Small Hands at the Bellows: Craft Training in the Viking Age.

Stephanie L. Stanley

MA by Research

University of York

Department of Archaeology

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Abstract

The purpose of this study was to determine what could be learned about how Viking Age craftspeople trained novices based on examinations of ethnographic accounts of craft training and medieval guild records of apprenticeship. By investigating the training practices of medieval crafting guilds as well as potters, bone- and antlerworkers, hornworkers, glassworkers, and non-ferrous metalworkers in other cultures, this study has shown that Viking Age novice craftspeople of both genders began learning in the workshops at a young age, and were likely the children of the senior craftsperson or craftspeople. Based on these findings, it is likely that Viking Age workshops were not highly specialized in one craft, but rather were operated by members of the craftsperson's family who were skilled in multiple crafting disciplines.

Most importantly, this study has shown that there is still a great deal still to be learned on the subject of Viking age craft training. It is my hope that this study will encourage further research and engagement on the topic.

Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

S. Stanley 2.)

Contents

Introduction

While the topic of craft production in Viking Age towns has been much discussed, little work has yet been done to investigate students of crafting traditions and their training. It was the dissemination of knowledge and skills from expert to the student that allowed crafting traditions to spread not only through the generations but also across regions and even cultures. We must ask ourselves then what were relationships like between masters and their protégés? What similarities in training practices can be found within different crafting traditions? What skills were introduced to the students at each stage of their training, and how did these learning networks spread from place to place? It is the aim of this study to answer these questions and others by exploring the various crafting traditions that would have been prevalent in the Viking Age.

By studying these learning networks and observing how information was disseminated from one generation to the next, we can begin to analyse where craftspeople came from in society as a whole, and how being accepted into a crafting tradition may have impacted the future social standing of a student craftsperson or 'trainee' (Minar and Crown 2001, 369). With careful study, we can also begin to understand how technological advances spread from one region or group of people to another, through the examination of how the individuals who carried on

these crafting traditions learned the skills they needed to become master craftworkers.

For this study, it is necessary to take a more speculative and metaphorical approach rather than one that is more heavily grounded in artefactual evidence. Due to how little we know about Viking Age craft training, we must devise new ways of thinking about how novice craftspeople received their education, which in turn may help us learn what types of evidence to look for when searching for novices withing the archaeological record.

We will begin by examining five major crafts of the Viking diaspora, which includes pottery production, antlerworking, hornworking, glass beadmaking, and non-ferrous metalworking. This section will be a consolidation of what is known so far about the different crafts and will highlight the limits of our knowledge for specific steps that made up the training processes for each craft. We will also briefly discuss the archaeological evidence that attests to the presence of novices in the workshop. These crafts will provide the foundation for section 3.

For section 2, we shall briefly step away from our five specific crafts and investigate the medieval crafting guilds in general to discern how novices were selected and trained, what sort of relationships existed between master craftspeople and their students, and the types of tasks novices were assigned in the workshop. The guild records provide first-hand accounts of what the life of medieval novices would have been like,

which will be a useful analogy for comparison with Viking Age novices. The medieval guilds are also a useful analogy as there were still many similarities in the types of tools, raw materials, methods, and technologies used in both periods. It is also possible that many of the methods and ways of working that were codified by the guilds during the medieval period would have previously been familiar to Viking Age crafts people, particularly in places where the city's development had been heavily influenced by Scandinavian settlers.

In section 3, we shall return to our five crafting traditions and examine how other cultures trained novices in these and related crafts. These examples will be drawn from a diverse selection of cultures that were selected based on the availability of detailed accounts of the *chaîne opératoires*, or operational sequence, and training practices of each group. Drawing from such a wide array of cultures will help us avoid basing our conclusions solely on the typical assumptions western scholarship has drawn about craft training and will instead enable us to focus on methods that have proven effective in the instruction of novices across dissimilar cultures.

Lastly, we will return to the archaeological evidence discussed in section 1 to determine if there are existing examples that matches what the medieval and ethnographic analogies have suggested.

It should be noted that there is a question as to whether Viking Age craftspeople were free, or if they were indentured to the elite. This

question is a study in itself and well beyond the scope of this project. At this time, we do not know enough to be able to determine whether these craftspeople or their novices were free or unfree, and so we shall discuss them in as neutral a manner as possible.

Section 1: Literature Review

The lack of written first-hand accounts detailing crafts training in Viking Age towns presents some difficulties when attempting to examine the transmission of knowledge from one master craftsperson to their students. However, archaeological traces of craft knowledge being spread from person to person and from one workshop to another that can help us overcome this limitation. Perhaps the most striking example of this comes from Gareth Perry's (2019) work exploring the link between a pottery production site at Torksey in Lincolnshire, and a pottery workshop in Newark, Nottinghamshire, that commenced production about a hundred years after the Torksey site was established.

I.) Pottery Production

It may seem odd to begin this study with pottery, considering that after the Merovingian period, pottery disappears from the archaeological record in Scandinavia (Rødsrud 2017, 77). However, while large-scale pottery production had ceased altogether in Norway during the early 6th century, it continued in a reduced capacity and in a different form in

Denmark and Sweden (Rødsrud 2017, 83). The use of pottery for domestic use and as burial urns "characterized the Pre-Roman Iron Age and Early Roman Period" throughout Norway, Denmark, and Sweden (Rødsrud 2017, 78). Rødsrud highlights the "Golden Age" of Scandinavian pottery occurring between 300 and 500 AD (Fig 1), after which the production of fine wares and the use of pottery in burial contexts began gradually falling out of usage throughout the Migration Period, before disappearing in Norway in the early- to mid-6th century (Rødsrud 2017, 78-79). In Denmark and Sweden during this period, we see a drastic "reorganization of production, where the polished, sand-tempered tableware is replaced by simpler, granite-tempered storage vessels'' (Rødsrud 2017, 79).

By the time of the Viking Age, pottery production had been reduced to low levels of domestic use and episodic household production,

Fig 1: Viking Age Pottery (Rodstrud 2017, 79)

S. Stanley 9.)

handmade using the coiling method, and "fired at low temperatures in open bonfires" (Ashby and Sindbæk 2020, 54). In Ribe and Hedeby however, there was a brief window where pottery was being made on a potter's wheel, though it was not very widely distributed and was probably only intended to supply the local communities (Ashby and Sindbæk 2020, 54). By the 9th century, the remaining Danish pottery traditions could be divided into four groups: northern Jutland, southern Jutland, Fyn, and eastern Denmark, (Wickham 2005, 816). Despite the lack of continuance of finewares and burial urns, the study of pottery production during the Viking Age, particularly in Anglo-Scandinavian England, offers valuable insight into the interactions that occurred not only among Scandinavian craftspeople who worked in different mediums but also between these individuals and the craftspeople of the new cultures that the Scandinavians were adapting to. These interactions in turn influenced the *chaîne opératoire* and the choice in materials used by Scandinavian craftspeople as we shall see. This shaping of ideas and materials is particularly evident in York.

Captured by the Great Viking Army in 866, York remained in the hands of Danish and Norwegian kings until 954, retaining "a strong Scandinavian element in population" until the Norman Conquest of 1066 (Hall 1984, 43). Here, both Anglo-Saxon and Scandinavian craftspeople worked side-by-side, influencing the development of each other's craft. Evidence of this was discovered in the Coppergate excavations, which

produced several different types of wares. Due to limitations of space, this study will focus on two pottery types in particular: Stamford and Torksey-type wares.

Torksey-type wares first appear at Coppergate in the mid- to late-9th century, becoming the "principle domestic ware" around 1000, before it was replaced by Stamford ware in the second half of the 11th century (Mainman 1990, 426-7). Initially, we see cooking pots, bowls, pitchers, storage vessels, and lamps, but as Torksey-type wares gained in prominence, we find an increase in forms and decorations (Mainman 1990, 427). Known for its sandy fabric, the Torksey pottery industry supplied the majority of the ceramics used in York, Lincoln, and much of the surrounding region (Perry 2019, 3). The raw clay was dug out of a slope approximately 1.5km east of the production site and was green in colour (Perry 2019, 9). The naturally occurring sandy inclusions in this clay made it nearly perfect for pottery production as it required little preparation and no tempering before it could be worked and fired (Perry 2019, 7). Once the clay had been dug, it was stored in pits near the kiln (Perry 2016, 91). From there, the clay would have been wheel-thrown, and the potters would have relied on tools "such as 'ribs' to assist shaping and to smooth the outer surfaces" rather than their hands alone (Perry 2016, 91). Next, the vessels were wiped and rouletted and decorations were added to the still-wet clay while it was on the wheel (Perry 2016,

91). Finally, the pots were cut from the wheel using a wire or cord and were then set out to dry before being fired in the kiln (Perry 2016, 91).

