A Craftsman's Perspective on the St. Ninian's Isle Treasure

Stephen Walker

An appreciation for the wonderful design and craftsmanship of early medieval Insular jewelry and metalwork was a powerful motivation for me to pursue a career as a craftsman. Like most modern metalsmiths who have been inspired by the "Celtic" style, I used the techniques of manufacture that are common to other craftsmen of my own era. Examination of the original medieval material clearly shows that certain techniques have been lost. The *kerbschni*tt or chip-carving style of producing relief patterns of interlace designs is one of these. The methods suggested by the available scholarly literature are all plausible, but trial and experience casts doubt on some of the suggested methods. Modern imitations typically fail to get the background space evenly faceted and to accomplish the even and fluid line control of the foreground. It seems that there must be some missing secret to how this once common technique was executed.

1. St. Ninian's Isle bowl no. 6. Silver punch work with gilt mount set with red enamel. Diameter 143 mm. The interlace casting of the mount is somewhat unique in that it is a variation on the negative chip-carving technique with open space between the ribbons and riveted over a separate background plate. Photo NMS.

The paper that follows traces how examination of objects in the St. Ninian's Isle Treasure led me to discover a practical method of duplicating this effect, a technique that I would argue was the most common original medieval method.

St. Ninian's Isle Treasure

In the summer of 1958 a Shetland schoolboy found treasure on St. Ninian's Isle. On his first day helping archaeologists from the University of Aberdeen, Douglas Coutts' discovery of a hoard of silver objects added 28 examples of early medieval decorative metal craft to the corpus of Insular art. Bowls, brooches, sword fittings and several other objects, made of inconsistent alloys of silver were found in a wooden box, along with the jaw bone of a porpoise. The find was under a slab of stone in the floor of a medieval church that had long ago disappeared under sand dunes.

The style, designs and techniques of manufacture, as well as their find location have suggested the material is the product of the Pictish

2. Sword pummel, no. 11, silver gilt, 55 mm length. 31 mm height. Photo by the author.

culture, with manufacture date in the 8th century. (Wilson, 1973:103) Since the hoard was deliberately hidden, it can easily be imagined that the time of deposit was in the early years of Viking raiding activity, which began at the end of the 8th century.

These objects offer a great deal of insight into the manufacture of chip-carved or *kerbschnitt* decorated cast metalwork. More famous examples of this technique include the Hunterston Brooch, the stem of the Ardagh Chalice and the Tara Brooch. The purpose of this paper is to examine the objects in this hoard that are decorated using this style, imagine how they may have been crafted and to report my tests of the supposed techniques by reproducing them in the workshop.

Condition of the brooches

Discussions of the St. Ninian's Isle Brooches often note the distressed condition of the pieces, which can be then used as evidence of their age and wear before they were placed in hiding under the floor of the church. In his *Catalogue of the Treasure* Wilson describes eleven of the twelve brooches as "worn", "well worn" or "much worn" (Wilson 1973: 67-80) My take on their condition is that they have always been handled very carefully. There are no unusually deep scratches or evidence of abuse during their life of use. The gilding is worn off of edges and high spots and the pin heads show wear at the points they would be gripped while fastening them to clothing. The missing edges which Wilson attributes to heavy wear is, in my belief, the result of incomplete mold fills, caused by materials not being hot enough during casting. (fig. 3 & 4) Other blemishes and cracks in the pieces, including some that have been repaired, are also results of poor casting, which Wilson correctly notes. These flaws give an impression of a piece that has seen a lot of hard use, but I argue that this is a false impression because the scars of bad casting quality exaggerate the appearance of age and wear. These defects were in the pieces when they were new.

3. Silver-gilt penannular brooch no.18, 70mm wide. Apparent erosion of the lower right edge is due to an incomplete mould fill when cast.

