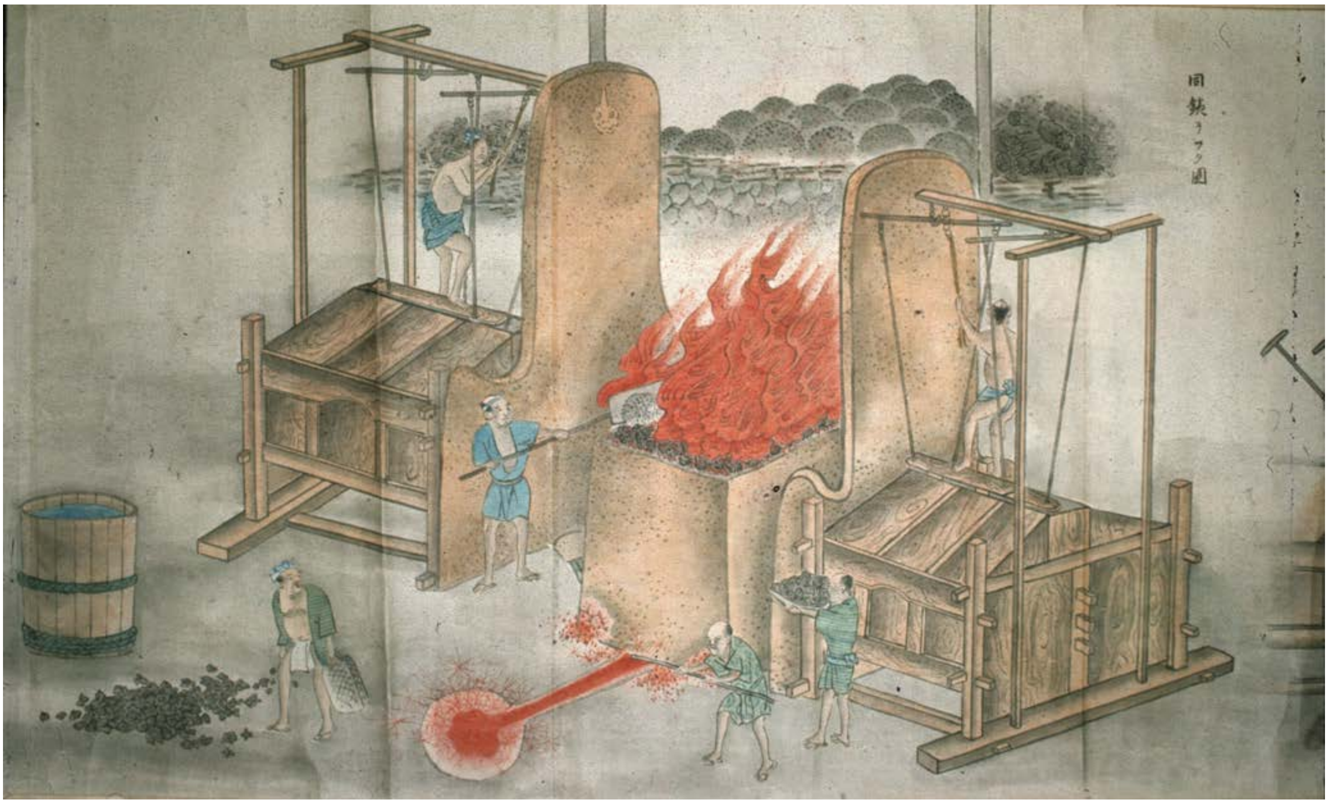
Japan-Insights
Exploring Expert Experiences



Tatara steelmaking furnace with bellows on each side; detail of the Saki no Ohtsu Agawa-Mura Yama-Satetsu Arai-Tori no Zu *mine pictorial made between 1830 and 1860, Courtesy of the Engineering Bldg.3 Library, Libraries for Engineering and Information Science & Technology, the University of Tokyo*

The Soul of the Japanese Blade

Traditional Tatara Steelmaking in Japan

Erich Pauer, France

The Soul of the Japanese Blade

Traditional Tatara Steelmaking in Japan

Koto Hironari working a high-grade steel blade, Shimane 2018

Motivation

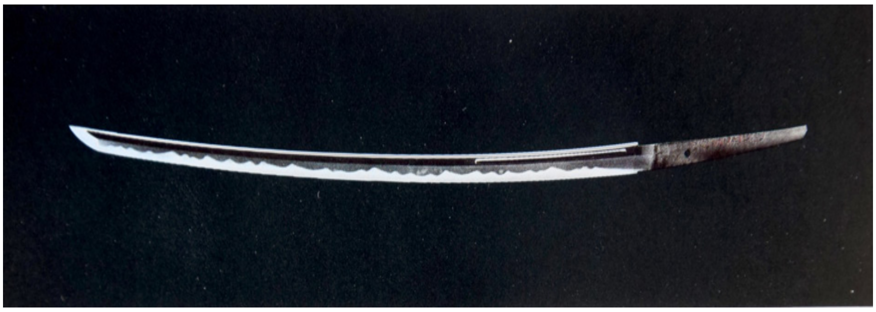
As a trained engineer, who came late to engage in Japanese studies, I was initially fascinated by traditional Japanese agriculture. Hoes, ploughs, threshing combs – all these tools had parts made of steel. The next step for me was to ask: where did the steel come from?
Several visits in the early 1980s took me to western Japan, especially to the prefectures of Shimane and Tottori. Many historical sites of traditional steel production have been preserved there to this day, and tamahagane, the high-grade steel important for modern swordsmiths, is still produced at one location.

Objective

While iron is common throughout the world, ore in the form of rock, as known in the West, does rarely exist in Japan. The raw material for smelting had to come from another source: Iron sand – a type of black sand that is rich in the metal. This was smelted using tatara, a traditional steelmaking process, producing not only the raw material for agricultural tools, but also all kinds of tools – knives, chisels, drills, pickaxes, etc. – as well as the samurai swords, which are considered the symbol of Japan in the West.
This essay describes the process of tatara steelmaking, from the extraction of iron sand to the production of high-grade steel *(tamahagane).*

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

It takes three such handfuls of tamahagane, or roughly up to 5kg, to forge a traditional sword



Traditional Japanese sword

Historical Iron Smelting in Japan

Iron sand is still used to make high-quality steel for blades, knives, swords, and other tools. In Japan, and especially in the west of the country, one can visit historical production sites that are still preserved, as in few other places in the world. At one of these places, steel is produced three times a year using the traditional methods. Visitors can even try out themselves.