This prolific industry boasted nine kilns, with potentially a further 6 that were too poorly preserved to be identified with confidence as pottery kilns (Perry 2019, 3). The Torksey-type wares' distinctive grey-black surface with orange to red-brown margins was created by its two-stage firing regime: oxidation followed by reduction (Perry 2019, 3 & 5). Constructed from Mercia Mudstone clay, the kilns were likely built on-site and were typically fired to temperatures between 800 to 850°C (Perry 2016, 93-95). There is also evidence of a second, less typical firing regime, known as "Kiln 2 Regime," in which the pots were fired between 800 to 950°C in a reducing atmosphere, resulting in a cracked surface caused by overfiring (Perry 2016, 95). Perhaps this is evidence that kiln 2 was being used by a less experienced potter who lacked the temperature controlling expertise of the other potters?

The pottery produced at Newark referred to by Perry as Newark-Torksey-type, or N-T ware, displays many of the same characteristics as the pottery produced at Torksey. N-T ware was produced using the same two-stage firing regime, resulting in the same grey-black surfaces with an orange to red-brown interior layer that we see in typical Torksey pottery (Perry 2019, 5). The raw clay was also of a similar greenish hue and was harvested from the Blue Anchor Formation, which was also 1.5km east of where the potter had erected their kiln (Perry 2019, 9). Though the

Newark workshop was much smaller and only boasted a single kiln, it is clear that the potter who founded the industry had come from the Torksey learning network.

From their preference of raw materials and close adherence to the stages of production to the Newark potter's "understanding of the landscape as a source of raw material" (Perry 2019, 10), we find evidence of an individual taking a century's worth of knowledge and expertise that was developed at Torksey, and applying it to a fresh site in Newark 23 km away. Such striking similarities indicate just how deeply ingrained the lessons learned during craft training become, remaining with an individual throughout their career.

Another English pottery industry that heavily influenced Scandinavian craftspeople was that of Stamford. Stamford wares gradually began appearing at Coppergate in the first half of the 10th century and included forms such as bowls, cooking pots, pitchers, and most importantly to this study, crucibles (Mainman 1990, 462-463). Made of medium to light grey and gritty fabric, the crucibles were among the first forms of Stamford ware to arrive at Coppergate (Mainman 1990, 467), and are usually "small rounded vessels with inturned rims and pouring lips" (Mainman 1990, 470). As we shall see below, these crucibles were vital additions to non-ferrous metalworkers and glass beadmakers of York.

Unlike the Torksey-type ware, Stamford ware would have required some preparation before it could be worked, especially considering that it

was made from a blend of clay that came from two separate sources (Kilmurry 1980, 77). Once the raw clay had been harvested, it would have been left out to weather before being moistened, and the hard lumps were worked out of the fabric (Kilmurry 1980, 77). Next, the clay went through a treading process to ensure the mix of clays was as homogenous as possible before it was kneaded by hand to remove air bubbles and wedged for use on the wheel (Kilmurry 1980, 77). According to Kilmurry, the Stamford potters were exceptionally skilled with the wheel, resulting in thin-walled vessels that required little trimming (Kilmurry 1980, 78), though there is evidence that hand formed pinch pots, coiled pots, and slab-made pots were also produced at Stamford (Kilmurry 1980, 79). Finally, the vessels could be dried and fired in the kilns.

Though pottery use fell into a sharp decline after the 6th century in Scandinavia, it still heavily influenced the *chaîne opératoire* of craftspeople in different crafting traditions as we shall see below. Next, however, we shall examine antler composite comb production, as these artefacts are among the most iconic and diagnostic products of Viking Age craftspeople.

II.) Antlerworking

There is a plethora of information available regarding the methodology of antler combmaking. From the early work by Hilczerowna

(1961), Ulbricht (1978), and Ambrosiani (1981) up until the more recent studies by Smirnova (2005) and Ashby (2011, 2013 a, b), the vast amount of data collected is far too great to be addressed fully in this study, but it is from these studies that we can begin to recognise that the steps involved in making composite combs appear to have been fairly similar throughout Scandinavia, Britain, and the whole of Europe (Ashby 2013b, 19). This process has summarized most recently by Steve Ashby:

First, the tines were removed from the beam of the antler and split to form the tooth plates. Next, the porous core was removed, and the usable pieces were shaped into blanks, including billets being cut from sections of the antler beam for the back. Once this had been accomplished, the pieces were ready to be assembled. The tooth plates and billets were riveted together and then back was levelled. Finally, the teeth were cut, decorations were added, and the finished piece was polished (Fig2) (Ashby 2013a, 197).

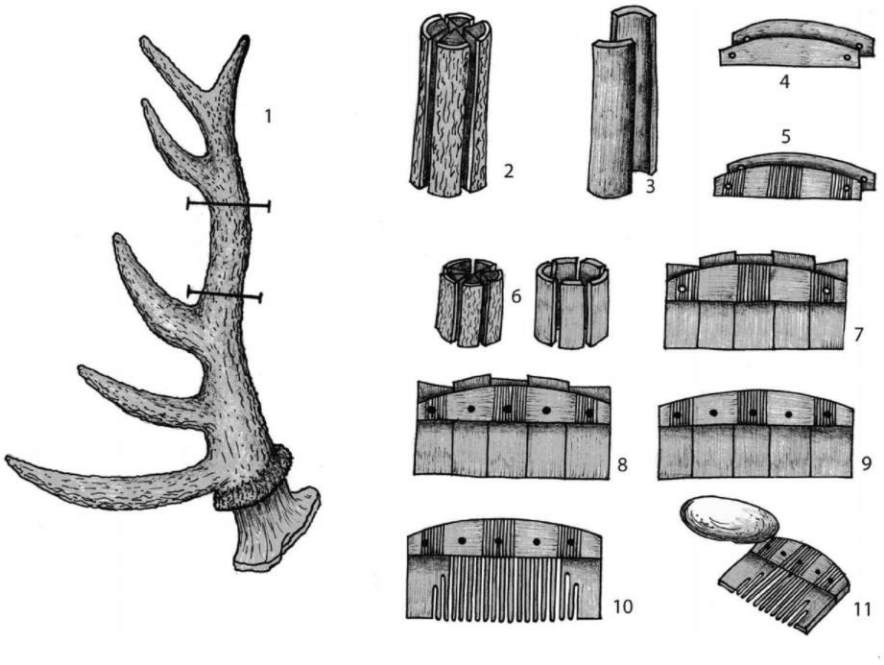

Fig 2: Sequence of comb production drawn by Hayley Saul, based on originals from Ulbricht (1978) and Ambrosiani (1981); copyright Hayley Saul (Ashby 2013a, 194)

S. Stanley 15.)

While these stages seemed to be relatively uniform throughout the Viking diaspora (Ashby 2013b, 19), there were numerous variations and possible choices in materials and procedures available to the craftsperson. It is through these variations that we begin to see evidence of crafting techniques being passed down through learning networks, as the choices in style, materials, and procedure that a craftsperson made during each stage in the production process were dependent on how the craftsperson understands the manufacturing process, "which is in itself borne out of a combination of inherited knowledge and experience of working with particular tools and materials" (Ashby 2013a, 201). An example of this can be seen when comparing the products of Viking Age combmakers in Scandinavia to those of their Anglo-Saxon counterparts.

In Scandinavian composite combs, we see a strong preference for using antler rather than postcranial bone, which was more heavily favoured by Anglo-Saxon combmakers (Ashby 2013a, 12). It can be argued that this preference was based on the physical properties of antler, which tends to have a greater bending strength and therefore durability than bone (MacGregor 1985, 28-29), and that greater flexibility would have allowed makers to cut larger tooth plates when working in antler rather than bone (MacGregor 1985, 28). One possible reason for the Anglo-Saxon preference to make composite combs out of bone rather than antler was the availability of the raw materials. Postcranial bone would have been more readily available, and therefore less expensive as

it could have been collected from midden heaps or butchers (Ashby 2013a, 199; Ashby 2013b, 20). Ashby points out however that once Scandinavians had begun settling in England and antler had become more readily available, Anglo-Saxon combmakers did not begin to replace bone with antler until the end of the 9th century (Ashby 2011, 20).

