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*Testing the spears!*
Reconstructing the Llyn Cerrig Bach Hoard

As part of the *Llyn Cerrig Bach - Treasure from The Iron Age Exhibition* at Oriel Ynys Mon, *Ancient Arts* was commissioned to reconstruct a number of the artefacts for educational and experimental purposes. By remaking these objects it was hoped that more information relating to how they were made and how they were used would be revealed.

The original artefacts from Llyn Cerrig Bach Collection, now housed at the National Museum Wales, were examined by Ancient Arts, providing valuable information on the fabrication processes. Photographs and scaled drawings were also taken to provide as much information on the artefacts as possible.

From this close study of the originals it was possible to understand and ‘reverse engineer’ the processes involved in their manufacture and produce modern examples using the same processes, but ones which were not exact replicas.

The tools, techniques and materials employed to reconstruct this collection were carefully chosen to be as close as possible to the original ones used during the Iron Age when they had been deposited in the lake.

*Ancient Arts* undertook the research and interpretation on the copper, cast bronze, wood, leather and composite artefacts; while Hector Cole, an expert on traditional and Prehistoric blacksmithing, undertook the manufacture of the wrought iron objects.

This short report records our observations and insights made from the research and manufacturing processes.

*The reconstructed Llyn Cerrig Bach spears!*

*The reconstructed gang chain & lead*
The Spears

How they were made.

The Spearheads

The blade has been forged from a billet of iron that was smelted at the Hereford College of Blacksmithing in 2004. It is a billet of variable constituents of iron with some parts being high to medium carbon and others of low carbon to wrought iron. The billet was 400mm x 35mm x 13mm and weighed 1.30kg. As can be seen on the blade, there are slag inclusions and cracks that only became apparent when the billet was forged to shape. One deep transverse crack from the edge of the blade was chiselled up, a piece of iron was then hammered in and then welded in the fire to seal the crack. This is a technique I have used on other blades with the same problem and works very well provided it is done before the edges get too thin. The socket was forged from a piece of smelted iron 100mm x 25mm x 12mm.

This was fire welded to the blade billet before forging to shape. The forging time was 5 hours 15 minutes and the grinding and finishing time was 3 hours 15 minutes. Some of the finishing was done using a York stone and water and was very effective. The smaller spear was forged from a sandwich billet of wrought iron and medium carbon steel with the socket being welded on while it was all in billet form. This spear took 4 hours 30 minutes to make. No heat treatment was carried out on either spear. The small spear will have a distinct pattern to the surface if treated with acid as the wrought iron used was piled iron.

I feel that the large spear is a good example of how the original would have looked at the time, warts and all, as the quality of the iron coming from the smelters would not be all that consistent. The only way to get really good iron is to re-forg and refine it by folding and welding a number of times. This is costly in time and materials and would only be used for the very best work. Hector Cole, Blacksmith
**The Shaft**

The shafts of the original spears was made from ash. This wood is a very strong, but light wood. Ideal for a throwing spear. One end of the shaft would have been whittle down to fit into the socket of the spearhead. This socket is itself used as a gauge during this process. It is simply pushed onto the end of shaft leaving a compression mark on the wood (see photograph below) which is then carefully whittled off and the process repeated until the spearhead fits tightly onto the end of the shaft.

*Removing the bark from the ash shaft.*

*Compression marks on the end of the shaft.*

*The completed spear.*
Observations on use

The most obvious aspects of the spears are their length and the narrowness of their sockets. These give us important clues to their original use. Spears are defined as weapons consisting of a long shaft with a sharp pointed end of metal, stone, or wood that may be thrown or thrust. If a spear is thrust into an object such as a shield (or person!) it has to be strong enough to project the thrusting motion into the target and to be removed from that target. If the spear head breaks away from the shaft during insertion much of the energy from the thrusting motion will be lost and hence the efficiency of the spear reduced or lost. Also if the spearhead breaks away from the shaft during the removal of the spear it can no longer be used as a weapon. Therefore the key part of the spear is where the spearhead joins the shaft at the socket; the weakest part of the spear. The sockets of these spearheads are narrow, only 20mm in diameter (having been whittled down from the shaft's diameter of 25mm). An ash shaft of this diameter would break under moderate pressure and in a hand to hand-to-hand combat situation break relatively easily; proving to be very inefficient, if not fatal for the owner!

If the spears were unlikely to have been used as thrusting spears, could they have been used as throwing spears or javelins as suggested by Fox?

We tested this theory by simply throwing the spears at a straw bale target. Both the reconstructed “javelins” worked remarkably well. They demonstrated a formidable penetrating power and good general flight. They were accurate from a range of approximately 20m. None of the spears or the shafts broke during the experiment.

It has also been suggested that the spears were purely ritual or ceremonial objects. There is no way to test this theory directly, however our experiments have shown that could have been used as highly effective throwing spears.

