Bronze Signet Ring

February – March 2003

Summary

Signet rings are a well-known medieval accessory. They originate in Roman times, and saw a resurgence after the invention of heraldry in the 13th Century. This signet ring, which depicts my arms, would be acceptable in a wide range of places and times during the Medieval period.

I have long wanted to make a signet ring. I recently obtained both the knowledge and the materials to attempt it. I sand-cast the ring, using a 3-part sand mold, by making a pewter ring blank (a signet ring with no signet). Then, I used wax to create a signet on the pewter blank and cast a bronze signet ring from that, again using a 3-part mold. This was my first casting project that used 3-part molds, and I learned a lot doing it.

Historical Documentation

Cast Rings

The ring shown to the right is from Viking Age York (Hall 103). It is a bezel-type ring with a zoomorphic design cast into the bezel, and its basic form was the inspiration for the entry. The generally rough surface of the ring suggests that it may have been sand-cast, rather than cast in a clay mold.

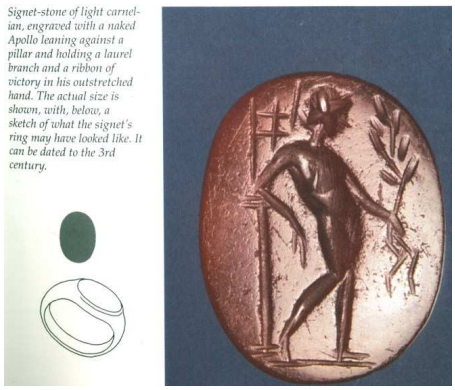
The ring shown to the right is WOV 4434, a silver ring from a hoard in Sweden. It has unusually detailed decoration. The way the decoration blends together, as far as I can tell from the photo, suggests that the ring was cast, not fabricated, probably in a clay mold due to the amazing level of detail achieved.

Signets

The four gemstones shown to the right are from Ribe, dated to the Roman Age (Jensen 19). These gemstones are carved with seals or signets of various types, and likely made their way to Ribe as trade items. The patterns carved into them are clearly in reverse, and thus designed to form an

impression in soft material such as wax. These signets are carved in a technique called intaglio (Newman), which could be described as the reverse of relief carving, and the impression they leave in wax, being the reverse of the stone, is similar to a relief carving.

To the right is a close-up of one of the signet-stones from Ribe (Jensen 19), along with a drawing of what the Roman signet ring may have looked like. This signet stone is dated to the 3rd Century.



Roman signet rings were ornate, such as these examples with carved gemstones (Newman). Anglo-Saxon signet rings were somewhat more crude (ibid). Decorated signet rings came back into use in Medieval Europe, particularly after the invention of heraldry (ibid).

Bronze Casting

The archeological evidence for metal casting in medieval Europe is extensive. However, some question remains as to whether medieval craftsmen employed sand casting, or exclusively used fired clay molds.

Evidence of casting in hard-clay molds is widespread. At the museum in Ribe, I saw hundreds of clay molds that had been pieced back together, some of which are shown in the photo to the right. These reassembled mold fragments showed that the craftsmen of Ribe could cast metal in many types of tools and jewelry.

Traces of metal in clay crucibles, used to melt the metal for pouring, found at Ribe show traces of bronze, brass, lead, silver, and gold (Jensen 31).

The archeological digs at the Coppergate site in York, England, dated to Viking Age, also provide information about clay casting. These included many crucibles, ingot molds, and cupels (Bayley, 799). The crucibles show evidence of being used to melt all manner of copper alloys (Bayley 803), including brass and bronze, as well as silver (Bayley 799).

The mold fragments at Ribe show that craftsmen at that location routinely cast a variety of objects, rather than specializing in keys, brooches, and so on (Jensen 33). A wide variety of copper-alloy items were also found in York, including strap-ends, buckles, brooches, and finger-rings (Hall 103-105).