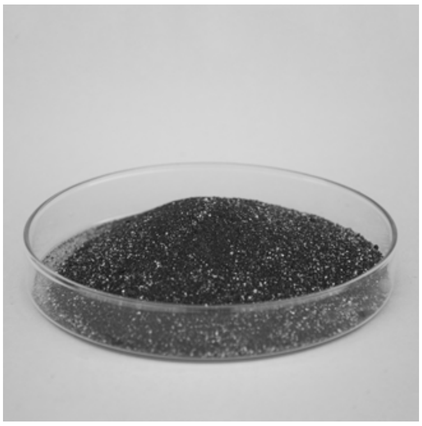
The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

The Tatara Process

The tatara process is the Japanese variant of a smelting operation that has been used to make steel in many parts of the world for thousands of years. It produces low-carbon, and therefore malleable steel by using charcoal and blasts of air to smelt iron sand. The deposits of iron sand in Japan are concentrated in the Chugoku region, now the Hiroshima, Okayama, Shimane, Tottori and Yamaguchi prefectures. The sand was extracted from the mountains, hills, and rivers as well as from the seashore.
Experts disagree about the beginnings of iron making in Japan. In the late Yayoi Period (2nd and 3rd century CE), iron imported from the Asian continent was used to make various tools. Some experts date the independent production of iron from Japanese raw materials to this period. Others put it later, in the 6th century. The first written references to steelmaking exist from the 8th century onwards. The use of iron sand can be traced continuously over the following centuries up to the present.
Japan is the only country that still cultivates this traditional steelmaking technique.

Basics of Tatara Steelmaking

Three materials are needed to make high-quality steel using the tatara process: iron sand (the raw material), charcoal (fuel) and clay (to make the furnace).



Iron sand

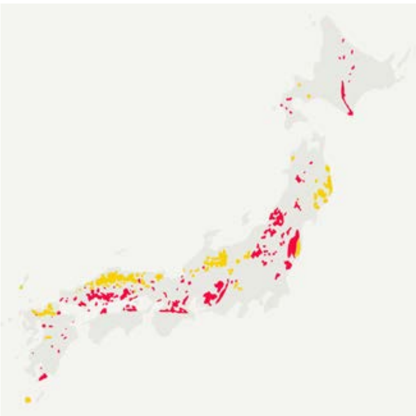
Charcoal

Clay

The Soul of the Japanese Blade

Traditional Tatara Steelmaking in Japan

Unlike in a blast furnace, tatara does not completely liquefy the iron. Instead, carbon monoxide from the incomplete combustion of charcoal reduces the iron oxides to metallic iron. Layers of charcoal and iron sand were placed in a hot, clay-built furnace, with air being blown in by bellows to achieve high temperature. The ovens were initially small and round, later square and then rectangular ovens were introduced.
The result of this process was a steel mass interspersed with slag and other impurities, which was deposited at the bottom of the furnace. When cooled, it was broken into smaller pieces that could fit in a hand. These pieces were then used for further processing, such as forging, and the production of various types of blades, including the famous samurai swords.
This type of steel extraction can only be done in a non-continuous process. From an economic point of view, the process is comparatively small and consumes a lot of charcoal as fuel.



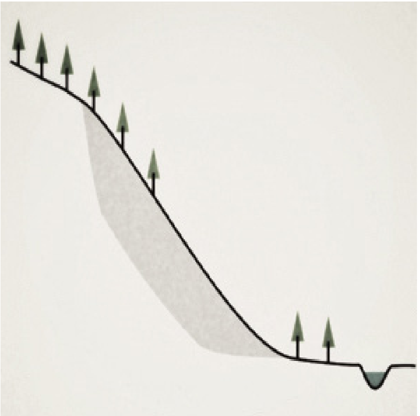
Iron sand deposits of Japan, masa tyype in yellow, akome type in red

Iron Sand

The basic raw material for traditional tatara steelmaking is iron sand, a residual material extracted from weathered igneous rocks. There are two types of iron sand in Japan: *masa* and *akome.* Both types are common, but are concentrated in different areas. Masa comes from granite, an acidic rock, while akome is basalt, andesite or diorite, basic rocks containing titanium. Masa iron sand deposits (yellow on the map) are concentrated in the northern Chugoku region, while other smaller deposits are located in the south, middle and north of Japan. Akome deposits (red on the map) are mainly found in the southern Chugoku region, with other smaller deposits scattered over the rest of Japan.
Both types of iron sand can be found in the soil at different concentrations: masa at a concentration of 0.5-2% and akome at 5-10%. The two types can also be distinguished by colour: masa is raven black and has larger particles, while akome is tinged with red and has fine particles.
The two types produce different results. Smelting masa takes 3 days; it results in a loop called *kera,* which is partly made of the tamahagane high-grade steel, used to make blades. Akome has a lower melting point and is used in a process called *zuku* to produce pig iron in a 4-day operation. Both operations use a similar furnace, which differs only slightly in size. The kera process is described in detail below.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Three types of iron sand can be distinguished: *mountain iron sand* is obtained from material extracted in mountainous regions; *river iron sand* is extracted from river beds; and *seashore iron sand,* as the name suggests, is found on the seashore.
Mountain iron sand is the best quality for steel production; *river iron sand* and *seashore iron sand* are of lower quality and are normally used only for the production of pig iron.



To extract iron sand, entire hillslopes (grey) were sometimes quarried and the soil washed into a nearby stream (right)