Voids and pits can occur when molten metal solidifies for a number of reasons. Gas porosity happens when the metal absorbs oxygen without sufficient carbon rich gas cover or flux protection. Shrink porosity forms when a smaller cross section and a larger cross section meet and the metal as it cools more quickly in the smaller cross section draws material from the still molten or semi-molten larger cross section. This leaves voids or stretch marks as the metal solidifies as it is also being drawn away from the last molten sections to chill. Inferior alloys can exaggerate these problems. The St. Ninian's Isle brooches are made of very hap-hazard material, probably a result of mixing scrap silver and bronze. With proportions of the major components, silver and copper, between 20 and 80 percent, most of the pieces also contain between one and four percent of tin, lead and zinc. (McKerrell 1973; 174-175) This random metallic soup is most likely further contaminated from previous reuse without refining and is not likely to give good results consistently. (McKerrell 1973; 174-175) This random metallic soup is most likely further contaminated from previous reuse without

refining and is not likely to give good results consistently. The results are poor in most cases, but some of the pieces, the cones, chapes and sword pummel turned out very well. These serve us well to point out that generalizations often have exceptions and that excellent craftsmen can make a silk purse out of a sow's ear. The range of quality, both of craftsmanship and design, are a good indication that the objects are the products of several craftsmen with different levels of skill, experience and talent. An alternative possibility is that the work is the product of the same workshop over time.

Proposed methods of manufacture

The chip-carving or *kerbschnitt* description of the decorative style borrows its name from the wood carver's technique. It is quite natural to assume that the process is very similar, whether the finished product is wood or metal. Several possibilities proposed to explain the technique are:

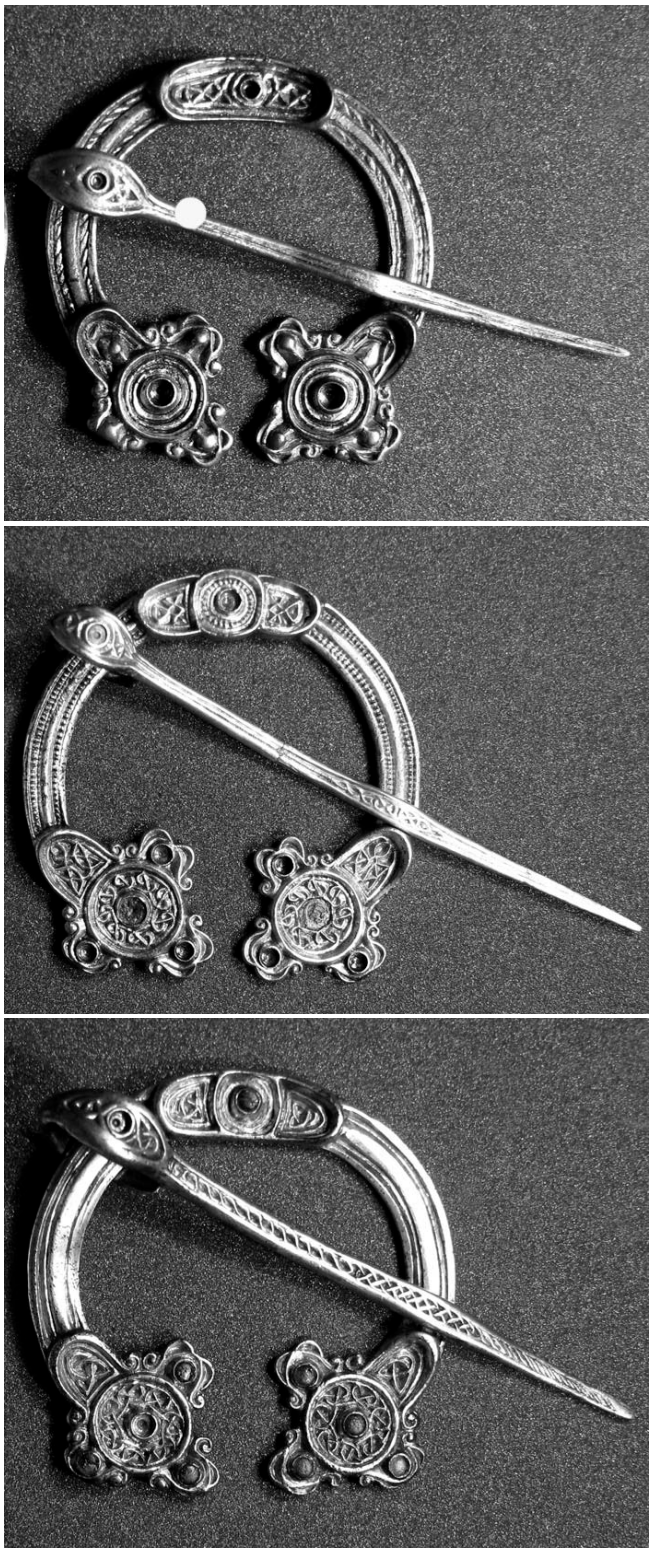
1. The decoration is carved in the metal after the overall form of the object is created by casting or forging. (Wilson 1973: 97)
2. A model of another material is carved and then used to make a mould. The two variations on this method are a hard object, such as wood or bone is pressed into soft clay to make an impression (Stevenson 1984: 19) or a wax model is enveloped in clay or plaster to make a mould by the lost-wax method. (Henry 1965: 94) Lost-lead has also been suggested.
3. The carving is done in the mold itself. To do this the negative version of the final design is carved. Two variations of this technique involve either carving the actual material into which the molten metal will be poured (Walker 2009) or to carve a die that can be used to make a wax model, which will be used to make a lost-wax mould. (Axboe 1984)