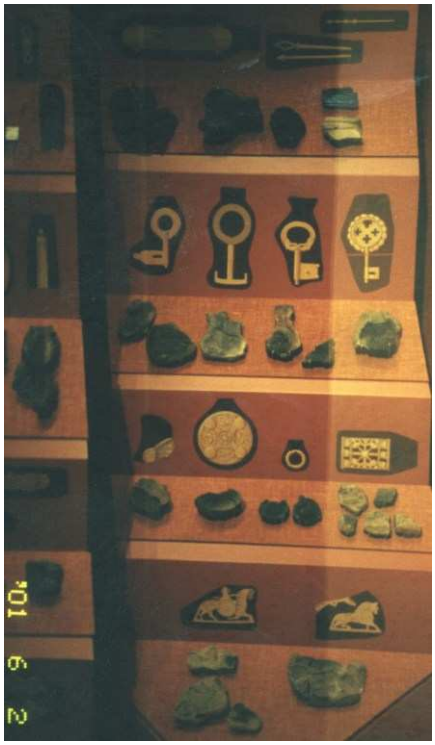


photo by Isabel Ulfsdottir

The process of clay casting is, in theory, simple. A "master," or original, is carved from wax, including a wax sprue or gate to pour the metal. This master is carefully packed in clay, which is fired to pour out the melted wax and harden the clay. While the molds are hot, the metal can be melted in a clay crucible and poured in. Finally, when the casting has cooled, the clay mold can be broken apart to free the metal item for finishing (Theophilus, 106). Clay mold casting can create nearly any shape including intricate shapes with undercuts, but requires one wax master for each item cast.

The use of the sand casting technique is more difficult to prove, because a mix of fine sand and clay is not recognizable in an archeological dig as a casting component. However, sand casting produces a rougher surface on an unfinished piece than clay mold casting. A sand-cast piece has tiny pits and bumps which, in my own experiments with clay versus sand casting, do not occur with a fired clay mold. Some artifacts show this type of bumpy surface and could, therefore, have been cast in sand.

Sand casting is documented by Biringuccio in the 16th Century (324-328), but Theophilus in the 12th Century makes no mention of it. I have not been able to prove any earlier dates when it was used. The technology of metalworking is believed to have changed little during the Middle Ages. The main advances during that time were in the use of chemicals for parting, assaying, and pigments (Agricola 354). It is at least possible that an item could be sand-cast earlier than the 16th Century.

Sand casting is different from clay casting, in that the mold is made from two halves of packed sand, mounted in frames that fit together. One half of the mold is packed and dusted with powder to prevent it from sticking to the master or the other half of the mold. The original is pressed into the mold and dusted again. Then, the second frame is set in place and the second half of the mold is packed down, around the master model. Finally, the two halves are pulled apart to extract the master and cut sprue, gates, and vents. Sand casting can create any shape that does not have undercuts, can make many castings from the same master model, and usually requires more finishing work because of the parting line left between the mold halves. However, the effort of packing the sand can gradually damage the master.

In either case, it is believed that the mold masters were usually made from wax originals, because beeswax was readily available, easy to carve, and has an advantage over wood or bone in that its lack of grain makes detailed carving easier. A copy of the wax master, of clay, lead alloy, or other durable material, was usually made as a basis for future castings (Jensen 33). Such a lead master could be used with clay to mold wax masters for clay molds, or directly in sand-casting.

Finishing

Finishing jewelry consists of shaping, smoothing, and polishing. There were many abrasives available in period, chosen by their availability and relative effectiveness on the material being worked. Theophilus describes the process of shaping with a flat hone (102) or flat sandstone (189). He describes a variety of files (93) and wire brushes (86) for shaping and smoothing harder metals such as brass and bronze. He describes smoothing as done with a piece of oak covered in ground charcoal (102) or fine sand and cloth (152). He describes polishing with a cloth covered in chalk (102) or

powdered clay tiles and water (128), or saliva-moistened shale followed by ear wax (115). Biringuccio describes shaping as done with files, smoothing with cane dipped in powdered pumice (366) or sand and water (390), and polishing using tripoli powder (366, 374), or a wheel of copper or lead coated with powdered gems (122), emery (123), or lime (372).

Materials and Tools

I used bronze for this project, because it is affordable, has a beautiful appearance, and has unique properties that make it just as challenging as silver or brass. This particular formulation of bronze is so beautiful that I showed this ring to a professional jeweler who is teaching me, and he asked, "Is this gold?" I purchased the bronze from a jewelry supply outlet, because I lack the necessary experience to safely alloy my own bronze. I made the original ring blank model from my wedding ring (because it fits my finger), beeswax, and an oval bezel cup I had lying around. Beeswax is cheaper than modern formulated carving wax, likely to be the wax used in period for making casting models, and is fairly easy to mold and carve.

