# Moravian 9th Century Swords

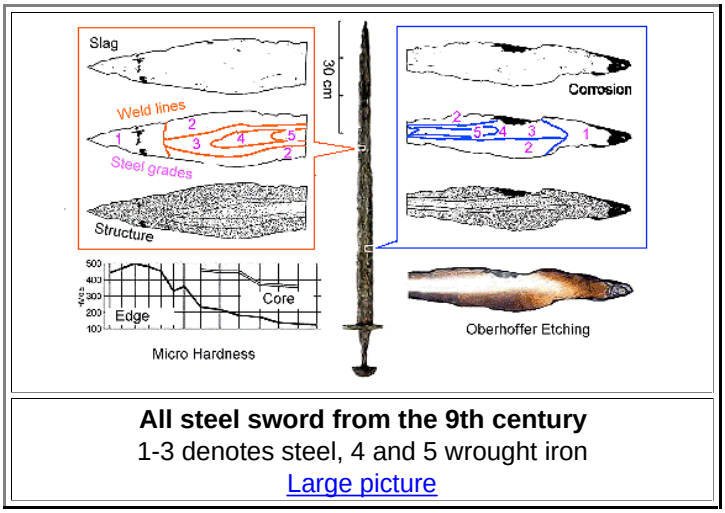
## Sword form Grave No 438

Advanced

There aren't all that many recent metallographic investigations of all-steel swords from the Viking era. The recent paper of **Jirí Hošek**, Jirí Košta, and **Patrick Bárta** is exemplary for what can be done and will be discussed here in some detail; all pictures shown here are from the paper. Some of the findings are also shown in the backbone.
The swords analyzed were found in an early medieval stronghold at the site of Mikulèice (Hodonín county) in Moravia (Czech Republic) that dates to about 830 - 900. This map shows the approximate location.

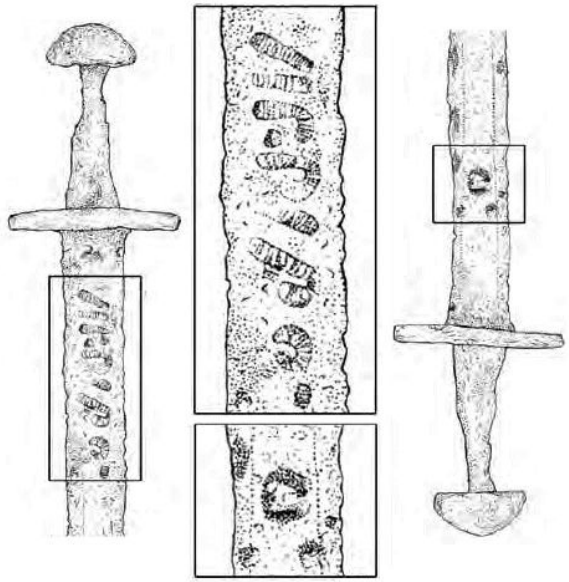
- A total of 16 swords have been discovered in graves at the site. If we take these swords to be Frankish swords, they are about the only ones that have been found in a clear context - graves! Pretty much all the ones found in the empire come from in riverbeds and thus cannot be related to anything else. The reason for this deplorable state of affairs is Christianity, which does not allow the resurrected hero to take his treasured sword (plus a wife or two and a number of slaves) along to heaven, not to mention hell. The Church top dogs also convinced people that their earthly possessions would do them far more good in the afterlife if left it to the Church in real life. You see why archaeologists by far prefer the more earthy religions.