The preference of which material was used to rivet composite combs together and where these rivets were placed in relation to the tooth plates are another set of technological choices that were likely influenced by which crafting tradition the combmaker came from. In Ireland and north-eastern England, comb makers exclusively used iron rivets, placing them through alternating edges of the tooth plates to secure the plates and backs together (Ashby 2011, 310). This practice remained unchanged until after the Norman Conquest when composite combs fell out of fashion altogether and were replaced by combs cut from one piece without any rivets at all (Ashby 2011, 311).

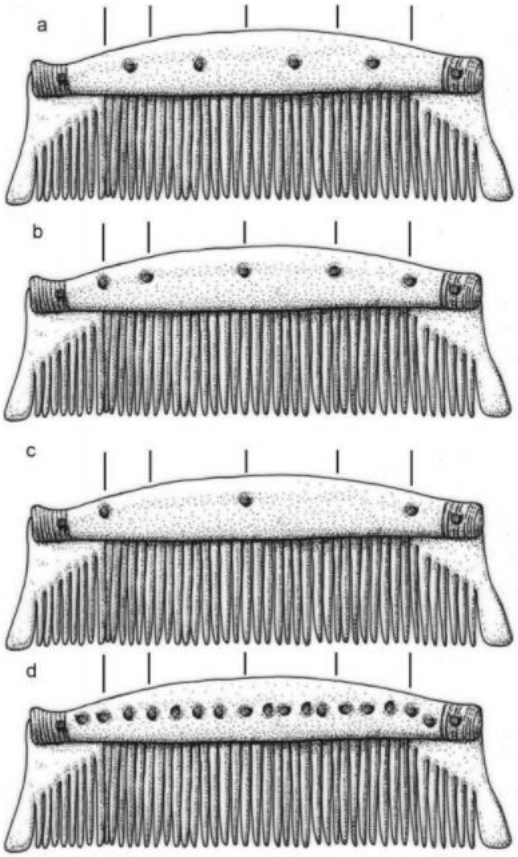

Fig 3: Riviting Methods (a) Central, (b) Every edge, (c) Alternating edge, (d) Decorative (Ashby 2013a, 201).

S. Stanley 17.)

In Scandinavia and the rest of the continent, we find a much greater variability in riveting

material. Throughout the 9th century, rivets made of iron were just as prevalent in Scandinavia and the rest of Europe as they were in north-eastern England, but by the 11th century, we see Scandinavia and the continent shift to using mostly copper (Ashby 2011, 310). There was also greater variability in where the rivets were placed compared to the plates than is seen in English/Irish combmaking traditions. In Scandinavia and the continent, the rivets could have been placed in the middle of tooth plates or on every edge rather than just at alternating ones (fig 3) (Ashby 2013a, 202).

When comparing Scandinavian/Continental stylistic preferences to the Anglo-Saxon/Irish corpus, we can see that while the process involved in making the combs encompasses all of the same steps, there are variations in preferred components that denote different learning networks and crafting traditions. These examples are just two of the many potential variations that could have been applied to the steps outlined above. There is significant debate regarding whether antlers were soaked before they were worked, and if so, what types of solutions may have been used to achieve the desired effects (Ashby 2013b, 200). Different preferences in the types of tools used is another example of a characteristic that may have been inherent to specific learning networks, but this will be discussed further below.

It can be argued that craftspeople simply would have chosen methods that would have been the most time or resource-efficient, thus

maximizing their production and therefore profit (Ambrosiani 1981, 117). I however am more inclined to believe that while craftspeople were not likely to completely ignore matters of efficiency, they would have been more likely to have depended on "methods that were familiar rather than innovative" (Ashby 2011, 312). After all, when doing the same task over and over an individual is far more susceptible to falling back on ingrained behaviours and automatic processing than trying to come up with new and different ways to accomplish the same task unless that task seems unnecessarily difficult or tedious. Ethnographers have also found that craftspeople will often say that their process is the best or even only way to perform their trade, showing that not only do students learn their craft by closely adhering to set formulas but that they also pass along those tenets to their own students (Ashby 2013a, 201). It is this understanding of the *chaîne opératoire* of craft production that allows us to assess where in that process evidence of students may be found.

III.) Hornworking

The next group of craftspeople that we must consider, the hornworkers, are a challenging group that have left little archaeological evidence of their trade, and thus must be examined cautiously. While at first glance one might expect hornworkers to have employed practices and methodologies similar to those used by combmakers, this is not the case (MacGregor 1985, 66). Whereas antlers are solid, bony outgrowths

that typically preserve well, horns are made up of a keratin sheath surrounding a bony core (MacGregor 1985, 20). While the core preserves just as well as any other type of osseous material, the horn sheath typically only survives in rare archaeological environments, particularly in those that are heavily waterlogged (Albarella 2003, 74). Because of this, we must take a more circuitous approach when looking for signs of Viking Age horn working.

One of the most easily recognizable signs of a potential horner's workshop is the presence of pits containing large amounts of horncores. One of the first stages in the *chaîne opératoire* of hornworking, which will be discussed in greater detail below, involves separating the keratinous sheath from the bony horncore that anchors it to the skull. Once removed, the cores would have then been disposed of in middens or left in the pits in which they had been soaking. It must be noted that while pits containing only horncores have been found and were most likely the result of dedicated hornworking, more often we find mixed assemblages containing horncores and other postcranial bones. To determine then whether an assemblage of horncores is evidence of hornworking or another industry such as butchery or leatherworking, Albarella suggests that we must consider the number of species represented, the parts of the bodies that have been discarded, and any toolmarks that can be found on the bones (Albarella 2003, 74-75).

Deposits that "are characterized by the fact that they derive from only one or two species, have a strong bias towards certain parts of the body- such as limb extremities and horncores- and may have evidence of cut or chop marks carried out in a regular and consistent way" can all be used to eliminate butchery as a possible source of the assemblage and restrict it instead to the probability that leatherworking and/or hornworking were the sources of the waste (Albarella 2003, 75). Typically, when an animal has been skinned, the extremities such as the tail and leg bones as well as the frontal bone and horncores in horn-bearing animals remain in the skin (Albarella 2003, 75). This was beneficial for the tanners for two reasons. First, neat's-foot oil could be derived from the hooves of the animal and could be used during the tanning process to dress the leather, and second, the horns were also beneficial to have as they provided a way for the leatherworker to determine the age and sex of the animal the skin came from (Albarella 2003, 75) and provided an additional source of income as it was most likely from the tanners that the horn workers received their raw materials (Albarella 2003, 75).

Archaeological evidence is not the only tool that should be considered when looking for where hornworking may have taken place. The study of place-names has proven to be instrumental in better understanding the landscape and history of Great Britain. When compared to archaeological finds, it can help explain a plethora of questions that excavation alone

would leave unanswered. The best example of this can be found in Leslie Peter Wenham's study of Hornpot Lane in York.

Wenham's 1957-58 excavations took place after the demolition of the Fox Inn in preparation for the construction of the York College for Girls (Scott, 2019). The site contained more than 500 horncores inside a pit with a bottom of clay and sides lined with wooden beams that were then sealed with an additional clay coating (Wenham 1964, 27). There were also four small furnaces nearby, one of which showed evidence of having been used to cast bronze (Wenham 1964, 27). While the pit and its contents dated to the late 14th century (Wenham 1964, 32) the name "Hornpot" can trace its origins to at least as early as 1295, though the street was in use and described in 1257 (Scott, 2019). It is worth mentioning that the etymology of the place-name hints that an even earlier origin might be possible. Wenham explains that according to the Oxford English Dictionary, the second element *pot* is indicative of "a deep hole, a pit dug into the ground," or "a tan pit, a hole out of which peat has been dug" (Wendham 1964, 28).