There is ample evidence in the form of discarded clay mould fragments that show that soft clay impressions were used to make bivalve moulds to cast objects such as brooches. It is important to understand that this technique can also be used to reproduce an object that was originally sculpted using a different method, The survival of clay mould fragments that show chip-carved decoration leaves unanswered the question of how the models were made. There are also clay mould remains from lost-wax casting, as well as medieval descriptions of the process by the twelfth century monk Theophilus. (Hawthorn and Smith 1963)

The survival of bone and antler "trial pieces" is very often used to argue that chip carving was done in this kind of material, or wood and used to make moulds. The problem with this proposition is that the best of the surviving trial pieces is not nearly up to the quality of even the most inferior chip-carved ornament in metal.

Clues from the brooches

In 2004 I stood in front of the case in the National Museum of Scotland that contained the St. Ninian's Isle brooches. When a friend insisted that I tell him how the craftsman made them, I made the observation that three of the brooches were nearly identical in size and structure, but varied only in the detail of their ornamental carving. This detail is contained in the bottom of walled cells, which present some difficult problems. The detail, which is interlaced knots, appears to be cast. If it had been carved in the metal from blanks cast from a common mold as Wilson had suggested, you would expect to see tool marks on the sides of the cell walls, as well as slips, gouges, burrs and scratches characteristic of carved metal. Pondering this puzzle and considering what the mould and the model would have to look like to make these variations, I realized that the detail that varies from one piece to the other would be on the high ground of the mould



4. Penannular brooch 24, 25 and 26. Silver gilt 65 - 70 mm width. The lower outside ear of the left terminal of no. 25 (top) did not completely fill in the mould. Other evidence of a very poor quality casting is spongy porosity throughout the cartouche and a solder repair of a shrinkage crack to the right of the bezel. The pin head shows wear from handling. Photo by the author.

and would be relatively easy to carve in the negative version of the volume of the object.

Once I began to see the chip-carving in terms of negative space and imagined the tool cuts that would produce it, I also began to see the overall shape as being sculpted in the mould rather than as a positive model. Fine raised lines are more easily and precisely created by carving a single groove in the mould than by removing material from both sides in carving away a positive model. The raised arcs that make the hoops of the penannular brooches or the raised circles of the terminals can be carved in the mould using a compass with its moving leg sharpened into a gouge. I developed a hypothesis that a basic brooch was created by negative carving in the mould and that this was used as a positive model to make copies of the mould that were modified by the addition of the chip-carved ornament.

