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Some comments on various topics about Japanese Swords: Part 1, the controversies concerning *nanban* steel.

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Introduction: In a previous article **(Coutinho 2009)** a hypothesis raised by Mr. *Kazushige Tsuruta* was discussed. This hypothesis was that the use of *nanban tetsu* (foreign steel i.e. steel imported to Japan) was the reason why *Hizen* swords are better than the *Takada* swords made in the neighboring *Bungo* Province. It was also claimed that *nanban tetsu* could be *wootz* steel which was made in India, as early as, 332 B.C.E.

This article provoked a few reactions. Some readers wrote claiming, for example, that *Bungo Takada* swords are completely different from *Hizen* swords. The article was also discussed in two threads on-line in Nihontomesssageboard. Here are the URLs :

http://www.militaria.co.za/nmb/viewtopic.php?f=9&t=8526&st=0&sk=t&sd=a&start=15

http://www.nihontomessageboard.com/nmb/viewtopic.php?f=1&t=8325&st=0&sk=t&sd=a&sid=300c2342969f5b9074181c00a5bad0a3

The focus of this article is to further explain *wootz* steel and to show how *nanban tetsu* could possibly be used by *Shinto Hizen* swordsmiths in the manufacture of samurai swords.

The question arises “What is *wootz* steel anyway?” This subject was discussed very thoroughly in the threads mentioned above and some subtle points were clearly explained by Carlo Giuseppe Tachini. This article will add more comments and clarifications. Some interesting questions, raised by Erich Hugelshofer, (one of the participants of the above thread), remained unanswered. These questions motivated a series of other questions one can ask about Japan in the 16th century and about the Japanese sword.

Erich asked: "Assuming the Portuguese transported *wootz* in large quantities why nothing is

seen of this miraculous steel in Swords, Sabers [and] epées made by Europeans? Toledo for example has a famous reputation."

He goes on to apparently conclude that "Damascus steel, *wootz*, from India was exclusively used in India and the orient (Persia, Turkey, etc.) and hence never in Japan".

We have here an interesting question and an affirmation. The affirmation is that *wootz* was never exported from India to Japan. Of course it is impossible to prove that *nanban tetsu* is *wootz* steel. However, most modern authors think that this should be the case, and as explained bellow *wootz* is not miraculous at all. Here is a quote from an article by **Suzuki (2004).**

> "*Nanban tetsu* is steel which was imported into Japan by Portuguese or Spanish merchant ships in the end of *Muromachi* period (1392-1573). The steel was produced in India and called "*Wootz* steel". *Nanban tetsu* steel was shaped in some forms of a gourd called "*Hyotan*", an oval called "*Koban*", a square timber called "*Saijo*", a semi-cylinder called "*Tajo*" and others. In 1613, one Japanese swordsmith, *Shodai Echizen Yasutsugu,* first produced a sword using *nanban tetsu*. Since then, many swordsmiths who lived in the *Echizen* area (*Fukui* Prefecture) used *nanban tetsu* as a material of Japanese swords. The steels produced using the "*Nittoho-Tatara*" furnace in *Shimane* prefecture has been examined by forge-welding as a function of phosphor content in the steels. It is concluded that "*Hyotan*" shaped *nanban tetsu* is not good for forging, "*Saijo*" shaped *nanban tetsu* is good for forging, "*Koban*"-shaped one is difficult to forge weld and "*Tajo*"-shaped one is intermediate."

Hizento and *nanban tetsu*

Sword literature relates that some *Bungo Takada* swords are made to resemble *Hizen* swords (See **Watson (1992)**). *Takada* swords that clearly try to imitate *Hizen* swords are often found.

Hizen swords can be divided into swords made by the **main-line** (*Tadayoshi, Tadahiro,* etc.) and swords made by *waki-Hizen* – **side-line** smiths such as *Masahiro, Yukihiro, Tadakuni,* etc. Sword literature frequently states that swords by the *waki-Hizen* smiths have **dark steel** compared with the main-line *Hizen* smiths and presumably to other *Shinto* smiths. This is confirmed in quotes from articles of both the NBTHK and the NTHK.