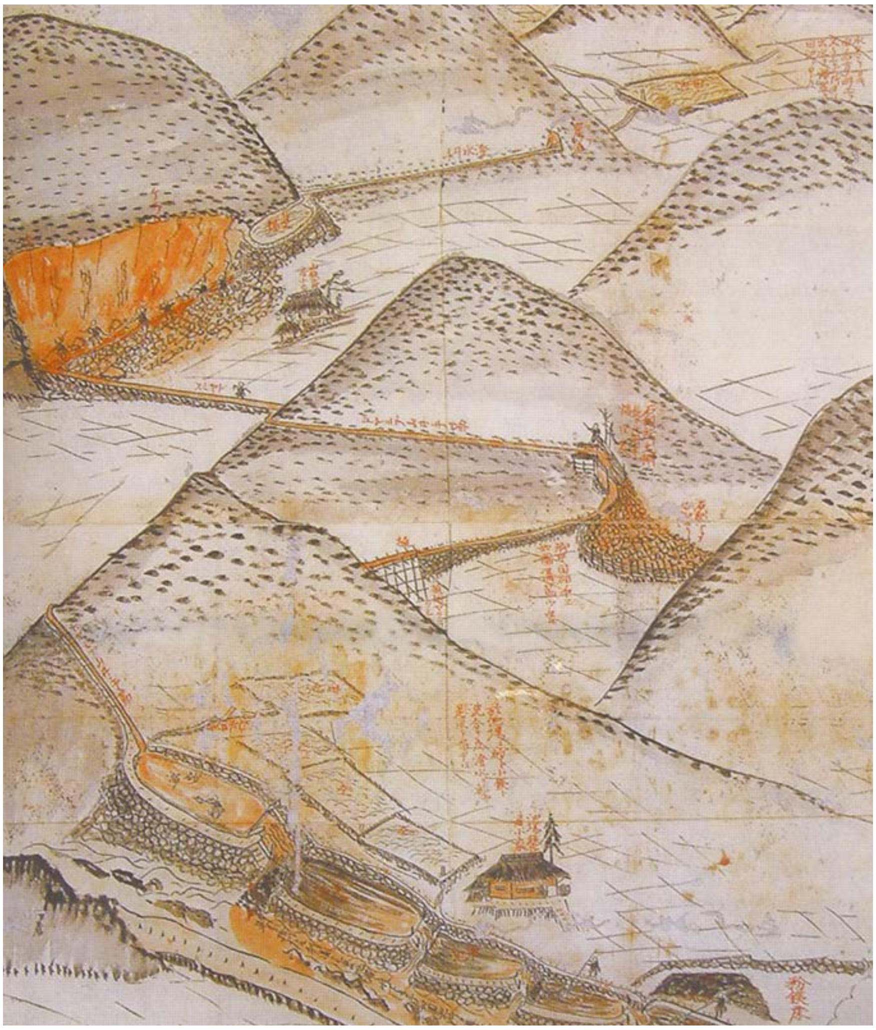
Extracting iron sands in the early 20th Century, Okuizumo ©Hitachi Metals, Ltd

Fields created by quarrying igneous rocks; the visible channels were used to transport crushed rocks and iron sand

Mining Iron Sand

To mine iron sand, weathered igneous rock was first crushed and the resulting material dumped into a stream or channel. The flowing water washed away the sludge and other impurities so that the iron particles, which are heavier, could settle on the channel bed. This washing process produced a lot of sediment that could affect the irrigation of the rice fields. Therefore, iron sand was often extracted in winter only, many times as a sideline for the agricultural population. Both steep slopes in the mountains and hilly terrain in the lower areas were quarried to extract iron sand. Whole ranges of hills were practically levelled; such areas were then reused for rice paddies or other types of farming.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan



Historic illustration from the middle of the 19th century Source: Wako Hakubutsukan Sogo Annai, *2007, p28*

Excavation of historic channels with simple stone walls (top) and remains of recent channels with cement lining (bottom). These channels had to be built in advance. They were about 50-60cm wide and between 8 and 12m long, with greater or lesser slopes, conforming to the natural landscape. Top: Tonami ni Okeru Satetsu Saishu no Kenkyu, *2017*

Purifying Sand

At the top left of the above illustration is the place where the rock was crushed and placed in water channels. Running water carried the mixture of iron sand and mud (in the middle) over a certain distance to a series of sedimentation tanks where the impurities were separated from the iron sand (below). The iron sand sank by gravity onto the bed of the channel and ponds, while the current carried the sludge, smaller stones, and other impurities. This process had to be repeated several times, so that often four or five channels – with collecting basins in between – had to be built one after the other. More and more impurities were washed out in each phase. The result was iron sand with a purity of almost 98%. The sand was then transported to the tatara furnace site.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Smelting iron sand consumed a lot of wood for the charcoal needed

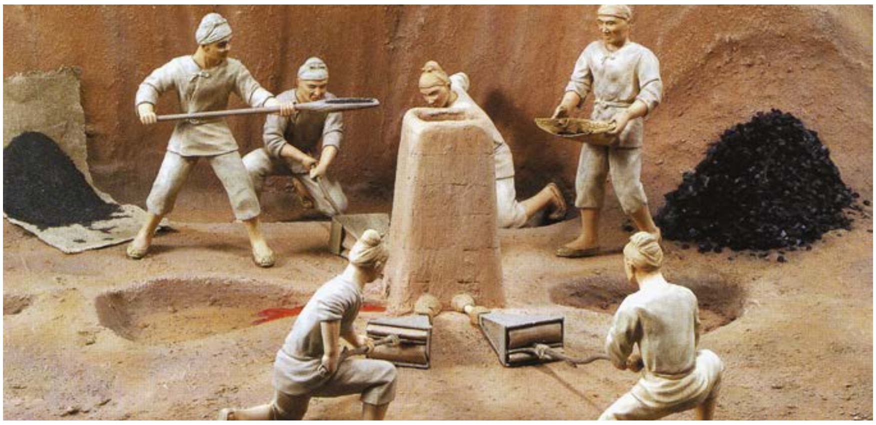
Charcoal

As an important raw material for the tatara steelmaking process, the production of charcoal suitable for tatara operation required expert knowledge and skills. The charcoal had to burn both hot and consistently.

In the Chugoku region of the Edo Period, a considerable amount of charcoal had to be supplied to the many Tatara operators – a single smelting process requiring about 12 tons; for a furnace with 60 production cycles per year, about 1,800ha of forest were needed; the Tatara operators depended on large forest stands to maintain iron smelting over a long period of time. The most suitable trees were pine *(matsu),* chestnut *(kuri),* twig *(maki),* and oak *(kashi),* between 30 and 50 years old. Pine and chestnut charcoal were used to start up the firing process; other kinds of charcoal were best for sustained heating to smelt the iron sand. Wood not yet completely transformed into charcoal was said to be the best for smelting.

Most of the charcoal kilns were located in the forests, where finished charcoal was brought, either by horse or carried on workers' backs in special baskets. A single worker could carry about 70 kilograms of charcoal.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan



Iron producing in ancient times, Wako Hakubutsukan Sogo Annai, *2017, p24*

Making Tamahagane
It is assumed that Japanese steel production technology *(tatara-buki)* was imported from China and Korea in the 6th century CE and originated in the Middle East in ancient times; it is one of the oldest steel production technologies in the world and has survived in Japan to this day. Only natural materials – iron sand, charcoal, clay, and air, forced into the furnace by bellows – are necessary to make the type of high-grade steel that is difficult to produce even using modern techniques.
Due to the numerous deposits of iron sand found all over Japan well as its extensive forests that were used to make charcoal to power the furnaces, the technique of iron smelting spread throughout the country. However, the main mining areas of this early iron industry were in western Japan, in what are now the Shimane, Tottori, Hiroshima, Okayama and Yamaguchi prefectures, the Chugoku region facing Korea.