I have already shown some pictures of the remarkable sword from grave No 438. I'll reproduce one here for easier reference:




**All steel sword from the 9th century**
1-3 denotes steel, 4 and 5 wrought iron
Large picture

- The grave itself can be dated to the middle of the third-quarter of the 9th century (meaning about 815). The occupant of the grave might have bought his sword shortly before his death or he might have inherited it from his father. The sword might thus be from around or somewhat after 850, or it might be considerably older.
  It is clear that this sword was built like the famous (but later) Japanese katanas. It was probably just as good. Not only is its composition outstanding, it is rather light but strong, as well as perfectly shaped and balanced for slashing and thrusting actions.
  The swords carries an inscription and is thus related to the "Ulfberht type" swords. Here is a rendering of the inscription:



**Inscription on Moravians swords of 9th century Frankish origin**

- Whatever that was supposed to spell, it wasn't +VLFBERH+T. We are thus are let to believe that this sword was a fake. Yet this is a very good sword, albeit not made from uniform crucible steel. It is composed of steel layers with increasing hardness towards the outside / edge. The maximum (Vickers) hardness is found around 500, rather large but not as large as it could be for a martensitic structure.The hardness together with the bainitic structure actually found testifies to an extremely well controlled quench hardening process. The sword was either fully quenched and then annealed to take off the extreme brittleness, or "slag quenched"; i.e. held for a specific and not too long time in the cold quenching fluid that allowed the edges to cool down sufficiently rapidly to low temperature as needed for martensite formation, but left the interior hot enough to allow re-heating of the edges after removal from the quenching liquid.

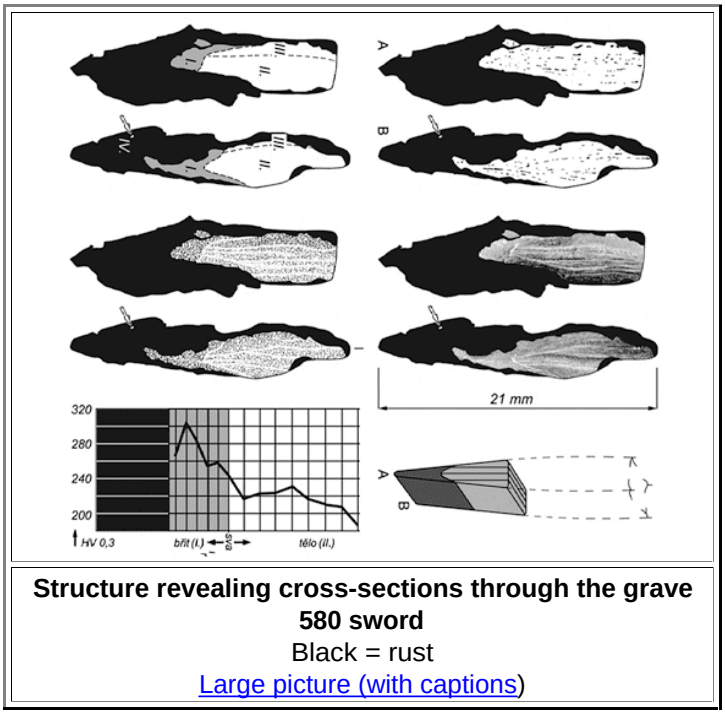
What the authors failed to do is to assess if faggoting was used to homogenize the blade materials. Their reason for this oversight is obvious: you just can do the required investigation with only two small samples. Since it doesn't make much sense to forge a blade from inhomogeneous long steel sheets, and considering that the smith obviously knew how to select "just right" materials for the various parts of the sword, we may safely assume that faggoting was employed. It remains to be demonstrated, however, e.g. by following Stefan Maeder's lead.

## Sword form Grave No 580

A related and somewhat earlier paper[1)] of Jirí Hošek and Jirí Košta complements the analysis from above, as does this paper (and probably many more that I haven't found yet; talk about publishing in obscure journals!). Here they look at a sword from the same burial place - grave No. 580 - and likely a little older; it dates to the early 9th century. The owner must have been ranked very high among the Great Moravian nobility. He owned an all-steel sword and a *pattern welded sax* (the authors call it "war-knife") that were definitely not produced by local Great Moravian craftsmen. He also owned a war axe, and plenty of other precious things; the fitting of the two scabbards and so on contained silver pieces.
Unfortunately the sword and the sax are heavily corroded. Nevertheless, several interesting features were found upon a metallographic analysis of the remains (including X-ray pictures).