Even more interestingly, he says that the definition of a tan pit or place where peat has been harvested is only used in that sense in places where "Scandinavian influences were strong" (Wendham 1964, 28). It is this combination of archaeological evidence and place-name analysis that allows us to assume with some confidence that this pit was indeed used by hornworkers at least as early as the mid-13th century. While there is

no indication of what may have existed on the site prior to this, it does raise the question as to whether or not the site may have been the home of earlier hornworking activities, potentially even tying it back to a time when the Scandinavian influence in York was even more strongly felt. Sadly, without further research into the site and its origins, we are left with only speculation.

Nevertheless, Wenham's acknowledgment of the importance of the place-name, especially in conjunction with the archaeological evidence, shows that it may be possible to locate other workshops in the landscape where horn might have been processed. A study of horn-related place-names in Scandinavia especially would be an enlightening project with the potential to shed even more light onto this elusive crafting tradition.

While the difficulties of locating signs of Viking Age hornworking can make it challenging to understand the development and spread of learning networks in the hornworking tradition, it is still possible to examine the *chaîne opératoire* of hornworking to detect where trainees would have been placed to learn their craft. As mentioned previously above, removing the horn sheath from the core was one of the earliest stages in the hornworking process. While it has been argued that the horns may have been separated by the tanners (Ervynck *et al.* 2003, 63), that was likely not the case in every situation as the Hornpot Lane site seems to suggest (Wendham, 1964). In cases where the horns arrived at

the workshop with their cores still intact, we find evidence of three variations to the separation process.

The first, as we have discussed, is by soaking the horns in pits or cauldrons of water. There is some debate as to how long the horns needed to have been soaked. Initially, in his examination of the Hornpot Lane site, MacGregor states that the horns were "steeped in water for a matter of weeks (depending on the ambient temperature)" (MacGregor 1991, 371), but in a later text asserts that "a year is commonly quoted as being the optimum period for soaking horn before it is worked" (MacGregor 1998, 14). Wenham on the other hand offers a soaking period of at least two months for the horners of Hornpot Lane (Wendham 1964, 39), and Ervynck agrees, offering two to three months as the recommended soaking time (Ervynck *et al.* 2003, 68).

This step was dependent on the decomposition of the connective tissue between the horncore and sheath, so undoubtedly there would have been some variance in the amount of time the horns were soaked. As previously mentioned, water temperature would have played the most significant part in influencing the decomposition process, as would have the condition of the horns upon immersion, the chemical and bacterial content of the water, and a plethora of other factors that are beyond the scope of this project. I expect to find longer soaking periods the further north the workshop was located, but further testing would need to be done to know for certain. Soaking did have an additional benefit that is

worth mentioning here as it improved the transparency and plasticity of the horn (Albarella 2003, 74).

Another method to separate the sheaths from the cores was to expose the horns to air and allow them to decompose naturally (Albarella 2003, 74). This method would have taken longer but seems to have been the prevalent practice on the continent, whereas soaking in water was limited mostly to Britain (Albarella 2003, 74). Once the horns had been either soaked or allowed to air dry, it was time to separate the cores from the sheaths. This step is where we see the final variation in the process as the horn sheaths could either be pulled off as one solid piece, or the horn could be cut into halves or quarters (MacGregor 1985, 51). This step would have been an ideal stage to place under the care of a young student as it would allow them to learn how to recognize quality materials early on in the process. This would have also taught them how variables such as weather and material quality affected the decomposition process, giving them the ability to predict when horns would have been ready to take to the next stage.

After the horn sheaths had been separated from the cores, they were sorted with regards to size and quality and then boiled for at least an hour to soften them (Wendham 1964, 39). Once this had been accomplished, the solid tips could be removed to make buttons or knife hilts and the remaining hollow horn sheath could be cut and either moulded into the desired shape or flattened into sheets (MacGregor 1991, 364). While the

production of buttons and knife handles could have been entrusted to the youngest novices, it is more likely that the cutting and reshaping or flattening of the horns was left to the slightly older students.

Once they had been cut, shaped, or flattened, the horns could be made into a variety of products such as drinking and blast horns, sword hilts, composite combs such as the 12th century finds from Dublin (MacGregor 1985, 52), and even helmets. The helmet recovered at Benty Grange, Derbyshire, is a particularly exciting example of this, as it dates to the latter half of the 7th century and is the only surviving example of its kind from Britain (MacGregor 1985, 154-155). Only the faintest traces of the horn plates that covered the iron framework of this helmet remain, showing up only as "a mineralized pattern on the outer surface of the strips" (MacGregor 1985, 155). Such an exquisite and undoubtedly costly piece surely would have been the work of a master craftsperson.

Finally, any sort of metalwork or etching would have been applied, and then the horns would have been polished, another set of tasks that likely would have been left to the students. This could have been done with a number of different materials including strips of leather, crushed chalk, ashes, or bundles of soaked shavegrass (MacGregor 1985, 58). Once these steps had been completed, the objects were ready to be sold.

While the earliest days of the hornworking trade are difficult to account for archaeologically speaking, there is a wealth of information that can be found in the later medieval period, including guild ordinances

and contracts from York and London (Wendham 1964, 32). The records from the British hornworking guilds and other medieval production sites will be examined in detail below.

IV.) Beadmaking

As beads form one of the most numerous groups of finds in the excavations of Viking Age towns (Wiker 2003, 24), it would be a mistake to overlook their significance as a source of information about craft training and learning networks in this period. Beads were highly valued as trade goods and possibly even used "as a form of currency or set-value exchange items" in some places such as Kaupang and Birka (O'Sullivan 2015, 82). The waxing and waning of bead production in Scandinavia and the importation of beads can also from India and the Middle East can be viewed as markers that illustrate how trade routes changed over time with the rise and fall of the caliphate's power in the Middle east.

In the 7th century and before, the beads found in Scandinavia were almost exclusively locally produced, appearing as monochromatic and millefiori beads that were predominantly green, yellow, and red (Callmer 1995, 49-50). Towards the end of the 7th century, however, we begin to see a change in the styles being produced in Scandinavia with the appearance of transparent blue and opaque white beads, as well as a preference for red and white decorations (Callmer 1995, 50). The craftspeople making beads appear to be producing a higher quality than

their predecessors, and we start to see more complicated patterns such as the reticella, or cable patterning among the previous styles (Callmer 1995, 50). This continued until the second half of the 8th century when the Abbasid dynasty took over the Caliphate (Callmer 1995, 51). There is a sharp decrease in locally produced Scandinavian beads in the archaeological record for this period, and a flood of the styles of beads common to the modern day Iran and India begin to appear in excavations of Scandinavian towns dating to this time (Callmer 1995, 50). We continue to see millefiori beads in this period, but those of eastern manufacture, as well as segmented beads and eye-patterned beads, fade from the archaeological record after the end of the 9th century (Fig 4) (Callmer 1995, 50).

The imported beads dominated the market from the second half of the 8th century until the late 9th century, showing up in graves and in vast numbers in trading centres (Callmer 1995, 51). What is particularly interesting about this period is the overwhelming number of defective beads that appear in places such as Kaupang and Ribe. In several different sites at this time, we see a higher percentage of defective imported beads than we do intact ones (Callmer 1995, 52). One could argue that

Fig 4: Imported polychrome glass bead from the Coppergate excavation. (Mainman and Rogers 2000, 2594).

this disparity in the representation of intact and defective beads in the archaeological record can be explained by the nature of the beads themselves. Defective beads, or beads that could not be strung onto strings as Callmer defines it (Callmer 1995, 52), would have been less appealing to customers than their functional counterparts and would likely have remained in the trading centres while the beads whose holes were intact would have been purchased and taken to secondary sites where they could be used. Towards the end of the 9th century, the imported beads begin to disappear from the archaeological record, and we see a resurgence of locally produced Scandinavian beads (Callmer 1995, 53).

With the reduction of trade relations between Scandinavian and the Middle East and the return to the prevalence of Scandinavian-made beads, we can return to the question of craft training and learning networks in the Viking Age. While the local production of glass beads in Scandinavia had declined between the 8th and late 9th centuries, it had never fully gone away, and at the end of the 9th century, we see a strong resurgence of these locally made beads as well as new production methods and colours. There is however the question as to where the Scandinavian glass makers got their raw materials.

