Working with Bone, Antler and Horn

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Introduction

This book is intended as a basic guide for anyone interested in bone working in the LHE/Wic/Village or whatever your society calls it's authentic living display area.

As well as dealing with the practical side of bone working – the methods and tools - there is also a brief outline of the biology of the material and explanations of *why* certain skeletal materials are better than others for certain artefacts as well as a discussion of comb making and the differentiation of trade and industry in Early Medieval bone working.

What is Bone Working?

Bone working is the catch-all name used to refer to the global skillset that consists of working all skeletal materials – bone, antler, horn and ivory. However, because ivory is very difficult to obtain legally, I will cover some artefacts of ivory where appropriate, but there won't be any discussion of how to work it. However, most of the techniques for bone and antler are applicable to ivory – although it is just a lot harder to work! The skill of bone working has been practised for thousands of years, and it is only really since the invention of plastic that we have stopped using skeletal materials. Until this recent invention, bone, antler and horn was used for almost everything for which we would currently use plastic.

Recommended reading and additional resources

In addition to the wealth of information available in excavation reports, there is one book that anyone interested in bone working should acquire –"*Bone, Antler, Ivory and Horn. The Technology of Skeletal Materials since the Roman Period"* by Arthur MacGregor (ISBN 9780709935070). While slightly out of date, it is still the major work covering the various technologies, methods and so on of bone working. It also has many examples and an extensive bibliography. Oxbow Books hold copies of it and it is priced around £15.

The Archaeology Data Service (http://archaeologydataservice.ac.uk) has many journals and articles stored in its database. This includes entire back catalogues of journals such as *Medieval Archaeology* and *Proceedings of the Society of Antiquaries for Scotland* (PSAS). Both of these series of journals are frequently referenced in this work and virtually all the articles will be available through this site. ADS also has many monographs and reports available, including the first 100 reports by the Council for British Archaeology (CBA) which includes excavations at Southampton, and the PSAS monograph covering the Brough of Birsay.

Contact Details

If you have questions, suggestions – or even, Odin forbid, notice any mistakes, feel free to contact me at vikeboneworker@gmail.com

I also maintain a blog covering period bone-working; (http://halldorviking.wordpress.com) and a Facebook group for general bone-working; "Bone, antler, ivory and horn crafting" (https://www.facebook.com/groups/640324786027016)

Raw Materials

In antiquity, almost all inedible parts of an animal were used for something. This includes the skeleton and similar hard parts of the body.

However, in modern times, most people will have very little contact with skeletal materials and will even often get identification and names confused; this applies to re-enactors as much as it does members of the public.

Given that the various materials have different biological construction and therefore different working properties, it is important to start out by knowing exactly what is what.

Definitions and basic biology of skeletal materials

Bone

Bones are the organs of a body that make up the endoskeleton (internal). A living bone is comprised of two components – an inorganic structural matrix (a calcium phosphate compound), and an organic protein (collagen).

The collagen in living bone is what gives it slight elasticity and "bendiness". In dead bone prepared for bone working the collagen is no longer present in the same amounts as living bone, and this causes the brittleness and rigidity of the bone to increase. A measure of this can be regained by keeping bone soaked as much as possible while working (this is especially the case when carving by hand).

Due to its physical composition and primary role (supporting a body), bone has a relatively high compressive strength but quite low tensile strength and exceptionally low sheer stress. This means that it can resist forces pushing at it quite well, but not pulling or twisting.

Additionally, bone is formed as one of two types – woven (the collagen fibres form haphazardly and are mechanically weak) and lamellar (the collagen fibres form parallel to one another and are mechanically strong).

Woven bone forms the bones of the foetus and in older animals following a fracture (both examples are later replaced by lamellar bone). This woven bone is the reason why the bones of very young animals (especially piglets, lambs and calves) can be very difficult or even impossible to work with satisfactorily, and also means that these bones can be quite variable in their workability.

Lamellar bone grows much more slowly than woven bone (which is why woven bone appears first to form the shape the lamellar bone will eventually replace), but is much stronger. Compared to woven bone, lamellar bone is far superior for bone working, especially when a smooth or polished finish is desirable.

Antler

Antler is a bony growth that is restricted to Cervidae (deer). Unlike horn, antler grows rapidly and is shed annually, then grown anew the following year.

The antler is grown from two nodules projecting from the skull, called pedicles. Despite being a bony structure, antler is formed by a much quicker process than internal bone, sometimes growing up to 20mm in a single day.

The site of new growth is saturated with bone growth cells (osteoblasts) and heavily supplied with blood, both externally via a hairy, blood rich sheath - the "velvet", and internally, by further large vessels. The external presence of multiple large blood vessels and numerous smaller ones as the antler is growing leads to the characteristic rough outer texture.

Once the antler is fully grown, complete ossification occurs and the blood vessels are slowly strangulated, cutting off the supply to the antler. The velvet then dies and eventually falls off or is rubbed off by the deer. The fully grown antler has no organic component; all of its properties derive from the inorganic structure. As with bone, antler has a hard outer layer and a spongy cancellous inner.

The structure of antler gives it strength even when used against the grain, hence its widespread use for combs, clamps and similar items that are put under stress

Confusion over the nomenclature of horn and antler appears to stem from the fact that the term antler is a relatively modern one. In the past it was referred to as "deer horn" quite regularly and it is only recently that science has caused us to make a distinction between the two. This was certainly the case during the Early Medieval, as a piece of antler from Dublin is inscribed with runes reading "hart's horn"[1]. The word antler most likely comes from the Old French word "*antoillier"* which originally was used to describe the first tine on the shaft (now known as the "brow" tine).

Even today, it is not uncommon to see both antler and horn confused (usually when referring to the unused material) and even antler and bone (especially when dealing with combs). This can even apply to archaeologists, especially in interim reports and the like where artefacts have only had a cursory examination.

Horn

As mentioned above, horn is commonly confused with antler, despite them being two totally different materials. Where antler is restricted to species of deer, horn can be obtained from a variety of species (goat, sheep, cow and so on).

The physiological structure of horn also varies greatly from either bone or antler; horn is not ossified tissue in any way, it is formed by layers of keratin (a fibrous protein that also makes up feathers, hooves, nails and claws). A complete horn is actually comprised of two major parts - a solid core of bone that protrudes from the skull and the outer sheath that is the horn proper. Separating these two layers is the "germinal epidermal layer" that actually produces the horn.

This outer sheath is slowly built up as the animal grows. The living core of spongy bone and blood vessels feeds the protective outer sheath. Unlike antler, the horn is a permanent growth and is never shed or replaced. If a horn core is broken from the skull then the animal will remain hornless thereafter.

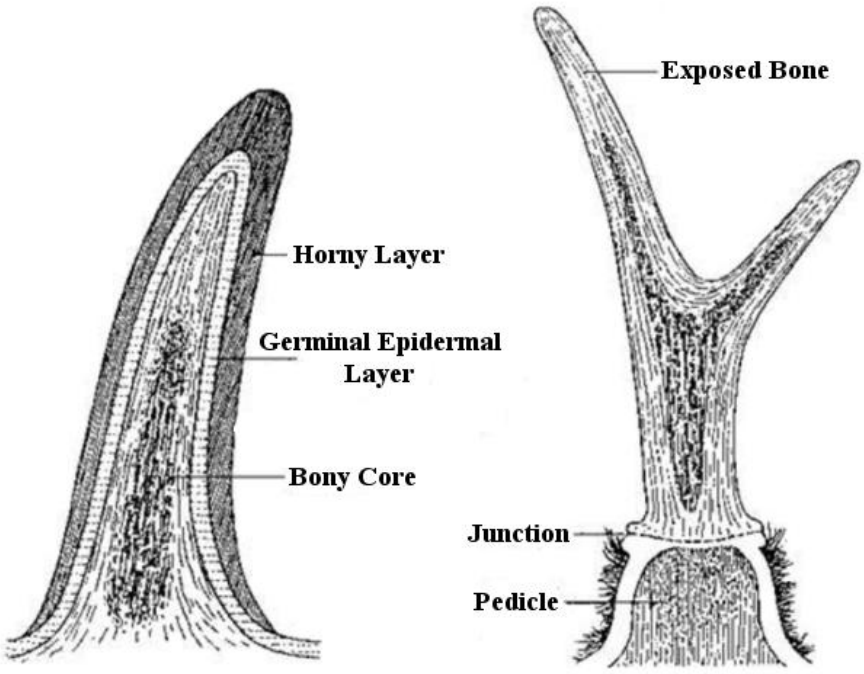

Fig 1 Differences between horn (left) and antler (right)

[1] (Page R. I., Runes, 1987), p56

Baleen

I include this simply for the sake of completeness, as it is often referred to as "whalebone" (as used in corsetry) and therefore causes confusion as it is not in fact actually whale*bone*, but a keratinous comb-like filtration system inside the whale's mouth. It was not widely used during the Early Medieval.

Historical Availability and Use

During the Early Medieval, the availability of the different skeletal materials utilised for craft varied greatly, from the very common through to the exceptionally rare.

Bone

Bone was the most widely available and utilised skeletal material of the Early Medieval. Studies of bone artefacts show that use of certain species and particular bones seem to have been preferred, or were more readily available to craftspeople.

Generally, the species whose bones were utilised for working were also common domesticated animals - sheep, cow, pig, horse and so on. Deer are one exception to this generality, though despite being one of the most commonly used wild animals, they are still much less frequently seen relative to the domesticates. Additionally, there is no evidence of any wild species being specifically hunted for their skeletons; this is not to say that the skeletons of wild species were not utilised, just that there is no evidence that their bones were the primary reason they were hunted.

Likewise, there are a number of common skeletal elements that are regularly used – shoulder blades (scapulae), metapodials (the lowest long bone in the leg of cows, deer etc, equivalent to the multiple bones in a human hand or foot and generally the most utilised bone), ulna, tibia, ribs and other similar bones that are usually not associated with food[2]. While there is some usage of the other long bones (particularly of large mammals such as cow and horse), these are primarily food orientated bones and thus can be unsuitable for working depending on how they were cooked; roasting/baking in particular will severely reduce the strength of a bone and increase its brittleness causing the bone to splinter badly at times while being worked.

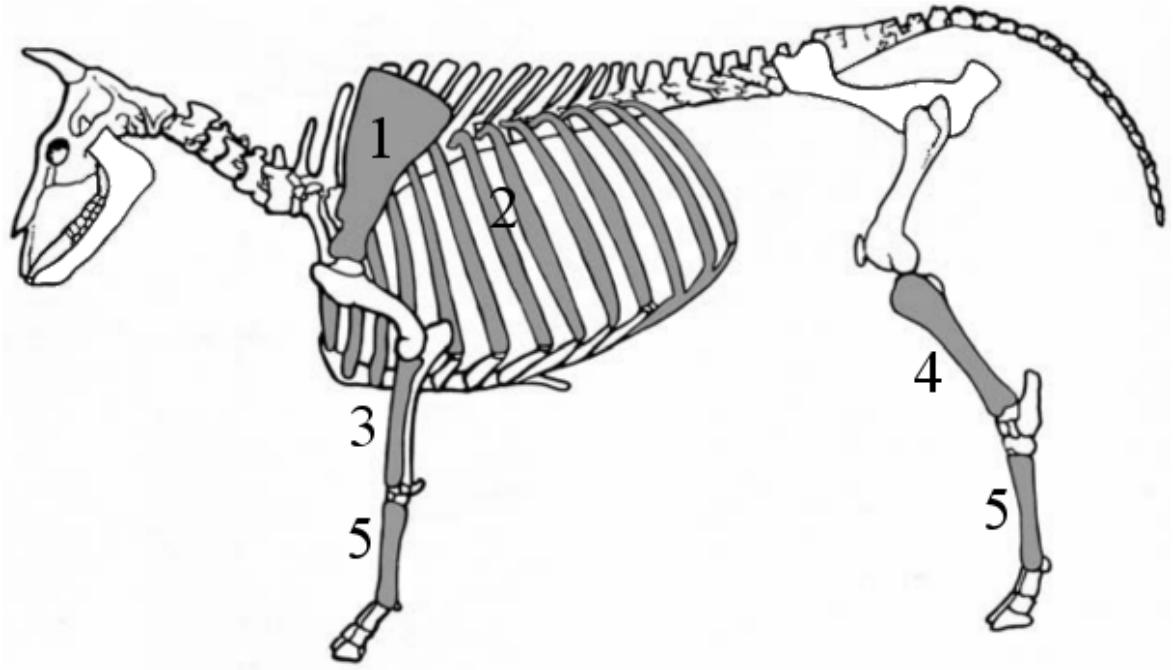

Fig 2 Main bones used for working– 1) Scapula 2) Ribs 3) Ulna 4) Tibia 5) Metapodials[3]

An interesting note regarding horse bones is that horseflesh was considered an unclean meat and therefore not edible; Pope Gregory III declared in 732 the act of eating horseflesh to be "an unclean and detestable practice."[4].

[2] (Riddler & Trzaska-Nartowski, 2011), p121-122

[3] Composite drawing, after (Riddler & Trzaska-Nartowski, 2011), p122, & (Lauwerier & Heeringen, 1995), p83

While the evidence suggests this was largely observed, it was unknown or ignored in other areas, such as the Anglian settlement of Dunbar, Scotland[5] and the crannog site at Moynagh, Ireland and even some ecclesiastical sites[6]. This prohibition meant that horse bones were not always as available as those of other, edible large mammals such as cows and deer.

Fig 3 Comparison of metadpodial size of commonly utilised animals; Horse (A), Cow (B), Red Deer (C) and Sheep (D)

Bone was utilised to make a whole range of objects; belt buckles, pins, combs (though not as common as antler), gaming pieces - pretty much all artefacts types have at least a single representative crafted from bone.

Further discussion regarding the use of the metapodials can be found in Appendix III.

Whalebone

Whale bone occupies an unusual place in the Early Medieval use of bone. Despite evidence of whaling on the continent, in the south of England it was a relatively rare material, and assumed mostly to have come from strandings[7]. The examples of southern finds of artefacts that are made from whale bone are generally very impressive - such as the Blytheburgh writing tablet[8]. However, whalebone also had more prosaic uses; vertebrae or similarly large pieces of bone from Southampton[9] and Bramber[10] show knife and axe marks indicating possible use as chopping blocks.

Further north, whalebone is far more common and much more widely utilised. Examples from Scotland vary from the mundane e.g. line strainers[11] to the exceptional such as the plaque from Scar[12].

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[4] (Harris, 1986), p96
[5] (Smith C. , 1998), p876
[6] (McCormick, 2007), p92
[7] (Gardiner, Stewart, & Priestley-Ball, 1998) p96
[8] (Waller, 1901)
[9] (Morton, 1992) p144
[10] (Gardiner, Stewart, & Priestley-Ball, 1998) p96
[11] (Curle C. L., 1982) p77 & Fig 50
[12] (Owen, Dalland, & Allen, 1999)

As for the availability of whalebone, no doubt strandings occurred in similar numbers to modern times, which would have given an easy, though infrequent supply. The Franks Casket appears to support this method of acquisition, and suggests that the material used for the casket was the result of a stranding; the runic inscription on one side has been translated as "The king of ?terror became sad when he swam onto the shingle."[13]

In addition, it is possible that there was small scale whaling activity occurring during the Early Medieval period. Aelfric's Colloquy includes a short conversation between the teacher and a fisherman; in response to a series of questions regarding his lack of desire to go and catch whales, the fisherman answers;

Forþam plyhtlic þingc hit ys gefon hwæl. Gebeorhlicre ys me faran to ea mid scype mynum, þænne faran mid m anegum scypum on huntunge hranes.

Forþam leofre ys me gefon fisc þæne ic mæg ofslean, þonne fisc ,þe na þæt an me ac eac swylce mine geferan m id anum slege he mæg besencean oþþe gecwylman.

This translates as;

Because catching whales is a dangerous business. I find it is far safer for me to go to the river with my spear than to go to the sea with many ships to hunt whales.

Because it is better for me to catch fish than to kill a more powerful one, as it could drown and kill with one blow, not only me but my friends as well.[14]

The teacher then responds by explaining that many man do catch whales and earn a lot of money, though the fisherman still maintains "*I would not dare sail on account of my fears"* Thus it would appear that some brave sailors were prepared to engage in actively seeking out and hunting whales, but the paucity of finds in England suggests that it was far from common.

It is possible that the large amounts of whalebone artefacts found in the North, and the apparent standardisation of certain objects could indicate a need for whaling to give a constant supply of materials[15]. While this has been disputed on the grounds that a single beached whale can provide a large amount of raw material[16], the fact that individual sites show multiple species over multiple phases[17] would suggest that it would be correct to assume that some whaling activity did occur in Britain during the Early Medieval even if it was confined to the North

Whalebone was most commonly used for artefacts where it was the only suitable sized skeletal material (weaving swords, plaques and so on) or for large implements that did not have to be made from metal (blubber mattocks, cleavers etc). However, there are also smaller finds of whalebone; such as the writing tablet mentioned above, and a line winder discovered in Norway[18] (and Fig 4).

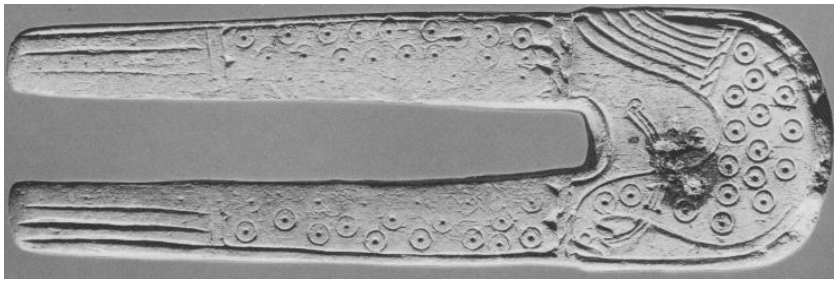


Fig 4 A whalebone line winder. Image: (Graham-Campbell & Kidd, The Vikings, 1980)

[13] (Page R. I., 1999), p175
[14] (Garmonsway, 1947)
[15] (MacGregor, 1974) p106 & (Sjøvold, 1971) p1203
[16] (Hallén, 1994) p199
[17] (Mulville, 2002) p38-39
[18] (Graham-Campbell, 1980) p12-13

Antler

Unlike bone, the species that supplied antler during the Early Medieval in Britain are restricted to just 4 - red, roe, fallow and reindeer, and of these only red and roe deer are native to Britain. Elk antler was used in some instances on the Continent but was relatively rare. Due to the small size of roe deer antler, the most common finds are of red deer antler, it being the most versatile and useful because of its larger size. There are examples of objects made in roe deer antler, but this is also in small quantities and never appears to be the preferred material[19].

The various species of deer all have different antler morphology, making it relatively easy to identify which species a complete or partial antler is from.

Fig 5 Comparison of Roe, Red, Fallow and Reindeer antler morphology (after (Rijkelijkhuzen, 2008)

Fallow deer were most likely introduced by the Romans, and probably mostly died out except for isolated pockets before being more successfully reintroduced by the Normans. The exact date of introduction and degree of post-Roman survival regarding fallow deer has been the source of much discussion[20].

Aelfric's Colloquy[21] does include a passage where the hunter describes how he catches *rann*, which is translated as fallow deer. Regardless of the date of introduction of fallow deer into Britain, there are only a small number of finds positively identified as being made from fallow antler and they are crude amulets.

Reindeer probably died out in Britain after the last glaciation as increasing temperatures caused them to move further north. However, they were still living in various northern areas of Scandinavia and their antlers filtered south through various trade routes. Finds of reindeer in Britain during the Early Medieval are restricted solely to antler – no other skeletal elements have been found. This in turn supports the idea that no reindeer were present and their antlers were imported for working, or that items made from reindeer antler were imported.

Antlers that have been previously identified as reindeer have been shown to be those of red deer, and a reference to reindeer in Caithness from the Orkneyinga Saga is now accepted to most likely be false due to the author using the terms “red deer” and “reindeer” interchangeably and having no need to distinguish between the two[22].

The antlers of the species present in Britain that were most used appear to have been shed rather than cut from carcases[23]. Evidence for this is that the majority of the burrs recovered from sites show that they were naturally shed and the base is intact rather than sawn (as you would if removing the antler from a skull). There are examples of antlers probably cut from carcases, but there was definitely a large market for shed antler[24].

[19] (Riddler, 2003) p46-47
[20] (Bendrey, 2003) p15 & (Sykes & Carden, 2011)
[21] (Garmonsway, 1947) p24
[22] (Clutton-Brocke & MacGregor, 1988) p28
[23] (Riddler & Trzaska-Nartowski, 2011) p121 and (MacGregor, 1998) p18
[24] (MacGregor, 1985) p35-36

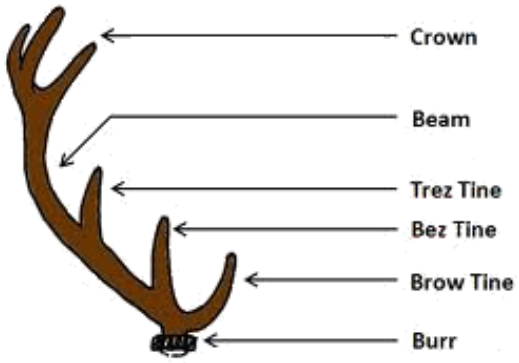


Fig 6 The parts of an antler, using a standardised red deer antler as the example.

There are other names in common use for the different parts of the antler, but the terms shown here are the ones that will be used throughout this text.

Generally antler was used for everything that bone was used for, and was the favoured material for certain items where the greater strength of antler is required, such as composite combs.

Horn

Given that horn is only available after the death of the animal, and each animal can only provide two (or four smaller ones in the case of some sheep breeds), its availability is much more restricted than bone or antler.

Owners of cattle may occasionally have a few after slaughtering some of their animals, though this would not be common, and the lack of wild animals with horns suitable for working means that horn working would usually be restricted to urban areas where it could be obtained in bulk as a by-product of the meat and tanning industries, rather than by itinerant tradesmen.

The large horns of the prehistoric Aurochs may have been found occasionally, or imported from remaining Aurochs on the continent, but would have been extremely rare. Indeed there is probably only one instance where it is noted that a find of horn could be that of an Aurochs, and that is from the great ship burial at Sutton Hoo[25]. It is also possible that the Taplow drinking horns were from aurochs.

While the actual horn is far less likely to be preserved than the other skeletal materials, the solid cores are often found on archaeological sites showing that in urban areas there was certainly utilisation of horn, though not in the same industrial manner that appears in the later Medieval period.

Horn was regularly used for knife handles during the Early Saxon period. Microscopic analysis of knife tangs has shown that horn was probably the most common material for hafting knives[26]. It was also used for flat artefacts such as combs, as well as inlay; for example, the saddle bow from York[27]. Additionally horns were used as instruments and examples have been found both in Scandinavia (Fig 7) and in Britain[28].

Fig 7 10th century horn from Västerby, Sweden (image: Dalarnes Museum website)

[25] (Evans A. C., 1989) p64-65
[26] (Cameron, 2006) p7
[27] (MacGregor, 1991) p365
[28] (Keily, 2011) and Fig 223

It has been suggested that the evidence implies that the techniques of flattening horn ready to work with were not as developed in the Early Medieval as they were in the latter medieval period[29]. This is supported by the lack of finds made from flattened horn, though that itself may be due to the poor survivability rate of horn, and the fact that flat horn items that are found, such as combs, have bone strips reinforcing them.

The use of horn is likely to have been much more widespread than the archaeological record suggests. Many of the basic items that are today made of plastic could easily have been manufactured from horn, and if the item was entirely of horn or another material with a low survivability rate (such as wood) then it would take exceptional circumstances for it to survive.

Thus many of the items that we know of from before or after the Early Medieval, or that have been found in Europe were probably crafted in Britain as well, but the finds have not survived.

Ivory and Teeth

During the Early Medieval ivory would be very rare, and mostly restricted to either fragments of imported elephant ivory or finds of mammoth tusks (or even occasionally hippopotamus teeth). In the earlier period it was certainly used (mainly as a ring for a wide necked pouch) but seems to fall out of fashion beyond the 7th century. There is a revival in the latter centuries of the Early Medieval, though the ivory used is now marine in origin and sourced from walruses and whales[30].

The teeth of various animals were used, mostly as charms or amulets[31]. Walrus teeth (and to some extent those of some whales) were used to make knife handles, gaming pieces and such. The teeth of beavers, canids (dogs, wolves, foxes) and boars were often perforated and mounted around the neck, or in some cases had a small bronze or gold fitting around the base of the root to enable the tooth to be worn.

Walrus and whale teeth would be rare, as mentioned above regarding whalebone. The teeth of other creatures though could be much more common, especially the canids. However, the majority of animal tooth pendants are very early (7th century and earlier); later finds tend to be very isolated and not a common occurrence.

[29] *ibid*
[30] (Riddler & Trzaska-Nartowski, 2011) p120
[31] (Meaney, 1981) 131-139

Period Toolkits

This chapter will cover the various tools available to the Early Medieval bone worker and will describe their provenance in Britain and Europe. Generally the techniques of how to use them are covered in the following chapter and will not be discussed here unless appropriate.

Despite the large quantity and variety of bone, antler and horn artefacts from the Early Medieval, there have been no finds of toolkits that can be categorically stated as being that of a bone worker. Possibly the closest example is a box of alder found at Birsay and most likely dating to the 8th-9th centuries[1], but the box contained only the handles of what were probably carving tools and it is also possible it was the box of a woodworker, or even that they were leatherworking tools. There are isolated finds of individual tools that are suspected to be those of a bone worker but no entire toolsets.

The reason for this is twofold. Primarily, non industrialised bone working can often require little more than a knife and possibly some additional tools that you may already have for other purposes (such as an axe or saw). Secondly, given the similarities between wood and skeletal materials, the tools that even a professional worker (such as a comb maker) would use are almost identical to those of a wood worker. Thus any number of saws, files, drills, rasps, light hammers and axes, scrapers, chisels and so on that have been attributed to being wood working tools could actually have been for bone working, or at least can be appropriated for it.

This means that a bone worker essentially has the entire corpus of Early Medieval toolsets to pick from when assembling a selection of tools for a bone working display. There are a few exceptions – a bone worker would generally have little use for heavy sledgehammers, long handled tongs or large heavy metal working tools. However, other than those examples, a bone worker can easily find a use for almost every other tool available.

Regarding references for tools: all reference for the tools mentioned in this chapter are contained in table 2.1 at the end of the chapter.

Basic toolkit

A core toolkit should include a saw, a hammer, a pair of files/rasp (1 coarse and 1 fine), a drill (bow or reciprocating), a ring-&-dot tool (see Fig 25), and a small selection of chisels. A strong, sharp knife is also a must.

Saw

These are invaluable for rough shaping and cutting down of large pieces of bone. The evidence of water material from both bone working and butchery clearly suggests that the saw is definitely a tool of the former rather than the latter. Two good examples are found in the Mastermyr toolkit (the longsaw and the hacksaw). Other examples of saws from Britain include Thetford, London and York (though technically this is actually a serrated knife).

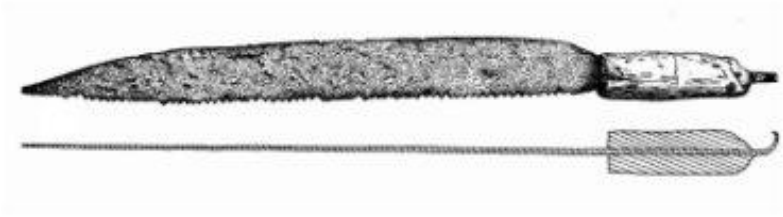


Fig 8 Mastermyr long saw, item 42. Image (Arwidsson & Berg, 1982)

Saws are difficult to make accurately and can be very troublesome to maintain at an acceptable level of sharpness. A very good stand-in can be made by cutting down an industrial hacksaw blade (or mitre saw blade for finer teeth, avoiding stainless steel) and hafting it with a suitable material. Such a blade can be suitable

[1] (Cursiter, 1885)

hafted into a piece of wood (or antler) running along the length of the blade to create a "shoulder saw" similar to the stadda in Fig 15.

When looking for reproductions of period saws for use rather than display, it is important to check the shape of the blade in profile. The saw should have parallel sides, or be slightly inclined inwards with the teeth cut into the widest part of the blade. Also, period saws are all pull saws and such have the teeth inclined as such.

Light hammer

Items such as combs will need riveting, and a good light hammer will allow you to successfully rivet without damaging your piece. Additionally, a light hammer can be very useful when carving (especially harder materials such as antler and whalebone).