One of the reconstructed spears imbedded in a hay bale after being thrown from a distance of 20m.
The Sword

The double edged sword blade was made from modern steel. The pommels and hilts (handles) from original Llyn Cerrig Bach swords didn’t survive. So we used materials known from other examples of the period. In this case the sword has a wood and bone composite hilt (handle). Scabbards did survive (in very poor condition) on two of the swords, these were made from iron. The reconstructed sword has a modern steel scabbard.

The La Tene sword from the collection was particularly interesting because of its length and its rounded tip. Its length and rounded tip may suggest that it was a cavalry sword. The length of the sword allows a mounted fighter a greater striking range. The rounded tip suggests that it was used with a slashing motion (again an easier action when mounted) rather than with a stabbing motion. Later cavalry swords developed with a curved blade to increase the slashing effect.

A sword used by a foot soldier (non-mounted) would be used in a thrusting or stabbing action, especially if fighting against enemies with shields.

The reconstructed iron sword and scabbard (note the rounded tip).
The Tongs

The tongs are made from two small bars of iron and forged (hammered) into shape. A small iron rivet joins the two pieces together.

The Long Handled Tongs

Both tongs are described as blacksmiths tools, however, Hector Cole the blacksmith who made them commented thought that the larger tongs were possibly crucible tongs. These could have been used to hold pottery crucibles full of molten copper or bronze. Their long handles necessary to protect the user from the very high temperature of the molten metal. If this is the case they would have been used by a copper or bronze smith and not an iron blacksmith.

The Short Handled Tongs

During our initial examination of the original artefacts in preparation of the remaking of the objects we identified previously unrecorded La Tene style decoration on the short tongs. These would have been chiseled into the cold metal using a cold chisel. Members of the conservation team at the National Museum believe they found evidence that the designs had been originally painted as well.

These show that although the tongs were practical tools they (and their owners?) were valuable ‘special’ items. Both the tongs were probably used in the making of valuable, iron objects, a highly skilled and very magical metal process at the time.
The tongs are also quite thin and seem more suited to fine, sheet metal working. Perhaps for the production of fine musical instruments or other fine sheet work.

Another suggestion for their original use is that were ‘bull tongs’. These tools are still used today for leading bulls (see picture of modern example below). They are used by clamping the bull’s septum (between the nostrils) with the tongs. This is a very sensitive part of the bull’s body and will subdue a bull quickly (so they say!). Modern example have rounded tips (see photograph) while the Llyn Cerrig Bach tongs have flat tips perhaps more suited to holding flat objects.

The shorter tongs.

Modern bull tongs.

The Sickle

The reconstructed iron sickle with ash handle.

This type of iron sickle is still in use today in undeveloped areas for harvesting plants or crops. No handle survived on the original artefact, so we looked at evidence for other Iron Age sickle handles in the UK. The one we used is based on an example from the Glastonbury Lake Village in the Somerset Levels. Organic artefacts survive on this Late Iron Age settlement site due to very wet ground conditions.

This handle is made from ash and the iron tang of the sickle is hammered into the handle. It was then bound with nettle plant fibre and sealed with pitch.
Iron ore is smelted in a furnace (see photograph below) and iron bloom is produced. This spongy mixture of iron and slag (waste products) then has to be refined or compacted into iron metal; a process known as *bloom smithing*. The iron bar reconstructed for the teaching collection was made by forging (repeatedly hammering) the raw iron bloom into this shape.

The reconstructed iron ‘currency’

These bars would have been used in the trading of iron. It is thought that different types of bars were used by different regions or manufacturers. As well as indicate the origin of the iron their shape and form would have demonstrated their quality. For example their long, thin form would have shown the buyer the strength and texture; while the folding and welding visible on the bars would have demonstrated their suitability for future forging. The tubular socketed type of bar reconstructed is very similar in shape and weight to ones found in hoards near Malvern, Worcestershire.

*A furnace for smelting iron ore.*
The Gang Chain

The Gang Chain is made from wrought iron and is cleverly designed to ‘pass through’ itself, doubly securing the wearers. The links are made from short lengths of iron bars fire welded together to close each link onto the adjoining one. Their wasted or pinched shape was made by heating and hammering the links. This made levering the links part even harder.

It was very clear when making and handling these chains how much damage they would have caused the wearers. The metal is rough and the weight and design would have pinch and rubbed the neck’s of the wearers badly, causing considerable suffering. We also added a rope to the end to allow for the gang to be led whether by hand or perhaps attached to a horse or cart. Again simple by pulling or jerking the rope the wearers would have been hurt and quickly pacified and controlled.
The Bridle

Iron

The small iron snaffle bits were made up of three separate iron rings, two side rings and a central mouth piece. They were forged into shape and fire welded closed. An interesting feature of the snaffle is the angle of the two side rings. This is thought to increase the lateral guiding effect of the bridle, which suggests that the rider wanted to turn more sharply (in simple terms the side rings would dig more deeply into the cheeks of the pony encouraging a sharper response!). This is thought to have been a feature of chariot bridles.