Raw glass was not produced in Scandinavia until at least the 16th century (Gaut 2011, 174). In fact, the only known glass kiln in operation during the Viking Age that can be definitively identified as such was located in Torcello, Italy (Guido and Welch 2000, 115). Because of this, it

would have been necessary for glass to have been imported into Scandinavia from the Mediterranean and the Middle East before it could be worked into beads (Bayley and Doonan 2000, 2527-2528). Based on waste material, we can see that glass was imported in the form of rods and tesserae made from imported soda glass and were available in a variety of colours (Gaut 2011, 169). While the tesserae were most likely made in places such as Torcello, Ravenna, or from other sites around the Mediterranean (Lundström 1976, 6), Lundström suggests that the rods were probably made in Scandinavia where scrap glass would have been melted down to form them (Lundström 1976, 10).

There has been a fair amount of debate as to whether or not scrap glass, or glass sherds from broken drinking vessels, was melted down and reused to make beads. Gaut (2011) finds the use of glass shards to be less than ideal, stating that "gas bubbles and impurities will often be trapped in the matrix" during the melting process, which would make the glass less clear (Gaut 2011, 175). Henricson (1995) however has found evidence of broken beakers being reused to make pendants for necklaces (Henricson 1995), and in York, we have evidence of distinctively Roman blue glass being re-melted to make beads (Bayley and Doonan 2000, 2528). Finally, an account from the 6th-century historian Gregory of Tours suggests that there was a demand for exported broken glass, in which Gregory describes a thief who broke a church window so that he could melt down the pieces to sell (Lundström 1976, 7).

Given the statements of both Henricson and Lundström's assessment of the account from Gregory of Tours, as well as the fact that raw glass was not being produced in Scandinavia itself, I find it likely that Scandinavian beadmakers would have imported as much glass as they could have, including fragments of vessels to be melted down to form rods for bead making. This method would have been challenging as such an assortment of glass sherds, presumably from different proveniences, would have had different qualities that would have affected the melting process.

The beadmakers would either have had to have been familiar with the qualities of the glass they received or have been skilled at finding "*ad hoc* solutions" to make the glass melt seamlessly together into one homogenous mass (Callmer and Henderson 1991, 147). Learning to adapt to fluctuating variables such as this would have been a major part of the student beadmaker's training (Callmer and Henderson 1991, 147). However, due to "the nature of glass production itself as well as the scarcity of evidence" during this period (Stephens 2011, 276), it can be difficult to fully understand how young beadmakers received their education. To do this, we must look to the four methods that were used to create glass beads as well as two different decorating styles that were prevalent during the Viking Age.

The technique most commonly assumed to be the preferred method of bead production is the winding technique (Hirst 2000, 122). In this

method, a red-hot glass rod is heated and wound around a narrow metal rod that is typically made of copper or iron alloys and then "usually (though not always) smoothed and shaped on a marver" (Hirst 2000, 122). Once the beads and metal rod had cooled, the glass bead could be removed from the rod fairly easily as the metal would contract more than the glass around it as it cooled (Astrup and Andersen 1988, 224). This method can be detected by looking at the structure of the glass. Beads that had been wound will show a horizontal structure to the material, running at a 90° "angle to the axis of the hole" (Hirst 2000, 122). This method would result in a hole that is fairly uniform throughout with no major differences at either end. This would have been a challenging technique to master, requiring speed and dexterity when handling the hot glass as well as a solid understanding of the "thermal properties" of the raw material (Callmer and Henderson 1991, 146).

Knowledge of heat control as well as the thermal properties of glass and metals would have been extremely important to student beadmakers, and likely one of the first lessons they learned. While the furnaces used to melt glass would not have needed to reach as high of temperatures as those of the metalworkers we will discuss below, a beadmaker would have needed someone to work the bellows and keep the temperature as constant as possible (Pedersen 2015b, 57). This would have been an ideal place to begin a students' training as it would have been a task that a novice could easily learn. It was also arguably one of the skills that they

would rely on most throughout the rest of their profession, regardless of which production methods they would go on to use.

The next technique to be examined is the piercing technique, in which a thin iron spike was dipped into molten glass and then driven into a post to perforate the glass mass and form the hole (Bayley 2008, 14). This method could also be used to produce finger rings if the glassworker removed the spike from the post and spun it, causing the hole to expand to the proper diameter (Bayley 2008, 14). This production method would have produced beads in which the hole tapered at one end and may have also been square-shaped (Hirst, 2000, 122). This fairly simple technique would likely have been a task that young beadmakers could have managed and would have allowed them to practice moving quickly and carefully with heated glass on rods.

The third and fourth production methods, blowing and drawing, are closely related and shall be discussed together. With blown beads, a glob of molten glass was gathered at the end of a hollow punty rod and the beadmaker would blow a steady stream of air into the mass to form a bubble, which could then be shaped with tongs and snipped off at the appropriate size (Hirst 2000, 122). In the drawing method, a larger glob of glass was gathered, and air was blown into the mass as before, but then the glass was drawn into "several, meter-long tubes" where it could then be cut and crimped into shape and made into several beads with tongs and shears (Hirst 2000, 122). These would have been more

advanced bead making techniques that would have required the cooperation of at least two people (Callmer and Henderson 1991, 146-147) as the rods would have been too heavy and awkward for one person to manage alone (Wiker 2003, 27). Perhaps this was another job that could have been entrusted to a more advanced student? Unfortunately, it is impossible to say for sure without any written records of the instruction process from this period.

Now that the production process of beads is better understood, we can begin to examine two decorating techniques that were frequently used in the Middle East and also later in Scandinavia: reticella patterning and foiled beads.

To create reticella beads, beadmakers would begin with a glass rod and wind thin threads of glass in another colour into a spiral pattern around it (Wiker 2003, 27). The glass rods themselves could also be heated and twisted, and further colours could be added to make a more complex pattern (Wiker 2003, 27). This was a process that would have also necessitated at least two people: one to turn and manipulate the glass rod, and another to manipulate and apply the glass thread (Callmer and Henderson 1991, 146-147). Twisted reticella rods could also be used to apply spots of colour to the outside surface of the beads, leaving them with spots of twisted colour (Wiker 2003, 146).

The final technique that needs to be examined is one that produced metal-foiled beads. These beads were produced by first drawing a long

hollow tube that was then wrapped in metal foil before being covered by a second, slightly larger tube (Jönsson and Hunner 1995, 114). This first tube, which would form the inner layer of the bead, "consisted of imperfectly melted glass", meaning that as the glass was initially melted, it was removed from its heat source too soon, resulting in glass that had a higher number of air bubbles and impurities (Jönsson and Hunner 1995, 114). As the glass mass was drawn into a tube, these bubbles "became so elongated that the glass tube seems opalescent or opaque, giving the tube a white, glittering appearance" (Jönsson and Hunner 1995, 114). Once cooled, the tube was then wrapped in metal foil, after which it could either be dipped back into the molten glass to coat the piece in a second layer of glass to seal it, or it would be threaded through a slightly larger tube and reheated and pulled again to seal it (Jönsson and Hunner 1995, 114-115).

Beadmakers could also produce "counterfeit" foiled beads by forgoing the foiling process and simply adding the second, outer layer of glass over the first, relying on the opalescent nature of the inner tube to fool the unwary or unwitting buyer (Jönsson and Hunner 1995, 115). While these beads are frequently referred to as silver- or gold-foiled beads, Astrup and Andersen have shown through chemical analysis of some foiled beads produced in Birka that all of the beads they have tested were produced with silver foil only (Astrup and Andersen 1988, 226). Even the beads that appear to have been made with gold foil were in fact foiled in silver

and then coated with a yellowish or amber coloured outer layer of glass to give them a golden appearance (Astrup and Andersen 1988, 226). Such deceptions would likely have required a great deal of trial and error, as well as extensive knowledge as to how the different layers of glass and foiling would have behaved throughout the crafting process.

Evidence of metal-foiled bead production can be seen to have taken place at both Birka and Kaupang at approximately the same time, though the quality of the beads found at Birka seems superior to those produced at Kaupang (Astrup and Andersen 1988, 226). This raises the question as to what sort of relationship, if any, existed between these two contemporary workshops. Could the beadmaker at Kaupang have been a student of the craftsperson at Birka? Or perhaps the situation was reversed and the student of the beadmaker at Birka left to set up shop at Kaupang and improved on their mentor's technique. There is also another tantalizing find from York that appears to be an attempt at crafting a foiled bead that was unsuccessful.