The earliest written source documenting the steelmaking process, a provincial survey called Izumo No Kuni Fudoki, is dated 733 CE; it mentions the high-quality of the steel produced in the Izumo region, from which a variety of tools were made.
From excavations of remains from the 6th century CE we can reconstruct what the earliest steelmaking furnaces looked like. A square furnace, a metre or so in height, tapers upwards. At least four simple hand-bellows, made of deerskin, are described in several old items of literature; they blew air through bamboo tubes into the furnace, allowing the charcoal to burn hot; the iron sand was poured into the kiln from above. The technique to make tamahagane high-grade steel changed in the following centuries. The furnace got higher and evolved into a rectangular furnace.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

The Itohara steelmaking factory, around 1900 in Yokota, Shimane prefecture
Courtesy of Itohara Memorial Museum

The Production Site

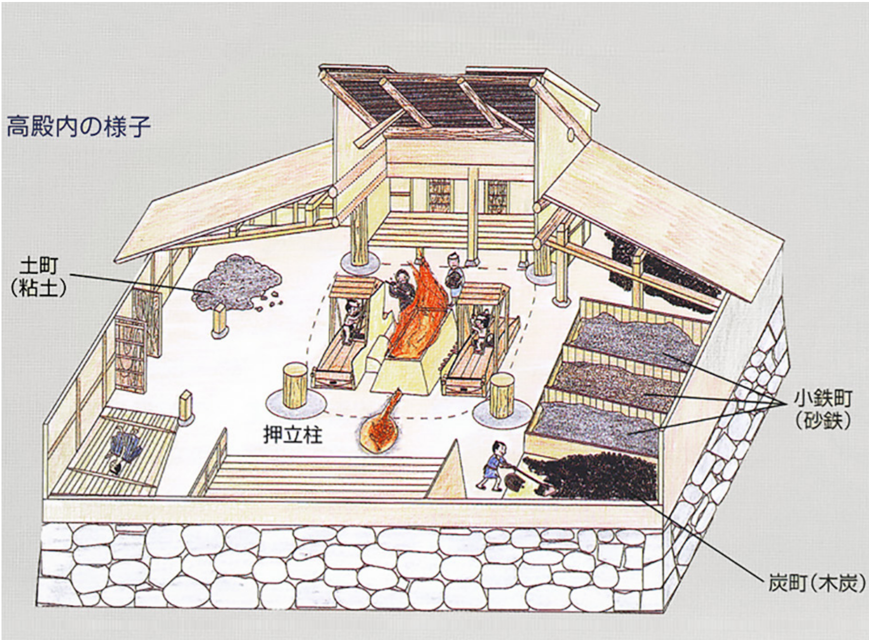
While the extraction of iron sand and the production of charcoal were both outdoor activities, steelmaking took place indoors. It had several special structural characteristics.

One of the oldest photos of an iron factory near Yokota in Shimane Prefecture dates from around 1900 and shows the Itohara Tatara. In the middle is the large furnace building, surrounded by buildings and warehouses for iron sand and charcoal as well as other working places.

The factory building *(taka-dono)* was made of wood and had an almost square ground plan, built according to methods of the mid-19th century. Although the building itself has not been preserved, the Itohara Memorial Museum stands on the site today.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Taka-dono at Sugaya Tatara Sannai



Inside a taka-dono furnace building, using the Sakurai steelmaking factory as a model Courtesy of Sugaya Tatara Sannai

The only preserved original taka-dono building from the mid-19th century, the Sugaya Tatara Sannai, is located in Yoshida, in the west of Shimane Prefecture. It is about 18m high and has a side length of about 8.5m. Four inner columns support the roof. Several warehouses for iron sand, char-coal, and food were built around the taka-dono. It has been run by the Tanabe family, large landowners with extensive forests, producing iron in this area since the middle of the 18th century. In 1880 the settlement con-sisted of 34 houses and had 158 inhabitants.

The furnace and bellows were located in the middle of the square building. Inside, along the outer walls, there were storage compartments for iron sand, charcoal, and clay, as well as resting places for the smelting manager *(murage)*, his assistant, the charging foremen, and the bellows workers. The roof was open at the top.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Small Shinto shrine on the wall in the factory building

Storage compartment for iron sand

On one side of the Yoshida building, above the iron sand storage, there is a small Shinto shrine, marked as holy place by a shimenawa straw rope with white paper flags; at the beginning and end of the tatara operation, the gods were worshipped.
This building is the only one of its kind that has been preserved in its historical form. Today it is a registered cultural monument and is used as a museum. While actual smelting is no longer possible, the process is shown in explanatory models.

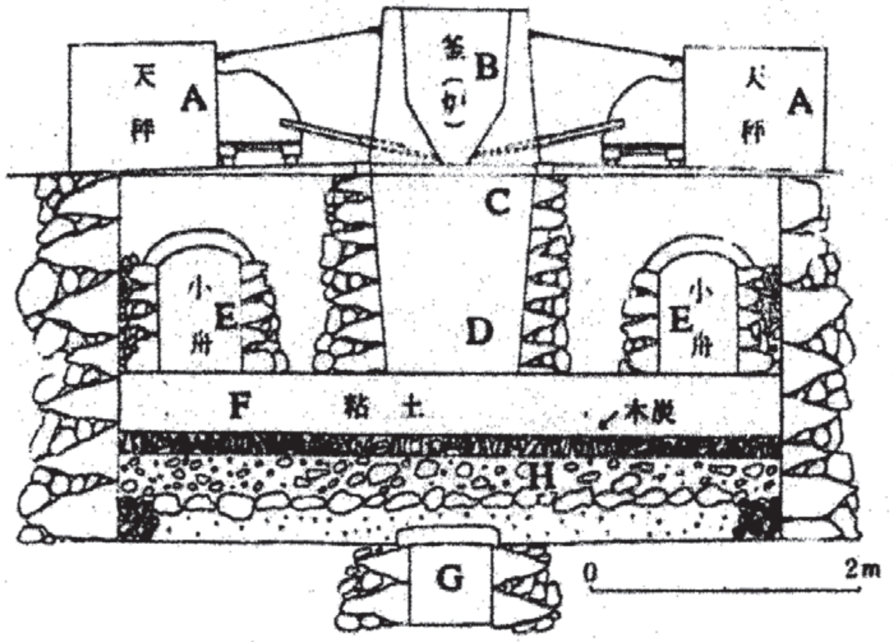
Beneath the Tatara Furnace

In order to optimize the smelting conditions, various innovations have been developed over the centuries. The furnace itself became more and more sophisticated in its shape: the walls were made thicker and more holes were made on the long sides through which air could be blown. Furnaces were built in different places and on different foundations. The heat of the furnace caused steam to rise from below, which cooled the furnace and disrupted the smelting process. Over time, a complex underground structure was developed to keep the furnace hot and dry. This structure consisted of a drainage channel under the furnace, layers of clay and charcoal above it, and open channels for insulation.