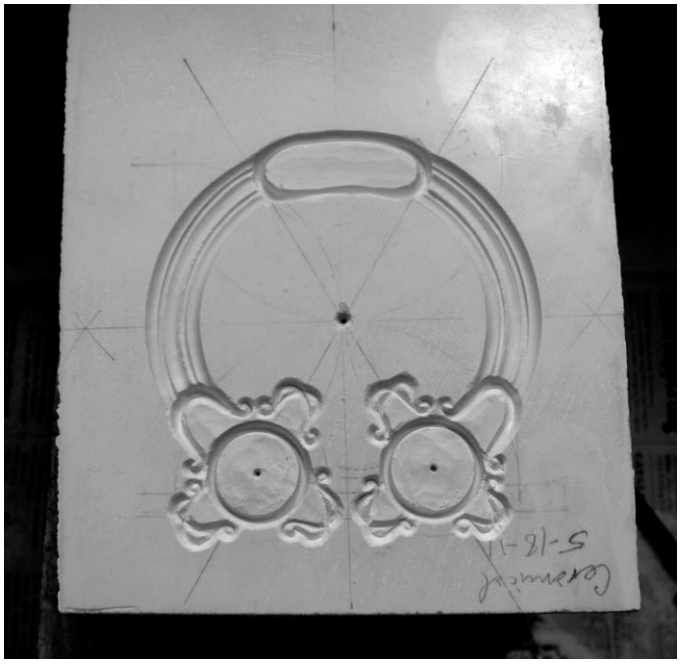
Materials and techniques

Trial carving in modern materials quickly established that chip-carved interlace ornament was well suited to carving in the negative version. Elaborate interlace designs could be traced with a "V" gouge, making a succession of deeper and deeper cuts until the original surface disappeared into patterns of pyramids and ridges. To establish the over and under weaving effect of interlace, deeper cuts were made on the final pass to establish what would become the "over" crossings. A double pointed tool could be used to make double strand ribbons, such as the large Ardagh brooch or the back of the Hunterston.

Since clay was a material known to be used to make moulds to cast these kinds of objects, my first trials were with various clays. It proved very difficult to carve on as fine a scale as most of the historical metal objects. Furthermore the typical failure of the clay was for the pyramid of material to

break off after three or four cuts were made around it. Chip-carved interlace ornament is a series of exactly this kind of cut. I never saw evidence of this sort of failure in even the sloppiest of historical examples. Craftsmen may well have been using different mould materials for different kinds of work, as clay is inadequate for this technique.

Gypsum plaster is the base material for modern lost-wax investments. It carves well and with small amounts of additives, clay, talc or sand, has excellent thermal properties as a mould material for casting metal. My experiments use gypsum plaster as the material for carved moulds. Although there is no archaeological evidence for its use from medieval sites in the British Isles, there are ample deposits of gypsum in the midlands of both Ireland and England with some smaller occurrences in Aberdeenshire. Unfortunately, gypsum deteriorates with prolonged exposure to moisture, so its survival in the archeological record could not be expected. The Insular metalworkers who created these objects had a very cooperative material available for their moulds. In the absence of any plausible alternative, I assume gypsum was that material.



5. Master mould carved in gypsum plaster. The principal proportions are derived from compass and straight-edge layout. (Stevick 2003)

Moulding and casting the brooches

Brooches numbers 24, 25 & 26 are each 65 to 70 mm in diameter and have all their major structural elements in such similar size and shape as to suggest that they came from the same "master mould". Using several compasses with legs sharpened to create gouging tools and some very simple carving tools I made a plaster mould that approximates the form that these brooches all have in common. (Fig. 5) Upon the platform of this structure, the chip-carved ornament, beaded patterns and bezels for setting jewels would be added.

The next step could be skipped if only one brooch was being made from this carved mould. Detail could be added to the original carving and cast with molten metal. But the three related brooches all are from second generation copies of the master mould. To make these, positive impressions from that mould are used to make the next generation of moulds. The second generation moulds can be modified to make the individual and varied reproductions of the three specific brooches.

6. Multiple potter's clay impressions are used to copy the master mould.

7. Plaster is poured directly on wet clay impressions of the master mould to make duplicate plaster moulds. Each mould used to cast metal can only be used once.

9. Interlace chip carving is carved in the negative using a “V” graver. This mould will be used to copy brooch 26. The chip-carving in each brooch is different.

8. The duplicate moulds usually need some re-carving to clean up irregularities from the clay impressions. A compass with the moving leg sharpened into a gouge is used to trace the arc of the loop of the brooch in the same way that the master mould was originally carved.

