Metal Casting in the Viking Age

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M E 401

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26 JUL 2012

The Vikings are a fascinating people. Living in Scandanavia from the 8th through 11th centuries, the Viking legacy lives on in modern history texts as the Viking Age. Much of Viking history has been romanticized to depict stories of fearless seafarers, fierce raiding parties, and a hearty people living in a harsh climate few others would have dared to try to live in. Because of this romanticization it is sometimes difficult to delineate between fact and fiction. Not to say that modern depictions of Vikings are completely false, but the most authoritative information available to us is based off of archaeological findings. Luckily, because metal casting produces resilient artifacts, we are able to glean quite a bit of knowledge about what they must have known about metal casting.

By the time Vikings began working metal, the Bronze Age was long past by about 2000 years. Despite the technology being antiquated, the Vikings were able to produce ornate jewelry, effective tools, and deadly weapons that served well for their crafters. The Vikings lived, traveled, and traded during the Iron Age so clearly they were not ignorant about other metal casting techniques available. It is important to note, however, that Scandanavia entered the Bronze Age late compared to the rest of Europe and bronze casting became a social tradition. Even though they worked in iron they did not abandon bronze. There are practical reasons for doing so. One likely reason that Vikings chose to continue bronzework is that the furnace did not have to be as hot as an iron working furnace. Another possibility is that while work hardening was probably barely understood by Viking metal casters, bronze has the ability to quickly work harden under impact. This would lead to finished products which were more than effective0. One last reason Viking bronze was not seen as inferior is that from a technical viewpoint it was actually brass (which boasts more desirable properties in terms of strength and resilience). Most recovered Viking artifacts are found to be made from an alloy of primarily copper and zinc. Small amounts of tin and lead are typically found depending on the exact era of production, but the recovered artifacts are classified as brass by modern day metallurgists. Brass is a much easier metal to work with during pouring due to its lower viscosity. This report uses the word bronze out of convention but no mistake should be made concerning the true composition of this “bronze”.

The heart of the metal caster's work was his hearth. This is akin to the modern day furnace. The fuel of choice was charcoal. More sophisticated types of fuel simply weren't available, but also weren't necessary. Typical Viking hearths were rather small. Using a modern perspective this makes sense as the metal caster would want to concentrate as much heat as possible in as small an area as possible. Castings of the Viking Age seldom exceed 40-50 cubic centimeters, so small hearths were very appropriate. The design was simple; commonly being just holes in the ground lined with clay. A primitive nozzle was placed somewhere along the wall to allow the bellows to deliver their air to the fire.

One key piece of technology in this process was that of the bellows. Because the fires of the furnace were in a pit, the bellows supplied a source of air. Constructed of leather each bellow was a pair of bags that could be pumped in an alternating style to keep a continual stream of air fueling the flames. Taking from runic carvings it is believed that a typical bellows was about 0.4 meters long and 0.2 meters wide. Replica models have been made. Reportedly, using the aforementioned dimensions with a "steady" and "laid-back" pumping, one can cause the fires to reach 1200 degrees Celsius and melt a crucible of bronze in 15 minutes.

The Vikings did not have access to the same materials that modern metal casters do, so crucibles were made of a clay-sand mixture. Experimental archaeologists have also tried other materials in the mix including water and animal dung in various proportions though authentic recipes have not been uncovered. There seems to be disparity in the archaeological community concerning the lifespan of traditional crucibles. Some argue that the crucible would only last one casting while others feel a well-made crucible would survive up to a dozen castings. The shape of the crucible was formed by spreading the desired crucible mixture over the end of a wooden pole of desired size/shape. In use, the biggest problem facing the metal caster was a delicate balancing act between having his hearth hot enough to melt the metal but not so hot as to melt the crucible. Typically clay does not melt at 1100 degrees, but the charcoal used as fuel contained fluxing compounds (like natrium and potassium) which drastically lower the melting point of clay. One way the casters combated this problem was by adding quartz sand to the mix. This helped in raising the effective melting temperature. Even with this measure it took

skill and attention to prevent the bottom of the crucible from bursting and spilling all the molten metal into the hearth.

Concerning the molds used by Viking metal casters there is still some debate about the techniques used, but most agree the Vikings employed both lost wax and stone mold investment casting techniques depending on the application.

Viking jewelry has a style and charm of its own. It often boasts intricate ornamentation with delicate structure. This could be achieved from lost wax casting methods. This would also allow each piece of jewelry to be unique giving it greater value to the owner. Molds were made out of a clay mixture, likely the same as used in crucibles. Viking molds rarely featured venting of any kind. While this might make the modern metal caster cringe at the thought, the bronze being poured was sufficiently low in viscosity that the mold could vent itself while still rendering beautiful, accurate detail. Molds were usually pre-heated in the hearth next to the crucible. This would help slow the heat transfer resulting in better castings.

One of the more correct aspects about the myth of Vikings is that of their warlike nature. With this war tradition came characteristic weapons to wage battle. Being primarily melee combatants, Vikings made heavy use of three weapons in combat: the axe, the spear/javelin, and the sword. With the casting technology of the time the Viking casters could make lethal, yet beautiful, weapons.

Bronze axe heads and spear heads have been recovered demonstrating their favor in the Viking world. Many believe the axe and spear were the primary weapon of a Viking warrior because they were easy to mass produce. Both require less metal than a sword, less skill to craft (not to take away from the difficulty of casting in the first place), and deliver large amounts of damage with each strike (an axe because of the concentrated energy and spear due to concentrated piercing force). Typical axe heads were between 10 and 20 cm long and had either utilitarian or combat designs indicating that the metal casters understood the basics of modifying tools based on application. Techniques for casting weapons (or utilitarian tools for that matter) were likely investment casting out of stone molds. The benefit to this technique is the ability to reuse the mold for however many pieces need to be produced.

In many cultures the sword is considered the pinnacle of weaponry. Any culture's weapon smiths take great pride in producing that culture's variant of the sword. Vikings were no different. A typical Viking sword was about half a meter long. The blade ran the entire length of the weapon in such a way that the handle was simply riveted on. One of the unique things about Viking sword making is that the edge of the blade was forged into the sword. This was a tricky process but imparted a much more resilient edge. As with Viking jewelry the molds were preheated which imparted a better crystal structure to the blade. Pouring the sword was done from one end though the preference of which side appears to have switched. It began with pouring from the point end, but later switched to pouring from the handle end of the mold. This illustrates the basic engineering idea of trying something new and seeing if it works better. The benefits of pouring from the handle side are more uniform cooling in the blade resulting in a better finished product.

Studying the methods of Viking metal casting and its evolution is a fascinating endeavor. It leads one to conclude that the Viking metal casters were a skilled group who looked for ways to improve their craft where they could. It also offers a glimpse into the ingenuity found in historical engineering and gives a chance to apply lessons that were learned long ago.

References

All of the material presented in this report came from one or more of the following sources:

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