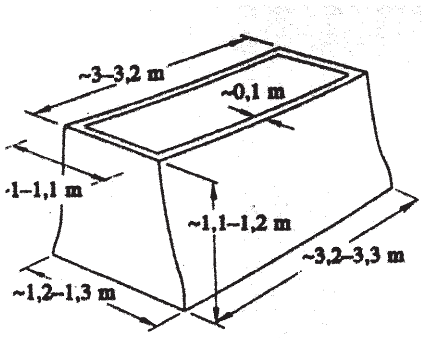
The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Cross-section and construction of a tatara furnace and bellows

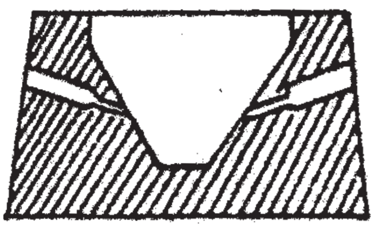
A *bellows*
B *tatara furnace*
C *ash* (ofune), *furnace bed*
D *charcoal* (ofune), *furnace base*
E *side channel* (kofune)
F *dry clay*
G *horizontal drainage channel*
H *charcoal, sand (shingles), round stones, washed sand, pine tree logs*



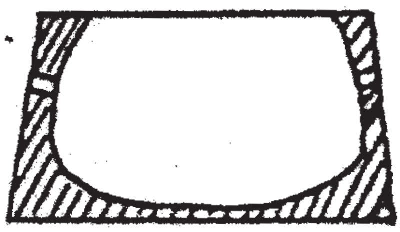
Furnace Construction
The furnace itself was located in the middle of the building. It was usually rectangular, about 3.2m long, 1m wide and 1.2m high. There is an interesting saying about the making of the furnace: *The most important element is the clay, the second is the wind, and the third is the the master* (murage). The murage was the knowledgeable, experienced supervisor who managed the construction of the furnace and the entire smelting process.



Typical tatara furnace



Cross-section of the furnace before



– and after the smelting process

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Model of a tatara furnace in Yoshida

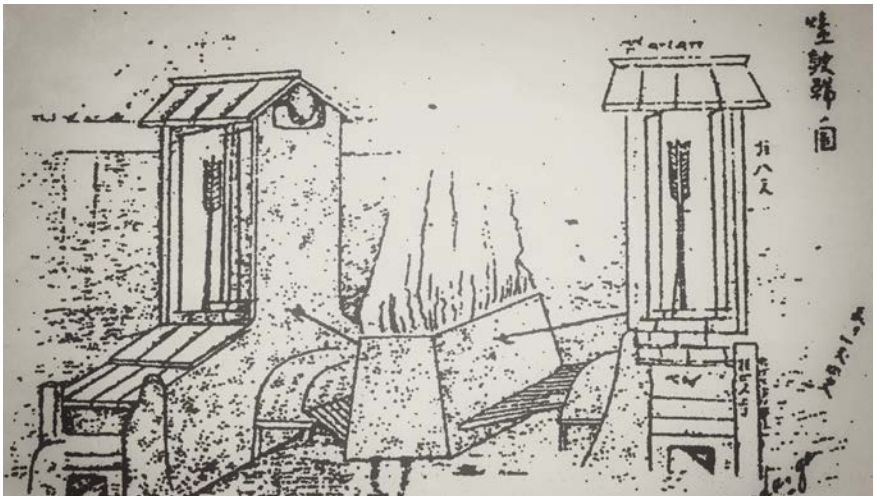
Model of a tatara furnace, tuyeres

The inner bottom wall of the furnace and the angles of the tuyeres – the blowing nozzles – were important because they influenced the formation of the kera, the loop resulting from the smelting process. Clay mixed with sand was formed into blocks and piled by hand to form the furnace walls. Twenty tuyeres were inserted into each sidewall. These nozzles made it possible to blow as much air as possible into the burning charcoal so that it could reach the required maximum temperatures.

A hole was made at the bottom of the two ends of the furnace to suck out the slag, vitreous waste, and the pig iron, brittle with a high carbon content. During the smelting process, the bottom of the furnace interior wore out, making it wider than at the beginning of the process.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Model of a tatara furnace with bellows on each side, Itohara Memorial Museum



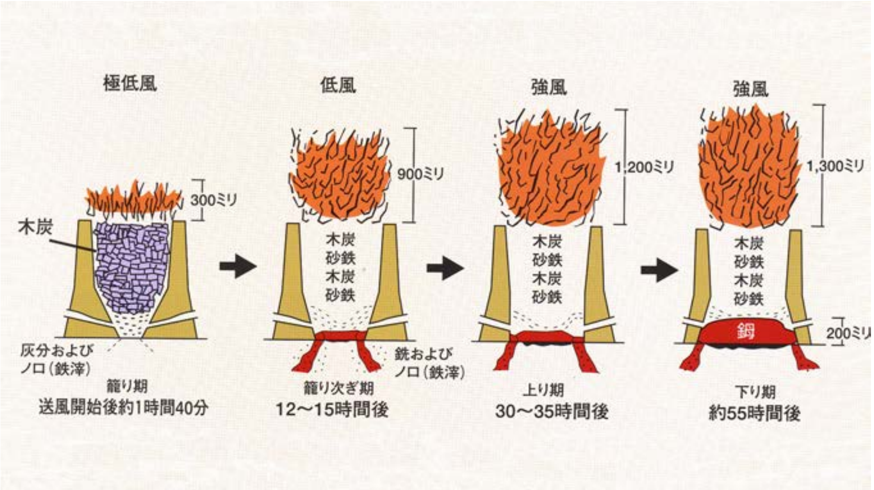
Sketch of a tatara furnace in operation from around 1900; the furnace in the middle and two bellows on the left and right
Courtesy of the Kondo family, Ne'u, Tottori Prefecture

Wind and Heat: the Bellows

The evolution of the bellows brought the most important changes for the development of the Tatara process. The hand operated bellows, which were used at an early stage, made it possible to reach temperatures of only 1,200-1,300°C, creating a doughy iron loop, interspersed with slag and other impurities.

