000 years old. The earliest Tantalus cup found is from Greece and is 2,600 years old.

The Japanese Tantalus cup, shown in Figure 14, behaves like a normal cup if it is only filled part way, but if the cup is filled up to the lady’s eyes, the liquid in the cup will all be siphoned out on to the floor, through the concealed tube and the hole in the bottom.

**Impossible Puzzles**

A remarkable fountain, invented by Hero of Alexandria in the first century, squirts water higher than the level of any water in the fountain. Two Edo period Japanese versions are shown in Figure 15, along with the diagram of how the trick fountain works.



**Fig. 15. Two Edo era Hero’s Fountains**

Several years ago I became very interested in Magic Mirrors when I saw an original Chinese Magic Mirror in the Shanghai Museum that was made 2,000 years ago. These mirrors are the oldest Impossible objects known. The front surface of a Magic Mirror appears to be a simple, perfectly smooth, mirror surface as shown on the left in Figure 16. However the reflected image of the sun from the earliest magic mirrors showed an image that was the same pattern as the design that was cast into the back of the mirror.

I wanted to understand how these mirrors are able to reflect an image from a smooth surface. So I experimented with five techniques of deforming the mirror surface.



**Fig. 16. Magic Mirrors**

However the image quality that I was able to achieve was very poor when compared with the Magic Mirror shown on the right in Figure 16, which was made in Japan by Mr. Yamamoto.

Now I would like to thank Mr. Takashima, Mr. Iwasawa, Mr. Iwahara, Mr. Sonneveld and Mr. Youngblood, Mr. Kalinin, Mr. Sandfield for their help and The National Museum of Ethnology in Leiden for photos of trick boxes.