Bead 1171 from the Parliament Street excavation was described as "covered with a layer of silvery and pale brown iridescence," (Tweddle 1986, 221), which sounds very similar to the description of the "gold"-foiled beads we see from Birka and Kaupang (Fig 5). It is impossible to say for sure if there was any connection between these three workshops, but it does make one wonder about the learning networks of beadmakers in Viking Age Scandinavia and Anglo-Scandinavian York.

By examining these production methods, we begin to see what kind of knowledge would have been important to pass on to student beadmakers and how that knowledge may have been transferred from workshop to workshop. As briefly discussed above, heat control would have been one of the most important skills a student beadmaker would have needed to master early on in their education. The clarity of the glass was heavily dependent on the melting temperature and the time spent during the initial melting process, especially when old glass was remelted, as the air bubbles and other gasses that had been trapped within the matrix being released were what improved the clarity of the finished product (Jönsson and Hunner 1995, 114).

Fig 5: Bead 1171 from the Coppergate excavation at York. Reprinted with permission from the York Archaeological Trust.

The annealing process was another stage in the young craftsperson's training that would have required in-depth instruction and supervision to ensure they had mastered the skill. Once the beads had been made and the decorations finished, the beads would have needed to have been heated one final time, and then were allowed to cool slowly to prevent them from breaking (Callmer and Henderson 1991, 146). This process needed to "proceed slowly and under full control", which would have required "a full competence to judge temperatures", otherwise all of the

previous hard work that went into making the beads would have been destroyed (Callmer and Henderson 1991, 349). Such expertise could have only come from long-term instruction and supervision from an experienced mentor (Callmer and Henderson 1991, 349).

Much like the non-ferrous metalworkers which will be discussed below, beadmakers would have also needed to understand a wide range of materials and their qualities even beyond the properties of glass and maintaining a furnace. It is likely that beadmakers were able to identify high-quality ceramics, which would have been essential when choosing where to buy the crucibles that would have held glass fragments whilst they were being melted down. At the Coppergate excavation in York (Bayley and Doonan 2000, 2520) and in several Lincoln excavations (Bayley 2008, 12, 17), Stamford ware crucibles showing traces of glass working have been found.

Unlike the Stamford ware crucibles that were used in metalworking as we shall see below, these pieces differed in that the "glassworking crucibles were oxidize-fired, unlike the metalworking crucibles found on the same site and contained shell-tempered vessels and sandy wares" (Bayley 2008, 6). While the beadmakers would not have needed to know as much about ceramics as the potters who had made them, they would have needed to at least be able to recognize which qualities in the clays would have been beneficial and which were detrimental to the melting process, such as recognizing that the high silica content of typical

Stamford ware pottery would have negatively reacted with the high-lead glass that was used in Anglo-Scandinavian England at the time (Bayley 2008, 12).

The similarities between the types of knowledge beadmakers and non-ferrous metalworkers would have needed to master raises the question of how much communication and knowledge-sharing may have taken place between these two crafting traditions. We know glass inlays were used in jewellery and decorative mounts throughout the Viking Age (Gaut 2011, 178), but we do not know what kind of relationship the non-ferrous metalworkers and glassworker had, if any, or if the metalworkers who made the jewellery were the ones who melted and shaped the glass inlays as well (Gaut 2011, 234). The question of communication and knowledge-sharing between Viking Age crafting traditions is a topic that will be discussed further below.

V.) Non-ferrous Metalworking

The final group of craftspeople that needs to be considered when attempting to understand Viking Age craft training and learning networks are the smiths. This group in particular is one that must be explored carefully as the term "smith" can encompass a large variety of disciplines. In fact, the Old Norse term *smið* can mean not only someone who worked in iron or other metals but also anyone who worked in wood or bone (Jørgensen 2015, 304). For this study, the term "smith" will be limited to

those individuals who worked in metals such as iron, lead, brass, bronze, and more precious metals such as copper, gold, and silver.

Based on the prevalence of slag at many Viking Age farms and town sites, smithing was a widespread craft that may have carried complicated social, and potentially even ethnic ties (Jørgensen 2015, 315). Most excavations of moderate to large-scale farms dating to Viking Age Scandinavia have produced slag, supporting the view that at least the basics of iron smithing were known to many individuals. Justine Bayley argues that while collections of tools such as the Mästermyr find seem to suggest rural smiths worked with both ferrous and non-ferrous metals, that does not seem to have been the case in urban settings. She states that what may have been normal and "appropriate in rural areas with dispersed populations" might not necessarily have applied to urban craftspeople, especially in places such as York where the minting of coins took place (Bayley 1992, 816). Due to the limited scope of this study and the availability of archaeological evidence, it is necessary to restrict our focus to those urban craftspeople who specialized in non-ferrous metalworking.

The average non-ferrous craftsperson would have needed to have been familiar with a wide array of materials as well as the skills and knowledge of how to work with each of these resources. This would have necessitated a long studentship, most likely beginning at an early age, to allow a trainee to build up the diverse pool of knowledge they would have

needed to handle the varied demands of working in such a complex environment (Pedersen 2015b, 56-57). One of the first and most readily apparent abilities a metalworker would have needed to have mastered was heat control and an understanding of the various melting points of the metals they worked with. While they had no way of measuring the specific temperatures needed to melt lead, silver, gold, and copper (which were 328°C, 960°C, 1063°C, and 1083°C respectively) (Bayley 1992, 754), smiths would have had an intimate understanding of heat control, just as the glassmakers discussed above did (Callmer 2001, 138). This familiarity with bellows and temperature regulation would have been best absorbed whilst working the bellows at the forge, again, much as the students of glassmaking likely did (Pedersen 2015b, 57). Under the direct supervision of the master craftsperson or one of the other smiths, the student metalsmiths would have been able to rapidly absorb how each metal reacted in the furnace, and how to extract or combine the different metals into the desired purities or alloys. They would have also learned to recognize when the metals had reached the desired temperature based on the colour of the metals as they were being heated (Glazzard 2020a). Understanding how to work with lead in particular would have been especially important in any metalworking shop.

Lead was an essential part of the metalworking process, not only as a raw material to be used in the production of tools and jewellery that were sold and traded but also as a tool for the metalworkers to use in

their craft (Pedersen 2015a, 179). The excavations at Kaupang and several other sites in the Oslofjord area of Norway have produced an impressive collection of lead artefacts that attest to the vital nature of this metal. There were numerous tools made of lead such as spindle whorls, weights, and line sinkers, as well as harness mounts (Pedersen 2015a, 180), but it is the lead moulds and models that the smiths made for themselves that can tell us the most about the skill and ingenuity of the craftspeople of Kaupang.

The frequency and volume of spillage finds at Kaupang, especially when compared to the remnants of other metals left behind at the site, indicates that lead was an inexpensive material, easy to obtain and replace, and not requiring special precautions to reduce waste or spillage (Pedersen 2015a, 180). Because of this and of its low melting point, lead could also have been used as a training metal for students, as the production of spindle whorls and line sinkers would have required very little skill (Pedersen 2015a, 180). These characteristics also made lead the ideal raw material to use in the production of moulds and models.

While clay and wax moulds were often used for casting metal objects, they were typically destroyed in the casting process, and drying the clay moulds took about 24 hours to complete (Callmer 2001, 138; Pedersen 2017, 126). By using lead models and moulds, the smiths could use the lead pieces as templates, rapidly making several clay or wax moulds at one time, resulting in multiple nearly identical pieces (Pedersen

201, 126). This helped combat shrinkage and flaws in the design as well. As the clay dried, it naturally reduced in size, causing some of the details to be lost (Fuglesang 1987, 219). If clay was used in both model and mould, the shrinkage in both pieces would cause the finished metal product to be smaller and less detailed than the original design. This problem would have been exponentially increased if the clay mould was used to make a clay model, which was then used to make another mould (Fuglesang 1987, 219). By using a lead alloy mould and model, the craftspeople were able to eliminate the variances the shrinkage would cause, which would have been especially useful when making a series of identical pieces such as harness mountings (Fuglesang 1987, 219; Pedersen 2015a, 187).