A number of different hammer heads have been found from this period. Again, there are some good examples from Mastermyr as well as English sites such as Tattershall Thorpe, Thetford and York.

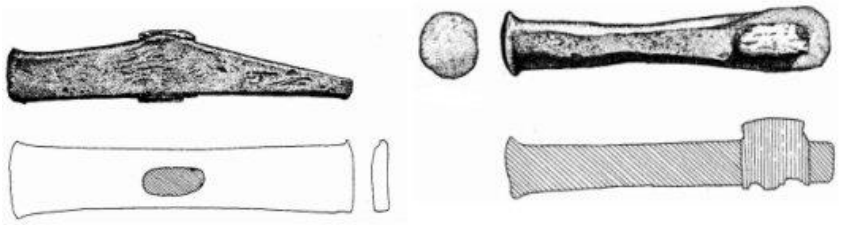


Fig 9 Mastermyr hammers, items 65 and 68 – not to scale. Image (Arwidsson & Berg, 1982)

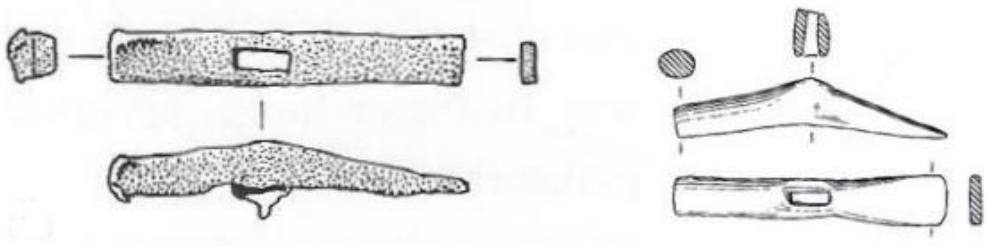


Fig 10 Hammers from Tattershall Thorpe and York – not to scale. Image (Leahy, 2003)

The example from York is particularly interesting as a light hammer due to the round cross section. It is almost unique in Britain though comparable finds have been made in Scandinavia. This Early Medieval "pin" hammer is particularly suited to light riveting.

Coarse and fine rasps

Rasps are incredibly useful when working with skeletal materials. Once the rough outline has been cut with a saw, the rasps allow you to curve edges and shape points before moving onto the finer finishing with a knife or scraper.

A larger and quite coarse rasp is excellent for taking the rough surface from antler and for rapidly shaping bone. A smaller and finer rasp is used more like a file and while it will not make much impression on antler, can usually shape born and horn quite quickly as well as finishing narrow spaces (the inside of a belt buckle for example).

As well as the ever present finds from Mastermyr , there are also a number of rasps from the British Isles. Most notable of those are the finds from York, Tattershall Thorpe and Flixborough.

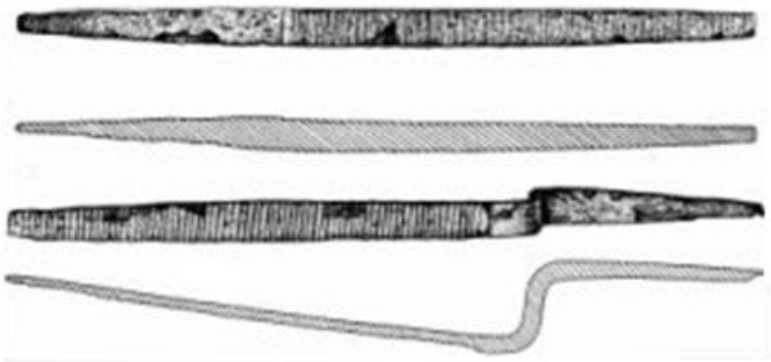


Fig 11 Mastermyr files 32 (top) and 37 (bottom) – not to scale. Image (Arwidsson & Berg, 1982)

Tongs

While many tongs are seen as blacksmithing tools, occasionally it is useful to have a pair handy for bone working, they are especially invaluable if simmering is used to prepare the material for working. If the tongs are marking the workpiece, wrapping a piece of soft leather around each of the jaws will avoid this. Leather wrapped jaws will also have an improved grip on unusually shaped items.

There are finds of tongs of various sizes from a number of sites in Britain including Tattershall Thorpe, Shakenoak, Flixborough, Ramsgate, Ballinaby and Sibertswold.

An interesting pair of tongs comes from the grave of a smith at Sæbø, Norway. At the end of one of the handles is a small projecting pin. On the other handle is a hinged bar with 13 holes drilled through it at intervals. This allows the tongs to function as locking pliers with a surprising range of jaw widths. A few of the British finds (such as Flixborough, Fig 12A) exhibit a similar hinged bar but with fewer holes and thus not allowing the same range of accuracy as the Sæbø tongs.

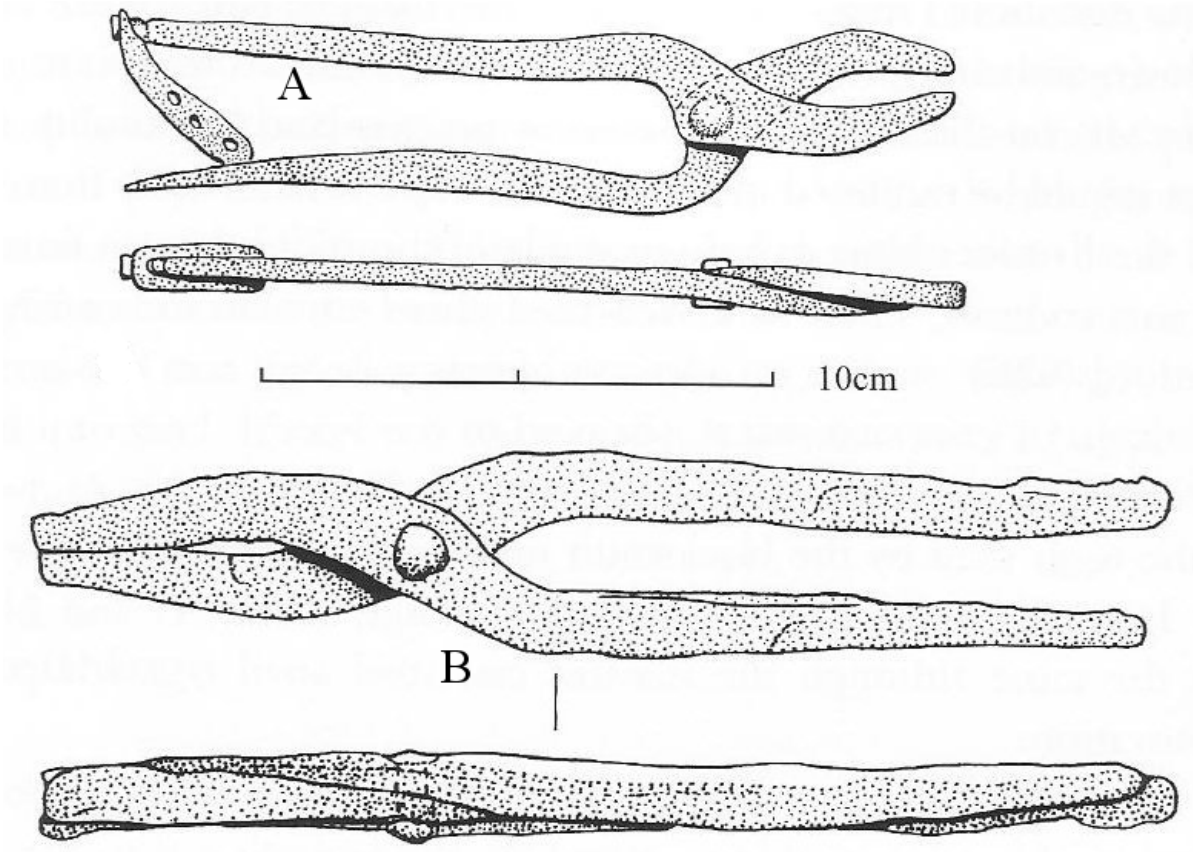


Fig 12 Tongs from Flixborough (A) and Tattershall Thorpe (B). Image (Leahy, 2003)

Drill (either bow or pump)

Drills are commonly associated with simply making holes, and while this is obviously true, they are also useful for decorating artefacts as well, as the rotary motion is excellent for quickly scribing concentric circles, thus a ring-and-dot bit is a very useful thing to have for either type of drill mentioned below.

Smaller items can be bored out with the point of a knife (and was frequently the case as demonstrated by “hourglass” shaped holes), but a functioning drill is so much easier (and looks better for an LHE display).

The two types of drill available to the Early Medieval re-enactor are the bow drill and the pump drill. While definite evidence of either is scarce from the period, evidence does exist for them in the Roman and Egyptian periods, as well as both being very basic tools that have been found more recently in native cultures that are still effectively Stone Age.

A bow drill is simply a vertical piece of wood (with a sharpened "bit" at the bottom) that has the string of a small bow wrapped around it and a freely rotating cap. As you push/pull the bow, the drill-bit will rotate anti-clockwise/clockwise and bore into the workpiece. While using the drill, pressure is applied by the hand to the top of the shaft so that the drill-bit can bite into the work.

A pump drill has the same vertical shaft as a bow drill, but the shaft passes through a horizontal piece of wood. A string is threaded from either end of the horizontal wood through a groove in the top of the vertical. This is then "wound" up so that the horizontal wood is near the top of the vertical. As the horizontal bar is pushed down, the wound string causes the vertical shaft to spin and bore a hole. A circular weight surrounds the bottom of the vertical shaft and acts as a flywheel.

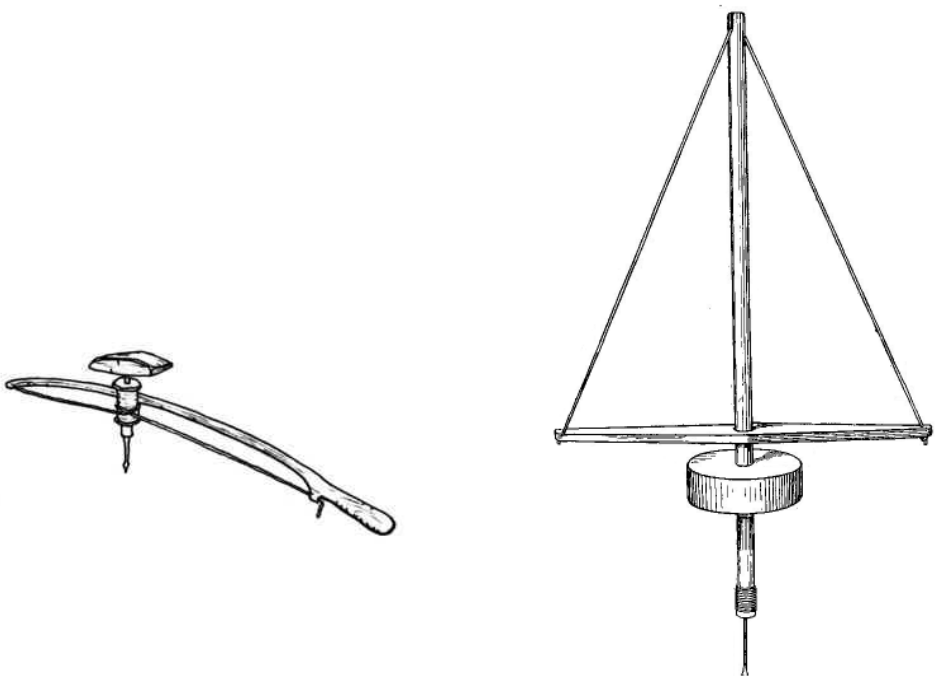


Fig 13 A bow drill (left) and a pump drill (right)

Chisels

Early Medieval artefacts are usually covered in decoration, and even the simplest bone item is no exception. As well as the very common ring-and-dot found on many items, there are often more intricate designs as well. Thus a small variety of chisels is an important part of any bone worker's toolkit.

As well as the many reproduction chisels available, it is also possible to make your own with relative ease. Small tools such as engineers’ scribes can be easily obtained and once hafted suitably (with ideally horn, antler

or a hard wood) make first rate flat bone carving chisels. They will often keep a good enough edge to be used by hand and not require the use of a hammer.

In addition to flat bladed and skew chisels, small "U" and "V" gouges are very useful. These can be a little harder to easily come by, and usually it is simply easier to buy some small, good quality wood carving chisels and re-haft them. The contents of the Birsay box shows a good range of handle sizes and shapes for small carving tools.

Larger chisels are known from across Britain, and have been found with differing hafting methods; a find from York is tanged, one from Nazeing is a solid one piece chisel and a chisel from Crayke is socketed.

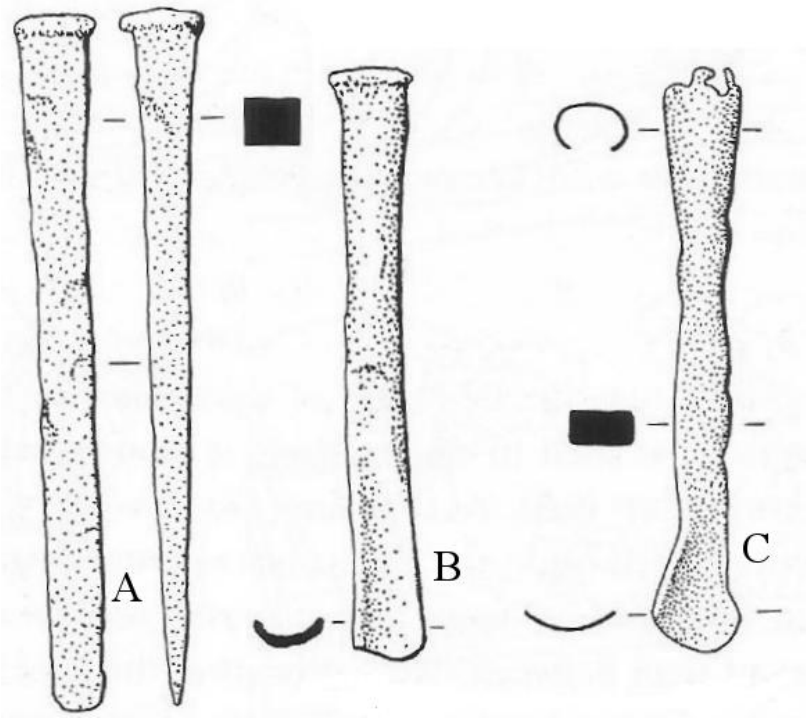


Fig 14 Solid chisels from York (A) and Nazeing (B), and a socketed chisel from Crayke (C) – not to scale. Image (Leahy, 2003)

NOTE REGARDING USING MODERN HAND-TOOLS: In the Early Medieval, tools were simply pushed into a handle and occasionally held with a basic ferrule, there is no evidence for the use of modern style metal ferrules. Thus modern wooden handled tools need any ferrules removing and when re-hafting modern tools be sure not to add ferrules unless you are certain that they are acceptable for the period. It is easiest to ignore ferrules and just bore tang holes in new handles slightly smaller than the tang, and use friction/glue to firmly hold the blade into the haft.

Useful Additions

Depending on your preferred area of bone working (or you simply wish to have a more complete display), there are further tools that may be useful. While none of these are essential, except possibly for certain specialist activities such as comb making, they will go towards making a more complete and interesting display.

Double bladed saw

While double bladed saws have not been found, there are a number of factors that point to their existence. Finds from both York and Hedeby have shown evidence of saw cuts rather than knife cuts (the cuts are straight sided and flat bottomed rather than V in section) and they are spaced equally apart, suggesting that some kind of regular spacing was used[2]. A simple way to achieve this result is through using the double bladed saw.

Twin bladed saws can also be used to ensure that the teeth on a comb are set apart evenly.

[2] (MacGregor, 1985)

Depending on the saw's purpose, it can either be an exceptionally simple, or rather complicated tool.

If it is only to be used for decorating items, then the handle can be solid and the two blades simply set into a pair of parallel grooves running down the length of the tool.

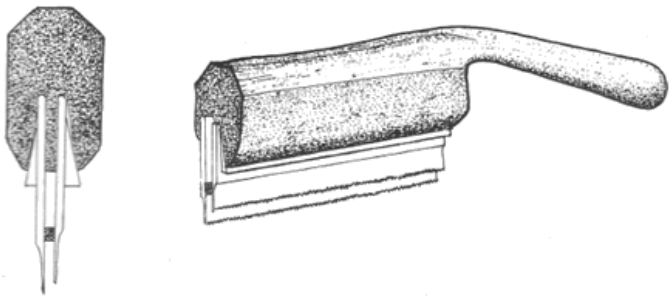


Fig 15 Solid twin bladed saw for cutting decorative lines. Image (MacGregor, 1985)

However, if the saw is to be used for cutting teeth in combs then it needs to be slightly different as there must be clearance for the blades to cut deep into the tooth plates. A design for a tooth cutting double saw is shown below. The handle is based on the antler saw handle from York (Fig 79).

Fig 16 Double saw based on the York find

Small Axe

A small, lightweight axe is a valuable addition to a bone workers toolkit. Rough shaping of whale bone, horn and larger pieces of antler and bone can be quickly carried out with a good axe.

Axe shapes such as 62 from Mastermyr are especially good for bone working. The blade does not want to be too heavy or large; a smaller axe will do a sufficiently good job with skeletal material, especially if it has been softened first.

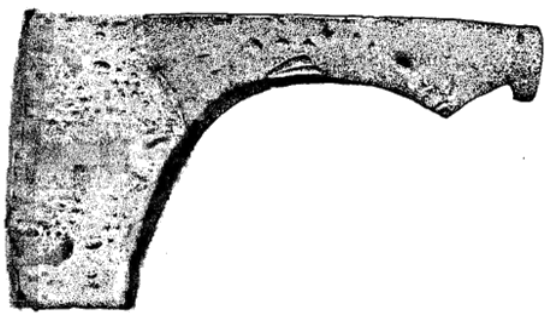


Fig 17 Axe from Mastermyr; unfolded. Image (Arwidsson & Berg, 1982)

Wedges

The long bones of large mammals, most whalebone and some antler can be split with relative ease using wedges placed into a pre-existing saw cut. Thus a set of differing size iron wedges is a useful addition to the bone workers toolkit.

Iron wedges have been found at York as well as the smith grave from Bygland, though it is important to remember that tools often have multiple uses, and the burring over found on the rear of some of the Mastermyr and Flixborough axe heads indicates that they were also used as wedges at times. Wedges of other materials can also be used. Hardwood wedges have been found in York, and should be sufficient to split material where the harder surface is pre-cut and it is only the cancellous tissue that requires splitting. An example from Hedeby is an antler that had been cut and then a bone wedge was used to split the antler[3].

Draw Knife

When finishing bone, horn or antler, few tools will give such a pleasing finish as a draw knife. While not essential for day to day working, draw knives are a must when crafting anything that involves a long length – e.g. comb side plates. They are also very useful for smoothing antler beams.

Draw knives (and similar blades), are known from Sandtun, Ramsbury, the Stidrigg and Hurbuck hoards, and three possible draw knives from recent excavations at Lyminge in Kent.

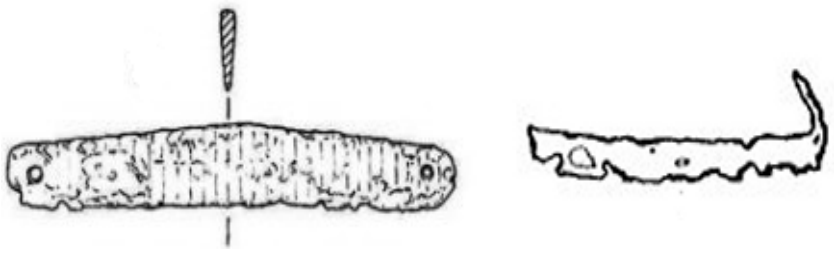


Fig 18 Draw knives from Thwing (left) and Sandtun (right) – not to scale. Images: (Ottoway, The products of the Blacksmith in Mid-Late Anglo Saxon England, 1995) and (Wilson, "Craft and Industry", 1972)

Shears

While not generally considered a tool of the bone worker, shears occupy a particular niche within the craft; that of cutting hot horn.

As noted in the following chapter, the usual method of cutting horn recorded in recent centuries was to cut the horn in a particular way with a saw, before heating. However, it is also possible to heat the horn first and then use a pair of shears to quickly cut and trim the horn to the required shape while it is still pliable.

Due to the ease with which hot horn can be cut, shears do not need to be particularly sharp to be effective. Use of shears in this manner would also avoid clogging a saw blade with horn unnecessarily.

Shears and snips were also a tool of non-ferrous metal workers. As such, finds of shears are relatively abundant in the corpus of Early Medieval tools. Some of the larger wool shears would also be more than adequate for cutting hot horn.

A number of suitable examples of potential horn cutting shears exist. In England finds from York and Tattershall Thorpe are good examples. While they are a little large for horn work, the plate shears from Mästermyr are an excellent example, with the offset handles making them especially good for keeping the hand clear when cutting a larger horn.

[3] (MacGregor, 1985) p57

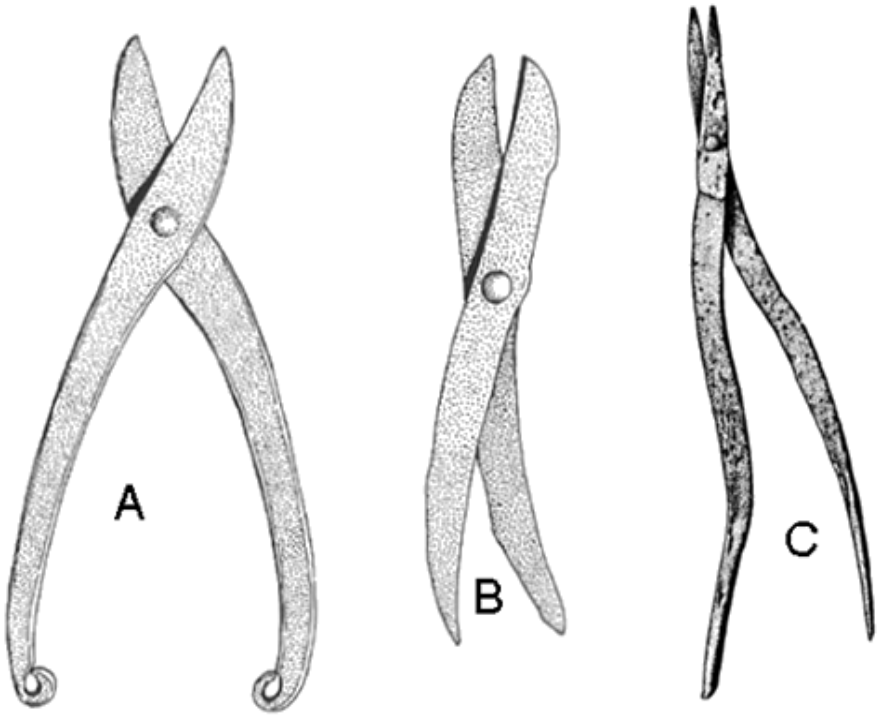


Fig 19 Shears from York (A), Tattershall Thorpe (B) and Mästermyr (C) – not to scale. Images: (Leahy, 2003) and (Arwidsson & Berg, 1982)

Spoon bit Auger

Augers have limited use for bone working, though for a few applications they cannot easily be replaced by anything else - hollowing out an antler to haft a blade for example.

Due to the relatively soft nature of the material, unless you are boring through solid bone or antler, there is no need to have a complex hafted auger. It is perfectly possible to use a simple twist auger and achieve the same result; though for later period (11th century) it would be acceptable to use a breast auger for larger work pieces.

Auger bits of various sizes are quite common and have been found at Flixborough, Hurbuck, York and Stidrigg as well as numerous other sites around Britain.

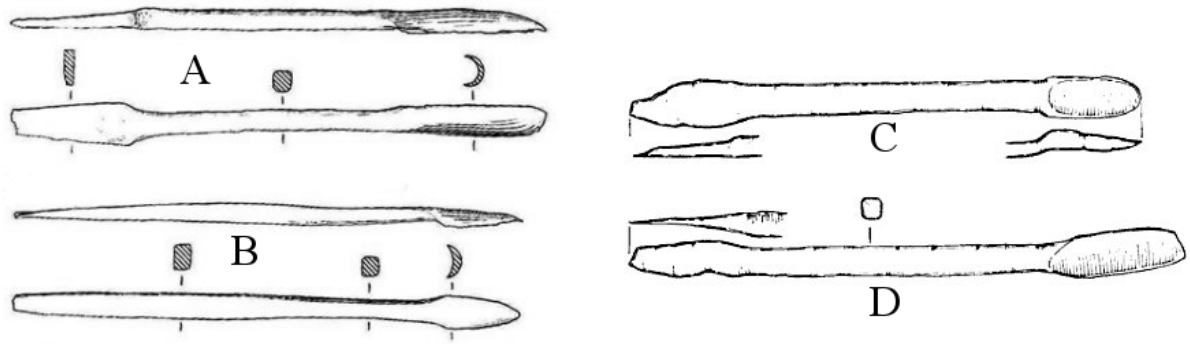


Fig 20 Spoon bit augers from York (A+B), Hurbuck (C) and Westley Waterless (D) – not to scale. Images: (Ottoway, 1995) and (Wilson, 1972)

Wooden Mallet

While a metal hammer has weight behind it, the hard surface will mark skeletal material and so makes it unsuitable for direct use on bone and such. Likewise, a metal hammer is less than ideal for use with a hafted chisel. In those circumstances it is better to use a wooden mallet similar to those used by carpenters.

Mallets can be turned on a lathe, in which case they resemble the "beetles" used in linen production. Alternatively, they can be assembled from separate head and handle as with the York find, which had a hazel handle and a willow head.

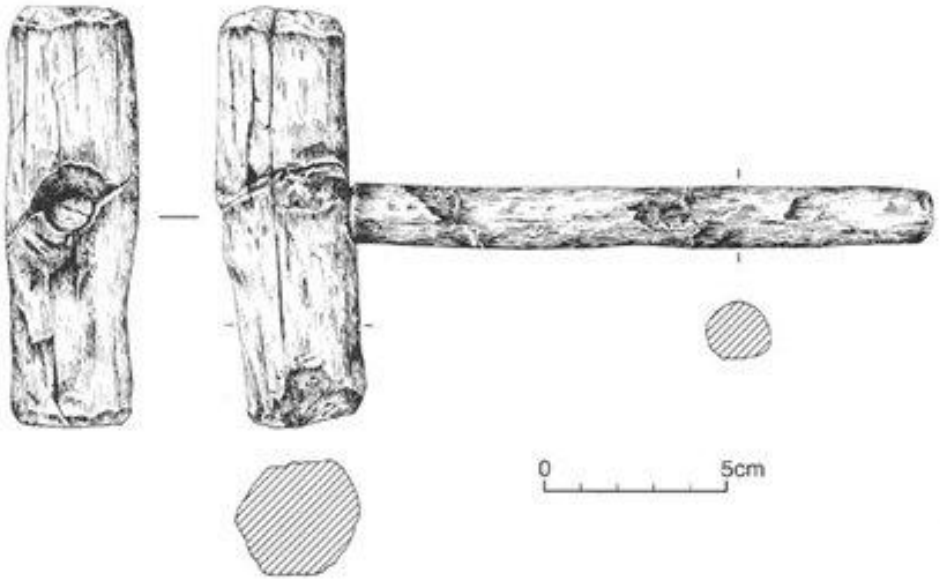


Fig 21 Willow and Hazel mallet from York. Image: (Leahy, 2003)

Clamps

There are a number of finds of small composite objects made from antler, or occasionally other materials, from throughout the Early Medieval. Their exact function is unknown, though it has been suggested that they are small clamps.

The objects comprise a pair of D section pieces that are either slightly curved or angled in both directions from the centre. The two pieces are laid face to face and an iron rivet through the centre holds them together. It is suggested that small work pieces such as buckles can be firmly held in the more open end while a wedge driven into the rear will exert pressure on the work piece and hold it in place.