Sano Masao (**Sano 2011**), writing in the NTHK club journal translated by Dr. Gordon Robson, wrote:

> "In addition, the main non-main line works (*Waki-Hizen*), in comparison with the main line smiths, have a **dark *jigane***, and the *hada* has a prominent feeling."

In the opinion of *Hinohara Dai* **(Hinohara (2011)):**

> "the main stream smiths, *Tadayoshi* and *Tadahiro*, made *jihada* which are a tight *ko-itame*, which is bright and refined. The branch smiths' *jihada* characteristics are a visible *ko-itame hada* and a **darker colored *ji-hada*.**"

This suggests that the dark *hada* of *waki-Hizen* smiths are due to the use of *nanban tetsu,* that the author believes is *wootz* that is, in fact, rather dark.

This is illustrated by the following comparison of two swords. One is by *sandai Yasutsugu* (*Edo*) and the other by *Hizen shodai Yukihiro.* Both blades are papered by the NBTHK. In the sword by *Yasutsugu* there is an inscription saying that the sword was made with *nanban tetsu*. Both swords have the *ji-hada* similarly dark. So it seems that this *Yukihiro* sword may have had *nanban tetsu*. On the other hand, a papered *nidai Masahiro* that has a very clear *jigane* was studied. One can conclude that not all *waki-Hizen* smiths used *nanban tetsu*.

One may ask why the *Hizen* smiths used *nanban tetsu*. *Wootz* steel has a high carbon content which is difficult (see below) to obtain from the *tatara.* Nakahara (**Nakahara (2010)** states that *Hizen* and *Osaka* swords are the most frequent swords made during the *Edo* period. One can conclude that they were produced in great quantities. To make such a large number of good swords one needs a large quantity of high carbon steel. So the advantage of using *wootz* steel becomes evident. Accordingly from this point of view, Mr. *Tsuruta Kazushige,* hypothesis makes complete sense. *Nanban tetsu* would have been easily available to the *waki-Hizen* smiths through *Deshima*.

What is *wootz* steel?

Lacking hands-on experience with forging any steel let alone *wootz* steel, the following information is derived from the literature rather than from personal experience. In some cases things were simplified in order to increase clarity and reduce technicality. The few smiths who correspond regularly will surely accept this simplification. The difference between *wootz* steel and *tatara* steel can be illustrated in the Figure 3, which was adapted partly adapted from the article by O.D. Sherby and J. Wadsworth (**Sherby (1985)**). (See **Coutinho (2008) a, b, and c**) for more information.)