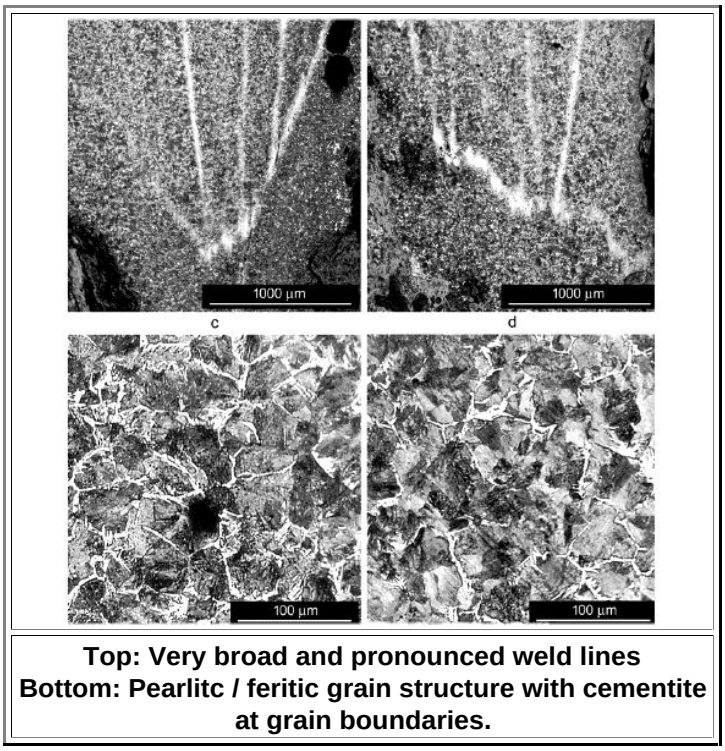
- The sword sported an inlaid symbol (only visible with X-rays), done in a non-ferrous metal; sort of a cross inside a circle.
- It is build similar to the one above but is un an advanced state of corrosion

Here is an only slightly edited picture from the publication:




**Structure revealing cross-sections through the grave 580 sword**
Black = rust
Large picture (with captions)

The blade has a piled steel core with welded-on steel cutting edges. Most of the edge has been destroyed by corrosion; the little pieces left suggest rather rapid cooling. The core consists of several layers and contains just a little less carbon than the cutting edges. The sword, in other words, is of very good or even excellent quality just as its brethren above.
No let's look at close ups of the especially interesting feature: the white weld lines and the structure in the steel core:




**Top: Very broad and pronounced weld lines**
**Bottom: Pearlitc / feritic grain structure with cementite at grain boundaries.**

The (white) weld lines are very pronounced - they must be about 30 µm - 100 µm wide, to judge by the scale provided. They also contain 1 % nickel (Ni) as found by an an EDX analysis. The authors do not belabor this point but I think it is significant in view of the not-so-clear fire welding technique. If you read this Hyperscript very, very carefully *and* have a perfect memory, you realize that this has came up before. You also realize in reading this right now, that we certainly don't know very well how exactly fire welding was done thousand and some years ago.

- The structure in the lower half is described as a "pearlitic-ferritic structure in the core". That is certainly true but there is also plenty of cementite at the grain boundaries. This simply attests to a rather high carbon level in the core, implying an even higher one in the no longer existing edges.
  The authors have reasons to believe that the blade was not only quench-hardened but that this was done in a "differential" way. The tip-near regions were made harder then the hilt-near regions; something that makes a lot of sense and has been found in other (later) swords as well.

Once more: we have an excellent sword that was a match for everything made elsewhere or much later - and I include Japanese swords and crucible / wootz swords here.
Once more I also point out that the forging techniques could not possible be improved upon any more; the smiths of old were probably better than our present day ones because the knew a number of tricks now forgotten and not yet recovered. Improvements can only come from better raw materials.

---

1) Jirí Hošek and Jirí Košta: "METALLOGRAPHY OF THE 9th CENTURY SWORD OF A GREAT MORAVIAN NOBLEMAN BURIED IN MIKULÈICE (GRAVE No.580)", Association of Metallurgical Engineers of Serbia Scientific paper AME, ???, p. 199 - 206