This also allowed the craftspeople at Kaupang to show off their skills in working with various materials by enabling them to make objects with the same designs in different mediums, which allowed them to mass-produce objects to suit customers of various economic positions (Pedersen 2017, 129-130). The desire of the average customer to emulate the styles and adornments of the elite likely made it a lucrative practice for the craftspeople to also produce copies of the jewellery they made for the elite in cheaper metals such as copper, brass, or even lead (Pedersen 2017, 134).

While indeed lead was an extremely important part of the metalworking process, the low melting point that made it so useful for

making moulds made it completely unsuitable to make crucibles, which were crucial tools for the melting and alloying of metals. For that, non-ferrous metalworkers needed a firm understanding of the strengths and limitations of ceramics. Crucibles needed to be both strong and refractory so that they could not only withstand the high furnace temperatures needed to melt gold and copper but also be able to survive the rapid cooling process that occurred once they were removed from the forge (Bayley 1992, 754-755).

Crucibles were often constructed with two or more layers, which were often made from clays with different compositions (Callmer 2003, 349). Nearly a thousand crucible fragments were recovered from the Coppergate excavation in York, the vast majority of which appeared to be Stamford ware (Bayley 1992, 754). As previously stated, Stamford ware ceramics had a fabric with a high content of both silica and alumina, which gave the clay improved refractory qualities (Bayley 1992, 754). While it is doubtful that the metalworkers in York made all of their own crucibles as Stamford ware was made in Lincolnshire (Cumberpatch *et al.* 2013), they would have needed to have had an understanding of what qualities were desirable in the fabrics that made up their crucibles. However, some of the crucibles were found to have had a soft outer layer of clay that had been added to them prior to use (Bayley 1992, 755). It is believed that this step was taken to insulate the main core of the crucibles from the fluctuating temperatures as they were rapidly heated

and cooled, thus protecting them from cracking and extending their usability (Bayley 1992, 755). Some of these crucibles even show evidence that these protective layers were added multiple times, supporting the theory that they were able to be reused (Bayley 1992, 755).

As we examine the *chaîne opératoire* of non-ferrous metalworkers, we begin to see the places where young trainees might have been set to work and observe. Working the bellows, collecting animal dung to fuel the furnace, preparing lead for moulds, and casting simple lead tools such as line sinkers or spindle whorls were all tasks a novice metalworker could have been expected to handle (Pedersen 2016, 201 & 202). The metalworking workshops at Kaupang in particular seem to have followed a "fairly rigid style of practice", which makes it "well suited to the delegation of tasks so that the student could gradually acquire more know-how" (Pedersen 2016, 202). Kaupang also provides a tantalizing piece of evidence for this in the form of a small crucible that would have necessitated tiny fingers for its creation (Pedersen 2016, 202). These small hands could have belonged to a child or even possibly a woman, which hints at the question of which genders could be expected to have participated in Viking Age craftworking, which will be discussed further below.

Summary

While the lack of first-hand written accounts detailing craft training in Viking Age towns can make it difficult to examine the transmission of knowledge from an expert craftsperson to a student, this study has begun to show that it is not impossible to detect these learning processes by examining the *chaîne opératoire* of these crafting traditions. By examining the step-by-step progressions of craft production, we can begin to see where it would have been most practical to start a young craftsperson's education, and what sorts of tasks these novices could have been entrusted with. Unfortunately, though, we just do not have enough information from this period to begin to draw firm conclusions about how a young craftsperson received their education and what the training process was like.

The lack of written evidence detailing the lives of Viking Age craftspeople and their students leaves many questions about these trainees unanswered. What strata of society did they come from? Were craftspeople only male, or did the acceptable gender vary from one discipline to another? What did the later stages of a student's training look like? To answer these questions, we must look to primary sources of the later Medieval Period to see how students were selected and how this may have compared to their Viking Age counterparts.

Section 2: Medieval Crafting Guilds

The difficulty faced when trying to understand how Viking Age craftspeople learned their trade is not only limited to the Viking Age. Even in the later medieval period, we find that descriptions of the training process are extremely scarce. This is most likely due to the inherently non-verbal nature of craft training, as well as the lack of a formalized or unilateral educational structure (Wallis 2008, 848). Nevertheless, given that "apprenticeship was one of the most important means by which occupational training was supplied in premodern Europe" (Wallis 2008, 832), it is still possible to find historical traces of how apprenticeship and craft training worked, even if it is not explicitly spelled out for us.

It is at this point in the study that we will briefly step away from focusing on the *chaîne opératoire* of craft training and instead seek to better understand the craftspeople themselves. This chapter will seek to determine how much influence if any the guilds had over the training of young craftspeople, how students were selected, what kind of relationship existed between pupil and teacher, and what we can discern about the ages and genders of the students in question. This is not meant to be a direct comparison between Viking Age and medieval workshops. Rather, it is a chance for us to set aside our modern conceptions of industry and to build a basis of comparison for our later examination of crafting disciplines in other cultures. At this point, it might be prudent to introduce

two terms that have until this chapter been conspicuous for their absence in this study: apprentice and apprenticeships.

Defining Apprenticeship in the Middle Ages

The term apprentice is derived from an Old French word that began to see usage in England during the 14th century (Epstein 1991, 65). Prior to that, these crafting students were most often referred to in documents by the Latin term *discipulus*, meaning disciples or students (Epstein 1991, 65). Apprentices were any individual who had entered into a contract with a master craftsperson "in which the master was obliged to teach, and the apprentice to learn" (Epstein 1991, 65). This specific focus on learning the craft is what sets apprentices apart from the journeymen, which will be discussed further below, as well as other forms of contracted work which is beyond the scope of this study (Epstein 1991, 65). It is important to point out here that medieval guilds and apprenticeships differed greatly from their premodern and modern counterparts and must be examined as separate entities (Richardson 2002, 4).

To begin to pick apart the finer details of medieval apprenticeship, we must consider three types of sources that are most likely to show evidence of how the training process functioned in late medieval Europe: guild records, indenture contracts, and records of inheritance. While none of these sources offer a step-by-step instruction manual explaining how craftspeople trained their protégés, they do allow us to examine the

challenges faced by both master craftspeople and their students, as well as the societal factors that fought to influence the economy by trying to regulate the crafting industry and those involved in it.

Medieval Guilds and Guild Records

When one begins thinking about medieval craftspeople and craft training, the mind is almost inevitably drawn first and foremost to crafting guilds. These iconic organizations were "one of the most characteristic and ubiquitous forms of association in the larger towns of provincial England in the later middle ages" (Swanson 1988, 429), and have heavily influenced the way in which both popular culture and academia have viewed the medieval marketplace. Here I think it is important to consider what exactly we mean when we refer to "the guilds."

The guilds have historically been viewed as "'industrial organization(s)', regulated by town councils as tools of economic policy" (Swanson 1988, 30), as "association(s) of employers who banded together to foster their self-interests" (Epstein 1991, 3), and as tight-fisted groups whose responsibility was "regulating craft quality and establishing local monopolies over the sale of particular items" (Pappano and Rice 2013, 476). Epstein defines the perceptions of the craft guilds best, describing them as "formal associations of specialized artisans… whose authority was backed by superior political sanctions" (Epstein

1998, 685). While there is some truth in each of these statements, none of them captures the full picture of how medieval guilds functioned.

The problem with this interpretation of crafting guilds is the tendency to lump all guilds together into one overarching category, assuming that they all had the same rules and ability to enforce their edicts. However, when we take a more discerning approach and examine guilds compared to their respective industries, size, the wealth of their members, or even location, we find a wide array of variation in the powers and agendas of medieval guilds (Richardson 2002, 3). For example, some guilds such as those in the German regions exercised strict control over who could be accepted as an apprentice, the terms of their contracts, and how they could achieve journeyman or master status (Wallis 2008, 835-836). In parts of France and Spain however, guilds were only able to act as mediators in disputes between masters and apprentices while the decisions on who could become apprentices and how an individual could advance were left up to the master craftspeople and apprentices themselves to negotiate (Wallis 2008, 835-836). Nevertheless, most guilds required masters to register their apprentices, as completing an apprenticeship was one of the foremost ways in which an individual could earn the freedom and gain citizenship (Wallis 2008, 834).