10. Clay impressions can be made to check details of the mould in progress.

This transfer model could be cast in metal or be a plaster positive impression of the plaster mould. A quicker, although less precise method would be to make an impression in potter's clay and pour the second generation plaster moulds directly on the wet clay. (fig. 6 & 7) This method, which is still a common sculpture studio moulding technique, offers a plausible explanation as to why the three brooches have slight dimensional variations. Some distortion of the soft clay and a certain amount of re-carving to clean up each mould explains why they are not more closely similar. (fig.8)

Detailed chip carving was added to the oval cartouches at the middles of the hoops of the brooches, the fingernail shaped cells within the hasps and inside the circles that are central to the terminals. (fig. 9 & 10) In the case of brooch 24, simple concentric circles were added to the terminals. The bezels were made by twisting and pressing a piece of tubing into the mould. The quill of a feather might work equally well for this purpose. The absence of bezels on the terminals of brooch 24 and the relatively less sophisticated detail of this piece's decoration could be an indication that a less skilled craftsman prepared this particular mould. Rows of raised round dots were added by twisting a simple tool to make a sequence of impressions along the hoop and around the bezel of brooch 25.

11. Moulds with backs for brooches 24, 25 & 26. Each mould has a funnel entering the brooch at the cartouche as well as riser channels to allow air to escape ahead of the molten silver.

12. Mould opened after casting with molten silver. The button of silver at the funnel and the risers will be cut off along with the fins of metal that flowed between the two halves of the mould.

13. Brooch number 25 with the copy.

The open moulds have “riser” channels carved out to allow air to escape ahead of the molten metal. (fig. 11) A flat back was added to each mold and the metal poured in with the cavity in a vertical position through the funnels carved that gate in the center of the cartouche. After casting, thin vanes of metal that leaked into the crack between the two parts of the mold are trimmed away along with the metal in the funnels and metal that flowed into the riser channels. The original brooches were then polished and gilded using a gold-mercury amalgam. The reproductions made for this experiment were simply trimmed, filed and given some very minimal polishing.

14. Three conical mounts, silver gilt. Largest is 43 mm high. Nos. 12, - 14. Photo by the author.

15. Detail cone mount no. 13. The chip-carved decoration on the left lacks any over-under rendering. The uniform curves of the outer surface and the flat facets on some of the negative spaces that should be concave curves are evidence that this piece was cast using a model carved in the positive version. Photo by the author.

Multiple techniques for similar effects

In January 2011 I examined the conical mounts, chapes and the sword pummel from the St. Ninian’s Isle hoard. Having determined previously that the stem of the Ardagh Chalice was created using the same negative carving technique on the inside of a cylinder to make a more complex mould, I assumed that other three dimensional forms that were decorated with chip carving could also be moulded using more complex, multi-part plaster moulds with chip-carving added by negative carving. (Walker 2009)

Examination of the cones revealed that instead of being carved in the negative, this chip-carved ornament was most likely carved in a positive model. There are several visual clues that this is the case. The foreground of the entire surfaces are evenly curved forms with none of the modulation and over-under sculpting of the chip carved ribbon design characteristic of the negative carving technique. The paths of ribbons do not flow as evenly across the crossings and are often slightly misaligned. The inside surfaces of ridges that should be concave curves are in many cases flat. The work is very well executed, but it is more characteristic of carving in a positive version than using the negative technique. This is especially evident in cone number 13. The smooth quality of the surfaces and the nature of the form lead me to believe that the models for the cone mounts were made in wax and cast by the lost-wax process. The sword pummel (fig. 2) appears to have also been crafted using the same technique.

16. Silver chape for a sword scabbard, no. 16. Width 82 mm. Photo NMS.

17. Penannular brooch no. 17. Silver gilt 114 mm diameter. The high ridges of the frame were carved directly in the mould. The double strand interlace panels in the sides of the hoop show raised islands material between the interlace strands that are characteristic of carving in the positive version which may indicate that this piece was a hybrid of both positive and negative sculpting. Photo by the author.

