**World Heritage**
**Tomioka Silk Mill: Introduction to the Four Sites**

The 2014 World Heritage listing "Tomioka Silk Mill and Related Sites" is comprised of four sites: Tomioka Silk Mill, Tajima Yahei Sericulture Farm, Takayama-sha Sericulture School, and Arafune Cold Storage. Each played a significant role in Japan's industrialization of silk production. Tomioka Silk Mill was Japan's first mechanized silk reeling mill, Tajima Yahei Sericulture Farm and Takayama-sha Sericulture School improved sericulture methods and silkworm strains, and Arafune Cold Storage made it possible to control when silkworm eggs hatched, thus increasing the number of growing seasons per year.

## Tomioka Silk Mill

Tomioka Silk Mill was opened in 1872 and includes a number of Western-style red-brick buildings. The reeling equipment came from France. French experts were brought in to instruct and advise, including Paul Brunat (1840–1908), an experienced raw silk inspector who oversaw construction of the mill and became its first director.

The complex grew to include the reeling plant, cocoon warehouses, administrative buildings, a cafeteria, an infirmary, the director's residence, dormitories for the women mill workers, and company housing for the administrators and their families.

*Layout*
The reeling plant and two red-brick cocoon warehouses surround a central courtyard. The two-story Western-style warehouses were built when there was only one silkworm growing season per year; their size was calculated to house enough cocoons to keep the plant operating for a full year. Later, sericulture advanced and multiple crops of cocoons could be harvested annually. Since reeling capacity had also improved, the large warehouses continued to provide sufficient storage. Today, the warehouses contain exhibitions on the history of the mill and sericulture in Japan. There is a gift shop and small event space.

The family housing units stand at the open end of the courtyard. They provide a glimpse of daily life in the early twentieth century.

*Historic Equipment*
The reeling plant contains some of the fully automated Japanese reeling machines from the 1960s that were in use when the plant was closed in 1987. In the central courtyard is the steam boiler plant housing the steam engine that drove the reeling machines. The steam engine was fueled by coal, which was stored at one end of the warehouse on the west side.

*Access*
Many of the mill's original buildings have been preserved and are open to visitors. The site's free Wi-Fi may be used to download the smartphone app that provides audio

guidance.

## Tajima Yahei Sericulture Farm

Silk was an important export commodity for Japan even before industrialized production began. As demand rose, sericulturists sought to improve silkworm cultivation to increase the number of cocoons produced and improve the quality of the thread.

*Adapting sericulture techniques*
The farmhouse built in 1863 by Tajima Yahei (1822–1898) in the village of Sakai-Shimamura in the southern part of Gunma Prefecture is one of the earliest examples of architecture designed to improve sericulture. Silkworms were important to this area; mulberry bushes thrived in the sandy soil, providing ample feed for silkworms, and the farmers used the attics of their houses for this cottage industry.

Yahei realized that silkworms grew better in a well-ventilated environment. When he added a *koshi-yane* (a raised section extending the length of the ridge pole) to his roof to improve air circulation, he found it increased the silkworm survival rates. His innovation became common practice, and even today Japanese farmhouses where silkworms were once raised are easily identified by this distinctive roofline.

*Research and storage facilities*
Yahei had a small laboratory where he researched silkworm hybridization and silkworm diseases with the aid of a microscope, which was unusual in Japan at the time.

Some of the farm's sericulture buildings remain, including a mulberry leaf storage shed, a separate building where silkworms were raised, and an egg storehouse. Period tools and equipment used in sericulture are on display.

## Takayama-sha Sericulture School

Further innovations were developed at Takayama-sha Sericulture School, a school opened in 1884 to teach young men sericulture. The school was started by village headman Takayama Chogoro (1830–1886).

*Improving sericulture*
Chogoro conducted experiments to understand and develop optimal conditions for silkworm development. He controlled the temperature, air flow, and humidity of the rooms where silkworms were raised using charcoal braziers in a method called *seion-iku* or "clean and warm nurturing."

Chogoro worked at his home, which he rebuilt in line with his *seion-iku* method. He incorporated space for charcoal-burning stoves, roof vents similar to *koshi-yane*, and vents between the floors to move warm or cool air to the upper floor as needed.

*Repurposing the home*
After the development of the *seion-iku* method, Chogoro and his family turned their farm into the Takayama-sha Sericulture School. Students came from around Japan, as well as the Korean Peninsula and China, to study the clean and warm method of silkworm raising. They lived in an on-site dormitory and helped care for silkworms as part of their training.

Today, the family home that Chogoro rebuilt while he was developing *seion-iku*, the student kitchen/bathhouse, the latrine, and the *nagayamon* (a structure combining an entranceway and space for storage or accommodations for people of low status) all remain.

The gate in front of Chogoro's home was built in 1687. It contains exhibits about the history of Takayama-sha Sericulture School and displays on seventeenth century building methods and the recent restoration of the gate.

The foundations of the student dormitory, a laboratory, and the underground storeroom used to keep mulberry leaves fresh and moist are reminders of the heyday of the Takayama-sha Sericulture School.

**Arafune Cold Storage**

As sericulturists began to control the living environment for silkworms, they realized it was also possible to manage when silkworm eggs hatched. They could delay hatching by keeping the eggs at a constant cold temperature. This meant that instead of just one silkworm growing season per year, multiple crops of cocoons could be produced.

In the prerefrigeration era, a site was developed near Mt. Arafune, west of Tomioka, where naturally chilled air could be trapped for cool storage of the eggs. A 400-meter-long tumble of boulders on the mountain's steep slopes, which is the result of an ancient landslide, traps rain and snow in the gaps between the boulders. The resulting cold air naturally flows down the mountain.

Arafune Cold Storage was built at the bottom of the boulder field, where the cold air emerges from the boulders. Stone enclosures capture the cold air and multi-storied wooden storage units were built inside to keep the silkworm eggs cool. By controlling the air flow, a steady temperature could be maintained year-round; the temperature of the air emerging from the boulders was well below freezing in winter and typically did not exceed 5°C in summer.

Between 1905 and 1914, three cold storage units were built at Arafune Cold Storage and sericulturists around Japan and the Korean Peninsula stored silkworm eggs there. Eggs were laid directly onto labelled paper cards and shipped to the site after being tested for disease. The cards were carefully catalogued so that they could be readily accessed and returned to their owners as required. The facility had the capacity to store

as many as 1.1 million such cards.

Electric refrigeration rendered Arafune Cold Storage obsolete by 1935 and the facility fell into disuse. Eventually the wooden storage units were dismantled, leaving only the high stone walls that remain today. At the base of the boulder field visitors can feel the cold air that still pours out from the gaps between the boulders.