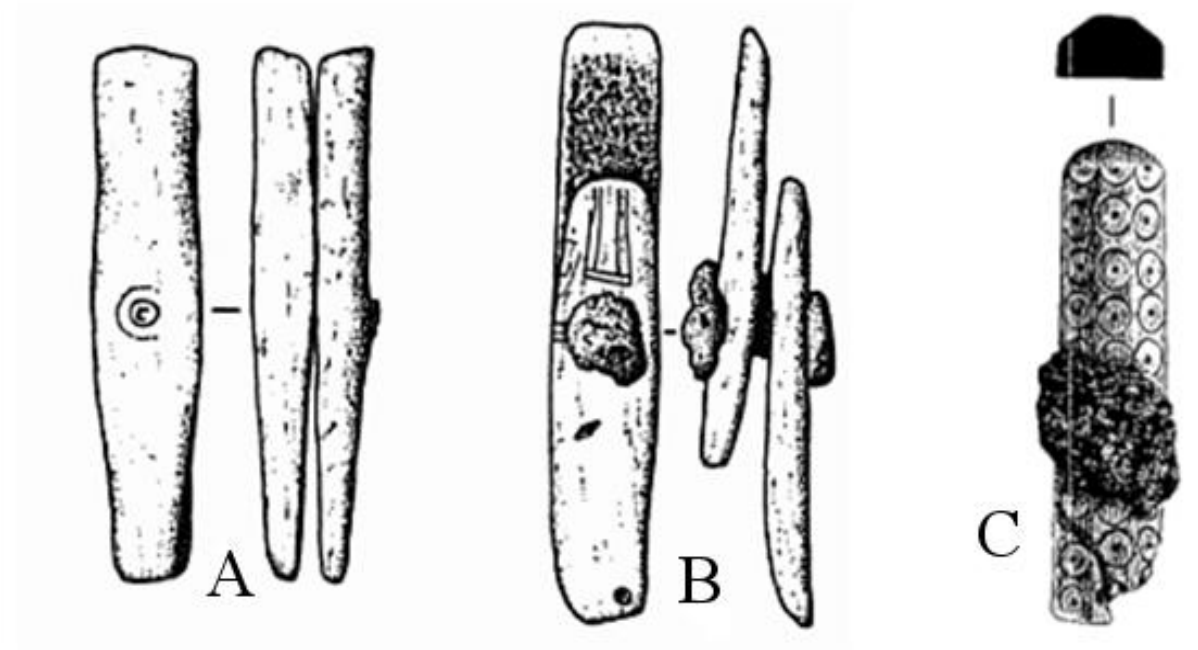


Fig 22 Antler clamps from Hedeby (A+B) and one of whalebone from the Brough of Birsay (C) – not to scale. Images: (MacGregor, 1985) and (Curle C. L., 1982)

Anvil

An anvil is particularly useful for comb manufacturing, though is occasionally useful for other bone working activities.

Due to the nature of the tasks it is needed for, a bone workers' anvil can be relatively small and light - after all, it is only supplying a flat surface for light riveting, not supporting hot iron as it is hammered. A good substitute for a metal anvil is a flat hammer head or heavy smooth stone such as granite.

Suitable anvils have been found at York and in the Tattershall Thorpe grave.

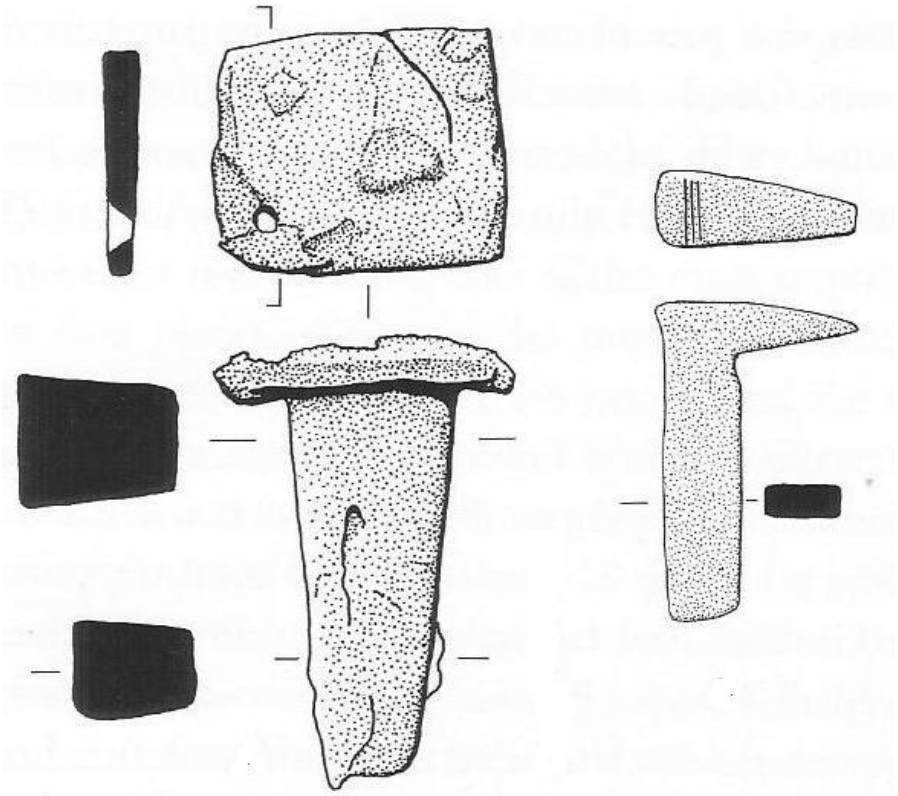


Fig 23 Anvils from Tattershall Thorpe (left) and York (right) – not to scale. Image: (Leahy, 2003)

Plane

The plane is another item more commonly associated with woodworking, though it is also very good at smoothing and finishing skeletal material as well.

As with saws, British finds of Early Medieval planes are scarce. However, also as with saws, there is a find from the start and the end of the period. The earlier find, the 6th-7th century example from Sarre, Kent, discovered in 1863, is a small "thumb" plane, with a bronze sole plate and an antler body.

The later finds come from Dublin and are a pair of planes, one partial and one complete. The complete example is approximately 400mm long and was found in an antler waste area. The examples from Dublin are 11th century in date.

The plane from Sarre is most usable in a bone working context, though the larger plane from Dublin could also have uses (particularly for comb making).

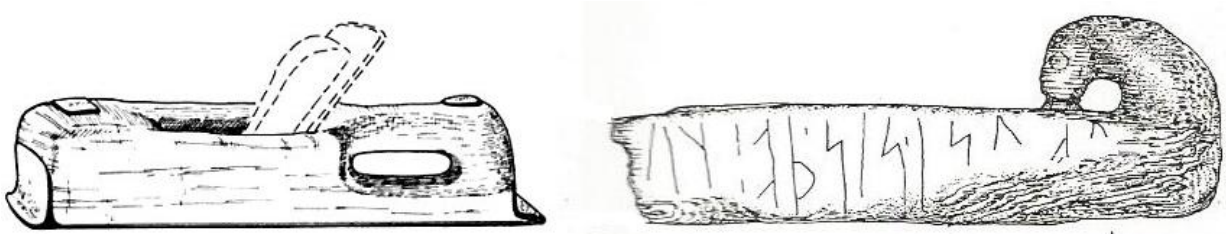


Fig 24 Planes from Sarre (left) and Dublin (right) – not to scale. Images: (Dunning & Goodman, 1959) and (Lang & Caulfield, 1988)

Decorating and Marking tools

The edge scribe and ring-and-dot tools are both very useful for making simple but effective decoration and are probably the most "basic" decorative tools available.

Despite the lack of finds of these tools in Britain, the sheer number of finds with R&D decoration that is tool cut makes it clear that they must have existed and have either been recycled in antiquity or have corroded so much that they have been wrongly identified after excavation.

Some of the few finds of ring-and-dot tools are from settlements at Staré Město and Levy Hradec. The finds are of a bit that was most likely hafted and used by hand rather than used with a drill. The tool itself is similar to a long nail, with a flattened end. This flattened end is then filed to produce three short prongs as the cutting edges.

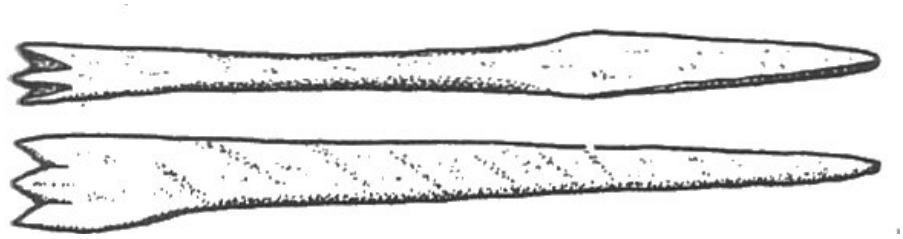


Fig 25 Ring-and-dot tools from Staré Město and Levy Hradec. Image: (MacGregor, 1985)

No examples of edge scribing tools have been found, but due to the small size of the blade it is unlikely that they would survive being buried. However, some finds display scribed lines that would be most easily made using such a tool.

Fig 26 Edge scribe tool

Miscellaneous smoothing and polishing items

This is not a single tool as such, but a selection of items to aid with smoothing work pieces is useful to have. Items such as;

- Small sandstone blocks of varying degrees of coarseness
- A pumice stone for very fine smoothing
- Dogfish skin (dried and salted)
- An assortment of small leather pieces, either to be used on their own, or dampened and used with ground pumice or sand

- A block of beeswax and square of linen. Over time the linen will become impregnated with beeswax and will produce a good finish without the addition of more wax.

None of these have been definitely found in context with a craftsperson's grave as "tools". There have been a few finds of pumice and sandstone in graves, but nothing that can be proven to have been used in this way. Likewise, small pieces of leather buried in a toolbox would simply rot and disappear.

Larger Equipment

As well as the basic and expanded toolkits, a bone worker may occasionally have use for some slightly larger pieces of kit. These not only make certain tasks a lot easier, but are also substantial showpieces for a craft that doesn't have a large central piece of kit such as a warp weighted loom, forge etc.

Shave Horse or Lap Shave

The shave horse and lap shave (or bodgers board) are very similar to each other and both derived from the same necessity - that of holding a piece of work still whilst working on it. Although both are generally associated with chair bodgers and their ilk, the same principles apply to bone working and they are equally useful when filing antler, scraping horn and so on as they are for using a spoke shave to finish a chair leg.

While evidence is lacking for either of these devices from the Early Medieval, they are known in history (earliest definite evidence is documentary from 1485) and the fact that they are of an all wooden construction means that the chances of finding definite remains of one would be slim. However, the shave horse and draw knife are often used together in many crafts and it is difficult to see how tooth plates etc could be smoothed with a draw knife (which we know they were) without using an item similar to a shave horse.

A shave horse is a free standing piece of equipment, with a general design that looks something like Fig 27.

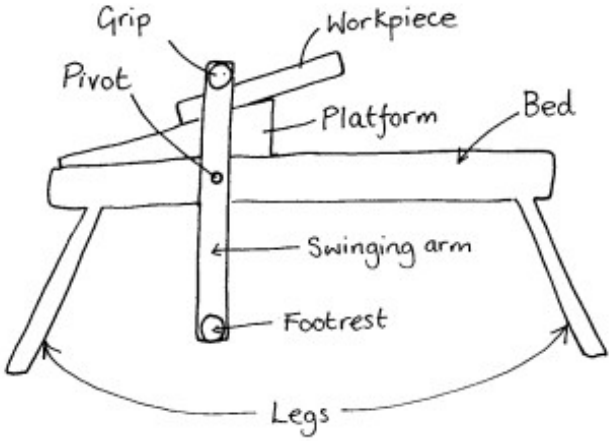


Fig 27 Generic Shave Horse. Image: Living Woods

A lap shave is almost like the front half of a shave horse, with the rear provided by the worker sat on a stool. A band of leather or strong cloth loops around the user's lower back to support the weight of the lap shave. A basic lap shave is shown below.

The basic principle behind both is the same – the work piece is placed on the platform, the worker sits towards the rear of the piece and pushes the footrest forward. This lowers the grip onto the piece and holds it in place while it is being worked on.

The grip can be shaped if required so as to grip certain items more firmly, as well as placing leather strips on both the grip and the platform in order to grip unusually shaped objects.

As both of these work on a combination of friction and pressure applied by the feet, there is a limit to how tightly the work can be held (hence the most common use being in green woodworking). Thus the use of these is better suited to tasks where the work piece is unlikely to be snagged or pulled.

They are perfect for finishing work, draw knifing and coarse rasping (if the rasp is sharp enough to cut cleanly), but are less useful for holding work to be sawn (due to the angle at which it is held).

Lathe

There are two styles of lathe that would be available for Early Medieval bone workers - the bow lathe and pole lathe. The principle behind both is the same; a cord wrapped around a work piece or around another block that is attached to the work piece. The cord is then moved either by hand (bow lathe) or by a combination of the foot and a springy branch (pole lathe).

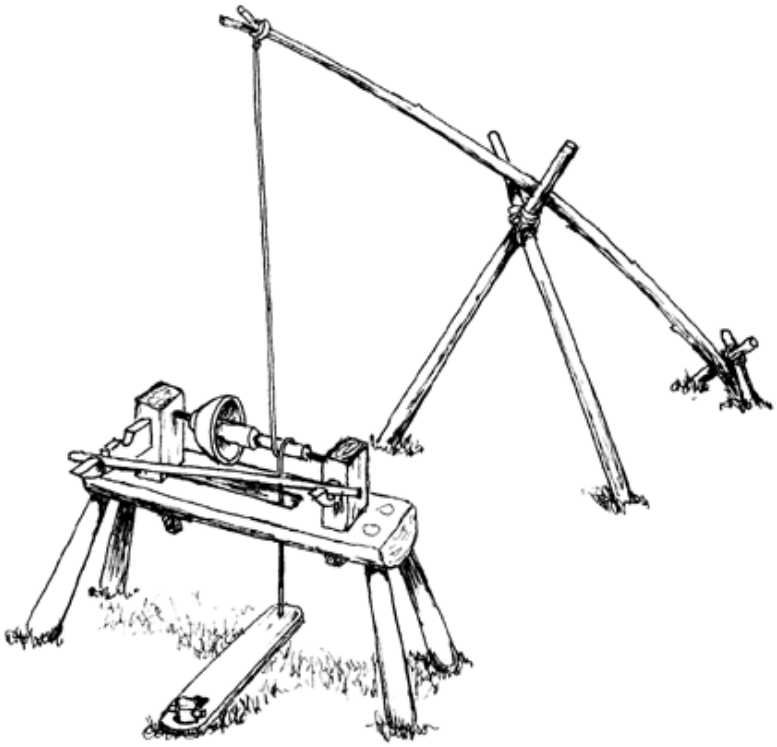


Fig 28 Pole Lathe

Due to the way they function, bow lathe are better suited for smaller items such as spindle whorls or gaming pieces, whereas the pole lathe works better for larger objects.

There is no direct evidence for either style of lathe in the period, though there is indirect evidence in the form of obviously turned objects such as the spindle whorls mentioned above. Also, pictorial evidence from early periods shows the use of such lathes. Additionally, a find from York has been interpreted as a long hooked tool (Fig 29) for use with a lathe, though this most likely to be for use with wood; skeletal material would probably just be cut using small chisels and knives.

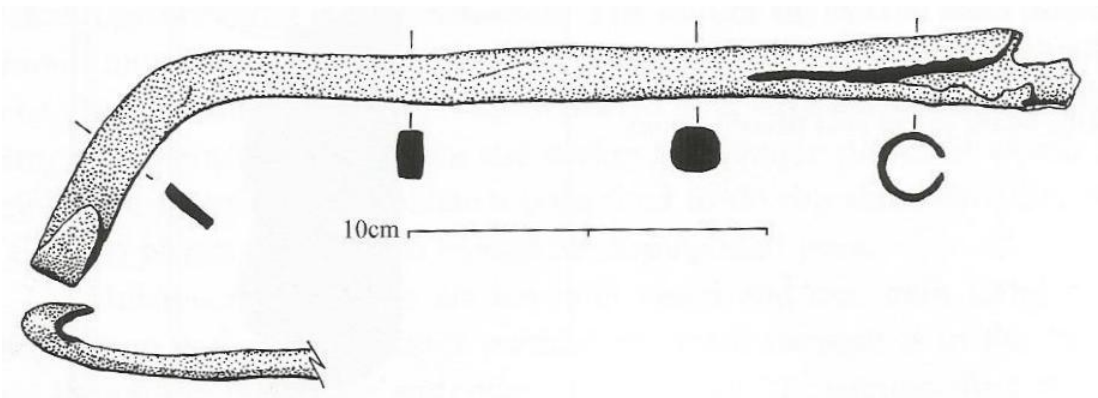


Fig 29 Possible turning tool from York. Image: (Leahy, 2003)

Dates of Described Tools

This table covers the tools discussed in this chapter, giving dates and sites for the finds.

Table 2.1

Date (C)	Tool	Site
9th - 10th	Adze	Hurbuck, County Durham, England, (Wilson, 1972)
7th	Anvil	Tattershall Thorpe, Lincolnshire, England, (Hinton, 2000)
9th - 10th	Anvil	York, Yorkshire, England, (Ottoway, 1992)
8th - 10th	Axe	Flixborough, Lincolnshire, England, (Evans, Loveluck, & Archibald, 2009)
10th - 11th	Axe	Mästermyr , Gotland, Sweden, (Arwidsson & Berg, 1982)
9th	Chisel	Crayke, Yorkshire, England, (Ottoway, 1995)
10th - 11th	Chisel	York, Yorkshire, England , (Ottoway, 1992)
10th - 11th	Chisel	Nazeing, Essex, England, (Morris, 1983)
9th – 10th	Clamp	Brough of Birsay, Scotland, (Curle C. L., 1982)
8th – 11th	Clamp	Hedeby, Denmark (Ulbricht, 1978)
8th – 9th	Draw Knife	Thwing, Yorkshire, England, (Ottoway, 1995)
7th - 9th	Draw Knife	Lyminge, Kent, England, (Ottoway, 2012)
8th - 9th	Draw Knife	Stiddrigg, Dumfriesshire, Scotland, (Leahy, 2003)
8th - 10th	Draw Knife	Ramsbury, Wiltshire, England, (Haslam, 1980)
9th - 10th	Draw Knife	Sandtun, Kent, England, (Wilson, 1972)
9th - 10th	Draw Knife	Hurbuck, County Durham, England, (Wilson, 1972)
7th	File / Rasp	Tattershall Thorpe, Lincolnshire, England, (Hinton, 2000)
8th - 10th	File / Rasp	Flixborough, Lincolnshire, England, (Evans, Loveluck, & Archibald, 2009)
10th - 11th	File / Rasp	Mästermyr , Gotland, Sweden, (Arwidsson & Berg, 1982)
10th - 11th	File / Rasp	York, Yorkshire, England , (Ottoway, 1992)
10th - 11th	Hammer	Mästermyr , Gotland, Sweden, (Arwidsson & Berg, 1982)
10th - 11th	Hammer	York, Yorkshire, England, (Ottoway, 1992)
11th	Hammer	Thetford, Norfolk, England, (Rogerson, Dallas, & Archibald, 1984)
10th	Mallet	York, Yorkshire, England, (Morris, 2000)
6th	Plane	Sarre, Kent, England, (Dunning & Goodman, 1959)
11th	Plane	Dublin, Ireland, (Lang & Caulfield, 1988)
9th	Ring-and-dot tool	Staré Město, Czech Republic, (MacGregor, 1985)
9th - 11th	Ring-and-dot tool	Levy Hradec, Czech Republic, (MacGregor, 1985)
4th - 5th	Saw	Icklingham, Suffolk, England, (Wilson, 1972)
8th – 9th	Saw	London, England, (Leary & Brown, 2004)
10th - 11th	Saw	Mästermyr , Gotland, Sweden, (Arwidsson & Berg, 1982)
12th	Saw	Thetford, Norfolk, England , (Rogerson, Dallas, & Archibald, 1984)
7th	Shears	Tattershall Thorpe, Lincolnshire, England, (Hinton, 2000)
10th - 11th	Shears	York, Yorkshire, England, (Ottoway, 1992)
10th - 11th	Shears	Mästermyr , Gotland, Sweden, (Arwidsson & Berg, 1982)

8th - 9th	Spoon Auger	Stiddrigg, Dumfriesshire, Scotland, (Leahy, 2003)
8th - 10th	Spoon Auger	Flixborough, Lincolnshire, England, (Evans, Loveluck, & Archibald, 2009)
10th-11th	Spoon Auger	Westley Waterless, Cambridgeshire, England, (Wilson, 1972)
10th - 11th	Spoon Auger	York, Yorkshire, England, (Ottoway, 1992)
9th - 10th	Spoon Auger	Hurbuck, County Durham, England, (Wilson, 1972)
7th	Tongs	Tattershall Thorpe, Lincolnshire, England, (Hinton, 2000)
7th	Tongs	Sibertswold, Kent, England, (Fausett, Smith, & Mayer, 1856)
6th – 7th	Tongs	Shakenoak, England, (Wilson, 1972)
8th - 10th	Tongs	Ramsbury, Wiltshire, England, (Haslam, 1980)
9th	Tongs	Sæbø, Sogn, Norway, (Lorange, 1889)
9th – 10th	Tongs	Ballinaby, Islay, Scotland, (Graham-Campbell & Batey, 1998)
6th	Wedge	Sarre, Kent, England, (Wilson, 1972)
Poss. 9th	Wedge	Bygland, Telemark, Norway, (Blindheim, 1962)
10th - 11th	Wedge	York, Yorkshire, England, (Ottoway, 1992)
10th - 11th	Wood Turning Tool	York, Yorkshire, England, (Benson, 1906)

Techniques and methods of working

This chapter discusses the various techniques and methods used to work bone, antler and horn, from the initial piece of material to the finished item. While the tools are mentioned, they are not discussed in any great detail as that was the focus of the previous chapter.

As they are natural, all skeletal materials will differ from each other. Just as wood has knots and such, thus bones will have unexpected thin areas, horn will have trapped dirt (which can form a pocket or bubble in the layers) and antlers will have hidden cracks from not having been collected soon enough after they were shed. These are just some of the variables to take into account when working with skeletal materials.

The nature of the various materials also gives them different properties and certain materials are better for specific applications than others.

Bone and horn both have a very pronounced grain and thus must be worked along this grain. This is especially important with bone; any objects that will have stress placed on them (needles, comb teeth etc) should always be made with the grain running vertically so as to retain the strength of the bone. Horn grain is less of an issue regarding structural strength but is more problematic when finishing an item; depending on the quality of the horn, sanding or scraping across the grain can raise a "fluffy" surface that then must be removed by scraping down the grain.

Antler also has a grain, though it is far less noticeable than in either bone or horn. However, for the sake of avoiding mistakes, the same rules should be applied regarding the cutting of items that will have stress upon them.

Preparing and Roughing Out

The first step of crafting any artefact is preparing and roughly shaping the material to reasonably resemble the finished item. There were a variety of methods used in the past for this preparatory stage.

Smaller bones and such can easily be cut by hand using a saw or a sharp knife (a modern hacksaw or coping saw is excellent for this), while larger elements can be roughed out using a small axe or even adze depending on the intended function of the item. Axe and saw marks are found on numerous examples of bone working waste, usually the bases of antler or horn cores where the material has been removed from the skull.

Bone will often split easily along a scored line, and it is possible to cut across the top of a long bone (where the ends have been removed leaving only the shaft), score down either side, then use a broad wedge or chisel to split the bone neatly into two. Sure signs of bone working on a substantial scale at an archaeological site are concentrations of the ends of cannon bones from preparation for splitting.

Antler will also split, though it is harder and will not always produce a neat finish. A piece of antler from Hedeby demonstrates this – a wedge cut from a tine was used to longitudinally split a pre-scored antler beam[1].

Additionally, there are finds of bone and antler that show the shaft had been partially cut before being rotated and cut again to prevent the saw blade binding in the kerf[2]. This process was repeated until all of the denser outer tissue was severed leaving only the cancellous central tissue remaining, this could then be twisted or broken by hand or a wedge, as can be seen on many examples of cut antler.

Due to the way horn is layered and because the grain does not run perfectly parallel in every layer, it is not usually possible to split horn using wedges. However, by making a series of cuts around the horn, it is possible to prepare it to then open the horn out into a flat, approximately rectangular sheet ready for further working. It is also possible to split horn into sheets as it de-laminates. The process of de-lamination needs to be started by

[1] (MacGregor, 1985) p57
[2] (MacGregor, 1985) p55

soaking the horn in water. Depending on how de-laminated the horn is before immersion, full de-lamination can take anywhere from a week upwards.

Once the work piece is cut from the whole, it can be quickly brought down to an approximation of its final shape using coarser rasps (farriers rasps are excellent for this), or even an axe if it is of a suitable size. The innate strength of skeletal material means that depending on how closely the rough shape matches the final item, the finer shaping can take a very long time if too much excess is left. Thus it is suggested that the rough shape be as close as possible to the final shape.

When working with rasps and such, it is important to always be aware of the angle of grain on the material. As with wood, rasping against the grain can catch the open grain and split it. This is especially a problem with bone because of its structure.

Generally it would be recommended not to use draw knives and the like for this stage. When used with skeletal material, they are better suited to a finishing role rather than rapid removal of waste. An exception to this is when working with antler that has been softened, a draw knife can rapidly remove the rough outer surface if the antler is soft enough.

Shaping and General Working

After the blank of the item has been roughly shaped it can be then more carefully worked to bring it to its final state. Knives, fine files and draw knives are all acceptable tools for this stage. As with the rough shaping, it is important to always go with the grain wherever possible. Sometimes an exceptionally sharp blade can manage to slice *through* the grain from the wrong direction, but usually it is better to go *with* it.

Smaller items such as pins, needles, belt fittings and so on are usually best worked in the hand with a strong knife. If required, they can also be held in a clamp or pair of locking tongs to allow both hands free to hold the tool. Slight modification to the grips of a shave horse will allow it to hold a clamp steady. Larger items can be held in a shave horse and worked on with rasps and draw knives.

Softening

Generally, skeletal materials are easier to work when they have been slightly softened. The manner by which they can be softened varies depending on the material and the degree of softening required.

Bone can be made slightly softer and easier to work simply by soaking in water. Once thoroughly soaked, the bone will cut more smoothly and can be scraped without creating so much dust. As it begins to dry out, periodic re-immersion will keep it damp enough to work. Usually my personal collection of needle blanks is kept permanently in a container of water until needed for precisely this reason.

Antler and horn can also benefit from soaking to make them easier to work cold. Horn can be made substantially more workable via various hot work techniques which are described later.

Antler which is boiled for around 15-20 minutes after prolonged soaking is much easier to carve and will produce true shavings from a chisel, rather than a series of small flakes. The softer nature of the boiled antler also means that the cutting tool will retain an edge for longer.

Horn is best softened by heat. This is covered in a later section.

As well as water, various solutions have been used in the past to soften the various materials. While not all of these have definite evidence of use in the Early Medieval, it is safe to assume that many techniques will have seen continuous use from the Stone Age.

The various softening treatments that have been noted are; cold water, water and sorrel solution, sour milk, formic acid, water and ash solution (lye), urine and boiling water[3].

NOTE: Many softening methods, whether chemical or heat based, can reduce the strength of the material over time. Be careful not to boil skeletal tissues or immerse them in chemicals for prolonged periods.

Drilling

There are three main ways of making holes depending on the size and neatness of the hole required. The simplest is to use the point of a sharp knife and twist it until a small hole is bored through the piece. Depending on the thickness of the material a knife can easily create a larger hole if required, especially in thin horn. A knife can also be used to achieve a countersunk effect on pre-existing holes to round the entry and exit - such as suspension holes on a pendant. This creates an "hourglass" shaped perforation that is seen on many finds.

Medium sized holes can be drilled using a bow or pump drill. This would be the usual way of drilling rivet holes for items such as combs.

Finally, large suspension holes and any other hole greater than about 3mm can be made using a spoon bit auger. Generally these will have little effect on skeletal materials if used from scratch, so it is usually better to start the hole with a bow or reciprocating drill and then enlarge it with the auger.

The smooth nature of most skeletal material means that the drill bit skids across and marks the work-piece more often than not. To avoid this it is recommended that the position of the hole be pre-marked and started slightly with the point of a knife or an awl.

While there has been some suggestion that some skeletal materials could be punched[4], the nature of the materials would suggest that attempts to use a punch would either fail or fracture the material. Experiments I have carried out with punches of various sizes and shapes prove that this is indeed the case; most punches have almost no effect on antler except to scratch the surface, and bone either is affected like antler, or fractures.

Smoothing and Finishing

Although many bone and antler objects will take on a sheen just by being handled, it is often necessary to further smooth them and erase small marks and lines. This is particularly the case with horn.

Generally, tools for finishing wood are acceptable for finishing skeletal materials as well, but the density of the materials usually means the tools need to be very sharp and will blunt quickly when compared to working most woods.