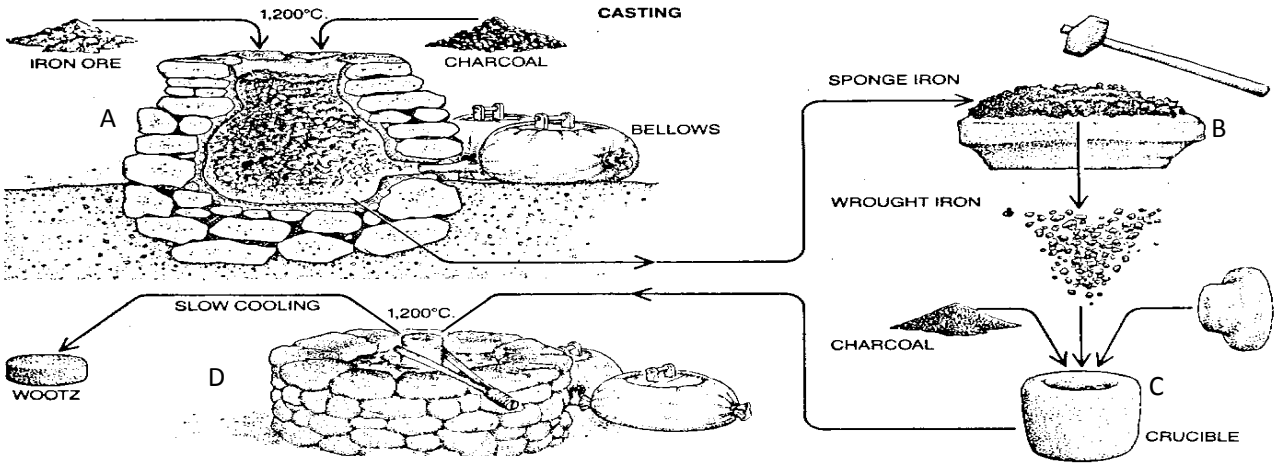

Figure 3

In the figure one can see a device labeled A. This device is called a **bloomery** in the west and a ***tatara*** in Japan. This device produces **sponge** or **bloom** steel in the west and ***tamahagane*** in Japan. This process was used almost universally. The bloom or ***tamahagane*** is a mixture of low carbon steel, high carbon steel and slag (impurities). From the ***tamahagane*** the Japanese smith must extract lumps of high carbon steel to make the outer skin of the sword. A lot of carbon is lost during the folding and welding process.

The **sponge** steel of the *tatara* stage is shown being hammered into "**wrought iron**". Wrought iron is a rather pure lump of iron welded together. The steel produced by the *tatara* (or bloomery) has pieces with high carbon content and pieces that are pure iron. The Japanese and European sword smiths had to sort the pieces and forge them in order to have steel with the desirable amount of carbon. See **Williams (2002**) for a description of the European systems and a comparison with the Japanese process.

Since the folding method can only reduce the amount of carbon, it is good to have from the very beginning a large amount of high carbon steel. This could be the main advantage of the *nanban tetsu*. So *nanban tetsu* would be nothing that cannot be replaced by hard work to obtain high carbon steel (see **Williams (2002**)). There is nothing mysterious or magic about it although the techniques of forging it are fascinating.

Consider next the **crucible**, labeled C in the diagram. This is a vase where the steel (wrought steel) with bits and pieces of carbon are heated until liquefied (see part of the Figure 3 labeled D). In this liquid state iron can absorb large quantities of carbon. The resulting steel, **crucible steel** has a high proportion of carbon (between 1% and 2%).

Extreme care is necessary at this stage. If the process goes on for too long one will end up with ***zuku*** (**cast iron or pig iron)**. This steel has 3% to 4% carbon and is almost useless for forging.

Pierre Nadeau, (**Nadeau 2011**) an apprentice swordsmith, explained in an article, a different hypothesis on Japanese steel. This information was provided to Nadeau by swordsmith *Manabe Sumihira*. According to this article there is a different method of obtaining high carbon steel that was used in Japan. Nadeau explains that the *tatara* used today by the NBTHK to produce ***tamahagane*** is called a low-furnace (*kera-oshi* method in Japan) and produces *kera* (sponge iron) that indeed contains relatively small amounts of high carbon steel. However it is possible to use a high-furnace (*zuku-oshi* method in Japan) that produces **cast iron** (also known as **pig iron**) which has very high carbon content. The difficult technique here is to lower this content, that is, to decarburize it. This is a process called ***sage*** in Japan is similar to the modern Bessemer process used in the West. It is the claim of *Manabe Sumihira,* a swordsmith, that this is the process that was used in old Japan - not the NBTHK *tatara* method used today. If he is right then *wootz* steel would be totally unnecessary for the Japanese.

Mr. Richard Furrer, a smith who specializes in *wootz*, confirmed that the *tatara* of the *zuku-oshi* type can produce high carbon steel. It is noted that Mr. Furrer gives courses on how to forge *wootz*. Here is a quote from him:

> "The tatara can indeed make high carbon steel. When I worked with *Akira Kihara*...the smelter at the *Yasakuni* shrine, when he came to the US in 2004....he made cast iron in the *tatara*.. it flowed out the tap hole. The Japanese call this "*ZUKU*" and it is used to up the carbon in blade making and also for the feed stock in casting tea pots..."*testubin*". It can also be decarburized and used in blades....just as one can take the iron from the smelt and add carbon."

