

## Playing with Fire

SSARG members had great fun playing with fire recently (and of course learning lots about the Bronze Age) at Avalon Marshes Centre. The tutor, Neil Burridge, has been bronze casting for fifteen years, so it was a great privilege to be on this course which was a classic experimental archaeology weekend.



*It was about the magic of fire*

The Saturday was concerned with smelting using African malachite and casiterite and the Sunday with casting primarily using sand moulds (not known in the Bronze Age) and clay moulds. There was a fair amount of time between setting up furnaces and time while they were heating in which Neil spoke about the history of bronze metalcraft and various technical issues.

Basically casting is difficult and open to a lot of error and doing it raises admiration for the skill and quality of work of those early metallurgists. We had two types of furnaces, one modern portable furnace and the other archaeologically-based and built on site.

The new version was used for smelting tin and copper in a modern graphite crucible. Layers of charcoal and ore were put in the crucible and heated to 1200+ degrees centigrade, measured with a pyrometer and held at above that temperature for half an hour.



*Preparing charcoal dust and malachite for mixing in the crucible*



*Neil chivvying the charcoal in the modern furnace*



*Marc Cox playing with old style open furnace*

On day two the other furnace was used for melting Bronze for casting. It consisted of a three sided box with internal measurements 6-7" and a height of 4". A fairly flat open dished crucible was placed on the floor and covered in charcoal to a depth of 3 1/2". This was left with lighted charcoal for around 40 minutes by which time it had reached a temperature of around 900+ degrees centigrade.

One of Neil's strong messages is to give everything time and to go slowly. This saves work and gives less stress to crucibles so that they last longer. Air was fed from above by bellows to raise the temperature. Note that all the heat to the crucible is coming from above, this may seem counterintuitive but it worked very well. The temperature of the furnace was held at around 1200°C for around 25 minutes. Copper melts at 1083°C and tin at 231.5°C.

On its own copper is more difficult to handle but with the addition around 10% tin to make bronze, it has a lower melting point of around a 1000c and flows more easily.

A temperature well in excess of its melting point is needed to get a good flow into the mould and also because bronze 'freezes' very quickly. The Greeks added 2-3% of lead for statues to give a better flow when casting. We cast a copy of the Otzi axe in copper and a bronze socketed axe.



*Bronze socketed axe*

There were a couple of failures using the old-style method, due to the entrance to the mould having a minor blockage of charcoal when pouring the molten metal. Watching that part of the process was truly magical. In fact, much of the firing was magical, sparky and totally absorbing.



*This shows the intricate way the bronze was poured into the cast – the top bits will be chipped off before the axe can be attached to the haft.*

Because this is his living, Neil keeps some information to himself, for example his clay formulae for crucibles, moulds and cores and he didn't like too much interest being shown in the valve system of his rather efficient bellows! Nevertheless he can out-compete probably anyone with the quality of his casting.

This was a great weekend with a lot to appreciate about the clever people of the Bronze Age. You may find it worthwhile checking out Neil's web site: <http://www.bronze-age-swords.com/>

John Bartholomew



*The Limehouse Sword* was the British bronze smiths' response to the European Erbenheim sword.