Creation of a Seax

From start to finish

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The Smelting of the Ore

The first step in this process is to gather ore. I found an iron mine in the North West corner of CT where I was able to collect it from the ground outside of an abandoned iron mine.

The second step is to roast the ore, this transforms the ore from hematite to magnetite. This transformation happens around 500°F. The roasting can be done in a normal camp fire and prepares the ore for smelting. The roasted ore is slowly added to a smelting furnace along with charcoal. An important part of the smelting process is the height and angle of the twiere in the furnace. This is where air is forced into the fire. In period this would be done with a set of bellows, which would be operated by an apprentice. I used the exhaust from a vacuum cleaner. The height and angle of the twiere will dictate whether you get iron or steel from the smelt.

Smelting furnace

The bloom that is removed from the bottom of the furnace is a very porous thing and needs to be condensed. Pieces of the bloom are forged down at a high temperature to ensure that it bonds into a solid material. These bars are layered to refine the material. A difficulty that I ran into in my first attempt to consolidate a part of the bloom was severe grain growth within the crystalline structures of the iron. This makes the material very brittle, a pour metal to work with, and all in all not a good material for the making of knives. I attempted heat cycling in order to normalize the material, but that had no real effect. I ended up starting over with a different part of the bloom and by using less heat I was able to forge out a successful bar.

This material will need to be run through an Aristotle furnace, being re-melted and carbonized, in a process very similar to the smelting. Wrought iron is placed vertically in the furnace which is packed with charcoal. As the fire burns it melts the wrought iron bar and it slowly drops to the bottom of the furnace. The iron picks up carbon from the charcoal and becomes wrought steel.

Layering of the Steel

At this stage the wrought iron and wrought steel are layered together, and forge welded into one bar. Historically this is not necessarily done with just two type of ferrous alloys. A late British Iron Age sword from Walthon Abbey, for example, was forge welded from at least 24 separate layers with different carbon contents. (Lange 1984) For the making of swords, spears, and seaxs, all the bars that make up the core are generally twisted before being stacked together and forged into the final bar that the blade will be made from. In the third C AD, the twisting became more complicated and true patter-welding could be said to have started (Hawkes 1989)

After the third century there are all manner of different types of twists and different numbers of bars used in this process. Since for this project I was making a seax, I used two bars twisted in opposite directions to make the spine, and then a piece of wrought steel for the edge. There seems to be no obvious connection between any particular shape of seax blade and any of the various arrangements of the

Alternating stack of wrought iron and wrought steel

pattern welded bars. (Hawkes 1989) Once these where forge welded into a bar, I used a cut-off tool to trim the angle for the clip on the back edge of the tip of the blade. If the tip was forged in, the pattern of the twisted bars would be distorted and taper down to the point of the blade. By looking at the patterns in historical finds, it is clear that the practice was to cut the piece off.

Forging of the Blade

Now the blade needs to be forged out. Seaxs have an edge to back bevel. This means that the cross section of the blade is a long triangle from the spine to the edge. The tang also needs to be forged out, this is the part of the knife that goes into the handle. After going though so much to get to this stage, the shaping of the seax goes quickly; these shapes are very straight forward to make.

Now that the blade is forged, it needs to be cleaned up. In period this would have been done with files and stones. In an effort to save time, I used belt grinders and sand paper. This part of the process allows the smith to refine the shape of the blade and polish the surface. If the blade is finely polished the different layers of the iron and steel. I brushed a bit of nitric acid onto the blade to bring out the pattern. It is unclear if anything was done historically to make the pattern more visible.

Alloying of the Bronze Guard

Now that the blade is done, it is time to make a handle. It is an uncommon thing for a seax to have anything more than some sort of organic material for a handle. However, for this project I decided that I wanted to add some bronze to the mix.

There are many types of bronze. The one that I have most experience with is silicon bronze. This is made up of 95% copper and 5% silicon. One of the things that I enjoy about working with this material is that you are able to forge it hot, and weld it with modern TIG welding equipment.

This makes it extraordinarily easy to work with. However, for this project I wanted to use a more historically accurate material, so I decided to go with a tin bronze. Tin bronze can range from 10%-15% tin, commonly 12%-14%. For this project I decided to go with 12%, so that is what I made.

It is important to note that copper and tin have vastly different melting temperatures. Tin will melt at 450°F and copper melts around 2000°F. If you where to put both materials in a crucible and turn on your furnace, you would burn most of your tin before your copper began to melt. This means that the copper must be made molten before the tin is dropped in.