In the late Middle Ages, stepping bellows operated by six workers were used. In the Kamakura era (1185-1333) they were replaced by a *piston bellows*. Around the 17th century, a wooden seesaw bellows or balance bellows *(tenbin fuigo)* was introduced in the Chugoku region. This bellows was efficiently operated on foot, reducing the number of workers required to operate it from 8-10 to only one – or two if the bellows were placed on both sides of the furnace. The worker stood in the middle above the bellows boxes and held on to a rope attached to a beam above his head to maintain balance. He operated the bellows by shifting his weight alternately from one foot to the other. This seesaw bellows had another advantage: now it was possible to raise the temperatures in the furnace to as high as 1,400°C, close to the melting point of iron, allowing the steel mass *(kera)* to melt and collect at the bottom of the furnace, which increased the quality of the steel produced. This new type of bellows also led to dramatic changes, allowing for buildings where furnace and the bellows were housed under one roof. More recently, air compressors driven by electric motors replaced the muscle-driven bellows.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan



The smelting process in a tatara furnace
Source Wako Hakubutsukan Sogo Annai, *2007 p54*

The Smelting Process
The operation began early in the morning, at about 3 o'clock, on the first day. Charcoal was poured into the furnace and then lit. After two hours, iron sand was added for the first time, followed by charcoal until the furnace was full. When the contents of the furnace sank, iron sand and charcoal were thrown in alternately at intervals of 30 minutes.
On the second day they were added more frequently and without interruption, and slag was regularly released from the furnace bottom. By the end of the third day, about 12-15 tons of charcoal and 10-13 tons of iron sand had vanished in the furnace. The process was then stopped.

During these three days, one or two masters *(murage),* two deputy operators, and eight experienced assistants took turns to pour iron sand and charcoal into the furnace to smelt the iron at a temperature of about 1,400°C. In the end, a large mass of steel, iron, slag and other impurities accumulated at the bottom of the furnace. This mass cooled and solidified into a 2.7m long, about 1.1m wide and 15-20cm thick block weighing 2 tons or more. It had to be broken into pieces, a third of which was good steel, that had to be further processed before it could be made into useful items.

At the end of the operation the furnace was demolished and the remaining charcoal was removed.

The Soul of the Japanese Blade

Traditional Tatara Steelmaking in Japan

The murage is the person responsible for the smelting process, Nittoho Tatara Factory

Pouring iron sand and charcoal into the furnace

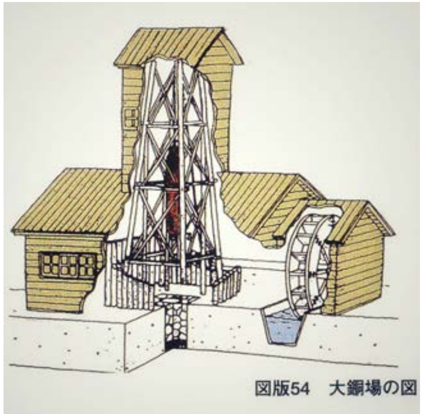
The kera block is removed from the remains of the furnace, Nittoho Tatara Factory

Kera block ready to be broken into pieces, Nittoho Tatara Factory

The Soul of the Japanese Blade

Traditional Tatara Steelmaking in Japan

Hammer used to crush the kera block, Nittoho Tatara Factory



Hammer building driven by a water wheel, Source: Wako Hakubutsukan Sogo Annai, *2007, p50*

Thanks are given to the gods –

and the responsible murage is congratulated with sake

Statue depicting the transport of iron on horseback, Yoshida, Shimane Prefecture

Transporting the Steel

Tamahagane high-grade steel was usually sent to swordsmiths in unfinished form. Low-grade steel and pig iron were forged into longer pieces and transported on horseback to the nearest port to be shipped to other ports on the Sea of Japan or to Osaka, where there was great demand.

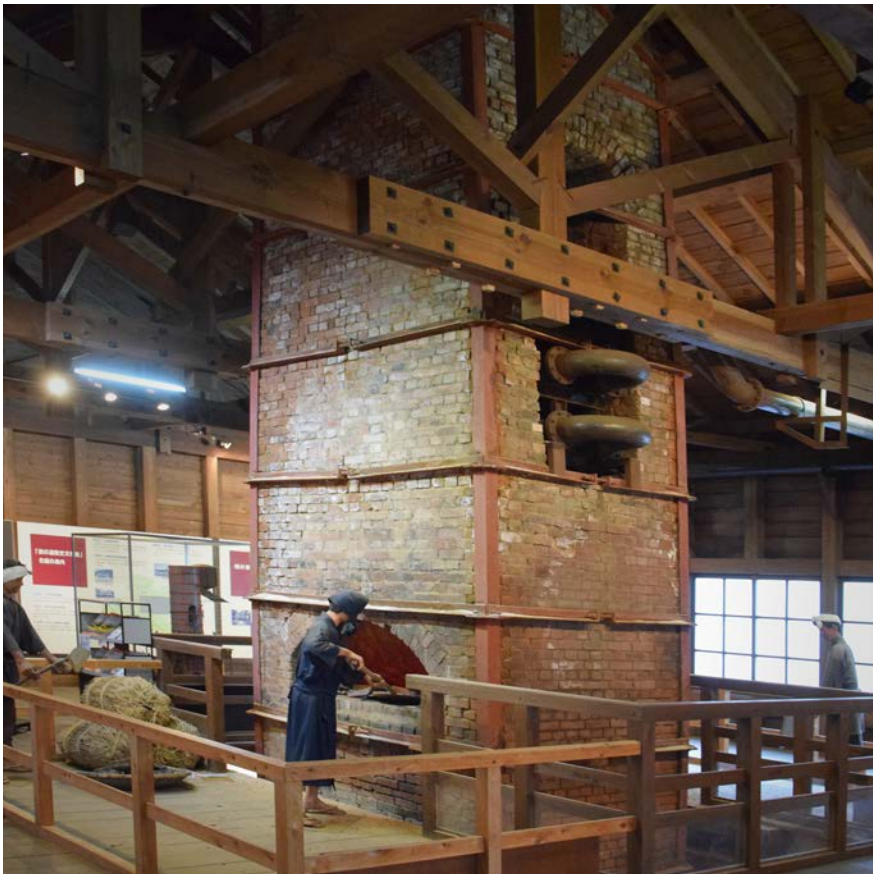
Closing

Over the centuries, traditional iron sand smelting evolved through various technical developments such as the construction of furnaces, the use of various forms of bellows, and many others. The technical development reached its peak from the late Middle Ages (16th century) to the Edo period (1603-1867).

With the beginning of Japan's industrialization from the middle of the 19th century and the transfer and adoption of Western technology, Western metallurgy also gained a foothold. Traditional iron industry alone could not satisfy the rapidly growing demand for iron and steel for industrialization; as a result, it lost more and more importance compared to modern iron and steel works.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Model of a square furnace



Old square furnace as a technical monument

Nevertheless, attempts were made to maintain the use of iron sand with the aid of new methods. The development of the so-called *kaku-ro* – literally square furnace – in the Meiji Period as well as in the interwar period, although few in number, is an example of these efforts. Such new methods were also used in certain places in Shimae prefecture, mostly for the production of pig iron.