They were made for a small (by modern standards) pony approximately 11 hands high. Native ponies of the period were shorter and stockier than modern ponies, similar to a Shetland Pony. The narrowness of the mouth gives a good indication of the size of the pony’s head.

No evidence for the original bridle what held it together survived for the original bridles. The leather bridle reconstructed for this project is one based on modern examples. The leather straps were riveted together using copper rivets.
The Bronze Bits

The bronze snaffle bits.

The bronze snaffle bits have two side rings and a single jointed, central mouthpiece.

Bronze objects were most likely made using the lost wax process of bronze casting. With this technique wax replicas of the items were made (probably using bees wax in Prehistory). The waxes were then invested; surrounded by a mould material (probably made from clay and dung). The mould is then heated to harden the mould material and to allow the wax to melt out of the mould. Molten bronze (a mixture of copper, tin and lead) is then poured into the now hollow mould.

Making these snaffle bits would have been a more complicated process as there is no evidence from this period that the rings could have been welded closed.

A process called ‘casting on’ would probably have been used. First the bronze side ring would have been made and cast, then a wax link made around the bronze ring and surrounded in a mould, melted out and the bronze poured in. Then another link made in wax and the wax surrounded in a mould etc. So that one element would have been cast onto the previously cast element.
One of the indications that this was the method used is a barely visible pouring sprue mark found on one of the mouth piece links. This is the remains of the hole into which the molten bronze would have been poured (called a cup). This would have been removed from the cast link by being heated to red hot, then the link would have been quenched in water up to the ring joint and struck off with a hammer blow. This and other manufacturing marks would then have been filed off.

The finished bridle.
Repoussé Copper Alloy

These decorative pieces were made from sheet copper. They are thought to have been made using the repoussé method of stamping a design into the metal.

As part of the experimentation we also attempted to reproduce them by drawing the designs into the metal. For both methods we started by heating the copper sheet and placing it onto a layer of wax on a flat wooden surface. The metal is then heated again and the design was drawn into the metal using a wooden stylus or stamped into the metal using a bronze hobb or stamp.

The layer of wax ready for the copper sheet.

Drawing the design into the copper sheet using a wooden stylus.
The bronze hobb or stamp with the decorative design.

The hobb and the stamped design on the copper sheet.

Both the stamping and drawing technique worked, but it was impossible to produce two identical designs using the drawing technique. So it would seem that the stamping technique was used to make the decorations.

Detailed ‘cleaning’ (removing creases) was needed with the stamping technique (see picture). This was done using the wooden stylus.

Once the design had been stamped into the metal sheet it was backed with pitch to prevent any damage (dents etc) to the piece. Remains of pitch was found on the reverse of the original pieces. This may also have been used as a glue along with copper rivets to attach the decoration to an object.
The Staff

A piece of bronze ribbon was originally found closely coiled spirally around the remains of an ash staff with nail holes at either end and an incised central line.

To begin the reconstruction copper sheet metal was incised to match the dimensions of the bronze ribbon and the metal strip cut out. Note how the ribbon was incised and cut in a spiral fashion.

The sheet copper marked ready for cutting.

The cut strips.

By twisting the ribbon into a spiral the diameter of the ash staff was revealed (30mm) and an ash pole of the correct diameter chosen and the bark removed.

The replica cut and incised copper strip.
The ribbon was then attached using copper nails, examples of which had been found in association with the original ribbons.

(Similar copper ribbons have been found in Ireland attached to musical instrument, notably trumpets. However, the length of the nail found with the Llyn Cerrig Bach ribbon indicates that the ribbon wasn’t associated with the trumpet. It would have been an unnecessarily long and would have damaged the structure of the trumpet.)

To attach the ribbon to the staff it was held in place (here by elastic bands, but string made from natural fibres could have been used) and a hole punched through the metal. We know that the hole was made first using a square sections awl because the holes on the original were square in section and the nails round in section. Copper nails were then hammered into place at the top and the bottom.

The end of the ribbon at the top was rounded and the bottom end flat. This suggests that more ribbon was originally added to the end, elongating the metal decoration.

We can never be sure what this staff was used for. The original bronze ribbons showed no obvious signs of wear or damage suggesting that it wasn’t covered by the holding hand, but was for show. Perhaps it had a ceremonial role. Certainly when the sun catches the metal it becomes an impressive object, visible for some distance and would have announced the arrival of an important person.

A prototype of the decorated staff.
Ancient Arts

For Oriel Ynys Môn

Ancient Arts would like to thank the teams at Oriel Ynys Môn, the Amgueddfa Cymru/National Museum Wales, Hector Cole & Castle Fine Arts for all their time & help during the project.

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