The material described in the article Nadeau (**2011**) can also be found in the book by *Tamio Tsuchiko* (**Tamio 2002** page 163). This book also discusses in several other places what *zuku* (pig iron) is and how it is used (see pages 211 and 140). *Tamio* on page 187 writes concerning *nanban tetsu* that *jigane* was vital to producing *toran-ba* and that *Sukehiro* is said to have used *nanban* to obtain it. *Osaka* was the other major sword producing sword in the *Edo* period. *Tamio's* discussion of the quality of the steel in order to produce *toran-ba* is very useful. **Nakahara (2010)** explains on page 55 that "The final outcome of the *nioi-guchi* depends upon the sword itself. When it comes to the final shape of the *hamon*, the steel itself must "approve". Darcy Brockbank **(2006)** when writing about a *Sukehiro* blade wrote:

> "Sword polishers (*Kenji Mishina*) have remarked on the quality of *Sukehiro* steel as being like no other in the *Shinto* period. A sword polisher has an opportunity to touch the steel and interact with it by placing stresses during the polishing process. These tactile sensations transmit to the polisher information about the resilience and the potential brittleness of the steel. In the case of *toranba hamon*, the great amount of hardened area can cause the blade to become too brittle though very beautiful. *Sukehiro* alone was able to master the art of creating flexible steel while maintaining the peaceful majesty of the ocean waves in his *toranba*."

More controversial opinions about the role of *nanban tetsu* among the Japanese swordsmiths can be found. These opinions are part of an article entitled:"The myth of *tamahagana*" that is available on the Internet at the URL: http://www.k3.dion.ne.jp/~j-gunto/gunto_146.htm .

Looking forward

Here are some further questions raised by the doubts raised by Erich in the threads referred to above. They will be treated in detail in the other articles of this series.

First consider the scarcity of Japanese swords in Europe during the late 16th century. It is commonly accepted that Japanese swords are superior to European swords. It is known that among the swords used by Europeans civilians in the 16th was the sword-rapier. A picture of a sword-rapier is shown in Figure 1 **(Oakeshott 1980)**.

Figure 1

Drawings from the late 16th century show that Europeans walked freely in Japan armed with sword-rapiers. (See Figure 2 taken from **Osaka (1997)).**

Figure 2

The question of conflict between European swordsmen and Japanese samurai should be considered. The sword-rapier is a cut-thrust weapon **(Oakeshott 1980)**, while the katana is a slashing weapon. How would the European fare against a samurai?

Given that there was very few swords exported to Europe and almost none from Europe to Japan (there is only one example known by the author) it is interesting to describe some of the items that were exported from Japan to Europe and that until recently were not well understood. From 1641 the trade between Europe and Japan was confined to the artificial island of Island *Deshima* and conducted by the Dutch Eastern Company. This trade was heavily regulated. Were weapons part of the imported or exported cargo?

Conclusions

Fred Weissberg, a friend, wrote saying that:

> "We have to remember that all of this study on Japanese swords must be viewed as a flowing river, changing course from time to time as new information is discovered. It is not a lake with fixed boundaries."

This appears to be absolutely true. A simple issue such as the use of *nanban tetsu* in Japanese swords is subject of great controversy that can be clarified with more study. It is perhaps premature to say, for instance, that all *nanban tetsu* is full of phosphorus and therefore not useful to forge swords. *Nagayama* (**Nagayama (1997)** page 33) expresses this opinion. On the other hand *Suzuki Takuo's* (**Suzuki 2004**) scientific study of ingots of *nanban tetsu* concluded that there are both good and bad ingots. The reader could consult the book by *Tamio Tsuchiko* (**Tamio 2002 page 140)** for the differences between **wa-tetsu (**made with charcoal**)** and **yotetsu** (made with coke). I think that at least some of the old Indian *nanban* steel was made with charcoal and therefore with less impurities.