Large pieces of bone and antler can be carefully smoothed with a fine file – remember to work with the grain to avoid flaking, especially with bone. A draw knife is also particularly good for finishing long lengths of bone and antler. Planes will give a very good finish, though they can be awkward to use depending on the workpiece.

Smaller work can be gently scraped with a knife blade to remove imperfections and leave a smooth surface.

Horn requires a slightly different technique. As mentioned before, the grain on horn can produce a "fuzziness" if it is disturbed. This means that the best way to achieve a smooth surface on horn is to scrape it with a long flat metal edge. The blade of a straight knife is ideal, but it must be used at 90˚ to the horn as the aim is to scrape, not slice.

Various materials can be used as a final smoothing tool. Pieces of sandstone or pumice are good for finishing long thin objects such as pins or needles, and wet leather covered in grit is able to give a good finish on more irregular items. As well as ground sand, pumice and so on, damp ash on leather will produce a pleasant finish on most items.

[3] (Osipowicz, 2007)
[4] (Hrubý, 1957)

It is also possible that tanned sharkskin was used as a substitute for sandpaper. This has been found in coastal communities around the world, as well as seeing use in Europe during the classical period[5] and the Later Medieval[6]. This would suggest that it is more than likely that, given the seafaring heritage of many of the cultures of the Early Medieval, that sharkskin would be used this way.

While Early Medieval bone artefacts do not appear to have been deliberately polished, items made of horn look especially good when they have a degree of polish to them. A lump of beeswax that can be lightly rubbed over the horn and then buffed with a soft linen cloth is a useful addition to a box of finishing materials.

Riveting and Gluing

Riveting

The majority of riveted finds from the Early Medieval are antler combs, and usually the rivets are iron, though some copper rivets have also been recorded[7]. A few examples of bronze rivets are known from the Early to Middle Saxon period (such as Taplow[8]) but they are not common and seem to fall from use in the Early Medieval after about 750, before re-emerging towards the end of the period

The rivets are not actual forged rivets with heads, but simply short lengths of iron rod, and because of this, the actual riveting process differs from that often used in metal or wood working. There are also no clench plates or washers on the rear of the rivet as the rivet is not actually going to be bent over or clenched at all.

The aim with most riveting of skeletal materials is to obtain a double sided flush rivet. This means that both sides of the item are smooth, with no part of the rivet protruding. Flush riveting is achieved by expanding the rivet inside the hole so that the pressure and friction of this horizontal expansion is what holds the work together (as shown in Fig 30 below)

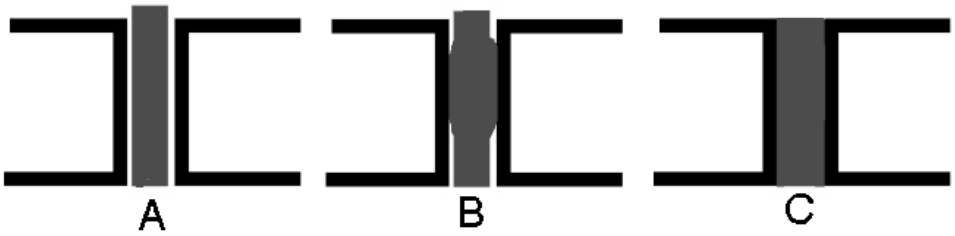


Fig 30 Steps of Flush Riveting

When cutting rivets for flush riveting, each rivet must be cut individually to the correct length, as excessive metal will cause the procedure to be much more difficult or fail. The ideal length is just a tiny fraction longer than the depth of the hole – maybe 0.5mm at the most. Any longer and the metal will bend under the hammer blows rather than compressing vertically and expanding horizontally; any shorter and the rivet will not expand enough to grip the hole before becoming flush with the surface.

The actual process of riveting is quite simple. Once the rivets are cut to length, place the piece to be riveted on a suitable hard, flat surface; if an anvil is not available, the flat head of a hammer will suffice or a flat stone. Slide the first rivet into place (Fig 30 A) and begin firmly to tap the top of the rivet squarely to compress it (Fig 30 B) until the rivet is flush with the surface and the workpiece is held firmly together (Fig 30 C). If the rivet is struck at too much of an angle, then it risks bending, rather than compressing as described above.

The aim is to use the rivet to apply enough horizontal pressure to hold the pieces together, but without creating so much pressure that the material splits along the grain or is weakened. This can particularly be a problem with bone combs and it is one of the reasons why most, as well as the strongest, combs are made from antler.

[5] (Humphrey, Oleson, & Sherwood, 2003) p343
[6] (Salzman, 1952) p346
[7] (MacGregor, 1985) p62 & 75
[8] *ibid*

Once the end of the rivet is flush with the surface of the work, stop hammering and check the strength of the joint. A well riveted piece should be tight with no movement in any direction (except possibly swivelling if only a single rivet is in place).

Riveting with copper rather than iron rod is the same process, though substantially less force is usually required to compress the rivet and care must be taken not to apply too much force and risk damaging the work piece.

Despite having no head or clench plate, flush riveting of this nature is very strong and especially suited to skeletal materials as they are generally good at resisting the pressures applied by the rivet.

As well as riveting, some items such as casket mounts have also been found held in place by either very small tacks or bone pegs.

Gluing

Despite not offering as secure a fixing as riveting, glue is more useful for inlays and the like where riveting is not a viable method of fixing. As well as delicate inlay work, glues were probably used for aiding with assembling composite artefacts such as combs or for fixing knife tangs into handles, as friction alone will not always suffice.

Early Medieval bone workers had an assortment of different adhesives available to them. While there is little evidence of bone workers using glue, humans have been using adhesives on tools and weapons for over 200,000 years[9] and Theophilus[10], writing in the 12th century, lists some recipes for glues that have been in use since at least the Roman period, making it probable that the same glues were available to Early Medieval workers.

The three principle glues for bone working most likely available during the Early Medieval are:

- Hide glue - this is the classic animal glue. Hide glue is made by boiling bones, horns, hooves etc until they are rendered down into a gelatinous soup.
- Resin - various trees (primarily pine and birch) produce a resinous sap that can be processed to make exceptionally strong glue.
- Cheese glue - soft cheese can be processed with lime to make a strong adhesive[11]

Hot Working Horn

Unique among the materials discussed here, horn is thermoplastic (it becomes more malleable as it is heated). While horn can be cold worked in much the same way as other skeletal materials, its true versatility can only be seen when it has been heated and it can be easily moulded into numerous shapes.

It is possible to cut a complete horn in a number of ways so that it can be unfolded into either a roughly square or rectangular shape. Horn can also be cut when hot quite easily with a pair of shears.

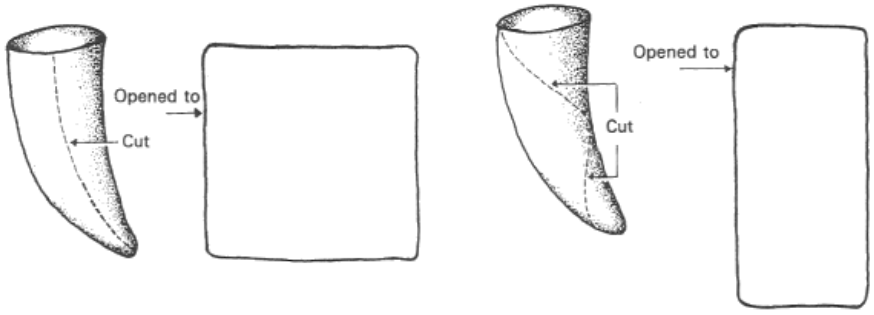


Fig 31 How to cut a horn for unfolding. Image: (MacGregor, 1985)

[9] (Roebreoks & Villa, 2012) p45
[10] (Hawthorne & Stanley-Smith, 1979) p26-27
[11] (Helm-Clark, 2007)

Horn can be heated by both direct and indirect heat, though more care has to be applied when heating directly.

A brazier or open fire can supply direct heat to a piece of horn held in tongs. As long as the horn is kept moving and the heat is neither too fierce nor concentrated on a single area of the horn, then it should heat through adequately without too much surface charring. If light charring does occur, this can easily be removed with a rasp or such. However, the charring can easily penetrate the entire thickness of the horn if the heat is too concentrated.

Soaking the horn in water before applying direct heat offers a few benefits; the pre-softening of the horn in water allows it to become pliable with less direct heat required; the additional water not only prevents the horn from drying out as rapidly but also reduces the chance of penetrative charring, and it can reduce the smell of the hot horn.

Heating the horn indirectly requires a bath of either water (for relatively low temperature work with thin horn) or preferably tallow. The hotter the bath, the quicker the horn will reach a workable temperature. A medium thickness horn in a water bath should take around 60-90 minutes to thoroughly heat through. If it is left too long, then the solid material begins to break down and the horn starts to look like gelatine. Extended periods of immersion in hot, but not boiling, water will also start to damage the horn, and it will remain flexible even when cooled.

Horn heated in water does not always retain a formed shape and can begin to curl back to its original curvature. As has been previously mentioned, it is suggested that the evidence shows the techniques of flattening horn ready to work with were not as developed in the Early Medieval as they were in the latter medieval period. This is supported by the lack of finds made from flattened horn, though that may be due to the poor survivability rate of horn as much as unsophisticated working methods.

As soon as the horn has been suitable heated, it can be eased out by unfolding it with tongs. If the horn cools too quickly, then gently reheat it until it regains pliability and continue to open it out.

If a flat sheet is required, unfold the horn to nearly flat, then reheat, place on a flat piece of wood and quickly place another flat timber on top, then weight it down and allow the horn to cool while flattened. The boards must be smooth and clean, as hot horn will mark very easily from grit and such. A thin layer of grease on the boards will prevent the horn from sticking to the timber.

Once it has been opened sufficiently and is heated through, it is possible to mould the horn around a former. A hardwood former is recommended, as it can be easily smoothed so as to not mark or damage the hot horn.

Decorating and Carving

Beyond the very simple artefacts such as pig fibula pins and perforated metacarpals, almost all items crafted from skeletal materials are decorated to a greater or lesser extent.

Simple Decoration

Where an artefact has not been extensively carved, there is usually at least some form of decoration of a simpler kind. This decoration usually takes the form of parallel lines, ring-and-dots, cross hatching, single dots and variations on those techniques e.g. a pair of ring-and-dot patterns joined by lines to form an elongated "8".

There are a variety of tools that will allow a bone crafter to quickly and neatly create these motifs. The two basic tools for this are;

- Knife – a strong knife will easily cut grooves and lines in skeletal materials, as well as creating small dots with the point.
- Saw – small, fine saws have been found and these are excellent for longer, straight lines. A double bladed saw (or "stadda") will allow these lines to remain parallel and equidistant from one another (see Fig 15)

Additionally, there is a pair of tools that would allow for further simple decoration; the edge scribe and a ring-and-dot tool. The edge scribe creates lines running parallel to an edge and the ring-and-dot tool makes the characteristic R&D pattern.

Edge Scribe
An edge scribe is a tool with a small handle that has an angled blade with the cutting edge at 90˚ to the handle.

Fig 32 Using an edge scribe

When the top of the handle is rested on the edge of a work piece it can be drawn along the work, it creates a scribed line a fixed distance from the edge in much the same way a mortice marker is used.

Ring and Dot
A very common decoration is the R&D, formed by a small centre dot surrounded by one or more concentric circles. This is very difficult to replicate with any tool other than a custom made bit, either for a drill or used by hand like a gimlet. The evidence from the finds also supports this, as despite a few showing some irregularities that suggest they were cut freehand[12], the vast majority of R&D decorations are perfectly symmetrical and must have been made using a tool.

After making a small pilot hole on the work surface (especially important on a curved surface), the centre point is located in the hole and the tool twisted until it starts to score the surface. Then the action is simply continued until the required depth of groove is reached. This is made much easier and quicker by the use of a drill.

Further tools with wider heads allow these multiple concentric circles around a single head. It would also be possible to create multiple circles at once using a tool with 5, 7 or more teeth, as each pair of opposing teeth would create a circle.

<u>Carving</u>
Bone carving in the Early Medieval never quite reached the artistic heights of the same craft during the Roman or Later Medieval periods. However, it was never abandoned, and many fine examples of Early Medieval bone carving do exist.

The carvings of the Early Medieval can be separated into three categories;

- Simple lines and relief – This style of carving is little more than deeply etched lines on a relatively flat surface. The designs are more complex than those of parallel lines and such, but can still be relatively easy to achieve. This style is often found on flat boards such as plaques (Fig 43 & Fig 105), or on knife handles.

[12] (MacGregor, 1974) p111

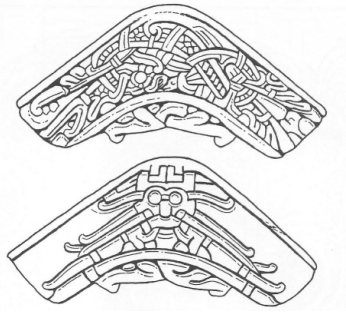
- Relief – High relief carving, where the design is sunk deeper into the material, is also found throughout the Early Medieval.
- Carving in the round – While not as common as the other carving styles, the items carved in the round are some of the most stunning pieces of art and craftsmanship from the Early Medieval. A particularly fine example is the ivory Alcester Tau Cross head (see below)

Fig 33 Tau Cross head from Alcester. Image: (British Museum website)

The majority of carved items, and especially those used by everyday people, are a combination of the first two carving types. Occasionally a carving in the round is found as a single piece or a component of something else, such as the head found at Sigtuna (see below).

Examples of antler carving from Sigtuna;
Fig 34 Right, end of a knife handle. Image: (tenthmedieval.wordpress.com).

Fig 35 Below, a sword guard. Image: (Smith A. G., 1999)



Carving in the round is usually found as a decorative feature for expensive and impressive items – like the tau cross mentioned before. This is partly due to the level of skill required as well as the expense of the materials and the specialised toolkit required to undertake such a work. This style and level of carving is worthy of a text entirely to itself and is beyond the scope of this work.

The more simple forms of carving are relatively straightforward and while not particularly difficult, they are time consuming given the hardness of the materials involved.

As with any carving, the first and most important stage is accurately marking out the design. This is easily done with a small, pointed piece of charcoal. Charcoal is easily rubbed off as well, meaning that it is a simple matter to correct mistakes.

Once the initial design is laid out, the next step is to scribe the outline of the design so that it cannot be accidentally rubbed off. Once this process is complete the carving proper can begin.

As previously mentioned, skeletal materials have a grain, and as with any cutting action, the blade must be used with the grain rather than against it. If the grain must be cut across or against, then the tool must be very sharp and used to make only light cuts each time to avoid catching the grain.

Suggested designs for carving

There are a number of relatively simple patterns that are repeated on various objects including those of bone and antler. The designs are quite straightforward but look very effective.

One such pattern is found on the bone shaft of a ring pin from York (Fig 36). This incised step (or "key") pattern is very common and found on all manner of artefacts throughout the Early Medieval. It appears to be particularly popular as a design on pin shafts (both bone and metal) as can be seen from various finds from York[13] and Buckquoy[14]. It also is seen on the whalebone plaque from Scar[15] and a comb from Lincoln[16].

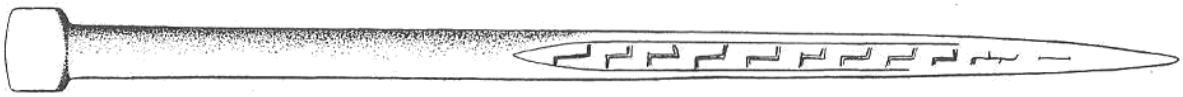


Fig 36 Bone shaft of a ring pin. Image: (Waterman, 1959)

Other pins such as those from Trondheim (Fig 37 top) and London (Fig 37 bottom) show some basic incised patterns that are natural rather than geometric.

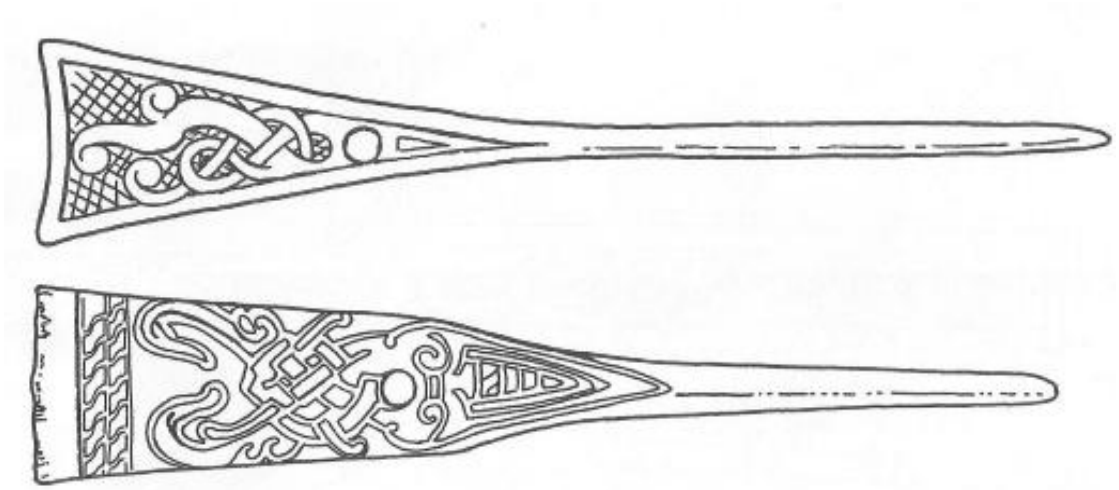


Fig 37 bone pins from Trondheim (top) and London (bottom). Image: (Smith A. G., 1999)

A bone belt buckle from Goodmanham (Fig 38) features an interlocking loop design that is characteristically of the Borre style and similar to designs found on the Gosforth cross.

Fig 38 10th C bone belt buckle from Goodmanham, Yorkshire. Image: (MacGregor, 1985)

Similar Borre style patterns (and again, similar to those of the Gosforth Cross) can be found on the handle of a knife from Canterbury (Fig 39).

[13] (Waterman, 1959) p78 (fig 11.13) & p81 (fig 12.1)
[14] (Ritchie A. , 1979) p200
[15] This volume fig 105 & (Owen, Dalland, & Allen, 1999) p74
[16] (Mann, 1982) p6 fig 3.6

Fig 39 bone handled knife from Canterbury. Image: (Graham-Campbell, 1978)

In addition to Fig 67, below is an assortment of strap ends showing different decorations. Other examples have also been found with plain incised lines and ring-&-dot decoration.

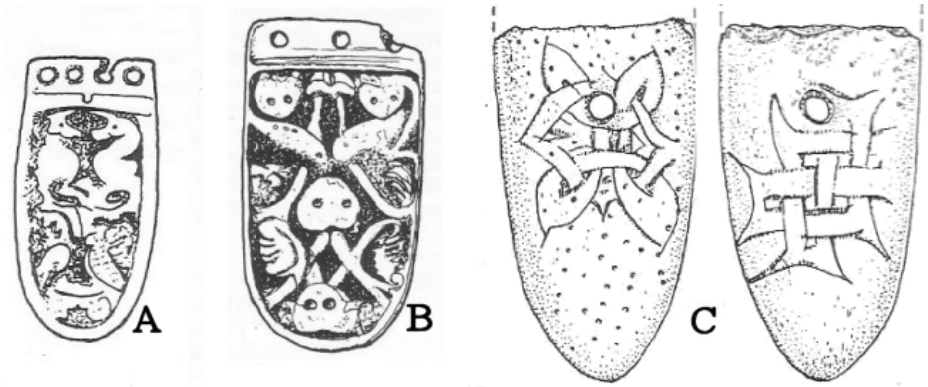


Fig 40 Decorated bone strap ends from Leicester (A), London (B) and a double sided example from Dublin (C). Images: (Page, Lee, & McKinley, 1907), (Page W. , 1909) and (Lang & Caulfield, 1988)

Further entwining patterns (and animal based designs) can be seen on the various bone trial or motif pieces that have been discovered. Some interesting examples come from York (Fig 41) and Dublin (Fig 42). Some of these trial pieces also show it can take a few attempts to get the design correct. These trial pieces are often cut on "scrap" bone – that is bone which would not usually be utilised for working, such as the mandible and pelvis. While these generally are all grouped together, it is possible that they are actually two separate types of artefact – trial pieces that are used for practising a design or technique, and motif pieces that are used as moulds for subsequent embossing with silver or gold foil.

Fig 41 Bone motif pieces from York. Image: (Anglo-Danish Viking Project, 1981)

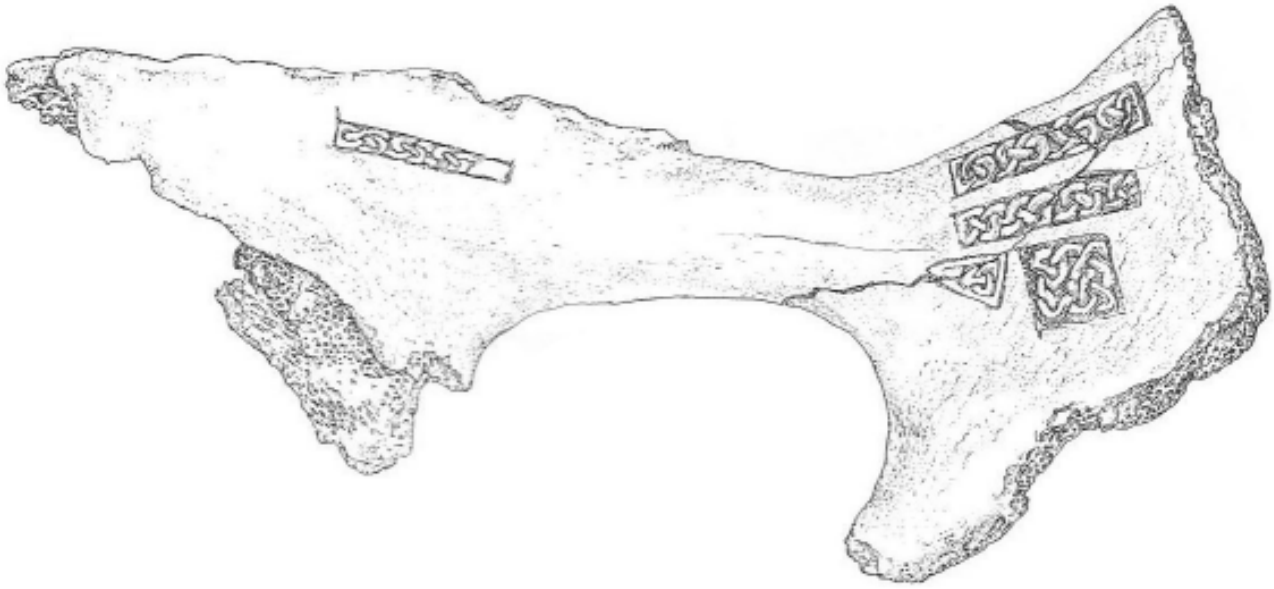


Fig 42 Bone motif piece from Dublin. Image: (Lang & Caulfield, 1988)

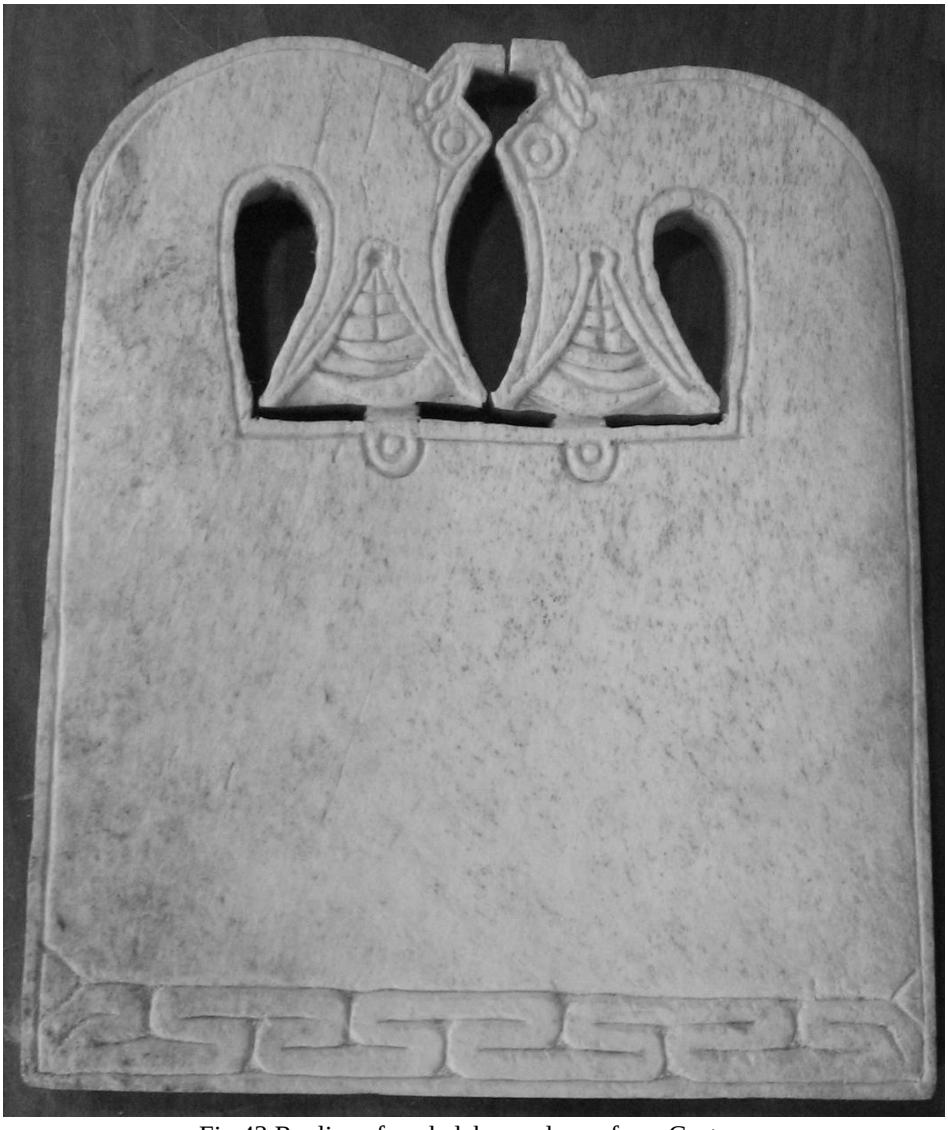


Fig 43 Replica of a whalebone plaque from Grytøy

Colouring

As with most natural materials it is possible to colour skeletal materials with various dyes, but the evidence for this practice is quite small.

Green

While in earlier periods green appears to have been a common colour to dye bone (possibly as a substitute for bronze or copper goods), Early Medieval examples are restricted to a single belt buckle from York (Fig 66). The buckle has been stained green and then polished[17].

The staining was possibly obtained by steeping copper in an acidic solution such as vinegar. It has also been noted that it is possible to stain bone and antler green by leaving it in a container full of goats milk and copper, and keeping it warm for a few days[18].

Red

There are no definite examples of red colouring on skeletal artefacts from the Early Medieval, but there is however, evidence directly before and after the Early medieval that supports the possibility of using red stains or dyes with skeletal materials. A migration period comb from Holzgerlingen was stained red, and the some of the Lewis Chessmen show signs of red colouring[19]. Additionally, Theophilus describes a method of staining bone red using madder[20].

Black

Unlike red and green, black was not used to completely change the colour of an artefact, but to enhance certain features of it e.g. a ring-and-dot decoration. In this way, it functions similarly to the niello compound on metal jewellery. However, as with red and green, there is a dearth of finds, though there is a comb from Birka that has traces of a blackening compound used to highlight the decoration[21].

A safe and authentic method to obtain a black compound for bone working is to use beeswax mixed with powdered charcoal. This can be worked in the hands until thoroughly mixed and soft, and then pressed into the decoration. Once the wax hardens, a sharp blade scraped across the surface will remove the excess, leaving behind the black wax in the decoration. The item can then be polished if required. An inauthentic method that is waterproof and more heat resistant (unlike beeswax) is to use black nail varnish and once it is totally dry, sand or scrape the excess from the surface.

Lathe Turning

A number of finds, including spindle whorls and gaming pieces, show that the lathe was a well used tool by bone workers. Lathe turned decoration also features on some finds. Generally the materials favoured for turning were bone or antler. It is possible that some of the knife handles of horn were also turned. There have been occasional finds of other materials, such as the ivory cylindrical box from Jarrow, but these are not common.

Regardless of the type of period lathe being used, the first important step is to ensure that the blank is trimmed as near to cylindrical as possible, and that it is balanced. Attempting to turn an object that is unbalanced and not at least nearly cylindrical can result in anything from simple frustration and failure to injury and a damaged lathe.