Also important at this point is to preheat the tin. If the tin is cold when it goes in it will form a layer of condensation when it hits the hot environment, and if that water gets into the molten copper you could have a steam explosion, which is no good for anyone. Once the tin is in the copper the alloying is quite quick. I had left it for one minute before pouring the bronze out into an ingot mold.

Once the bronze is in ingot form, I cold forged it down to the size that I had wanted for the spacer between the handle and blade. Then, using drills files

The process of making the alloy bronze

and scrappers, I made a hole in the bronze so that the blade would slide in and nest nicely into the bronze. As a way to add a decorative element to the top the of bronze, and also help tighten up my fit up with the blade, I used a ball-peen hammer to add texture. Once this was fit up nicely, I used a chisel to put a decorative line around the top edge of the bolster.

Carving of the Handle

For the handle proper I used a piece of moose antler. Normally I would use high speed rotary tools to do my carving, but for this project I just used chisels and scribes. I laid out a grid so that the knot work would be even on both sides.

At this point I chiseled in my outline and then began to carve away the back ground. The most important thing in this it to have crisply defined lined, this being said I try to keep good hard corners to define my shapes.

Once the carving is done the next step is drilling a hole and using scrappers and files to make sure the tang will fit into the handle, and that the bolster will fit nicely with the handle.

The carved moose antler.

The Assembled Seax

The final step is to assemble handle onto the tang. Seax tangs are never found with any holes or notches cut into them, this leads to the conclusion that they were all glued together. In period this would have been done with hide glue, but since I didn't have hide glue, the best option was to use 5 minute epoxy.

This project illustrated to me the efforts needed to create a blade with historically accurate materials. It was a very labor intensive project, even with the use of the modern tools I have at my disposal. Although it was time consuming and difficult, it is the thing that I would like to do again so that I can refine the process more and hopefully next time make a larger blade, with a more intricate pattern.

The finished piece.

References

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The Exploration of Historical Pattern Welding with Modern Steels

In the creation of these blades, I used modern steels. I chose 1084, which is a high carbon steel that becomes very dark after etching. The second steel I chose for this project is 15N20, which contains a high amount of nickel, which resists etching and stay bright in the pattern. The high contrast patterns that I achieved in these blades cannot be obtained with historic materials. By using these high contrasting materials, it really shows off the traditional pattern welding done to create these blades. It is unknown if Viking and Saxon blades were etched in any way to reveal the patterns created in the elaborate assembly of the steels. However, in this project I am looking to accentuate the details created in the swords and seaxs of the Viking Era.

The Saxon Sword

In the making of this blade I started by making an eleven layer billet. Five layers were made of 15N20 and six layers of 1084. After forge welding these together, I drew it out into four long square bars, about 1/2" thick. These bars were then twisted tightly, two to the right and two to the left. When these bars are place side by side, alternating between right twist and left twist, it creates a herringbone patter. This can be made with two, three, or four bar. I used four bars for the core of this sword.

To make the edge bar I created a twelve layer billet, half of 1084 and half 15N20, and re-stacked it six times to make a seventy–two layer stack. When looking at historical pieces you can see that the edge bar goes from one edge around the tip of the sword and back to the other edge. There are two ways to achieve this. One is to wrap the edge bar completely around the core, and the other is to cut the edge bar into two pieces and stack it on either side of the core. In order to make the bar connect at the tip, a wedge is cut out of the tip and then that gap is forge welded closed. This will weld the edge bar together at the tip so that the pattern continues all the way around the core. This is the method that I used.

Once the forge welding was complete, I began forging in my edge bevels. Traditionally the fuller down the center of the blade is forged in, however I elected to grind it in with an 8" wheel on a belt grinder. Now that the profile and shape of the blade is complete, it is polished by hand to 800 grit and etched in ferric chloride to show the pattern.

Wolf Tooth Seax

The wolf tooth pattern is a type of pattern welding that is only found on seaxs and spears. Unlike many of the other pattern welding that is commonly found, it is never present on swords. To create this, I started with a two bar herringbone pattern of 1084 and 15N20 and added a bar of 1084 to one side. Once these were forged welded together, I let the bar cool and then with a file cut my wolf's teeth into the 1084. It was then my intention to forge a hot bar of high layer 15N20 and 1084 down onto the wolf's teeth so that it would conform to the spiky pattern. However, after several heats of this and making very little progress I ended up tacking them together with a TIG welder and putting the whole thing into the forge and hammering it down this way. This method worked in getting the bars to weld together, however I lost quite a bit of the pointyness of my wolf's teeth. What I have taken away from this experience is to cut shallower teeth the next time a try this type of patterning again.