

***Hikiyu* at Dake Onsen**

The hot springs at Dake Onsen are fed by *hikiyu*—water piped in from off-site rather than drawn from the ground directly below. The ultimate source is 1,500 meters above sea level on nearby Mt. Tetsu. The system of pipes and conduits that delivers this *hikiyu* extends more than 8 kilometers, making it one of the longest in Japan.

Bringing the Mountain Springs to Town

The source of Dake Onsen is a group of open-air hot springs on Mt. Tetsu with a combined flow of 1,290 liters per minute. A series of conduits combines the waters from the springs into a single flow that is then piped down the mountain. No pumps are required, as gravity does all the work.

When the flow reaches the town, it is divided among multiple smaller pipes that lead to individual *onsen* bath facilities.

At their source, the hot springs range in temperature from 40° C to 90° C.

The temperature of the combined flow is 52° C, and with today's pipes keeping the water at that temperature all the way to Dake Onsen, no reheating is required.

History and Engineering

In earlier centuries, inns prospered at the source of the hot springs, which was then known as Yui Onsen. After Yui Onsen was destroyed by a landslide in 1824, Nihonmatsu domain ordered a new *onsen* town built lower down the mountain, with hot water piped in from the original source. As Nihonmatsu Castle already had a similar system that delivered fresh water from mountain rivers 14 kilometers away, domain engineers knew how to build and maintain the necessary infrastructure. This was the

beginning of the *hikiyu* system that now supplies Dake Onsen.

The original *hikiyu* system used conduits made of red pine with removable

lids, but these were poorly insulated and deteriorated quickly in outdoor conditions. In the early twentieth century these were abandoned in favor of wooden pipes known as *mokkan*. Each *mokkan* was a single massive pine log hollowed out using a drill obtained for this purpose from overseas. That solved the heat retention problem, but deterioration of the wood remained an issue. Starting in the 1950s, *mokkan* were gradually replaced with the more durable PVC pipes in use today.