The two sword chapes differ from each other in their methods of manufacture. Since chape 16 has more of a chip-carved look, it is of particular interest. Like the cones, there are also alignment inconsistencies at interlace crossings that are common in pieces carved in the positive version by removing material. It is significant to observe that unlike the other chip-carved pieces in the hoard, the chape shows very choppy texture with burrs and scratches. This suggests that this piece was actually carved directly in the metal.

The large brooch 17 is different from the others in the group in both size and style. The framework of is certainly carved in the mould. While the overall composition is striking and sophisticated, the chip-carved ornament is rather weak. The double strand knot-work panels, rather than showing the sort of parallel ridges that a double pointed tool would produce in a negative carving, such as the back of the Hunterston brooch, has instead many characteristics of a positive carving produced by removing material from the positive version of the ornament. There are no nicks or burrs that would indicate this was done in the metal after casting.

The islands of material that stand out at the same level of relief as the foreground of this pattern between the strands of the knots are very typical of these kinds of carvings in wood or stone, done in a positive version. A hybrid version that combines an impression from a positive carving as well as negative carving in the mould to create the frame is suspected.

Implications for other pieces

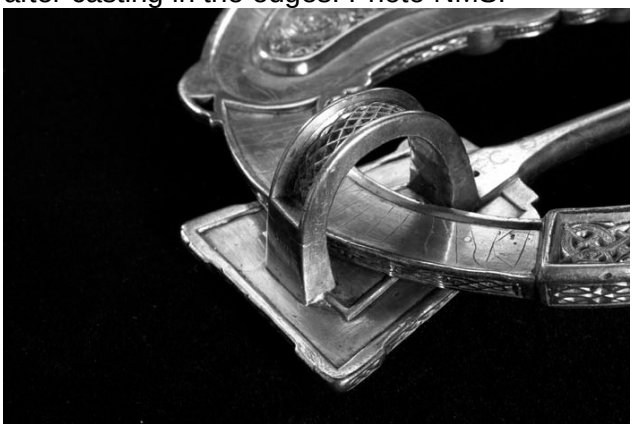
While the objects in the St. Ninian's Isle Treasure certainly were high status possessions for their medieval owners, the brooches are rather poor distant cousins of masterpieces such as the Tara and Hunterston brooches. The latter pieces are of such high standards of skill, design and imagination that they seem beyond the abilities of mere mortal craftsmen and are, as Gerald of Wales described the Book of Kells, "the work of an angel, and not of a man". Many of the St. Ninian's Isle brooches show

18. Stem of the Ardagh Chalice. Gilt bronze. 37 mm outside diameter of the straight sided cylinder. NMI.

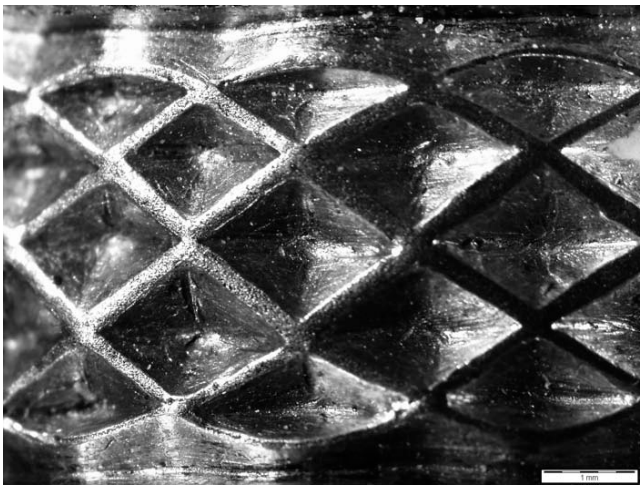
19. Reverse of the Hunterston Brooch, gilt silver flat panels of chip-carving were carved in the negative in the mould. Photo NMS.

20. Top of the Hunterston Brooch. Knot work on the edge carved directly in the metal after casting.

21. Edge of the pin head of the Hunterston Brooch showing chip-carving worked directly in the metal after casting in the edges. Photo NMS.