After interruption during the Second World War, the operation of furnaces was resumed, but ceased in the mid-1960s. The remains of some can still be seen, and models are on display in various museums.

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

New type of a square furnace at Future Science Museum of Iron
©Regional Development Agency Foundation for Historical Village of Iron

After the traditional iron industry had been marginalised by modern industrial development and almost forgotten over time, it was the lack of the raw material necessary for the production of traditional blades, namely steel obtained from the smelting of iron sand, which led to the resumption of traditional tatara steelmaking. At the same time, this technique was also recognized as an important heritage of the past. This new appreciation and its products led, on the one hand, to the preservation of tatara smelting sites and, on the other hand, to the revival of the historic metal industry, as can be witnessed today in various places. Recently, there are also attempts to revive the extraction of iron sand with new forms of smelting.

The Soul of the Japanese Blade

Traditional Tatara Steelmaking in Japan

Eric Pauer received his doctorate at the University of Vienna. He taught Japanese Studies at the Universities of Vienna, Bonn and Marburg, where he was Director of the Center for Japanese Studies for many years. His vocational training prior to his studies made him concentrate his scientific research on the historical development of Japanese technology, including economic and general history.

He spent many years in Japan, where he made several excursions to the Chugoku region to research the traditional iron industry. After his retirement in 2008, he and his wife set up a Japan Library at the Centre Européen d'Etudes Japonaises d'Alsace (CEEJA) in Alsace, France. A collection of about 100,000 books, dozens of current periodicals, mostly in Japanese, and a special collection of woodblock printing books of the Edo period, the so-called *Edo bunko,* offer interested researchers from nearby France, Germany, and Switzerland the opportunity to study various Japanese topics.

ceeja-japon.com

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Places

Kabeya Shuseikan Museum
The Sakurai family has been one of the leading steel producers in Okuizumo. The name of the museum refers to *Kabe,* an area in Hiroshima where the family business originated.
Nestled in a tranquil mountain setting, the museum displays documents that describe in detail the history of the family's steel production and works of art they have acquired over the centuries.
Next to the museum is the former residence of the Sakurai family from the 18th century with a Japanese garden; best time for a visit is when the autumn colours of the trees and bushes are beautifully reflected in the pond.
699-1621, Shimane, Nita gun, Okuizumo cho, Kamiai 1655
web-site

Kubota Library
Housed in the Yoshida Community Center, this library has a substantial amount of written materials collected by the scholar Kubota Kurao, who studied the traditional iron industry in the Chugoku region throughout his life.
690-2801, Shimane, Unnan shi, Yoshida cho, Yoshida 1061-1

Nittoho Tatara
When the former Yasukuni tatara furnace in Okuizumo, Shimane Prefecture, faced a production shortage in the late 1960s to early 1970s, the site was restored in 1976 as Nittoho Tatara under the auspices of the Society for the Preservation of Japanese Swords, Nihon Bijutsu Token Hozon Kyokai (NBTHK), to preserve the tamahagane craft. Nittoho Tatara is now the only government-authorized Tatara factory, where two Murage produce tamahagane high-grade steel every winter in sufficient quantities for the Japanese swordsmiths. This plant is closed to the public.
699-1802, Shimane, Nita gun, Okuizumo cho, Oro 529
web-site

Okuizumo Tatara Sword Museum
A twenty minutes walk from Izumoyokota Station on the Kisuki Line, the museum comprehensively presents the technique of tamahagane high-grade steel production with life-size models of the tatara furnace, supplemented by illustrations and diagrams
699-1832, Shimane, Nita gun, Okuizumo cho, Yokota 1380-1
web-site

Places

Sugaya Tatara Sannai
Village about four kilometers northwest of Yoshida, where the only existing example of a taka-dono steel production plant is located. The smelting furnace and bellows, now electrically operated, were owned by the Tanabe family and are a designated important folk-cultural property, preserved in their original state.
690-2801, Shimane, Unnan shi, Yoshida cho, Yoshida 4210-2
web-site

Tanabe Museum of Art
The Tanabe family was one of the largest steel producers in the San'in region. This private museum, founded in 1979 in Matsue, the capital of Shimane Prefecture, displays the family's collection of works of art, many of which are related to the tea ceremony.
690-0888, Shimane, Matsue shi, Kitahori cho 310-5
web-site (Japanese)

Itohara Memorial Museum
The Itohara family was one of the most important steel producers in Shimane Prefecture. Built in 1784, the family house was restored in 1924 and is now a museum with a traditional Izumo style garden with a carp pond, stone pagodas, trees and shrubs arranged in a hilly terrain.
The exhibition consists of three rooms dedicated to steel production, historical artifacts, and documents related to the region and the family.
The museum is best reached by taxi from Okuizumo Yokota or Izumo Minari stations of the Kisuki Line.
699-1812, Shimane, Nita gun, Okuizumo cho, Otani 856
web-site

Wakou Museum
Established in 1946 by Hitachi Seisaku-sho, now Hitachi Kinzoku, it was handed over to the city of Yasugi, Tottori Prefecture, in 1993. The name *Wakou* is translated with Japanese steel, tamahagane high-grade steel. The museum offers a comprehensive overview of the history and process of tatara steelmaking. Visitors can study original tools and models of historical and modern furnaces such as the Kaku-ro square furnace with detailed descriptions. A separate room is dedicated to Tawara Kuniichi, one of the first scientists to study and document the tatara technique for the production of tamahagane.
692-0011, Shimane, Yasugi shi, Yasugi cho 1058
web-site

Publications

Tonami ni Okeru Satetsu Saishu no Kenkyu
San'in Tatara Seitetsu Kenkyu-kai (eds.); 2017;
A comprehensive report on ancient iron-sand extracting technique of the Tonomi area in Tottori Prefecture; based on extensive research led by Tawara Kuniichi (Japanese)

Wako Hakubutsukan Sogo Annai
Wako Hakubutsukan; 2007; Yasugi
Comprehensive guide, published by the Wako Museum, which describes the origins of the Tatara technique and its development with numerous illustrations (Japanese)

Organizations

Nihon Bijutsu Token Hozon Kyokai (NBTHK)
The Society for the Preservation of Japanese Art Swords is a government-authorized organization founded in 1948 to preserve the Japanese sword and its techniques, which were threatened with extinction after World War II.
In 1976, NBTHK restored the Yasukuni Tatara production facility in Shimane Prefecture, now Nittoho Tatara, the only official tamahagane production facility for art swords; it also operates the Japanese Sword Museum in Sumida ku, Tokyo.
web-site