The tools needed are:

- Carving tools to carve the original or "master" model (I made some from 10-guage wire)
- Casting sand, talcum powder, mold frame, and palette knife, to make the molds
- Crucible with tongs and a heat source that can keep the crucible at 2000° F
- Fire extinguisher, fire-resistant apron, and safety glasses
- Brass, bronze, pewter, or silver raw material, and flux (boric acid crystals)
- Graphite spoon and/or rod for stirring molten metal in the crucible
- Oven or kiln with controllable temperature capable of 300° F
- Wooden dowel the diameter of the ring size
- Short pipe with an inside diameter equal to the ring size (as close as you can get)
- Wire cutters or jeweler's saw to remove the sprue and vents
- Tools to file and polish the cast piece
- Dust filter mask for polishing
- Heavy welding-type insulated gloves for handling crucible tongs, hot molds, and metal
- Light leather gloves for holding items while grinding and polishing

Method of Construction

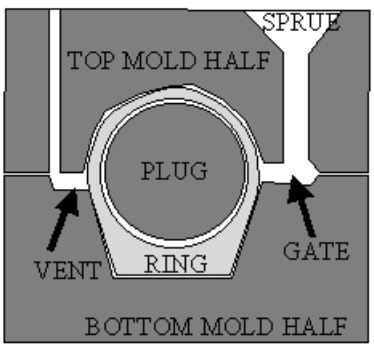
Making the Model

I used the wax to stick the bezel cup to the wedding ring, and to build up the bezel area of the ring to the shape I desired. I used this master to cast a pewter ring blank, that is, a ring with no signet. After shaping and polishing this blank, I used wax to build up the signet on it, which then became the master for casting the signet ring. Once the pewter blank was made, I melted the wax on the original master to recover my wedding ring. Thus, I actually went through the entire casting procedure twice, but this was worth the effort because I now have a pewter ring blank that I can use to make signets of different design in the future.

Preparing the Mold

Put the flat side of the mold frame on the bench, fill it with sand, and pack it down firmly, but not hard. Turn it over and powder it with talc. Put the dowel through the ring blank and, with the signet side down, push it firmly into the mold. If it does not go all the way, you can slice away sand from the back of the mold frame to make more room for the sand to pack. Push the ring blank into the mold so that exactly half the dowel’s diameter is buried, and so that the sand's pattern of the ring blank is smooth, and the sand is packed down hard. This is difficult to do.

Put the second mold frame in place. Powder the master a bit, and sift the sand over it. Once the ring is covered with a layer of finely crumbled sand half an inch thick, fill the frame with sand and pack it down. Separate the halves and carefully remove the original and dowel. Pack the pipe with sand to create a sand plug the exact same diameter as the dowel. With a palette knife carve a sprue channel into the sand, use a nail or small dowel to make a gate in one side and a vent in the other, and with a thin wire poke a vent opposite the sprue. Gently tip any loose sand out of the mold and insert the sand plug. The diagram shows a cross-section of how the completed mold should look. Put the mold halves together and set the mold up to pour.



Melting and Pouring

Heat the metal in the crucible, using a kiln, oven, or torch. Silver, brass, or bronze should be heated to about 2000° F; it will have a "sheen" on the top and glow orange when the metal is above its "flow" point. Pewter can be heated to about 600° F. Most metals develop an oxide crust on top which you should scrape away. With any metal, it is ready to pour when it reaches "flow" temperature, that is it should be as liquid as water or mercury. If the temperature is too low, the metal will not flow properly and may not enter all the recesses of the mold. If the metal is too hot, it may oxidize or implode by cooling unevenly. When the metal is at or slightly above flow temperature, pour it into the mold. Pour it all in one smooth motion into the sprue channel, taking only about one second to do so. This takes practice to do well.

After the visible top of the sprue cools to a darker color, carefully separate the mold halves, take out the casting (it will still be very hot), and tap the sprue on the bench to remove the burned sand. Then, polish the casting a bit to see if the pattern came out well. If it did not, you can melt it down and try again. If it came out well, cut off the vent and sprue with the saw or wire cutters.