After the blank is prepared and ready to be cut, there are a few points regarding a period lathe that it is important to note; especially when compared to modern lathes.

Firstly, the work piece is rotating very slowly relatively to a modern lathe. In practice this means that using a period lathe to turn bone or antler is not a quick process. The tool will only be removing very small amounts of material with each cut and will quite probably require frequent sharpening.

[17] (MacGregor, 1985) p67
[18] (MacGregor, 1985) p70
[19] (MacGregor, 1985) p 67-68
[20] (Hawthorne & Stanley-Smith, 1979) p188-189
[21] (MacGregor, 1985) p70

Secondly, the mechanics of a pole or bow lathe mean that unlike a modern lathe that spins in one direction only (counter clockwise when viewed down the bed towards the headstock), the period lathe spins both counter and clockwise. The counter clockwise spin occurs when the bow or pole runs down to turn the work, and the clockwise motion is when the bow or pole is returned to the starting position.

Thus with a period lathe it is vital to cut only when the work is spinning *counter clockwise* to avoid kickback or the tool adversely marking the work piece. This also combines with the first point to further compound the great amount of time taken to turn skeletal material.

Lastly, all evidence of period turning on a lathe (including wood turning) is turned between centres, or "spindle turned". This is when the work is held in place at either end by both the headstock and the tailstock. "Face turning" is when the work piece is held only by the headstock (usually a plate is screwed to the work piece and then attached to the headstock) and no evidence exists from the Early Medieval for faceplate turning.

This has been the cause of some confusion as certain archaeological works whose authors are not turners, have used the term "face turned" to mean working on the face of a blank - such as when a bowl or box is hollowed out. However, this terminology is incorrect; the terms “spindle turned” or “face turned” refer to how the work is held, not how it is worked on by the tool.

Combs and Comb making

As has been noted previously, the various hard skeletal tissues were used in the past in place of plastic and thus many different items were made of bone, antler and horn. However, one particular group of objects appears on virtually every archaeological site, whether it is a cemetery, city or isolated farmstead – combs.

Unlike other objects of bone, antler and horn, combs appear to have been produced by specialised craftsmen rather than an individual at home, and stylistically they are far more diverse than other items.

Comb making is a very particular skill requiring substantial amounts of raw materials as well as a specialised toolset in order to create an item demonstrating the finesse shown on many archaeological finds. It is most likely that any "professional" worker of skeletal materials within Early Medieval society would primarily be a comb maker who also made other items[1].

Significance

Unlike the present day, in the Early Medieval period hair combs seemed to have been imbued with an importance greater than would be expected for such a simple item. Despite being very common everyday hygiene objects, with no apparent economic value and which do not seem to have been treated as heirloom items[2], they were treasured enough to be repaired and were possibly kept for the duration of an individual's life.

They were certainly used for combing hair and were not merely "for show", as close examination has revealed lice and nits trapped between the teeth of some finds. However, there are no examples of such from York, despite popular myth and erroneous reports in various texts[3].

Composite combs also seem to have been an important cultural item, with various regional styles developing and being exported or imported in other areas. In some cases the local style remained the same, but the material that was used changed as different raw materials were imported or traded.

Typology

Regardless of their particular method or material of manufacture, combs of the Early medieval can be broadly divided into one of four types (Fig 44).

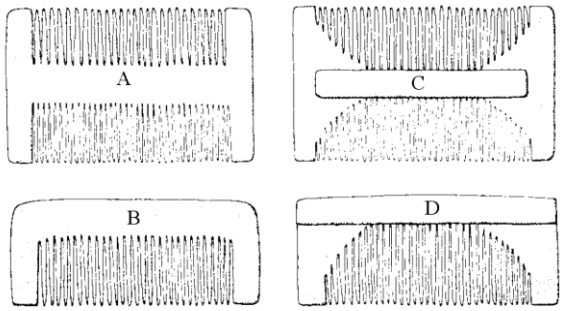


Fig 44 Basic comb types. Double sided simple (A), Single sided simple (B), Double sided composite (C), Single sided composite (D) after (Galloway, 1976).

These four basic types can be further broken down into a series of distinctive regional styles. Various typological groupings have been suggested based on certain sites or areas such as Dunlevy's categorisation of Irish combs[4], Ambrosiani's work based on combs from Birka and Ribe[5], and more recently; Ashby's examination of the combs of Early Medieval North Western Europe[6].

[1] (Riddler & Trzaska-Nartowski, 2011) p133
[2] (Ambrosiani, 1981) p15 & p55
[3] (Kenward, forthcoming)
[4] (Dunlevy, 1988)
[5] (Ambrosiani, 1981) p15-23
[6] (Ashby, Bone and Antler Combs, 2007), (Ashby, 2010), (Ashby, 2011a)

Given that Ashby is the most recent work and integrates the British Isles into Europe, it is the primary source to use for Early Medieval combs in Britain. Rather than list all the variations noted by Ashby (there are 13 from his typology that are applicable to Britain), below is a selection of the types that are particularly appropriate to Early Medieval Britain.

Ashby Type 3 – Handled, asymmetric

This style of comb is seen during the 8th – 11th centuries and is mostly present in Britain and the Netherlands, making it more of a Saxon style than Viking. The handle is made of either a solid tine with a slot or from two side-plates with a "packing" plate between them.

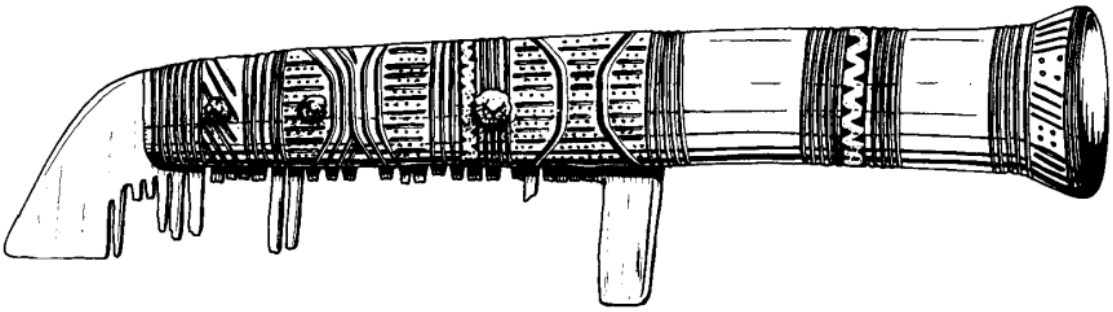


Fig 45 Example of Type 3 comb from London. Image: (Riddler, 1990)

Ashby Type 4 – "Riveted mounts"

The name of this type derives from the use of horn as the primary material. As mentioned before, horn has a very low survival rate and thus usually all that is left is the bone side-plates (the so called "riveted mounts"), as the horn has decayed fully. As with the Type 3 and 12 combs they are predominantly seen in England and the Netherlands and are virtually unknown from the Viking world, though Ambrosiani[7] does note possible manufacturing evidence from Ribe. Type 4 combs are generally 10th C and later.

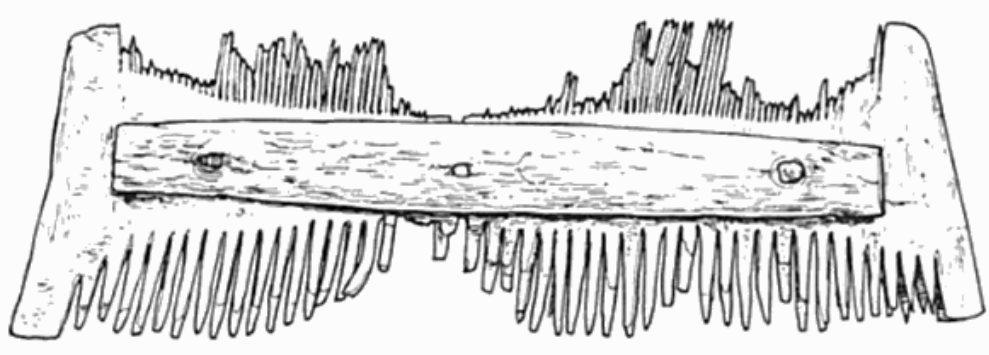


Fig 46 Example of Type 4 comb from London. Image: (MacGregor, 1991)

Ashby Type 5 – Long plano-convex

Type 5 combs are found throughout North Western Europe in the 8th – 9th centuries, but are concentrated in the Viking homelands and their colonies. Type 5 combs are characteristically quite long (over 150mm).

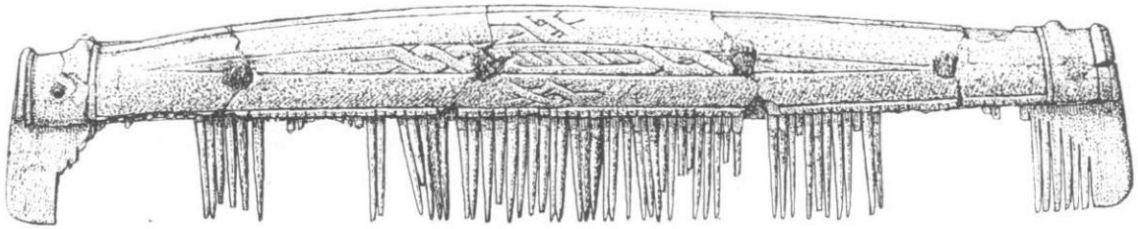


Fig 47 Example of Type 5 comb from Drimore Machair. Image: (MacClaren, 1974)

[7] (MacGregor, 1985) p95-96

Ashby Type 6 – Short plano-convex

These are typically 10th – 11th century combs and are found across North Western Europe, but do not appear to have been a style used by the Norse as there are only isolated finds from Scotland and Norway. However, many examples do exist from Sweden, Denmark and England. They are shorter than Type 5 combs (usually 100-150mm in length).

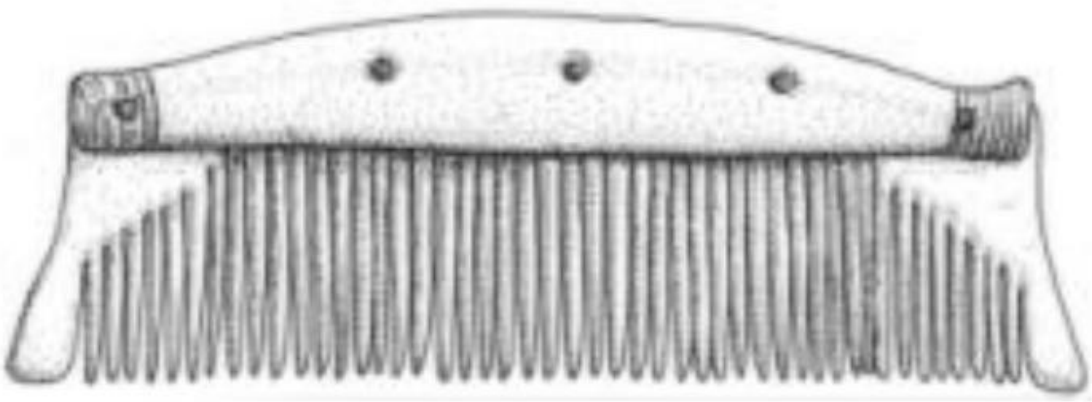


Fig 48 Example of Type 6 comb from Birka. Image: (Ashby, 2010)

Ashby Type 12 – Long double-sided

During approximately the same time period that the long Type 5 combs are prolific in Northern Europe, a different style emerges in the South and is prevalent in Britain, France the Low Countries. The type 12 generally ranges from 100-200mm and has rows of teeth on both sides of the side-plates.

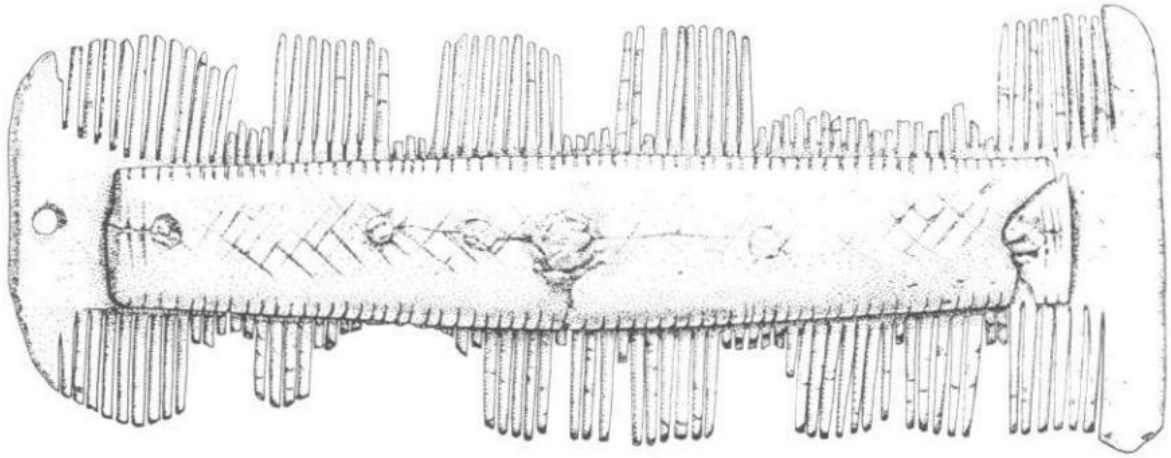


Fig 49 Example of Type 12 comb from Saevar Howe. Image: (Hedges, 1983)

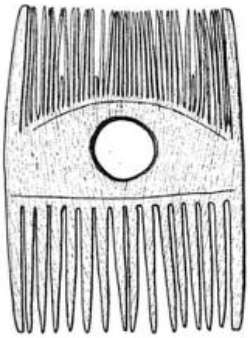
Ashby Types 14a & c – Ornate one piece double-sided

These are two very similar styles of comb that appear in the 11th century. They are quite rare and generally made from ivory (most frequently elephant or walrus) or antler (usually elk) as they can be quite substantial in the case of Type 14a. The style of the combs can vary in size and complexity. The Type 14c walrus ivory example currently in the British Museum (Fig 50) is only 41mm wide x 54mm long[8] whereas the Type 14a elephant ivory comb from St Cuthbert's tomb (Fig 51) is 118.5mm wide x 163mm long but is undecorated[9].

[8] (Wilson, 1960)
[9] (MacGregor, 1985) p79

Fig 50 (left) The walrus ivory comb from the British Museum. Image: British Museum website.

Fig 51 (right) The elephant ivory comb from the tomb of St Cuthbert in Durham. Image: (MacGregor, 1985)



While no finds similar in form to Fig 44B have been found in skeletal material, there are some examples of simple single sided combs from earlier contexts such as Caistor-by-Norwich[10]. While it was originally suggested that these were "ritual" items made specifically for burial, more recent examinations have shown wear patterns on the teeth demonstrating that they were actually used. In light of this data, it is now suggested that they may be beard combs[11].

It is possible that single sided simple combs were made from horn and thus none have been found due to preservation issues, but it is probably unlikely given that none are known in other skeletal materials.

Construction

The various styles of combs shown in previous paragraphs show that there are three main construction methods for combs;

- Composite antler/bone
- Composite bone/horn
- Single piece

Each of these has a slightly different method of construction due to the style and materials used. The methods and dimensions described below are not based on a specific example, they are designed to give a "generic" outline of the manufacture of these items rather than replicate a particular find. Additionally, the following doesn't cover the specific manufacturing issues arising from the construction of double sided combs.

Single piece combs

The single piece comb is the simplest construction method and is exactly what the name implies – a single piece of raw material cut, there are no additional pieces and no actually construction takes place. A suitable sized billet of bone, antler or ivory is selected and then cut to the desired shape, the teeth are cut and then the comb is decorated as appropriate. While these are the simplest combs to make, ironically they are also the rarest finds.

Horn and bone composite combs

In terms of manufacturing complexity, horn and bone composite combs are slightly more difficult than single piece combs but not by much as they still only comprise three parts – the body and two side-plates.

The majority of the work involved in a horn/bone combs is flattening the horn sufficiently to make the body of the comb (see chapter 3 for techniques of flattening horn).

The side-plates for this style of comb are usually made from a single section of rib split down the middle. Smaller combs tend to use the ribs of sheep and goats, while larger combs use cow and horse ribs. The inner side of each split section is trimmed with a drawknife to lie flat against the horn and then the comb is assembled and the teeth are cut.

Usually the side-plates are secured with a single rivet through each end, though sometimes one or more rivets may be distributed along the length of the side-plates as well.

[10] (Myres & Green, 1973) plate XXXIII
[11] (Riddler & Trzaska-Nartowski, 2011) p137

Antler and bone composite combs

Before discussing the manufacture of these combs, it is important to note that while composite combs of both antler and bone are made in much the same way, the vast majority of combs are entirely made from antler, a limited number from antler and bone and very few from bone alone.

Despite the range of styles that are represented by these combs, the construction method is essentially the same. Fig 52 shows an exploded generic composite comb illustrating the various components.

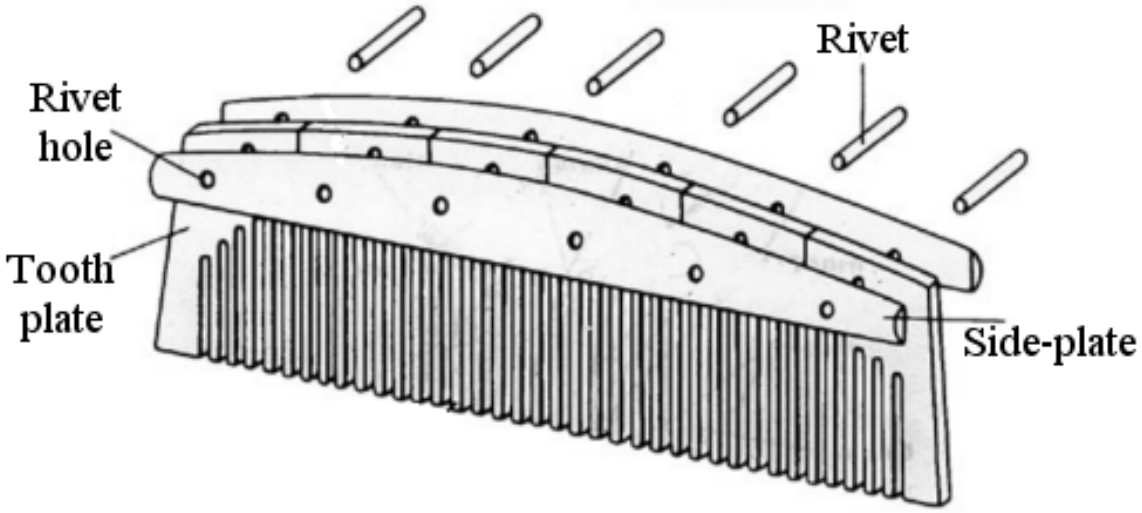


Fig 52 Components of a composite comb. Image: after (Carlsson, 2002)

Even though they are complex items, even the grandest composite comb can be broken down into two parts – the side-plates and the tooth plates.

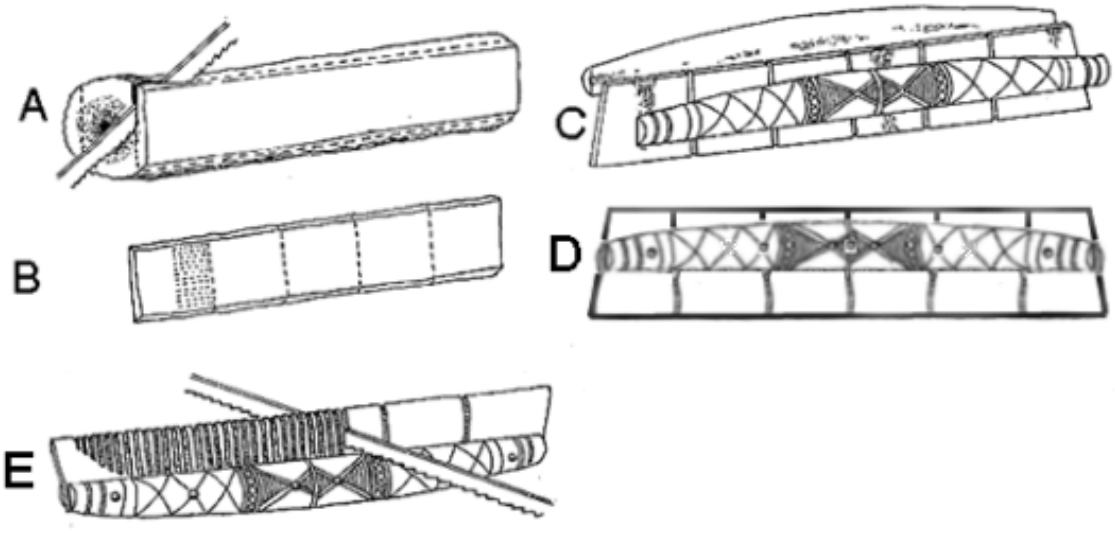


Fig 53 Stages of making a composite comb. Image: (after Regia.org).

The side-plates were cut from a beam of antler or from a particularly thick tine that did not have a lot of inner (cancellous) tissue; the exact thickness of the side-plates varies depending on the style of the comb, but usually the finished side-plate should be no thinner than about 4mm. If bone was used, usually it would be from the metapodial of a cow or horse. Similar sections of beam would be cut ready to make the tooth plates (Fig 53 A). Usually relatively wide sections (20mm or wider) would be used for the tooth plates.

After being cut, the long lengths of antler or bone would be trimmed and flattened with a drawknife. As mentioned above, the side-plates would be taken down to no less than about 4mm and the tooth plates to about 2-3mm[12]. Once suitably flat, the tooth plates would be cut into their individual sections (Fig 53 B). It is rare that the cut teeth do not fit the tooth plates evenly or that the tooth plates are substantially different thickness, thus a jig or similar would probably be used to ensure an even width and thickness to each plate within a comb[13].

Usually the decoration was applied to the side-plates at this stage – many combs show that the rivets were not cut into by the decoration on the comb. The tooth plates would also be arranged into a particular order and shaped as necessary to fit neatly side by side (Fig 53 C).

The comb would now be assembled and riveted together. It is possible that glue was used to temporarily hold the components together while they were drilled. See page 35-36 for details of period glues. Generally the rivet holes would be drilled through the end plates and then through every second joint between the tooth plates. The rivets were usually of iron, though some bronze rivets are known, such as in Fig 81[14]. Not all combs are flush riveted; on some examples the head is "mushroomed" on either or both sides.

Once the comb was riveted and secure, the upper portions of the tooth plates protruding above the side-plates would be cut flush with the top of the side-plates and filed smooth before turning the comb over and cutting its teeth (Fig 53 E).

Cutting comb teeth

Regardless of the construction method or style of a comb, the teeth are the most important part especially when dealing with removing lice and nits. The cutting of comb teeth can be a particularly complex art as the number of teeth per cm can vary from around 4 to 10 depending on the style of comb[15].

Many finds exhibit teeth of a uniform width' suggesting that they were cut with a fine double bladed saw (such as Fig 16). However, the actual cutting of the teeth is only the first step. It has been recorded that 19th – 20th comb makers would have no less than 7 stages in finishing comb teeth[16]. The lack of sandpaper and similar, thin flexible material in the Early Medieval means that finishing the teeth is even more time consuming.

There are a number of methods that can make this task easier. The technique that I use is to cut the angle on the tips first before cutting the teeth; this is done with either a chisel or a file (Fig 54).

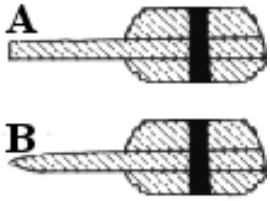


Fig 54 Preparing the tips of comb teeth.

The flat tooth plate ends (A) need to be shaped in order to give the finished teeth a point (B). Alternatively the entire projecting length of the tooth plate can be tapered down to the tip.

Once the ends of the tooth plates are wedge shaped, I pick the starting point from one side and cut only a few millimetres down into the plate, moving across the comb until all the teeth are marked. After I am satisfied that the teeth positions are correct I cut down the length of the tooth plate to the side-plates. Evidence shows that the saw was often allowed to cut slightly into the side-plate; in some cases this was used as a decorative feature. Saw blades of around 0.6mm thickness were often used for coarser teeth, with blades of 0.2-0.3mm being used for fine teeth[17].

Now that teeth are cut, the long process of finishing them begins. A combination of angled stones, small files and sharp knives slowly shape the tooth until it is ovoid in section with a good point at the end. In the case of a very fine comb, the teeth are more rectangular in section with rounded corners. In place of sand paper, scraps of damp linen with wood ash or very fine grit can be used, but they are not always successful.

[12] (MacGregor, 1985) p74
[13] (Leahy, 2003) p56
[14] (MacGregor, 1985) p75
[15] (Riddler & Trzaska-Nartowski, 2011) p137
[16] (MacGregor, 1985) p75-76
[17] (Carlsson, 2002) p5

Decoration

As would be expected with the range of sizes and styles present in the corpus of Early Medieval combs, decoration is also highly variable. While there are regional and cultural distinctions within comb types (Fig 55 for example), there are certain recurring motifs as with all artwork – ring-and-dots, incised lines and key patterns are all popular.

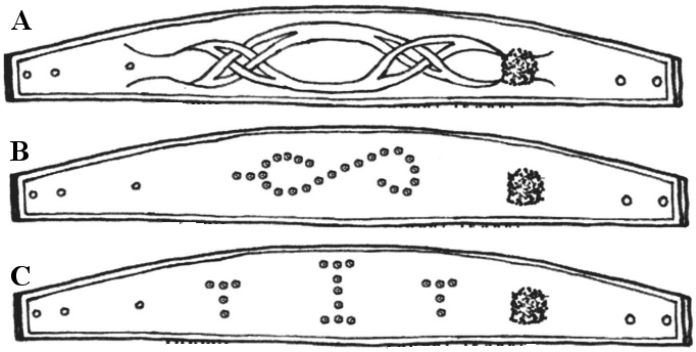


Fig 55 Regional differences in decoration of Type 5 combs.

A and B (interlace and recumbent S) are known from Birka, Frisian Terp mounds and Scotland. C (T and I motifs) are found at Birka and in Terp mounds but are unknown in the British Isles[18]

One style of decoration that appears to be virtually lacking on combs is intricate low relief carving and such. Other than a few examples such as Fig 50, combs seem to be decorated just with simple designs.

A selection of various simple designs is shown in Fig 56, which illustrates a range of designs found at combs at the fortress of Oost-Souberg in the Netherlands[19]. The date of the fortress is between 900-975 AD and there is a lot of cultural crossover between the British Isles and the Netherlands so it is a good example of acceptable 10th century combs patterns for Britain.

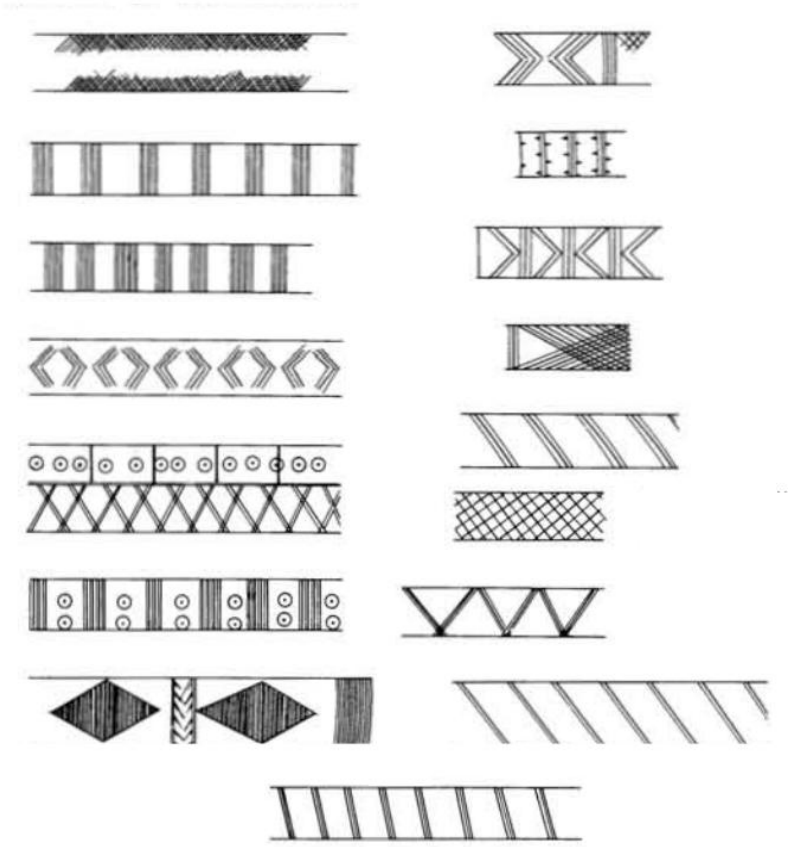


Fig 56 Patterns on combs from Oost-Souberg. Image: after (Lauwerier & Heeringen, 1995)

[18] (Ashby, 2011b) p13
[19] (Lauwerier & Heeringen, 1995) p74-80

Occasionally runes will appear on combs and comb cases such as the finds from Lincoln, proclaiming that "Thorfast made a good comb"[20] (Fig 57) and Whitby asking for help from God[21].

