The Archaeology of Metalworking
fieldworkers practical guide

Guide 35

Jeroen Zuidervijk recreating bronze age smithing at Archeon. Image: Hans Splinter (Flickr, used under a CC BY-ND 3.0)
Metalworking guide

Introduction

“Found any gold yet?” It’s an irritating question, but it does highlight human attraction to metal in all its forms, whether jewellery, coins or axes. Metals form the basis of our standards of value. After all, the Olympics don’t award medals of shells, pottery and stone, and even comic books are divided into gold, silver, and bronze ages.

In the real world metals were one of the first means of dividing prehistory into chronological sections. Even though our understanding of cultural changes have made the divisions between the Neolithic, Bronze Age, and Iron Age out of date, metals are still the way we identify and sort prehistoric periods.

Since metal was first discovered people have been fascinated by it. Even today people are drawn to demonstrations of metalworking, whether it’s a smith striking sparks while hammering iron on an anvil, or the magic of solid metal being melted in a crucible, and then poured into a mould. It’s no wonder that it would be one of the first things people ask about when they meet an archaeologist.

The following guide provides a brief explanation about how to excavate and care for metal artefacts. Most of the care and curation will go on in the lab, but the archaeologist who excavates the artefact has one of the most important roles in preserving the object.
The fieldwork process

Understanding how to remove metalwork from the soil, how to bag or box it properly, and when to treat it as a priority artefact that needs immediate care can mean the difference between the preservation of a unique object, or the sad story of the artefact that didn’t survive.

Archaeology isn’t about the objects, but the stories they have to tell. Coins and axes are valuable in what they tell us about what people were doing in the past, but there’s a lot more to archaeological metals. We may never find a hammer and anvil from an Iron Age smithy, but the silhouette of hammerscale will show us exactly where the smith stood and worked at the anvil.

Analyses of metal droplets can tell us how metal was smelted or how alloys were made. Close examination of tools can even tell us details such as if the smith who used them was right or left handed. This all depends on the skill of excavators who understand the importance of the initial care and treatment of metal artefacts, so that their story can be told for generations to come.
General excavation of metals

Metals have very different material properties than pottery or bone and need different treatment as a result. While we think of metal as being durable and strong, both corrosion and the surrounding soil environment can weaken metal objects until they are extremely fragile. The following list provides information about removing metal from the ground and how to bag artefacts.

Metal objects are often fragile.

Corrosion can completely replace the metal, leaving a delicate replica of the artefact. Don’t attempt to remove corrosion or dirt on site. Until the artefact can be examined and conserved, the dirt and corrosion are protecting the artefact and might be the only thing holding it together. For example, I examined a number of Roman silver plated horse harness pieces that had been recovered by a detectorist. The silver was decorated with niello, a black colourant used on silver to enhance the design. Thinking that it was dirt and soil, the detectorist removed much of the niello before realising that it was supposed to be there - the cleaning also caused some of the silver plate to flake off revealing the bronze underneath. -- Niello, enamelling, and other types of decoration can come loose from an artefact, so when you find a metal object, try to retain as much of the matrix around it, and resist the temptation to clean it up on site.

If a metal object appears to be fragile, it might be necessary to remove it as a block. Smaller objects might be lifted out supported on a trowel. This is sometimes a difficult choice, since it might compromise the context. If in doubt call in your supervisor or the specialist so that a decision can be made about the best way to lift a metal object out. Sadly sometimes all that remains of a metal object will be a small stain in the soil indicating where an object had been. There’s nothing that can be done. It’s gone. Mourn the loss of an interesting artefact but be on the lookout for some more that might still survive. Fragile metal objects might best be stored in padded boxes rather than loose in bags. Make sure that you are prepared for the eventuality.

A mount from a medieval coffett, probably enamelled in Limoges, France. (PAS) if roughly cleaned on site, would have easily damaged the decoration.
Keep them dry and cool

All metal objects have a problem with condensation. Poke small holes in the bag to allow moisture to escape. Make sure the holes are small. I’ve seen bags sliced by trowels with holes big enough for the artefacts to fall out, which is pretty much defeating the purpose of bagging them in the first place.

Metal expands when heated, which can cause artefacts to flake or crack. If it’s a sunny day, put the bag in shaded part of the bin (under another bag or shaded by sherds). This might protect the bag from heating up, but also prevent condensation from forming in the bag.

Clean bag, with careful perforations and clear indication of metal.
Used bag with large trowel tear and labelled with artefact term but no mention of metal.

Labelling

Avoid being specific when labelling bags. Writing “metal” or “metal object” on the bag is good enough. What is written on the bag will stay with the artefact, and if it turns out to be something different than what is on the bag, then confusion will continue down the line.