Regional Development Agency Foundation for Historical Village of Iron
The museum, library, and research facility of this foundation located in an idyllic natural setting of the Yoshida village in Shimane Prefecture offer visitors many opportunities to experience tatara Japanese steelmaking first hand.
web-site (Japanese)

Glossary

Akome
One type of iron sand, also called akome satetsu, used for tamahagane high-grade steel production
web-site
►Iron Sand
►Masa

Chugoku
Collective name of five prefectures in West Honshu, namely Tottori, Shimane, Yamaguchi, Hiroshima and Okayama, where the traditional tatara steelmaking is concentrated
web-site
►Shimane Prefecture
►Tottori Prefecture

Edo Period (1603-1867)
Epoch whose name is derived from Edo, its capital and today's Tokyo, with the seat of the military governor, the Shogun

Iron Sand
The basic material for the traditional production of hig-grade steel. The two types of iron sand, akome and masa, differ externally in their colour; they can be found in many places in Japan and are processed in the same furnaces using different methods
►Akome
►Masa
►Tamahagane
►Tatara

Itohara
Family of important tamahagane producers in the Edo period. Like other major iron producers, they owned large areas of forest and agricultural land. Although the former buildings for steel production have disappeared, the family property is now restored as a museum dedicated primarily to the technology of traditional steel production.
web-site (Japanese)
►Sakurai
►Tanabe

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Glossary

Kamakura Period (1185-1333)
Epoch of the Japanese Middle Ages, when the city of Kamakura, located south of today's Tokyo, was the seat of the military governor, the shogun. This was the time when the social group of warriors known as Samurai came to power. The period ended in 1333 with a civil war.

Kera
Block of steel, which is produced when masa iron sand is smelted in a three-day process called kera-oshi. Kera contains slag and other impurities as it comes out of the furnace; only a small part of it, 30-40%, can be used to produce tamahagane high-grade steel.
web-site
►Iron Sand
►Masa
►Tamahagane
►Zuku

Masa
Predominantly found along the north side of the Chugoku mountain range, one of the two types of iron sand used for high-grade steel production; the resulting tamahagane is of higher quality than the one produced with akome iron sand
►Akome
►Iron Sand
►Tamahagane

Murage
The person responsible for the entire iron smelting process; the murage had to decide how the process was to proceed, when and at what intervals charcoal or iron sand had to be loaded into the tatara furnace and the time the process was completed.
web-site
►Tatara

Sakurai
Family that has been associated with traditional tamahagane production in the San'in region, now Shimane and Tottori prefectures, since the early seventeenth century. One of the major owners of forestry and agricultural land. The importance of the family is reflected in the impressive main building, constructed in 1738, and the adjacent traditional garden with pond, waterfall, hilly terrain, and tree population.
web-site
►Itohara
►Tanabe

Shimane Prefecture
Part of the Chugoku region in which most of the traditional tamahagane producers and their manufacturing sites are located
►Chugoku
►Tottori Prefecture
►Yoshida

Shimenawa
Laid rice straw or hemp rope used for ritual purification in Shinto religion; the shape can vary in diameter from a few centimetres to several metres, and are often seen festooned with zigzag-shaped paper streamers, *shide*. A space marked by shimenawa is considered sacred or pure.
►Taka-Dono

Taka-Dono
The furnace building; its floor plan is usually square, with sides measuring between 8 and 10 metres. The tatara furnace and the bellows are placed in the middle; the smoke escapes through an opening at the top. Along the walls there are storage places for iron sand, charcoal, tools, and other equipment. A special area is reserved for the murage, the supervisor.
web-site
►Iron Sand
►Murage
►Shimenawa
►Tatara

Glossary

Tamahagane

High-grade steel obtained from smelting iron sand through direct reduction, the so-called tatara process. *Tama* means bullet, but also tuber, which corresponds to the shape of the material obtained, and *hagane* means steel.

web-site

►Iron Sand
►Masa
►Taka-Dono
►Tatara
►Kera
►Zuku

Tanabe

One of the *Three Families of Tatara,* major tamahagane producers and landowners in the San'in region of today's Shimane and Tottori prefectures. The Tanabe family started iron production in the fifteenth century in Yoshida, a city in the western part of Shimane Prefecture.

web-site

►Itohara
►Sakurai
►Shimane Prefecture
►Yoshida

Tatara

This term refers both to the traditional steelmaking process and to the furnace in which the melting takes place.
Place names with the tatara component are common throughout Japan and often indicate a connection with tamahagane production.

web-site

►Iron Sand
►Murage
►Taka-Dono
►Tamahagane
►Tenbin Fuigo
►Kera

Glossary

Tenbin Fuigo
Also known as balanced *fuigo*, a type of foot-operated bellows, which was popular in the late 17th century and was considered an efficient technical innovation in high-grade steel production in the Tottori and Shimane prefectures.
web-site
►Shimane Prefecture
►Tatara
►Tottori Prefecture

Tottori Prefecture
Part of the Chugoku region, rich in iron sand deposits, which attracted many traditional tatara furnaces in the western part of the prefecture.
web-site
►Chugoku
►Iron Sand
►Tatara

Yayoi Period (circa 300BCE-300CE)
Also known as the period of renewal, it is characterized by the development of agriculture, the settlement of Japan, but also by new types of ceramics and the beginning of metal crafts
►Edo Period (1603-1867)
►Kamakura Period (1185-1333)

Yoshida
Hometown of one of the biggest tamahagane high-grade steel producers, the Tanabe family, in Okuizumo, Shimane Prefecture
►Shimane Prefecture
►Tanabe

Zuku
High-carbon pig iron, obtained from a four day smelting akome iron sand in a process called *zuku-oshi*
web-site
►Akome
►Kera

The Soul of the Japanese Blade
Traditional Tatara Steelmaking in Japan

Imprint

Publisher

Japan-Insights, *Exploring Expert Experiences,* is one of the many activities pursued by the Toshiba International Foundation, TIFO.
Japan-Insights promotes a deeper understanding of the country – its people, places, and culture.

Leading experts, scholars, and professors in Japanese studies present a broad range of historical and contemporary topics, encouraging visitors to engage with the real Japan through immersive experiences.
Essays that share their excitement and depth of insight are complemented by relevant information for travelers on the site.

Looking towards the 2020 Olympics and Paralympics and beyond, we hope to contribute to a Japan that offers people from around the world many opportunities for discoveries and memorable encounters.

Japan-Insights
Toshiba International Foundation
©2020

info@japan-insights.jp
japan-insights.jp

*Japanese names are given in the order of surname/given name while all other names follow the given name/surname pattern