Fig 57 Rune inscribed comb case from Lincoln. Image: (MacGregor, 1985)

Select Catalogue

In addition to the various examples shown in this chapter and chapter six, below is a select catalogue of assorted combs and cases from across Britain.

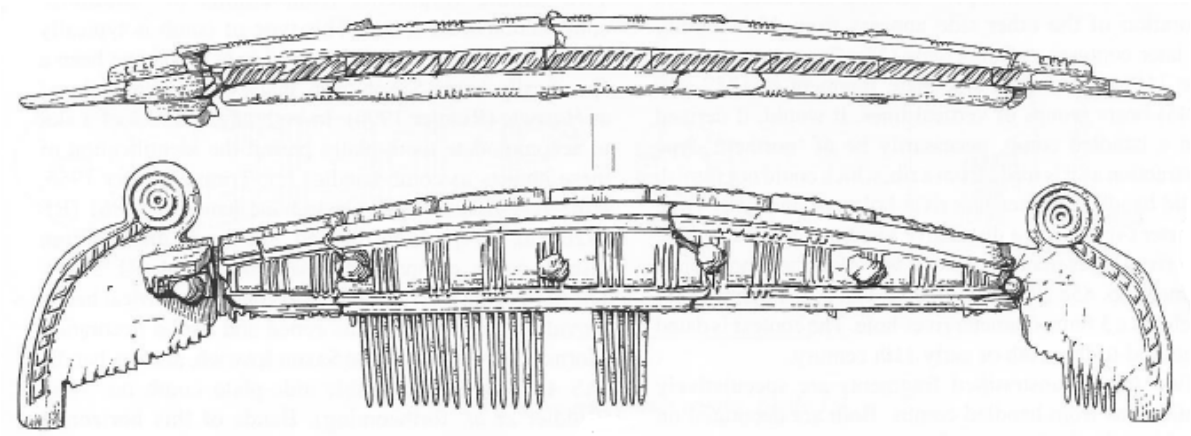


Fig 58 Single sided comb from Flixborough. Image: (Evans, Loveluck, & Archibald, 2009)

As well as side-plate decoration, the top sides of the protruding tooth plates are also decorated, as are the terminal tooth plates.

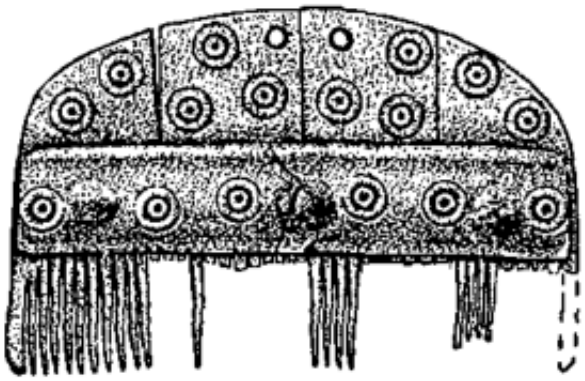


Fig 59 High backed Pictish style comb from Buckquoy. Image: (Ritchie A. , 1979)

Ring and dot decorated top plates that extend above the side-plates as high as the teeth extend below are quite common on Pictish style combs from Scotland.

[20] (Jesch, 1991) p46
[21] (Page R. I., 1999) p103

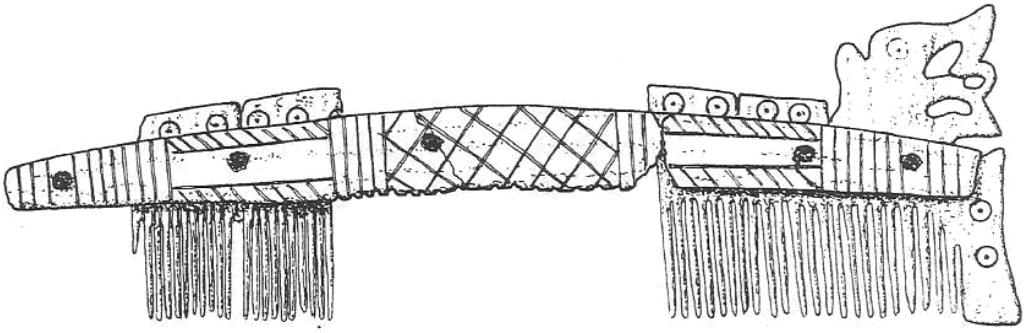


Fig 60 Single sided comb from London. Image: (MacGregor, 1985)

The terminal tooth plates are decorated with zoomorphic cut-out designs, and the upper portion of the tooth plates has ring and dot markings.

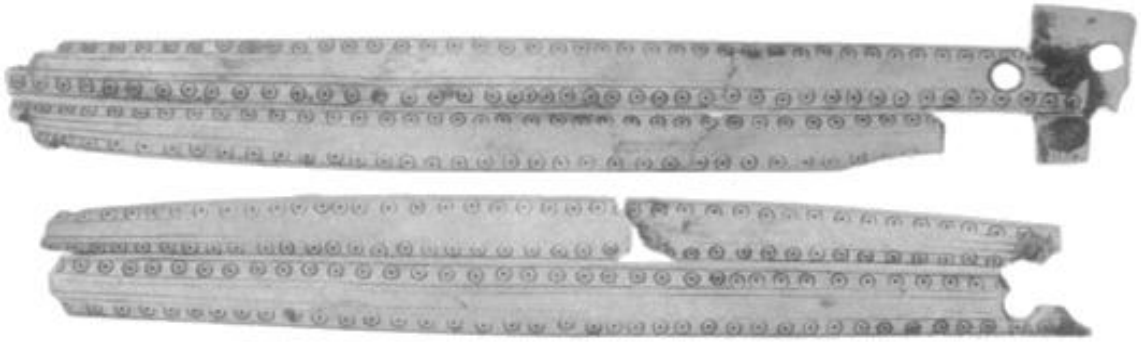


Fig 61 Decorated comb case from Freswick Links. Image: (Curle A. , 1939)

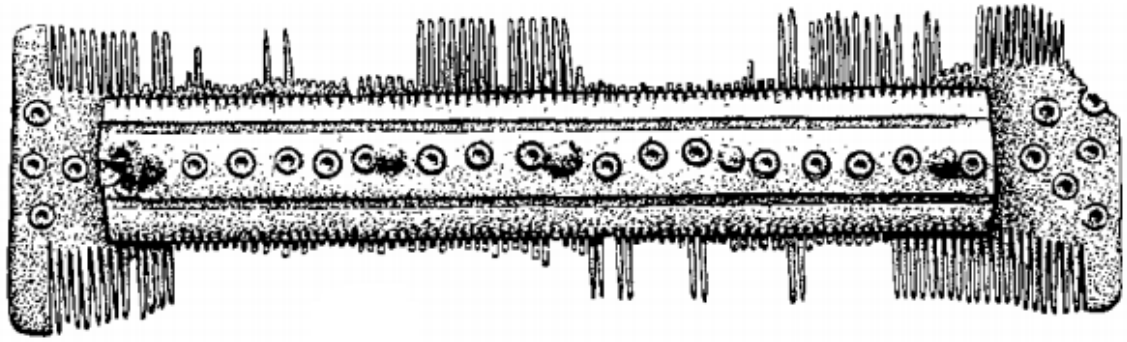


Fig 62 Pictish double sided comb from the Brough of Birsay. Image: (Curle C. L., 1982)

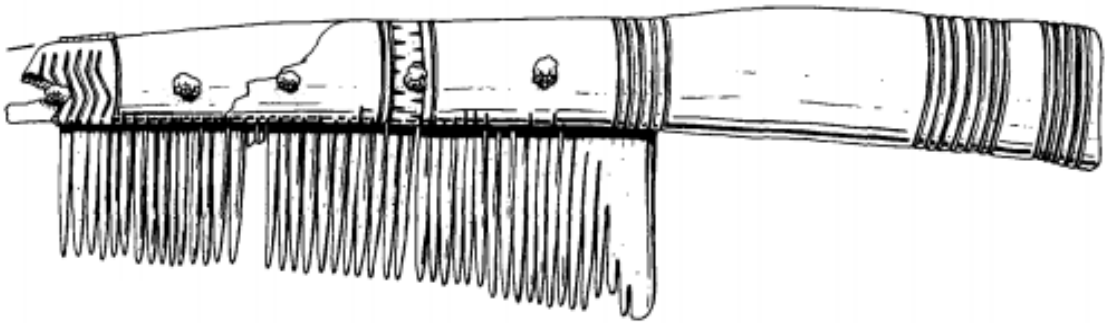


Fig 63 Handled saxon comb from London. Image: (Riddler, 1990)

Craft or Industry?

Overview

During the Early Medieval there appear to have been two distinct groups of bone workers. Firstly there are those who have produced the many objects that are clearly simple and roughly made items, crafted when the need arose. Secondly there are the more skilled workers; either people who were naturally gifted at crafting more decorative items, or who were true professionals and made a living from their craft.

The items crafted by the first group are obviously utilitarian and have no serious decorative function. Some examples are totally practical and undecorated items such as scapula scoops, pig fibula pins and bone skates; all of these could be readily crafted with a knife and may have seen only brief use. Likewise many of the basic textile implements such as weaving tablets and pin beaters are very simple and mostly undecorated. Other finds are almost as crude and roughly made, but clearly were meant to last a little longer. Belt fittings from York and Dublin show a certain degree of shaping but very rough decoration[1] and although it is possible these have been roughly prepared ready for further carving, it would be unusual for them to have been discarded as they are not broken.

These objects do not require a particularly high level of skill, and at a time when most families would keep some animals, the materials would not be especially rare either. Additionally, the simplicity of some necessary items, such as pin beaters, means that there would not really be a niche available for a professional bone worker to exploit.

As well as these relatively plain, everyday objects that could be crafted by a non professional, there are certain groups of artefacts that are almost certainly indicative of a collection of professional bone workers. These professional craftsmen were most likely comb-makers first and foremost, but would be skilled enough to make a living from the craft as a whole, and provide the market with either more complex items (combs) or the more detailed and skill-dependant artefacts (carved pins etc).

It is also possible that they would utilise their trimmings to make some of the more mundane items that are discovered. An example of this would be turned spindle whorls. A bone worker with a saw, drill and lathe would be able to easily and quickly produce these and use whatever small amount of income they provided to supplement his main profit pieces. Exercises such as this could even be a "time filler" or learning experience for apprentice bone workers. It is well recorded that blacksmithing apprentices have long had similar simple and repetitive tasks – such as making chain or nails.

Separate to these manufacturing professionals are the expert carvers of ivory, bone and antler. It is most likely that these were a craft apart and that they were primarily excellent artists and carvers rather than particularly skilled bone workers. While their main skill may have been carving skeletal material, they would probably be more likely to supplement their trade with carving wood rather than by turning out antler combs and bone pins.

In addition to the degree of skill required to produce many of the finds, the tools required to craft the objects must also be considered. Certain items like fine bladed saws for cutting comb teeth, small fine chisels for detailed zoomorphic designs and even lathes, would be unlikely to be standard tools for an average person. Even if the person in question were also a craftsman, the specialist tools for bone working are only liable to crossover with the toolset of a fine woodworker or similar as generally the tools of other trades are too unwieldy and inaccurate for bone-working.

Evidence for industrial scale bone and antler working

Regardless of the specific industry, be it comb making or mass producing spindle whorls, there are certain assemblages that will aid in identifying a bone working industry. Primarily these are large deposits of bone and antler working waste material. Larger or more recognisable waste might include cut articular ends of long bones, antler burrs and tines, trimmed or cut scapula and mandibles and any other clearly cut or sawn bone not

[1] (MacGregor, Mainman, & Rogers, 1999) p1942 fig 902 item 7697 , (Lang & Caulfield, 1988) p96 fig 121

normally considered being representative of butchery. Additionally the presence of many fragments of skeletal material, particularly displaying cut or saw marks, would suggest waste from bone working.

Fig 64 Evidence of comb manufacture from Anglian levels at Fishergate, York. Image: (Rogers, 1993)

The deposit contained many offcuts of antler beams, longbone shafts and various other miscellaneous skeletal trimmings.

Further collections of waste indicative of bone working are partially completed artefacts or prepared elements of a composite item. Such assemblages are represented by finds from Thetford, where a single area produced over 600 pieces of cattle or horse rib, many pre-drilled ready for riveting[2] and the numerous sites that have produced concentrated quantities of comb components such as York[3], London[4] and Dublin[5].

Evidence for industrial scale horn working

As noted previously it is difficult to trace the specifics of horn working due to poor survival of the material. However, the horncores do survive and while evidence of crafted artefacts may be lacking, a number of sites such as Lincoln[6] have yielded quantities of horncores showing axe or saw marks, or skulls missing horncores showing that they were removed. It is possible that the axe marks are indicative of the tanning trade or of butchery, though it is worth noting that the saw is a tool of the bone worker, not the butcher.

Macgregor (1991) suggests that there is possible evidence from Saxon law that horns had an inherent commercial value. The *Laws of Ine* state that the value of an ox horn is 10d and that of a cow horn 2d[7]. MacGregor also notes that these values are regarding damages, though the supposition would be that unlike an eye or foot, the animal has no "need" for the horn and therefore the value ascribed to it would be that of its own worth, not the animal's need.

Fig 65 Horn cores from Thetford. Image: (Rogerson, Dallas, & Archibald, 1984)

These demonstrate the marks of the class bone worker's tool – the saw. Most likely representing the horn being sectioned before or as it was removed from the horn.

Major industry or individual craft?

The evidence suggests that the majority of everyday objects would have been crafted by individuals as and when they were needed, with the more complex and ornate items such as combs being made by a dedicated professional.

Antler, the best quality primary material of the bone worker, is seasonal as it is at its strongest when freshly shed[8]. That this was noted by workers is known because in all contexts where a substantial amount of antler

[2] (Rogerson, Dallas, & Archibald, 1984) p199
[3] (MacGregor, Mainman, & Rogers, 1999) p1917-1918
[4] (Leary & Brown, 2004) p48
[5] (O'Sullivan, McCormick, Harney, J, & Kerr, 2010) p135-136
[6] (Dobney, Jaques, & Irving, 1996) p84 fig 30a
[7] (Douglas & Whitelock, 1996) p405
[8] (Riddler & Trzaska-Nartowski, 2011) p121

waste exists, shed burrs far outweigh those obviously sawn from carcases[9]. Thus the craft of the bone worker would fluctuate over the year as supplies of premium grade antler waned and he was required to use either inferior antler or work in other materials. As the most common antler in use is that of red deer (which sheds in spring), it would be appropriate to assume that the bulk of a bone worker's antler craft would be carried out through the summer and early autumn[10].

This is not to say that a bone worker would spend 6 months making nothing but combs and then 6 months waiting for more shed antler. However despite the shedding times of the various deer species being staggered[11], there would be periods of the year where a bone worker would be low on supplies of top quality antler.

Due to this importance of antler and the fact that the bulk of all utilised antler appears to be shed rather than cut from a carcase, there are a number of suggestions as to how the bone working trade was operated and how it tied into the seasonality of antler. Below are the two major theories concerning the working patterns of bone workers.

- They were fulltime itinerant craftsmen who moved from place to place, possibly with a limited stock and would make items as required when they stopped at settlements, possibly trading finished goods for raw materials.
- The majority of bone workers were sedentary and based around large urban centres where they would gather together the materials they required at a permanent workshop. If necessary they would also be proficient in other crafts such as amber working[12].

Finding shed antler is not an easy task and is considered quite a skill. Therefore it is most likely that fur trappers, forest workers and similarly skilled people would gather shed antler rather than the bone worker themselves. Depending on the model of working patterns, this antler would then either be stored ready for the bone workers next visit or, through a series of traders, would reach the larger urban areas to be made into combs etc before being shipped back out via the same network of traders[13].

Certainly it is known that there was some trade in raw materials during the Early Medieval – Birka[14] and Wolin[15] both have a quantity of red deer antler when it lies outside the geographical range of the species.

Ultimately it is most likely that the range of bone workers was an amalgamation of the two primary suggested patterns. There were no doubt some sedentary workers who lived and worked in cities such as York and Southampton, producing mostly combs but possibly other items as well; these combs may have then been traded around the country and even abroad.

However, it is more than likely that there were other bone workers who either travelled within a relatively small area over the course of a few months or a year, gathering supplies from one settlement and supplying its bone working needs before moving on. It is even suggested that some combmakers may have travelled even further afield and crossed seas to ply their trade[16].

Finally, there were the "general" crafters that may be most likely found in isolated settlements; those with enough skill and a general enough toolset to turn their hand to wood work, antler work and so on. They were not necessarily dedicated professionals within their own communities but were simply the person you knew to go to if you needed a comb repaired or such.

[9] (MacGregor, 1998) p18
[10] (Riddler & Trzaska-Nartowski, 2011) p130
[11] (Schmid, 1972) p90 fig 26
[12] (Ambrosiani, 1981) p40
[13] (Ashby, 2014) p46-47
[14] (Ambrosiani, 1981) p36
[15] (Müller-Using, 1953)
[16] (Ashby, 2014) p196

Bone artefact rich archaeological sites

There are a number of archaeological sites in Britain that have produced large quantities of bone and antler artefacts. Horn is less well represented; as mentioned before it has an exceptionally low survival rate and most finds of horn artefacts are actually based on the fittings found in graves.

The combined artefacts of these excavations number in the many thousands and it would be impossible to list everything. However, a few sites stand out from the rest due to their diversity or condition of finds.

In this chapter I will cover three separate sites from around Britain, giving a brief outline of the history of each and then presenting a selection of the finds from each. As well as their substantial catalogue of finds, these sites have also been chosen due to their varying cultural background. York is Anglo-Scandinavian, Thetford is (mostly) Saxon and Birsay is Norse. Additional sites that are worth looking at are Southampton[1], Lincoln[2], Jarlshof[3] and Winchester[4].

York

Principle text

- *Bone, Antler, Ivory and Horn from Anglo-Scandinavian and Medieval York.* MacGregor A., Mainman, A.J., Rogers, N.S.H., 1999

Brief Outline

The history of York in the Early Medieval spans two periods – the earlier period is the Anglian settlement of "Eoforwic" (about 5th-8th C AD) and then the later Viking settlement of "Jorvik" (about 9th – 11th C AD).

This mix of Anglian and then Viking cultures that occurs in the Danelaw gives rise to a particular new culture – Anglo-Scandinavian. York is probably the prime example of a late Early Medieval Anglo-Scandinavian city and as such has the breadth of finds you would expect from a major trading centre.

Excavations at Coppergate were especially interesting and produced the largest quantities of bone artefacts as well as evidence of a comb making workshop. This was identified by the amount of antler waste and offcuts, as well as partially finished pieces of combs.

Select Catalogue

Though they are not illustrated, York also has many examples of the skates, fibula pins, spindle whorls etc that are found on most Early Medieval sites.

Note: With the exception of Fig 66 all images in this section are from (MacGregor, Mainman, & Rogers, Bone, Antler, Ivory and Horn from Anglo-Scandinavian and Medieval York, 1999), Fig 66 *is* (Waterman, 1959)/ (Anglo-Danish Viking Project, 1981)

[1] (Holdsworth, 1976), (Holdsworth, 1980), (Morton, 1992)
[2] (Mann, 1982)
[3] (Hamilton, 1956)
[4] (Biddle, Goodall, & Hinton, 1990)

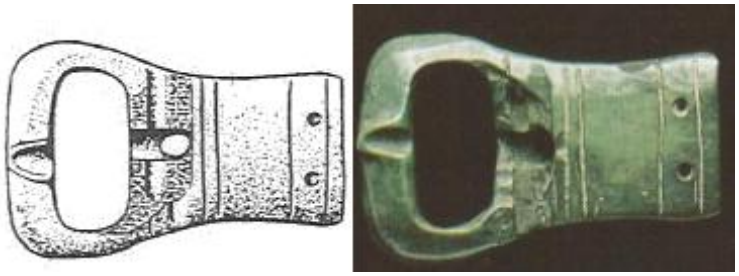


Fig 66 Belt Buckle – Bone, has been dyed green with copper. 11th century.

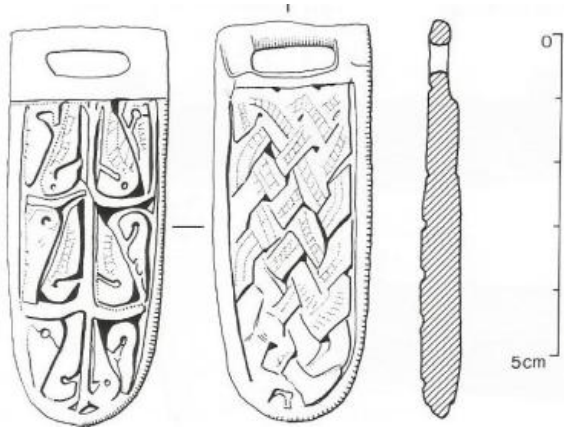


Fig 67 Strap End – Bone, very well carved on both sides, 10th – 11th century.

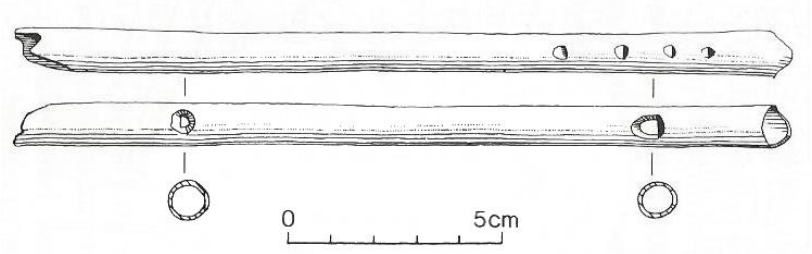


Fig 68 Whistle – probably Goose ulna, 11th-12th century.

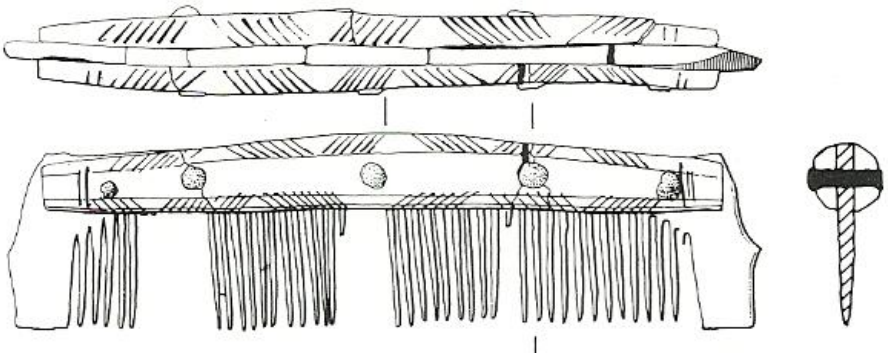


Fig 69 Comb – Red deer antler. “Standard” single sided generic comb. Slight decoration with incised lines. 10th Century.

Fig 70 Gaming Piece - Antler. 10th Century.

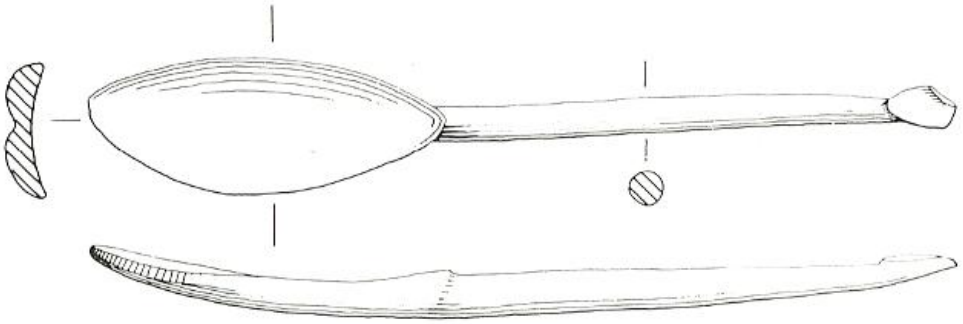


Fig 71 Spoon – Bone, double ended, 10th – 11th Century.

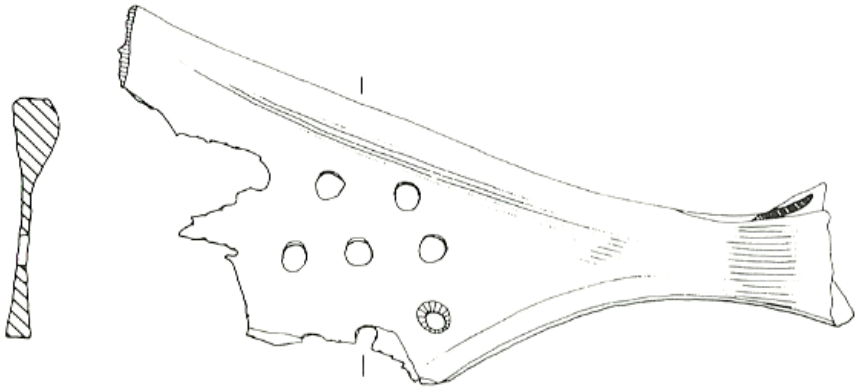


Fig 72 Scoop – Cow scapula. 10th – 11th Century.

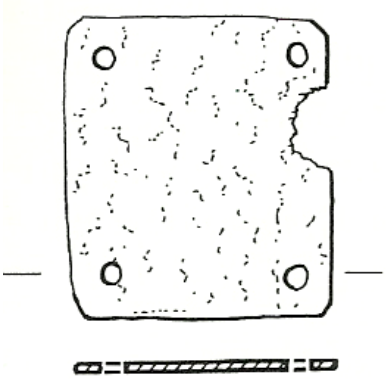


Fig 73 Weaving Tablet – probably sheep or goat scapula, 27mm x 24mm. 10th Century.

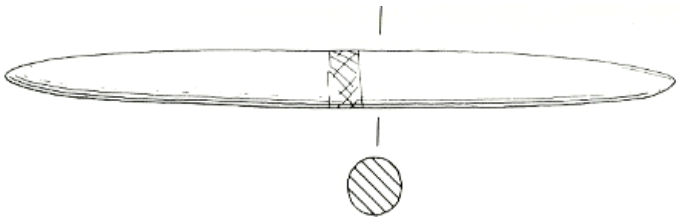


Fig 74 Pin Beater – Bone, double ended for warp weighted loom, 10th Century.

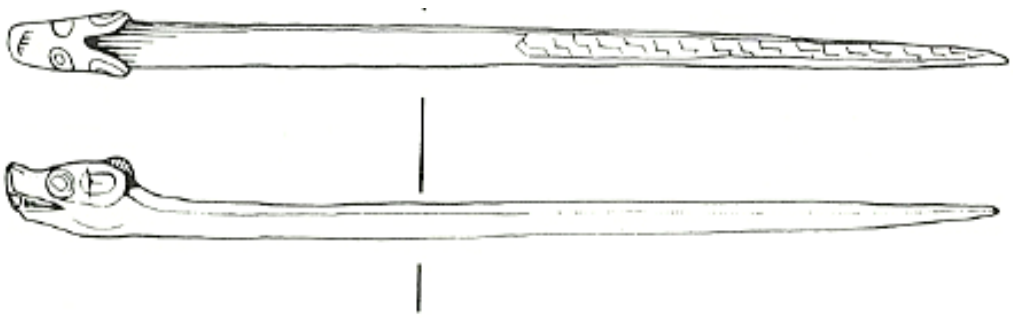


Fig 75 Pin – Bone, zoomorphic design (dragon), similar to Jarlshof pins. 10th Century.