If it has green corrosion don’t assume it’s bronze. It should be labelled as “copper alloy” or “Cu alloy”. If you have a magnet and it sticks, then you could label it as “iron”. If it has white corrosion, it could be lead. Handle the artefact as little as possible.

Tools to keep on hand: telescoping magnet, and a loupe or hand lens.
Metal and organic materials

It is rare, but occasionally metal is recovered with wood or even fragments of cloth still attached. This is a challenge for both excavators and conservators, but the effort is worth it. Even if it is covered with corrosion, microscopic examination can reveal a range of details about the material. (Remember that the first call should be a specialist conservator – they are always the best person to work with items such as these).

Metal objects with organic material attached such as wooden hafts or bone inlays are especially rare finds and need special care. As with metal objects they should be kept dry, but should be treated quickly since organic materials can disintegrate rapidly. Any organic material should be given a high priority for processing and conservation off site.

Corrosion often will preserve cloth that was next to the object. This could be a bag that an axe was placed in, or clothes that a pin was attached to. Take care not to remove soil from what might be cloth embedded in the corrosion since it could easily be scraped off.

Copper sheet with various corrosion materials – this could contain vital evidence – so don’t clean it!
Treatment of Copper Alloys and Iron.

Bronze is an alloy of copper combined with one or more metals. Some Early Bronze Age objects were alloyed with arsenic, however tin quickly came into use in Britain.

Late Bronze Age objects were alloyed with tin and lead. Different alloy recipes were used in different regions. Note that brass, an alloy of copper and zinc, arrived here with the Romans.

Bronze artefacts can have a brown patina, but bronze is usually identified by green (and sometimes blue) corrosion.

Iron is easily identified because it is magnetic and has a rusty red corrosion. However, iron is more properly steel, since it was discovered that introducing a bit of carbon made the iron more durable.

Bronze can sometimes be tricky since, under the right conditions, it can have a rusty coloured patina as well.

Large bronze objects such as axes, swords, and tools are very rare. They are usually found in hoards and hardly ever found during excavations. Finding an intact hoard would be a cause for celebration, but proceed with caution. There could be organic materials, or non-metal components of the hoard. In addition, the arrangement of the objects could indicate if the hoard was a votive deposition. Call a specialist.

It’s far more likely to find smaller objects, such as ornaments, coins, or non-portable utilitarian objects such as door hinges and nails.

Don’t knock nails. They are probably the most common metal objects found on historic sites and, well, they do soon become boring. Nails might not be exciting, but they have their uses. Recognising different types of nails and being able to identify how they were made and can be useful for dating a site. There are specialised nails for various types of construction, and there are also nails from sandals and boots, coffin nails, horse shoe nails, the list goes on. Nails used in construction (walls, roofs, etc.) can be useful for delineating a wooden structure and the types of nails can indicate different parts of the structure. Note that nails were not used in prehistoric Britain.

Iron nail (Gerechtigkeitsgasse, Bern) showing disastrous swelling and delamination of the surface following damp storage conditions (Photograph courtesy of the archaeological service of Canton Bern, Switzerland).
Treatment of Lead and Tin

Both metals are slightly heavy and have white corrosion. In Britain they were used both in prehistoric and historic times for a variety of uses including ornaments, leading windows, roofing, and as weights.

When constructing buildings or structures from stone, Romans frequently coated iron fasteners with lead to prevent rusting.

It is worth considering wearing gloves when handling lead, as the white powdery corrosion deposits are dangerously poisonous, however, you should always wash your hands thoroughly after handling any metals.

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Medieval lead. Beware of any crumbling white oxidation!
Gold and silver

Gold has been mined and used in Britain from prehistoric times onwards. Gold is found in its native form here, meaning that it needed no smelting. Here silver is found in a type of lead ore called galena. However, like copper and lead, no early smelting sites have been found for silver. In fact, no silver objects have been found in Britain before the Late Iron Age (I would love to be proved wrong! Find some from an earlier context and let me know).

Unless it’s a coin, gold or silver objects are as scarce as hen’s teeth. If a precious metal object is found the supervisor should be notified immediately.

Precious finds should not be discussed in the pub or on social media. Word travels fast and there are few things sadder than arriving in the morning to find a looted site because you put up a picture of a gold ring.

Coins

Coins show up fairly frequently and are useful for dating a site. Having a cursory knowledge of coins is useful. The website of the Portable Antiquities Scheme has some useful guides for coin identification, and the references at the end of this article also has some useful books listed. As with other precious metal objects, if there’s a find of a rare coin, it shouldn’t be discussed openly.
**Metalworking sites**

These are rare and wonderful things and are possibly dismissed as cooking hearths.