Finishing

The pipe I used to make the plug was a bit too small, and I did not forsee the amount the metal would shrink as it cooled, so I had to do a lot of filing on the inside of the ring to bring it to the proper size and thickness. While it is possible to size a ring by annealing and stretching it, I have neither the knowledge nor equipment for this, so I had to file it. I used half-round hand files and a Dremel-size coarse sandpaper drum, held in a drill press, for this process. I also used a fine sandpaper drum to smooth out the sides of the bezel area (where the ring meets the signet). I shaped certain easy-to-reach areas, such as the signet surface, gate and vent connections, and edges of the bezel, with a 600-grit belt sander.

Bronze is fairly hard, so I was able to polish it quite well with a fine wire brush wheel followed by a medium buffing wheel with the black polishing compound. I tried using a succession of the white, black, blue, and green polishing wheels and the result was only slightly better that the wire brush and buffing wheels, though these high-tech polishers are excellent on brass, pewter, and silver. While such polishing wheels are designed for a handpiece or Dremel tool, I use them in my drill press at a slow speed (1100 rpm) with very good results.

If desired, you can accent the design by filling the recesses with niello or enamel, use acid to darken it, or age and surface-polish the item. I decided that the roughness of the unpolished indentions contrasted nicely with the polished raised portions of the signet, and no further accent of the design was needed.

Lessons Learned

This was my first project that used a 3-part sand mold. My first attempt failed because the gate was too small. Getting the metal to flow down into the signet was no problem, but getting it to flow all the way around the ring and reach the vent was the challenge. Making the gate larger solved the problem. Since my heraldry is based on white, not yellow, I will probably cast another signet ring from sterling silver when I can afford to do so.

It took 30 minutes to build the ring master. Time to carve the signet will vary according to its complexity; mine is simple and took 15 minutes. It took 45 minutes to build a 3-part mold, and 2 hours to shape and polish the ring. Because I cast two rings, the blank and the signet ring, the entire project took about 7 hours, not including the failed casting.

Bibliography

Agricola, Georgius, trans. Herbert & Lou Hoover, De Re Metallica, Dover Publications, NY, 1950, ISBN 0-486-60006-8. This book covers the 16th-century techniques of metallurgy, including the technological, legal, and safety aspects of surveying, timbering, mining, refining, smelting, alchemy, and the other tools and techniques required to locate ore and turn it into usable metals. It provides excellent background technological information for any metalworker.

Bayley, Justine, N*on-Ferrous Metalworking from Coppergate*, from The Archeology of York, Vol 17 The Small Finds, Fasc. 7 Craft, Industry and Everyday Life, Council for British Archeology, York, 2000. ISBN 1.872414.30.3. This small book in the Archeology of York series focuses on the evidence for gold, silver, copper, lead, tin, and alloy crafts from the Coppergate site in York. Most of the evidence is for the tools and methods of parting and refining these metals.

Biringuccio, Vannoccio, trans. Cyril Smith and Marth Grundi, Pirotechnia, Dover Books, New York, 1959, ISBN 0-486-26134-4. This translation of a sixteenth-century work on metals and metalworking contains a great deal of information on metallurgy and casting, but is useful for other branches of metalworking as well.

Hall, Richard, The Viking Dig: The Excavations at York, Bodley Head, London, 1984, ISBN 0-370-30802-6. This book provides an excellent overview of the excavations of York, covering a time period from the Iron Age up to Medieval times. It focuses on the history of the town, as told by the artifacts found. It provides documentation for a wide variety of crafts.

Newman, Harold, An Illustrated Dictionary of Jewelry, Thames and Hudson, London, 1991, ISBN 0-500-27452-5. This book is exactly what the title claims, and is a great resource for jewelers of all time periods.

Jensen, Stig, The Vikings of Ribe, Den antikvariske Samling, Ribe 1991, ISBN 87-982336-6-1. This book provides an excellent overview of the excavations of Viking Age Ribe, the artifacts found, and what it all means, with emphasis on trade, crafts, religion, and the town's history.

Theophilus, trans. John Hawthorne and Cyril Smith, On Divers Arts, Dover Books, New York, 1979, ISBN 0-486-23784-2. This translation of an early twelfth-century treatise on painting, glassworking, and metalwork is one of the foremost period sources for researchers of these arts.

York Archaeological Trust and the National Museum of Denmark, The World of the Vikings (CD-ROM), Past Forward Limited, undated. This CD contains thousands of photos of artifacts, but the photos are described only as the item, the place it was found, the museum where it is located, and sometimes the date the item was originally buried.

Back to Danr's A&S page.