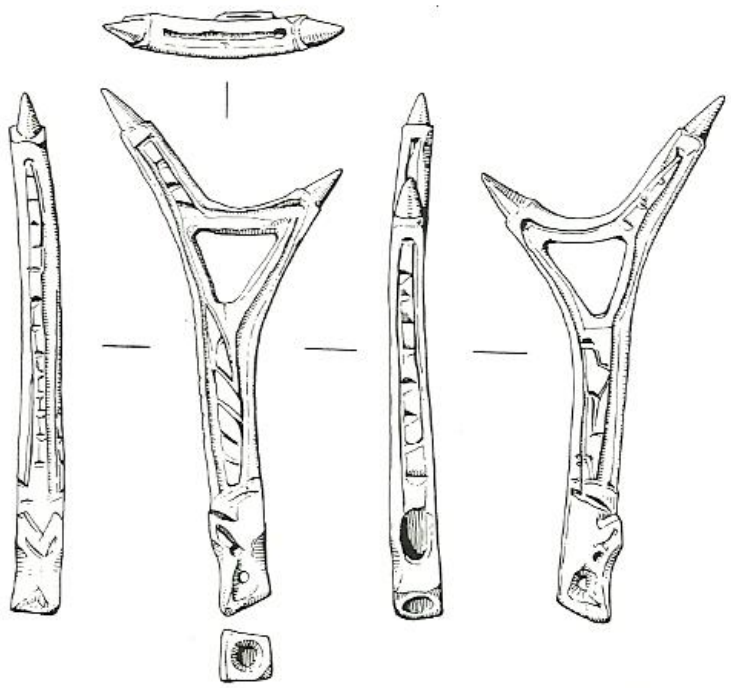


Fig 76 “Lucet” – Antler, possibly a lucet for braid weaving.

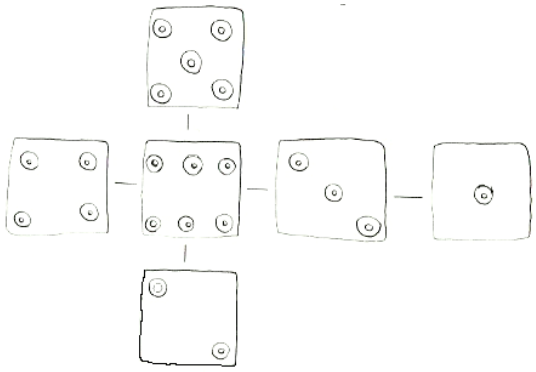


Fig 77 Dice – Antler. Conventional numbering. 10th – 11th Century.

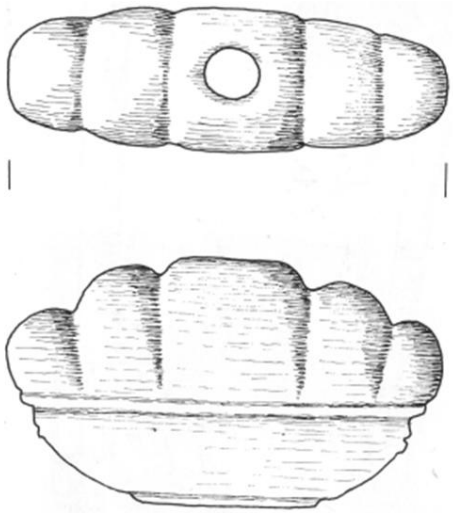


Fig 78 Sword Pommel – Whalebone. Probably 11th Century based on style.

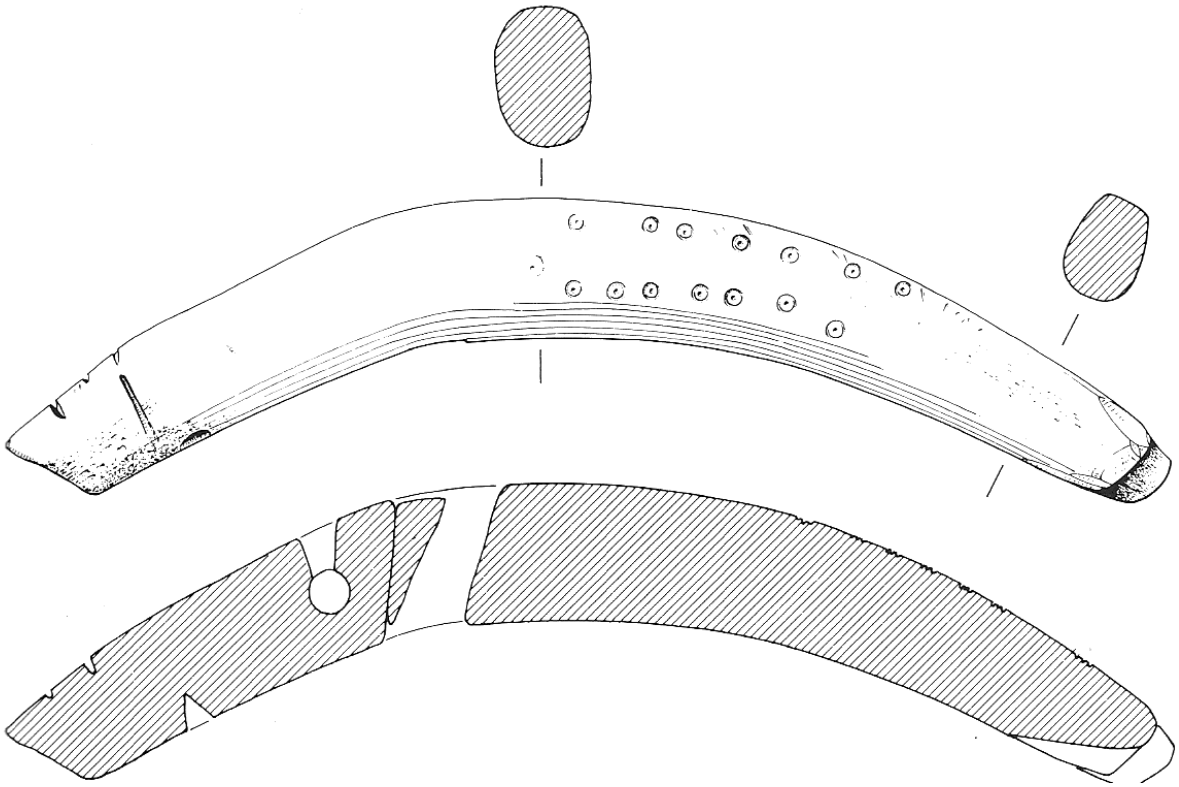


Fig 79 Bow Saw – Antler. Possible handle for a bow saw. 9th – 10th century.

Brough of Birsay

Principle text

- *Pictish and Norse Finds From the Brough of Birsay, 1934-74.* Curle C.L., 1982. (also the source of all images in this section). Available online though http://archaeologydataservice.ac.uk

Brief Outline

The Brough of Birsay is a small island situated just off the North West coast of the Orkney mainland. It is thought that the island was originally settled by missionaries in the 5th century before becoming a Pictish village by the 7th century. Norse settlement begins around 800AD and continued to about 1200AD, and spans three separate periods, each with its own buildings and finds.

The excavations here uncovered a range of everyday implements of bone and antler covering the Pictish and Norse levels, showing both the similarities and difference between the cultures as well as demonstrating the adoption of some Pictish styles by the later Norse settlers.

Approximate dates for the Norse settlement are;

Lower	Late 9th C to second half of the 10th C
Middle	Late 9th C to second half of the 10th C
Upper	Second half of the 10th C to 12th C

Select Catalogue

There are few finds from the upper Norse levels at Birsay, so unless noted otherwise, the finds listed below are from the Lower and Middle Norse horizons.

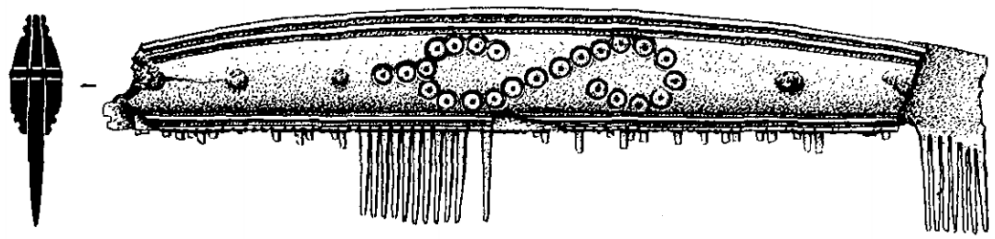


Fig 80 Comb – Antler, iron rivets, most likely an import from Scandinavia

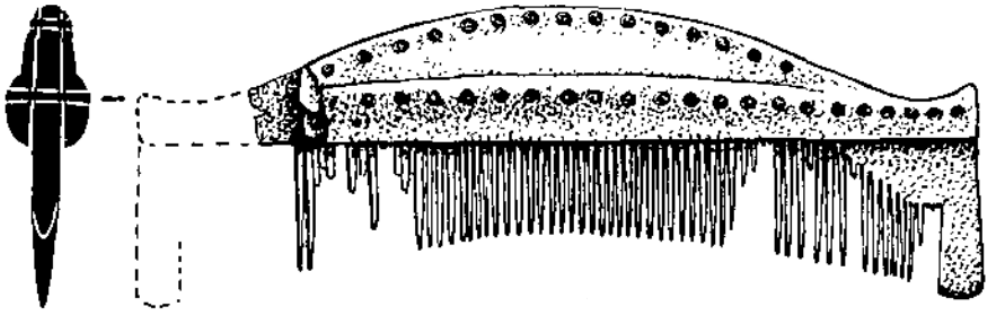


Fig 81 Comb – Antler (red deer), bronze rivets made from rolled sheet (U. Norse Horizon).

Fig 82 Pendant – a perforated bear's tooth (NOT seal), the only bear tooth pendant from the British Isles. The runes simply spell out "FUTHARK"

Fig 83 Basic needles and pins – assorted bones including fibula. Suggested as netting needles given coastal location of site.

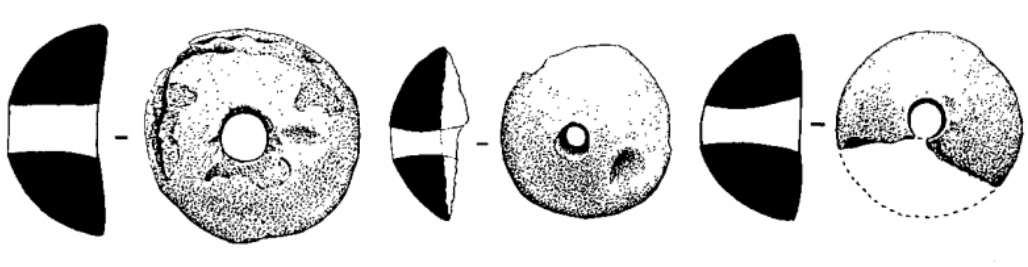


Fig 84 Spindle whorls – made from cow femur heads

Fig 85 Possible pin beater – bone

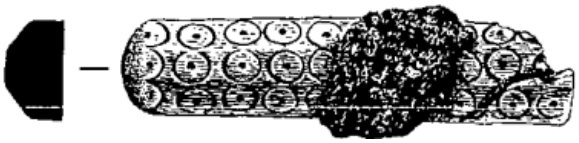


Fig 86 Clamp – rounded whalebone, extensive ring-and-dot decoration

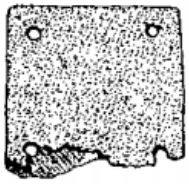


Fig 87 Weaving tablet – most likely scapula of a sheep or goat

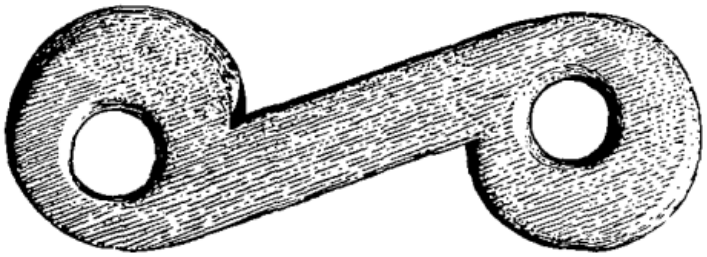


Fig 88 Line stretcher – whalebone, most likely used for tents as it is quite small

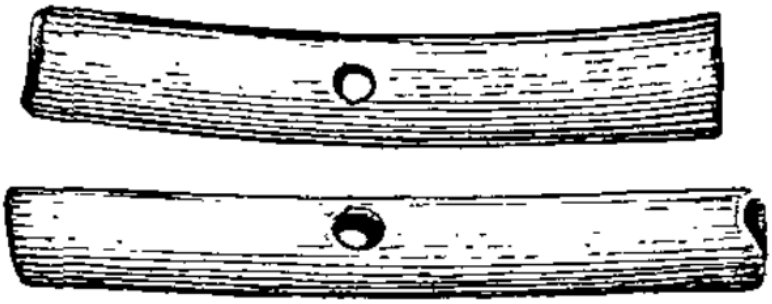


Fig 89 Hollow bird bones – probably partially made needle cases.

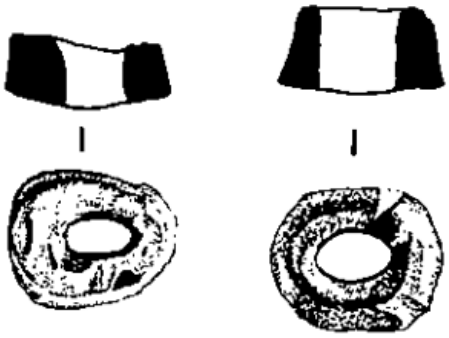


Fig 90 Beads – most likely cut from seal teeth

Thetford

Principle text

- *Excavations at Thetford. 1948-59 and 1973-80.* Rogerson A., Dallas C., 1984. (also the source of all images in this section).

Brief Outline

Thetford was a substantial middle to late Saxon town in East Anglia. First mentioned in the Anglo Saxon chronicle around 870, Thetford grew into an important Saxon settlement with a Danish influence. A mint was established during the reign of Edgar (959-975) and persisted through the rest of the Early Medieval. The main period of occupation was from the 9th – 11th centuries and excavations have uncovered many finds and evidence for buildings. The fill of various pits suggests that over the course of the settlement's occupation there were multiple bone workers and one particular context indicates the manufacture of horn/bone composite combs (many horn cores and split ribs together as waste).

Select Catalogue

All listed artefacts are from the Saxon settlement (mid 9thC to late 11thC). Many of the finds from Thetford are everyday items, the high quality carving and such from York is generally absent, so the finds below are single examples from each group while the text describes the composition of the assemblage.

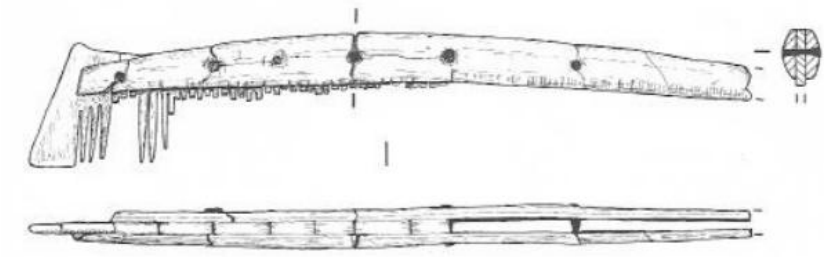


Fig 91 Comb – Antler, iron rivets.

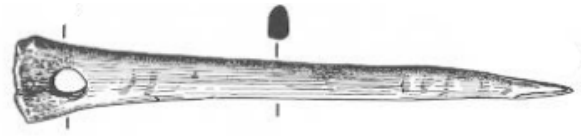


Fig 92 Fibula Pin – roughly cut from pig fibula

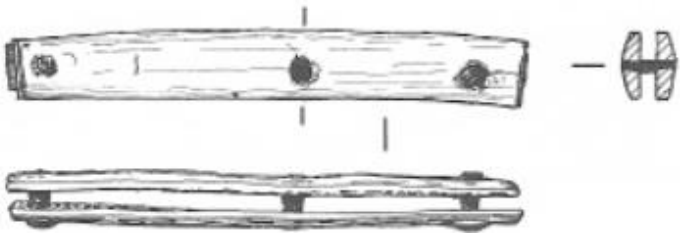


Fig 93 Riveted split ribs – possible remains of bone/horn composite combs, ribs are sheep, horse and cow

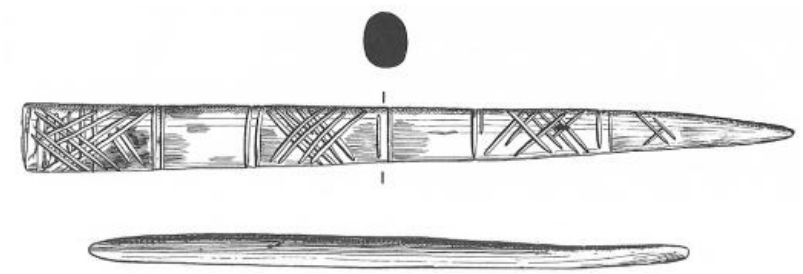


Fig 94 Single (top) and possible double ended (bottom) pinbeaters – most have been made from horse metapodials

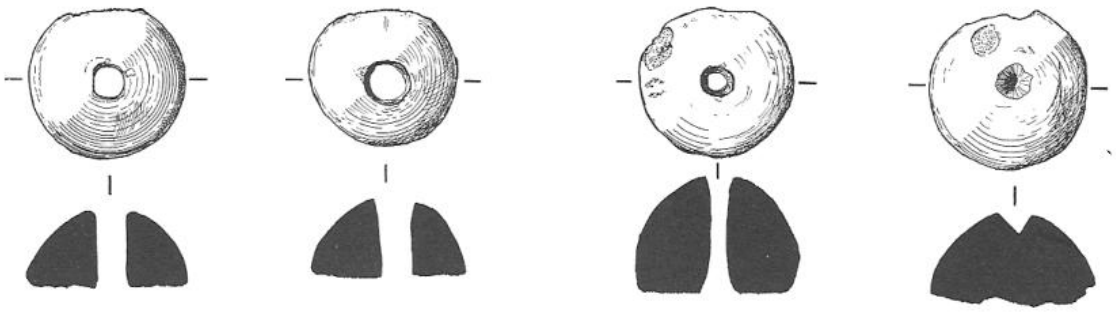


Fig 95 Spindle whorls – cut from femur heads of cows and horses

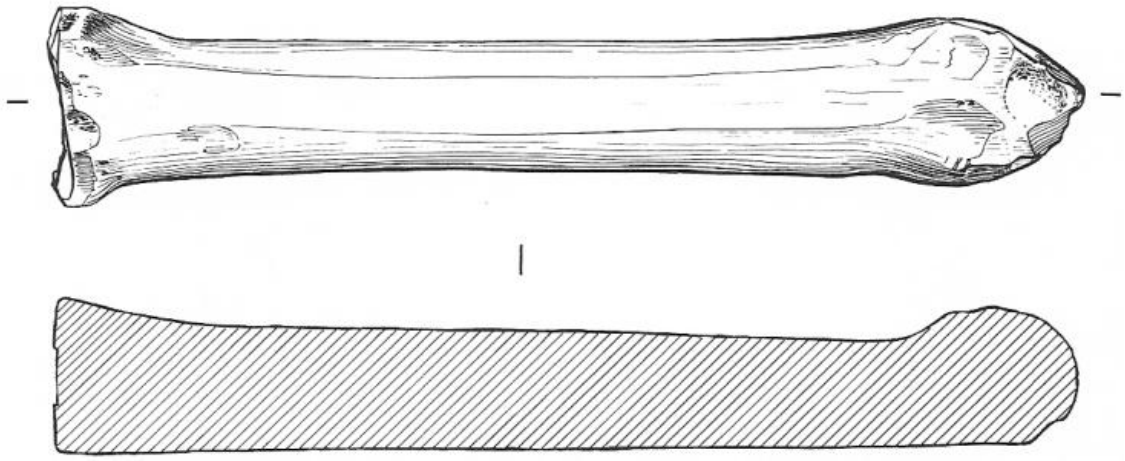


Fig 96 Skates – none have attachment holes, most are horse or cow metapodials

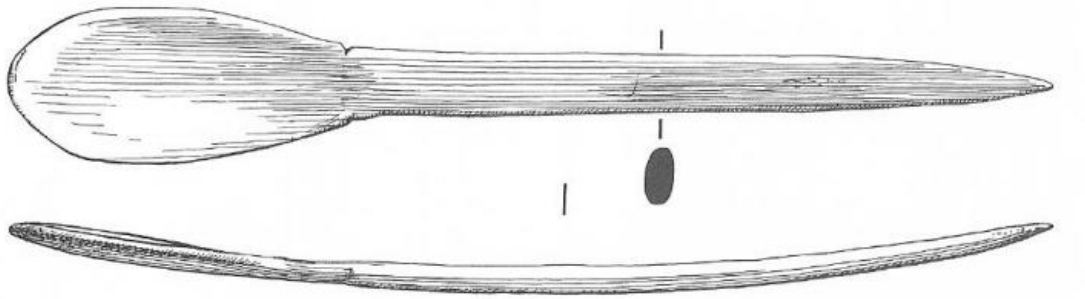


Fig 97 Spoons – most are horse fibula or metapodials

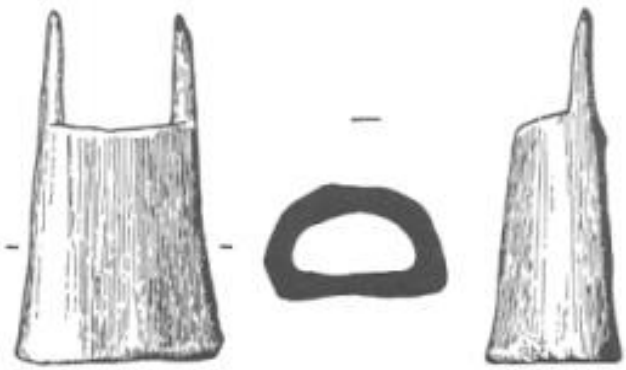


Fig 98 ‘Lucet’ – most are sheep metapodials

Fig 99 ‘Buzz bone’ – generally pig tarsel/carpal

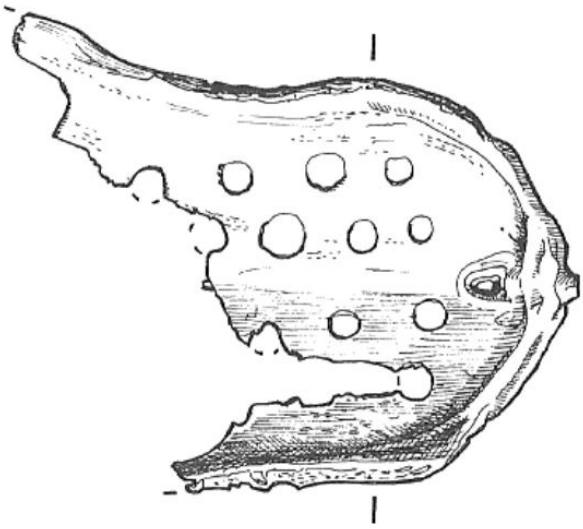


Fig 100 Scoop/Strainer – goose sternum,

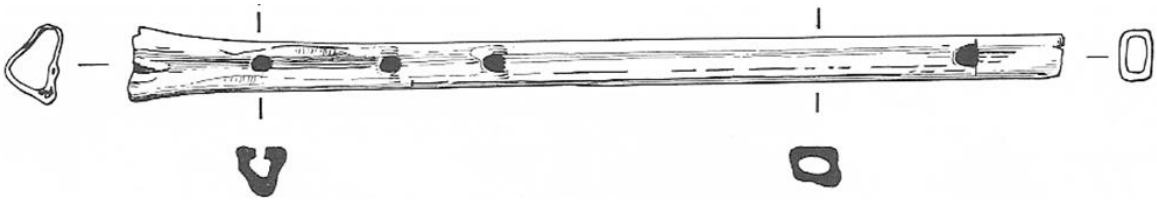


Fig 101 Whistle – Crane tarsometatarsus,

Finds from assorted sites

The three sites previously mentioned in this chapter show a good range of various finds, however there are other sites with unusual or interesting examples, or isolated finds that are worthy of note. In no specific order this section outlines a selection of these other finds.

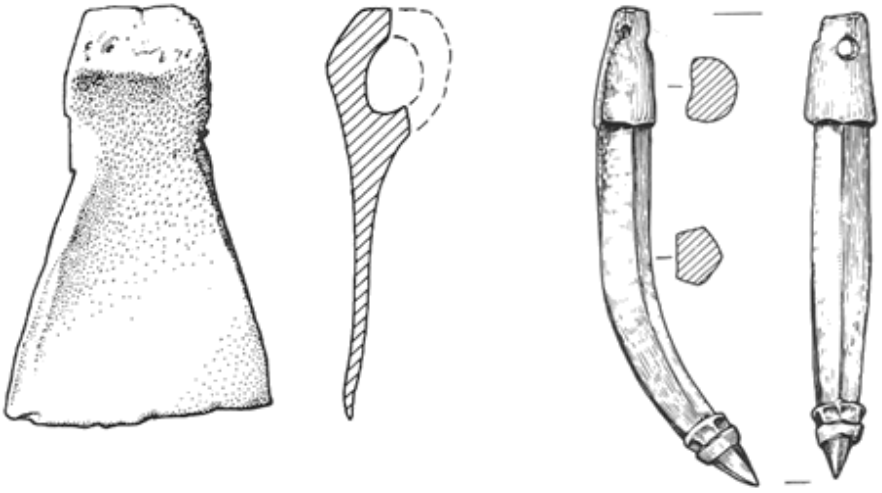


Fig 104 Axe shaped amulet of bone (left) and possible phallic amulet made from an antler tine (right). Both from Lincoln, around 10th century. Image: (Mann, 1982)

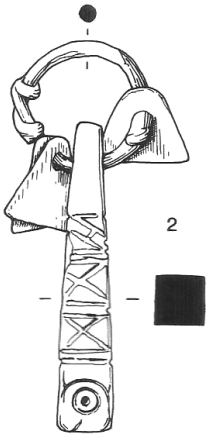
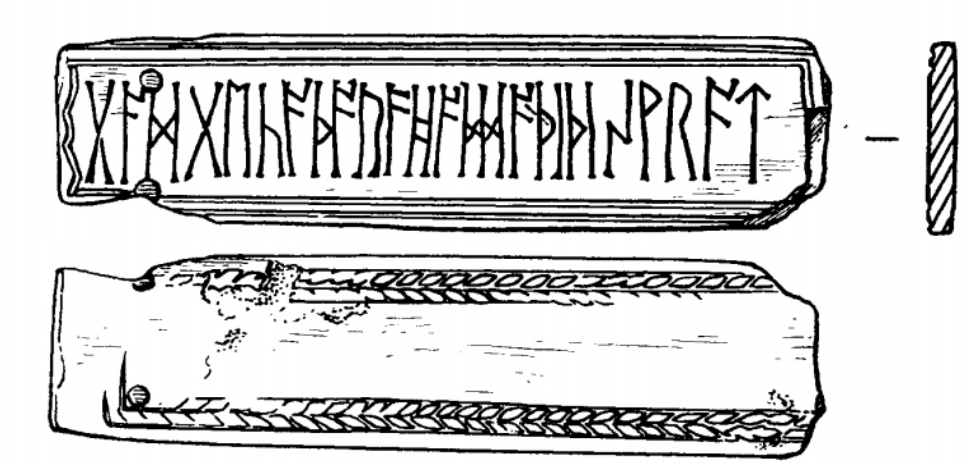


Fig 102 (left) "Hercules Club" amulet carved from bone.

Suspended on a bronze ring with three bronze klapperschmuck, from Butler's Field, Gloucestershire. 7th-8th century. (image: (Boyle, 2011))

Fig 103 (below) Rune inscribed bone piece from Derby.