Iron working sites are fairly common, but Bronze Age metalworking sites are extremely rare. Even worse, there are no known copper smelting sites in Pre-Roman Britain.

Iron forging sites can be identified by hammerscale. These are the sparks that fly when the smith hammers iron on an anvil, but really they are small fragments of metallic slag. A magnet can be used to pick up samples of hammerscale. Careful sampling will enable you to see the silhouette of where the anvil and smith stood.

Iron smelting furnaces can be identified by burnt clay, vitrified ceramic material, and slag. Copper and lead smelting produce very small amounts of slag, but large finds of slag will indicate iron production.

![Illustration of metalworking slag](image)

No excuses for not recognising Iron Slag. Note the vesicular holes that could easily be mistaken for worm-holes or from roots.

Slag from iron smelting can be magnetic, but not always. Most slag is not diagnostic unless it is analysed using a microscope, or equipment such as a portable XRF. However, there are two types of slag that can be identified; one is tap slag which looks as if it was flowing. The second is the smithing hearth bottom. This is circular with a rounded bottom and a fairly flat top. This type of slag forms at the base of the furnace and could be used to indicate where the furnace stood.
Bronze and non-ferrous metals (any metal that is not iron) were most likely processed in hearths. These can be identical to cooking hearths with burnt stones and scatters of charcoal. However droplets of metal, fragments of slag, crucibles, or moulds will indicate that it is much more than a cooking hearth. Only a handful of bronze casting sites have been found in Britain, so positively identifying even one more would be significant. As with copper, no prehistoric lead smelting sites have been found and it is possible that smelting was done in crucibles. Lead and tin both have low melting temperatures, so sites where they were cast or processed might closely resemble cooking hearths. Indicators might be droplets of metal or pieces of ore.

Crucibles and moulds are used for non-ferrous metalworking. They are the grey area between ceramics and metals and will not look like the usual pottery. The fragments will be coarse, porous, and usually burnt or even glassy with a brick red or green tinge. Moulds can be either clay or stone. Clay moulds often have two layers of clay that are two different colours. These should be bagged separately from other ceramics and labelled as “refractory materials”, “burnt clay”, or “burnt stone”.

Crucible fragments (note the glassy texture from vitrification. That's a clue, but is not always present.) Sometimes crucibles used for bronze will have a reddish tinge
Metal excavation tips

1. Care should be taken when excavating metal objects. They are often more fragile than they appear, and could have additional material adhering to them. Resist the urge to clean them off.

2. When bagging, punch **small** holes in the bag to allow moisture to escape. Keep the bag shaded so that condensation doesn’t form inside. Small, fragile objects can be placed in sample boxes.

3. Provide minimal description on bags. Knowing that it is metal is enough.

4. If iron working is suspected in the area, take soil samples for hammerscale using a magnet. A magnet on a telescoping handle makes it easy. Careful sampling and labelling of the context can provide information about where the anvil was located and where the smith stood.

5. Consider hearths as potential metalworking sites. Check for small droplets of metal, slag, or burnt ceramic material.

6. Metal corrosion (oxides) can be harmful to your health, especially copper oxides and lead oxides. Avoid handling metal objects if at all possible, but if you can’t avoid it, wash your hands afterwards.

7. If word gets out that metal objects are being found, the site might be visited by nighthawks. Avoid posting about finds on social media or discussing them in the pub until after the excavation is finished.

8. If in doubt call in the expert, and keep in mind that the care and skill you use in excavating metal objects can mean the difference between a valued artefact or crumbled bits of disappointment.
References
These are a few of the more popular books that can provide more information about archaeometallurgy and metalworking.

The Historical Metallurgy Society http://hist-met.org/

An Introduction to Roman Coins (Portable Antiquities Scheme) http://finds.org.uk/romancoins

Medieval Coin Guide (Portable Antiquities Scheme) http://finds.org.uk/medievalcoins


CASEY, P.J., Reece, R. 1998 Coins and the Archaeologist.


**Giovanna Fregni** has recently completed her PhD thesis on Bronze Age metalsmithing *The Compleat Metalsmith: Craft and Technology in the British Bronze Age*. In her earlier life she was a jeweller and metalsmith and also was an assistant curator at the Science Museum of Minnesota where she researched the care of metal artefacts and the mitigation of corrosion. In her work she strives to apply her practical knowledge of metalworking to interpreting artefacts, hoards, and early metalsmithing technology.

More information about her work is available at [https://sheffield.academia.edu/GiovannaFregni](https://sheffield.academia.edu/GiovannaFregni)