Future articles in this series will try to answer the questions that were described in the introduction and that came to mind when thinking about *nanban tetsu*.

Study of swords made with *nanban tetsu* using non-destructive tests and documents in Japan will, as Fred Weissberg suggests, allow us to follow the river.

Acknowledments
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REFERENCES

Brockbank (2006) – Darcy Brockbank http://www.nihonto.ca/sukehiro-2/

Coutinho (2009) - F.A.B.Coutinho "Namban steel and Hizen swords: a provocative hypothesis" *Newsletter of the Japanese Sword Society of the USA* Volume 41 (5) pages 7-10..

Coutinho (2008 a) - F.A.B. Coutinho "One problem and three solutions: The steel of the European, Indo-Persian and Japanese swords compared. Part 1- The European swords of the seventeen and eighteen centuries" *Newsletter of the Japanese Sword Society of the USA* Volume 40 (4) pages 7 –16.

Coutinho (2008 b) - F.A.B. Coutinho "One problem and three solutions: The steel of the European, Indo-Persian and Japanese swords compared. Part 2 - Indo-Persian swords and *wootz* steel". *Newsletter of the Japanese Sword Society of the USA.* Volume 40 (5) pages 13 –20.

Coutinho (2008 c) - F.A.B. Coutinho "One problem and three solutions: The steel of the European, Indo-Persian and Japanese swords compared Part 3 - The *hada* of Japanese swords" *Newsletter of the Japanese Sword Society of the USA* Volume 40 (6) pages 9 –18.

Hinohara (2011) - Hinohara Dai *Token Bijutsu* 652, 45-46 (2011)

Nadeau (2011) - Pierre Nadeau "Japanese swords are made of steel" Newsletter of the Japanese Canadian Cultural Centre (JCCC) Token Kai 3 14-20 (2011).

Nagayama (1997) - Kokan Nagayama *"The Connoisseurs Book of Japanese Swords"* Kodansha Tokyo 1997

Nakahara (2010) - Nobuo Nakahara **"***Facts and Fundamental of Japanese swords. A collector's guide"* Kodansha International Tokyo 2010

Oakeshott (1980) - Ewart Oakesshott "European Arms and Ar mour" Lutterworth Press Guilford and London (1980). During the sixteenth century in Europe there were four types of swords in use. They are described in page 126 of this reference. The sword shown in Figure 1 was taken from this reference is what is called a sword-rapier was the most popular type at the beginning of the century and was a cut-trust weapon. It was gradually replaced by the rapier which was a purely trust sword.

Osaka (1997) - "Hideyoshi and the culture of the Momoyama Period." This figure was taken from page 76 of this very interesting catalogue of this exhibition.

Sano (2011) - Sano Masao *Token to Rekishi* 699, 9 (2011)

Sherby (1985) - Oleg D. Sherby and Jeffery Wadsworth**,"** *Damascus Steel -Myths, Magic and Metallurgy* "The Stanford Engineer Fall/ Winter 1983-94 pages 27-37

Sherby (1985) - Oleg D. Sherby and Jeffrey Wadworth "Damascus Steel" Scientific American **253 112-120**

Suzuki (2004) - Suzuki Takuo "*Effect of Phosphorus Content of Nanban-tetsu on Forgeability of Japanese Sword Making"* Tetsu- to-Hagane 90 (1) 43-47 (2004)

Tamio (2002) - Tamio Tsuchiko "The new generation of Japanese swordsmiths" Kodansha International Tokyo and New York 2002.

Watson (1992) - H. A. Watson **"***Nihon to Koza Volume IV "* Afu Research Enterprises, Inc New Mexico. page 310

Williams (2002) - Alan Williams "*The knight and the Blast Furnace*" Brill, Leiden and Boston 2003