22. Detail of the reverse of the pinhead of the Hunterston Brooch showing edges carved direcly in the metal as well as the connecting loop that also shows indications that it was carved in the metal as a positive version. Photo NMS



23. Close up detail of the silver gilt pin head loop of the Hunterston Brooch. Tool marks show that cutting was done directly in the metal. Slight misalignments and width variations of the ridges of the lattice work also are indicators that this detail was wrought in the positive version. Photo NMS.

the very human struggle with materials and rather limited skill which gives up the secret of their struggle with materials and rather limited skill which gives up the secret of their manufacture much more easily than the most splendid masterpieces of Insular metalwork. It is quite fortunate that the three brooches from a common master mould survive together in this hoard, for it was the puzzle of how they might be made that lead me to understand the technique of carving negative space in moulds for both the overall form of the pieces and the chip-carved detail which makes up the major portion of cast chip-carving in early medieval Insular metalwork.

Negative chip-carving is most easily understood on flat relief pieces. The problems of how the cylinder that makes the stem of the Ardagh Chalice (fig.18) could be fully decorated with high relief chip-carving or the edges of the Tara or Hunterston brooches could be also decorated with chip-carving throws doubt on the validity of the conclusion that it was done by negative carving in the mould. Experiments carving on the inside of a cylinder of plaster mould material have successfully demonstrated that the stem of the Ardagh Chalice could be made with the carving done on one contiguous surface using off-set carving tools. (Walker, 2009) The modulation of the over and under alternation, the deep and consistent ribbon quality and lack of tool marks (Organ 1973) are all consistent with a pattern cast in a negative carved mould. This example would lead one to expect that a similar method of carving on the inside of a curved surface could be the method used to achieve the decoration of the conical mounts of the St. Ninian's Isle Treasure, but the evidence described above suggests it was not.

Close examination of the Tara and Hunterston brooches (fig. 20 & 21) shows that the decoration on the edges was carved directly in the metal after it was cast, although negative carving of the mould accounts for the overall structure and other chip-carved details. The semi-cylindrical loop that connects the pin head to the hoop of the Hunterston brooch (fig. 22 & 23) also shows tool mark evidence as well as other characteristics of positive carved chip-carving, done directly in the metal. The St. Ninian's Isle hoard gives us examples of both positive and negative methods of achieving the chip-carved effect. The Tara and Hunterston brooches use both methods on the same pieces, executed to such a high level of perfection that the differences in technique from the edges to the faces of the brooches are difficult to distinguish.

Conclusion

Casting metal into negatively carved moulds, while it is not unheard of, is rarely a part of a modern goldsmiths' repertoire of techniques. Directly carved metal, as well as positive carving for impression moulds or lost-wax casting remain popular techniques in metal craft tradition down to modern times. This best explains why moulds made by negative carving have largely been overlooked in the interpretation of cast Insular chip-carving. A larget majority of chip-carved metalwork from early Christian Ireland, Pictland and Britain appears to have been done by carving in the moulds used to cast them. Likewise, the structure of many cast penannular brooches of this period were also created in the mould by using compasses sharpened as gouges on their moving legs as a primary carving tool. But these were not the only methods of achieving the effect of chip-carving. The conical mounts of the St. Ninian's Isle hoard are evidence that lost wax models were used in some instances to make very similar decoration. St. Ninian's Isle chape #16 as well as the edges of the Tara and Hunterston brooches show that this type of interlace decoration was also carved directly in the metal in some instances. Practical workshop experiments using the negative carving technique show that this

is a very useful way to create interlace patterns with a chip-carved effect. Not only is this valuable for understanding the methods of medieval metalsmiths, it is a useful technique to recover for craftsmen in our own time and for those of the future.

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Information for craftsmen who would like to replicate this technique.

Gypsum plaster or 'plaster of Paris" was used for the molds in this recreation.

Before casting hot metal into a plaster mould it is important to drive off all the moisture, including the chemically bonded water in plaster. This can be done by baking in a kiln. At temperatures higher than 500F or 260C straight gypsum plaster will begin to crack, so drying must either stay below this temperature or use some additives.

Superior detail is captured in castings if the mould material is hot at the time the metal is cast.

Tempering the plaster with clay, sand, talc or pumice will allow the plaster to be heated to higher temperatures without cracking. One percent of any of these additives will allow plaster moulds to be heated to 1200 F or 650C without cracking. Greater amounts of these additives weaken the plaster and sharp carving becomes more difficult.

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