Possibly a strap end for a bookmark or similar. Possible translation is "God increases honour for Hadda who wrote this". Dates sometime between 700-1000AD. (image: (Bately & Evison, 1961))



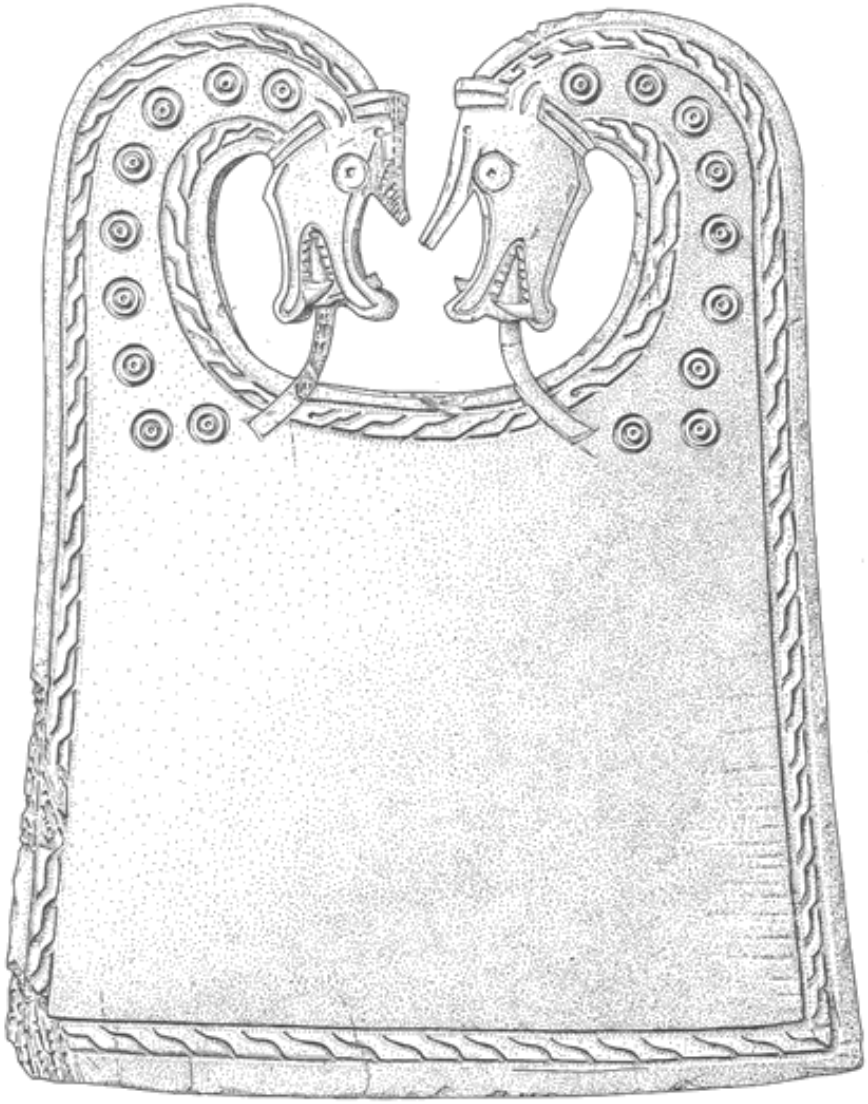


Fig 105 Whalebone Plaque from Scar, Orkney.

The finest plaque from Britain, and one of the best examples from the Viking world as a whole. Dates from 9th-10th centuries. Image: (Owen, Dalland, & Allen, 1999)

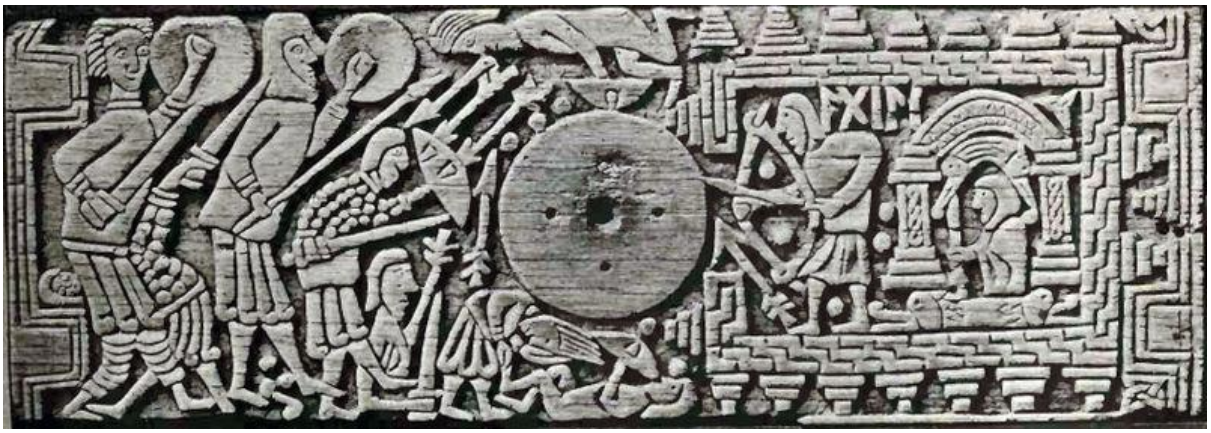


Fig 106 The lid of the Franks Casket

Early 8th century, probably made in Northumbria. Image: (Ritchie C. I., 1975)

Fig 107 Horn panelled helmet from Benty Grange.

The frame of the helmet is overlaid with horn as well as the panels being horn. Dates from mid 7th century (images: after (Bateman, 1849) and Sheffield Museum)

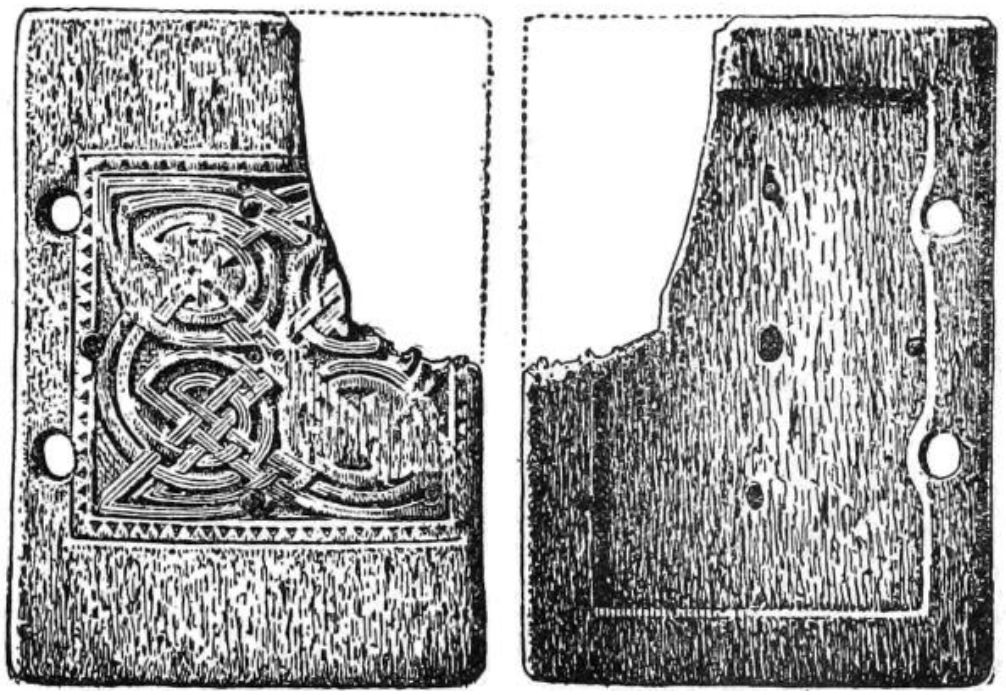


Fig 108 A whalebone writing tablet from Blythburgh.

Appears to have had a cross mounted on the front that is now missing. Probably dates from 8th century. Image: (Waller, 1901)

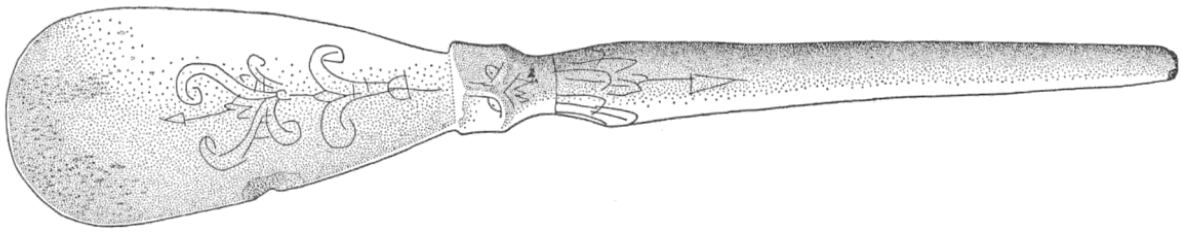


Fig 109 Bone spoon from Winchester.

Early 11th century. Acanthus pattern. Image: (Collis & Kjølbye-Biddle, 1979)

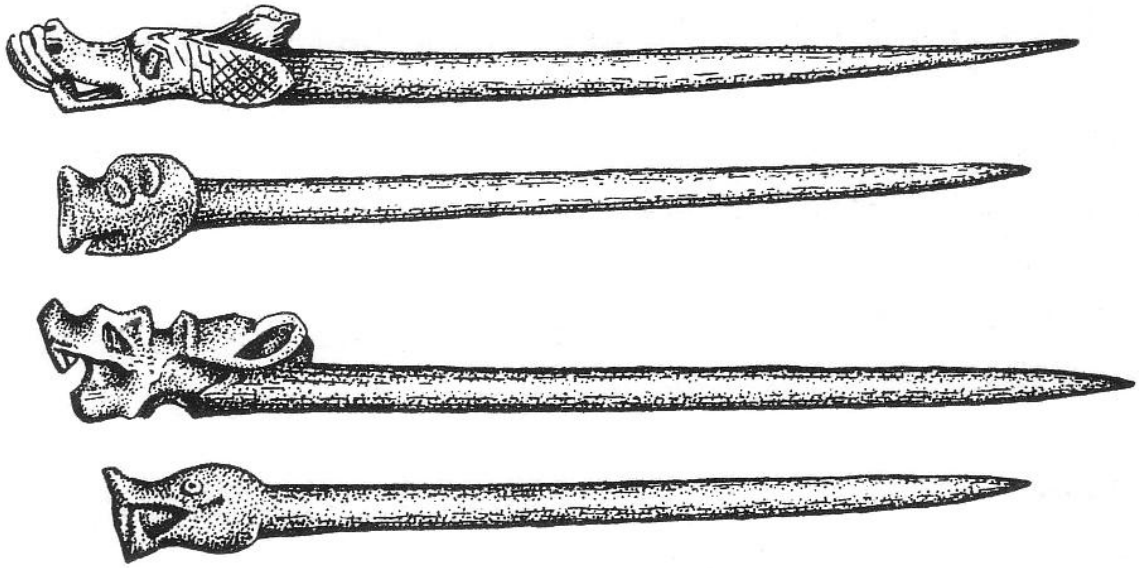


Fig 110 Zoomorphic pins from Jarlshof. Image: (Ritchie A. , 1994)

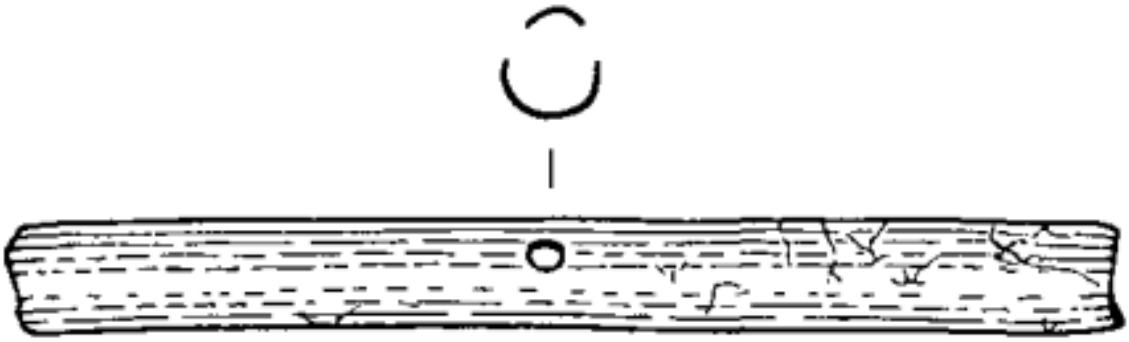


Fig 111 Bone needle case from Kneep, Lewis.

Most likely the radius or humerus of a gannet, goose, cormarant or sawn. 10th – 11th century in date. Image: (Welander, Batey, & Cowie, 1987)

Appendix 1: Acquiring and Preparing Skeletal Material

Acquiring materials for bone working

Unfortunately, unlike with almost any other craft, bone working does generally require some rather smelly and downright unpleasant work at times, especially if you are going to get certain choice materials for your work.

Also, while you can go and buy certain materials, it is rare you can get very specific items and particularly there is no "standard" - you can't walk into a DIY shop and buy a 150mm x 150mm piece of whalebone.

This means that once you move beyond the basic materials that you can easily acquire ready cleaned, you will have to prepare your bones and such yourself, and this is not a task for the squeamish.

Luckily there are a few ways of obtaining at least some basic materials for bone working without it getting to be too much of a messy (or smelly) job.

Always remember that any bones not bought already cleaned could be carrying any amount of various contagions – take precautions and use gloves etc as well as ensuring everything is well washed and disinfected after use.

- Go out and look: The simplest way of all to obtain ready to use bones (though very hit and miss) is to look out while out walking in the countryside or on the beach. It is possible to find everything from sheep knucklebones right up to whale ribs and vertebrae depending on where you are looking (a license is required to hold whalebone and the penalties are severe if the license is not obtained). However, in the interests of hygiene and generally being safe, always use gloves when collecting the bones and put them in a bag rather than your pocket. Depending on where you live, you may also be lucky enough to find shed antlers from local deer herds.
- Home cooking: Another possible source of bones is from cooking at home. Boiled ham joints, chickens and the like are all good sources of material, though sometimes the bone can be weakened so check carefully before using them. However, DO NOT use roasted/baked bones as the bone is weakened and much more likely to fracture and splinter when being worked. Also the inherent strength of any item you do manage to make will never be very good.
- Pet Shops: Most pet shops will stock cow bones (usually the metapodial) that have been drained of marrow, cleaned and degreased. These are generally ready to work with no further preparation needed. Occasionally the surface will be flaky, but as long as the bone beneath feels sound, the surface flaking will sand off and leave a perfectly good finish. It is also possible to sometimes find antler shafts in pet shops as well, though these seem to be much rarer than cow bones and are generally very expensive for what they are.
- Specialist craft shops: Certain specialist shops will also stock various bones, antlers, horns and so on as well. Look out for turning suppliers, stick dressers, materials for knife handles and so on. Prices vary massively depending on the supplier, the material and the quality. Generally the most common items you will get from shops like this are: long bones (usually cow/buffalo), red or reindeer antler, complete and pre-cut sections of horns (usually cow/buffalo) and small squared off bones/antlers ready for turning. Some will also stock fake ivory which is a very good substitute for the real thing if you really want to have some ivory gaming pieces or such. The best place I have found for bone, antler and horn is Highland Horn. They are very reasonable both for materials, price and delivery, and will discuss what it is exactly that you want, to try and ensure you get what you need. A number of society boneworkers source their material from there so they are used to re-enactors and know what is right for combs etc.

Once the above options have been exhausted and you require something you cannot easily obtain ready prepared, then there is only one course of action left – to collect and prepare it yourself.

There are two main ways of collecting suitable material for more advanced preparation.

- Go out and look: Just as for clean bones, go out and look. This time however you are looking for carcasses instead of just bones. Usually the beach is the best place (especially after a winter storm) as you will find all kinds of things washed up that can be quietly taken home and processed (including seals, sheep, large birds etc). This is also an excellent way to guarantee the provenance of your materials – "yes, I am positive that is the wing bone of a goose because I collected and processed it myself!"
- Local butchers and similar: You may well get some funny looks for asking, but local butchers usually have a stock of bones that will just be dumped and they are often quite happy to give you a bag full. This is one of the few easy ways of getting hold of certain bones such as cow ribs, sheep metapodials and pig fibula. The only downside is that the animals will generally all be quite young specimens and sometimes the bone quality (especially with lambs and pigs) is not ideal for working. Depending on how friendly you are with local vets, knackers yards, farmers and such, you may well be able to obtain various carcasses or bits of carcasses from them as well. However, be aware of the law regarding various dead animals and the fact that some carcases have to be incinerated.

Overall, when collecting or negotiating with people over dead animals, be very sensitive and careful – not everyone is comfortable dealing with such things and I have had informal official encounters when "in the field" on more than one occasion because suspicious members of the public were certain that collecting carcasses from various places must somehow be illegal.

Preparation of materials for bone working

Once the raw materials are obtained, some of them will require various levels of cleaning or preparation before being used. There are various chemical methods as well as using beetles etc, but those are beyond the scope (and cost) of most people so I will just deal with the easiest methods.

Any bones that have been collected from outside should be dealt with as soon as possible once you get them home. Put them in a bucket with some hot water (with a splash of disinfectant or weak ammonia, NEVER household bleach as this weakens the bones). Scrub the bones to remove any dirt, mould etc and check their general condition. Then allow them to air dry (but not for prolonged periods in direct sunlight as it also weakens the bone). If there are any residual bits of tendons etc remaining, allow them to dry fully then trim with a sharp knife to remove them.

Fresh bones

Bones that are a bit more fresh (such as from a butcher) require a little bit more work.

1. Trim off as much excess meat, gristle etc as you can – the more you remove now the easier your job is later.
2. If the bone is relatively small, skip this step. With larger bones (cow longbones etc), cut the ends off with a saw (an old hacksaw or similar) and clean out the centre of the shaft with a stick; remove as much marrow as possible.
3. **WARNING: HERE ONWARDS IS SMELLY, USE AN EXTRACTOR OR DO IT OUTSIDE AND AWAY FROM OTHER PEOPLE. THERE IS A REASON TANNERS ETC WERE OFTEN OUTSIDE CITY WALLS.**
4. Set up a large pan, fill with bones, cover with water and bring to almost boiling point.
5. Simmer (NOT BOIL) the bones until the remaining flesh is shrivelled and easily falling off. This can easily take upwards of an hour or two depending on the bones and how rigorous the Step 2 de-fleshing was.
6. Once the flesh is very loose, empty out the pan and trim/pull off the remaining bits from the bones. Allow to cool before handling. NOTE: DO NOT try to cool them by immersing in cold water as the bone could crack or even shatter.

Alternatively, if time and possible discolouration are not an issue, replace steps 4-6 with either of the following:

- Dig a hole in the garden about 1 metre deep, fill with bones and backfill, excavate in about a year.
- Place bones in barrels of water and leave for a few months, periodically scraping the slime off them. **WARNING: THIS IS SMELLY.**

Carcases

Finally, if you have a carcass (complete or partial, but certainly more than a few fleshy bones) you will have to process the body. This is quite easy, but messy. Generally, this is better done outside, in a shed or similar on an easily washable, non porous, smooth surface (a piece of worktop is ideal). Once you have a working area ready, the various tools you will need are:

- An apron
- Sturdy waterproof gloves (marigolds will do)
- A sharp knife (preferably with a blade that curves back and ends in a good point)
- A large bucket/old bin
- Bin bags

This process assumes the skin is waste i.e. you do not want it for tanning purposes (as skinning for tanning is more complicated than just to remove the skin quickly).

Preparing Carcases

The following procedure will allow you to quickly prepare a carcase for processing. As it does not need to be plucked, this method is also fine for birds.

1. Lie the carcase on its back and make an incision though the skin (and only the skin! There are some smelly things around there, especially on male animals!) at the base of the anus and gently run the knife straight up the belly, chest and neck until you reach the lower jaw.
2. Cut down the inside of each leg, from the foot down to the lateral cut you made. Then cut around each foot from the start of the leg cut. On a bird slice down the inside of the wing right next to the bone.
3. Cut around the head, starting at the jaw line and circling the neck.
4. It should be possible to slide your hand under the skin and over the ribs to create a "pocket". By sliding you hand over the flesh while gently pulling the skin you should be able to work all of the skin off the body. Start on the top half of the body and work down towards the anus, once that is exposed slice through the attaching tubing.
5. You should now be left with a mostly skinned carcase, with skin only remaining on the feet and head. Now it needs to be gutted.

To gut smaller animals (up to about fox sized);

1. Cut the windpipe just above where it exits the chest cavity, then slice around the membrane covering the innards
2. Slide your hand up between the organs and the spine and hook two fingers over the top of the mass.
3. Pull down sharply to sever the fleshy connections and all of the innards should come away in one. If they resist, *CAREFULLY* cut around them with a knife and repeat until they are free.

Larger animals will need to be dealt with slightly differently;

1. Cut the windpipe just above where it exits the chest cavity, then slice around the membrane covering the innards
2. Carefully cut around the lower organs (stomach etc) and remove them from the body, then do the same with the chest cavity. Generally you will not just be able to pull the organs to remove them.

Now that the carcase is gutted and skinned, it will need to be roughly de-fleshed to make the final preparations as easy as possible. As with preparing butchers' bones, the more thoroughly this stage is performed, the easier the final de-fleshing will be.

The aim of this is to essentially remove as much of the muscle mass as possible from the carcase. Therefore, with the exception of a few large areas it is simply a case of finding the bones and cutting along them to remove the meat. The largest areas that need to be dealt with are;

- Hind legs – there is always a great deal of meat on mammal hind legs, so be sure to remove as much as possible.

- Fillets – down either side of the spine there are usually large quantities of meat, especially the likes of deer and sheep.
- Ribs – generally there is quite a lot of meat over the ribcage, also try to cut out as much of the flesh from between the ribs as well.

Once the major areas of muscle have been dealt with, it is simply a matter of cutting off as much meat as possible. The vertebrae and pelvis can have relatively large chunks of muscle and while not as large as the hind legs or fillets they should still be defleshed as thoroughly as possible.

When the carcase is finally stripped down as close to the bones as possible, use the knife to dismember it into easily manageable pieces and proceed with the steps detailed above for preparing fresh bones.

Fresh Horn

A horn that has been recently removed from a carcase is relatively easy to clean out. Depending on how much of the horn core is protruding from the base of the horn, a flexible knife run around between the core and the horn to sever any tissue should be sufficient to free the core and allow it to be removed. If there is not a lot of core left outside the horn, consider drilling into the core and screwing in a hook or such to aid with removal.

Once the core is removed from the horn, as much of the internal tissue that is remaining should be cut and scraped out. Once the majority of it is removed, scrub the inside of the horn with hot water and a stiff brush to loosen any remaining tissue, then allow it to dry and repeat with a wire brush if necessary.

If the horn is to be used as a drinking horn, take extra care to ensure the inside is totally clean, then sterilise the inside of the horn. The easiest and safest way to do this is by using a strong modern sterilising solution that is suitable for food items.

Fresh Antler

Whether shed or cut from a carcase, antler will require little or no preparation before working. If any velvet is remaining on the surface, a stiff brush or a wire brush will quickly remove it.

Degreasing

Any material that is found to be greasy can be degreased to some extent by simmering in a washing soda solution and then leaving to air dry somewhere out of sunlight. However, a certain level of natural grease in bones makes them easier to work and prevents a lot of flaking when they are being worked.

Appendix 2: Myths about bone working

There are a number of myths surrounding bone working and the artefacts created by it. Many stem from misunderstandings about the material, but some others are unfortunately nothing more than recent inventions by re-enactors to support the use of various items. In this appendix I will take some of the more common myths and explain the truth about them.

Myth: *Bone workers only made stuff that peasants would use*

Truth: As has been seen with the range and quality of the artefacts crafted from bone, this is a total fallacy. While many objects would have been roughly made at home as and when they were needed, other items such as combs required skilled crafts people to make them and would be used by all levels of society.

Myth: *Early Medieval people used antler/horn tips or finger bones as toggles*

Truth: While many early finds of perforated pig bones were interpreted as toggles, this idea has been long discarded. As more sophisticated examinations were carried out, it was found the bones did not exhibit the expected wear patterns for toggles. It is more likely they were "buzz bones" – a primitive instrument. As for horn/antler tips, this appears as nothing more than a "re-enactorism" and there is no evidence for the use of them in this way. In fact a diagnostic feature of an antler waste pit is concentrations of antler tines, and horn core pits would probably show the same with horn tips if the preservation allowed.

Myth: *Bone working is easy to get material for as everyone just used bones after they had eaten the meat from them*

Truth: Most of the bones that were used in the Early Medieval actually came from areas of the body generally not associated with meat use, and were probably sourced from the butcher and not the kitchen. Additionally, bones that have been roasted cannot be safely or confidently used, so it is unlikely that they would have ever been used.

Myth: *Bone or horn trollen braiding wheels are a quick, easy and authentic item to make*

Truth: Partially true. They are indeed pretty quick and easy to make, however they are not at all authentic. Trelleborg or trollen braiding is another "re-enactorism". The braiding is derived from Japanese Kumihimo and the earliest possible evidence of it in Western Europe is *maybe* 17th century, certainly no earlier. Also, no matter how many times it is repeated, **there was no bone wheel with braid found at Hedeby/Birka/York etc.**

Myth: *Tooth amulets were a very common bone item, especially the silver clad boar's tusks that were often worn by warriors*

Truth: Again, this is another frequently repeated fallacy by re-enactors. Tooth amulets usually are very early (pre 9th C as a rule) and never appear to have been common. Boar teeth were one of a number of teeth used as pendants, but the vast majority were worn by women and they were not bound in silver and had certainly stopped being used by the 9th C. The often quoted find of the Viking boar tusk amulet at Repton is wrong; it was buried between his legs and there was no evidence of it being a pendant[1].

Myth: *One of the finest examples of a carved whalebone plaque comes from the Oseberg ship burial.*

Truth: Whalebone plaques are indeed exceptional artefacts and very rare, especially the highly decorated examples. However, despite the presence of many amazing artefacts, there was not a plaque in the Oseberg burial. The one that is often mistaken as being from Oseberg is actually from Grytøy (Fig 43).

Myth: *The majority of combs that are found are actually bone combs and the few antler examples are made of reindeer antler and were Viking in origin.*

[1] (Biddle & Kjølbye-Biddle, Repton and the Vikings, 1992) p41 & Fig 6.12

Truth: This is a myth that has arisen from old excavation reports and the practice of talking about "bone combs". As mentioned earlier, bone and antler can be difficult to tell apart by eye, especially when freshly excavated, thus many reports have used the phrase "bone combs" as a catch-all to cover all bone and antler combs. In reality, the vast majority (probably over 95%) of composite combs are antler as bone is generally just too weak for the teeth. As for the species of antler, most of the combs that have been closely examined have been found to be either red deer or "red/poss. reindeer", likewise the identifiable waste that is found is overwhelmingly from red deer. Reindeer was used sometimes, but was not common and certainly not the only material used for antler combs. It was particularly rare in the British Isles.

Appendix 3: Cow cannon bones: The essential bones for working

This appendix briefly outlines the importance of the cow cannon bones (or metapodials) to early medieval bone workers, and then explains how to break down a cannon bone to make a variety of items. Some of this is covered elsewhere in this guide but is repeated here for ease.

What is a cannon bone?

Fig 112 Cow cannon bone

As hoofed animals essentially walk on their finger/toe tips, the long bones in their feet have fused together to form a third long bone below the wrist/ankle. This third long bone is the cannon bone (or metapodial).

Why are they useful?

The principle reason for their usefulness comes from the fact that they are straight and broad, quite thick walled and allow for a range of items to be made from a single bone. Additionally, because they are not a particularly meaty bone, they were not usually cooked in the Early Medieval and were discarded as waste.

As a result a bone worker could have an almost unlimited supply of cow metapodia if they were close to a major butchery site or in a settlement. This means that cow cannon bones are by far the most commonly identified bone used for working (in some cases accounting for almost 90% of the worked bone).

Preparing and breaking down a cannon bone

Assuming that the bone is already clean and ready to use, the first step is to saw the ends off the bone, leaving a tube. Once the ends are removed it can be seen that the cannon bone has a roughly "D" shape section. The flatter rear section of the bone can be removed by either sawing down the sides, or scoring before splitting with an axe (sawing is more time consuming but less likely to break the bone). Remember that the grain of a bone runs from end to end, so only attempt to split the bone down its length, not across.

The flat piece can then be used to make belt buckles, decorative mounts, gaming pieces, strap ends, comb plates and a number of other items that you wish to have straight instead of curved e.g. some pins and weaving beaters. The remaining curve of the "D" can now be split to produce blanks for curved pins, spoons and such.

Do not worry if it appears that your spoon handle or pin looks like it will have a curve; this is perfectly normal and many of the finds are actually curved but this is often not seen due to the way they are drawn or photographed. Likewise, bear in mind that many of the pins are also quite short (less than 100mm long) and it is usually possible to get at least a couple of short, straight pins out of most metapodials.

Another thing to remember is that if a bone is sawn rather than split, most of the small fragments that are left can be made into naalbinding needles.

Fig 113 Cannon bone marked out ready to cut

Uses for cannon bones of other animals

- Horse – skates, long pin beaters, spindles
- Small deer/Sheep/goat – whistles, handles, needle cases, lucets
- Large deer – skates, handles (when halved),

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