In many places, the power of the guilds to influence the daily lives of craftspeople was mostly an illusion as they lacked the necessary manpower or political clout to "effectively police their precincts" (Epstein

1998, 685). In these instances, the guilds acted more as mediators whenever there was a dispute between masters, or whenever a master or apprentice was in violation of their contracted agreement (Wallis 2008, 852). While most guilds had limited authority over how apprentices were selected and trained, there were others that maintained strict authority. An example of this can be seen in the smith's guild in Bologna where the master smiths were required to enrol their sons or brothers into the guild by the time they reached the age of fifteen (Epstein 1991, 105).

Up until the late 1990s, research on medieval craftworking and craft guilds had been "overwhelmingly concerned with the official organizations of master craftsmen," which created a "misleading impression of coherence and comprehensiveness" that the guilds simply did not have (Rosser 1997, 4). Despite rules outlined in guild charters and regulations that had thus far been cited as proof of the guild's supremacy in standardising craftspeople and establishing monopolies, we begin to find that the guilds had little influence on the working conditions and selection process of individual students (Richardson 2002, 2). Particularly in larger cities, guilds simply did not have the resources or manpower to effectively enforce their regulations (Epstein 1998, 685).

One example of the inability of crafting guilds to adequately enforce their rules can be seen in the collaboration of different crafting professions on large projects. As Rosser explains, a major altarpiece that had previously been attributed solely to the late 14th-century artist

Jacopo di Cione was a collaborative project (Rosser 1997, 14). Analysis of the one remaining panel and an examination of the surviving documents surrounding it show evidence that an "extended series of different designers, painters, carpenters, and gilders" had all had a hand in its production (Rosser 1997, 15). Temporary collaborations on large projects such as this were fairly common even though many guilds had statutes that strictly forbade their members from working with craftspeople from outside their own guild (Rosser 1997, 15).

Another common guild rule that was frequently ignored was the requirement for each craftsperson to only professionally pursue one craft. Individual craftspeople frequently practiced more than one occupation or trade to maximize their earning potential (Richardson 2002, 3), and in reality, a single household would likely have been involved in multiple money-making enterprises to supplement their primary, guild sanctioned craft (Swanson 1988, 37). We can see this in practice in the city of York during the late 14th century. Craftspeople were required to only "hold them every one to one Mystery," and in the York Freeman's Register, any man applying to take up the freedom, which was the right to "practice his occupation free of tolls" (Fitzgerald 2007, 25), was recorded under only one occupation each (Swanson 1988, 33). This classification system completely overlooks that most medieval families also sold fish, ale, and other victuals as a means of supplementing their incomes (Swanson

1988, 33). The Freeman's Registers also overlook female craftspeople and their contributions to the trade as will be discussed below.

Considering how greatly guild influence and structure varied from town to town, and the fact that their ability to enforce their edicts is questionable in many cases, it is necessary instead to look at individual contracts between masters and apprentices to better understand the relationships between them, and how students progressed in their training. These contracts give us a clearer picture of the rules and expectations that governed the relationship between master and student, as well as insights into the social dynamics of a craftsperson's shop.

Contracts and Indenture Records

One of the most basic provisions laid out in apprenticeship contracts was the length of time the apprentice would be expected to work for the master craftsperson. The length of the indenture varied greatly and was influenced by several factors including the age of the apprentice at the time they were bound (Epstein 1991, 104; Goddard 2013, 165), the gender of the apprentice (Goddard 2013, 169), and the city in which the agreement took place. Surprisingly, however, there seems to have been no correlation between the length of the apprenticeship and the complexity of the craft in question (Epstein 1998, 688; Goddard 2013, 167). Age, however, seems to have been the major deciding factor when assigning the length of the apprentice's contract.

S. Stanley 53.)

Epstein divides apprentices into two main age groups: children bound between the ages of ten to thirteen or fourteen, and children bound between the ages of fourteen to twenty-one (Epstein 1991, 104). In his study, apprentices in the younger group tended to have contracts averaging about five years, whereas the older group of students usually had contracts lasting an average of three years and were likely to receive a stipend (Epstein 1991, 104). In the case of the younger children, most came from households where their parents were craftspeople in the same or similar crafts as the master training them, and they likely would have already been familiar, with and had already been involved in, many of the tasks their new masters would have given them (Epstein 1991, 105). There were of course outliers for both the ages of the apprentice and the length of their contracts. In Genoa, contracts typically ranged between "four and twelve years, with the median being seven," whereas in Bristol most contracts lasted for seven years, "but it was not unusual for contracts to be longer, with terms of eight, nine or ten years not being uncommon" (Goddard 2013, 167).

As stated above, the primary duty of a master was to teach and for the apprentice to learn (Epstein 1991, 65). Teaching was not, however, the only obligation most master craftspeople took on when they accepted a new apprentice. Along with imparting knowledge of production methods, a master also taught his pupils about "standards of manufacture", customer service skills, how to negotiate with merchants and evaluate the

qualities of raw materials, pricing of goods, how to navigate guild politics, and numerous other business related-skills (Goddard 2013, 166).

Some masters even agreed to further their apprentice's education beyond craft training and moral instruction. It was common in the greater London companies to ensure that apprentices received an education that included learning to read and write (Bergart 1997, 22). If a master was too poor to ensure that a student was receiving a satisfactory education, such as in the case of John Holand recorded in London in 1415, the apprentice could be removed from the tutelage of their current master and reassigned to one who was better equipped financially to support their educational needs (Bergart 1997, 22).

The provision of tools upon the completion of an apprenticeship contract was another feature that appears in some indentures. In Genoa, apprenticeship records dating from 1186 up to the 13th-century record that every single master blacksmith promised to gift their apprentices with the tools necessary to ply their trade once the apprentice had completed their contract (Epstein 1991, 69). This practice, at least in Genoa, was a common trait for many of the crafting guilds (Epstein 1991, 69), and raises the question of whether a gift of tools was a common but unwritten practice for masters in other cities as well. Masters also frequently left tools to their apprentices in their wills, as will be discussed below.

More than this, however, the master was in many ways expected to provide moral guidance to their students (Goddard, 2013, 167). An example of this can be seen in the pre-Black Death contract of Robert Sharp of Coventry, in which the master stipulated that Robert must not "habitually frequent the tavern, unless it be for the sake of trading and dealing to the advantage of his master", and if Robert was caught having conjugal relations with a woman in his master's house, an extra year of service would be added to his contract for each woman (Goddard 2013, 168). Lastly, Robert was not permitted to get married without his master's permission, which was a common condition in these contracts (Goddard 2013, 168). An apprentice named Walter Byse was required to be "lawful and lefull" and was not to be an "ale goer" during his eight-year contract with master John Gare (Lyon 1920, 598).

An early 14th-century apprenticeship contract between a purse-maker named Robert Raulot and a girl named Agnes of the Felde outlines the full terms of their agreement. In this contract, Robert promised to train Agnes for three years, providing her with room and board as well as clothing, and assured her that she would be instructed in every stage of purse-making including incising, modelling, and dying, though the contract gives no restrictions or conditions for Agnes's behaviour (Goddard 2013, 173-174). Most likely along with her training duties, Agnes would have been expected to serve in Robert's home assisting with the household chores (Epstein 1991, 109; Goddard 2013, 174). Epstein

asserts that this understanding of female apprentices also working as domestic servants in addition to their other duties was a motivating factor in many masters' decisions to take on female apprentices (Epstein 1991, 109).

While most contracts do not spell out specific details of an apprentice's duties during their time with their masters, it can be reasonable to assume that these students would have been expected to help open and close their master's shops, make deliveries and purchase raw materials, and most importantly, they would have been expected to assist the more experienced craftspeople in the shop with their work before they would have been permitted to begin pursuing more skilled production-specific training (Wallis 2008, 848). Assisting more experienced colleagues would have been one of the most important aspects of an apprentice's training.

As both Epstein and Goddard have pointed out, the lives of apprentices would have been quite difficult. Apprentices were expected to work long hours, especially the female trainees who were more likely to be expected to fulfil domestic duties in addition to their professional ones than their male counterparts (Epstein 1991, 109; Goddard 2013, 174). Wallis explains that about 10% of medieval apprentices died before completing their contracts, and an even higher number surely experienced serious illness, injury, or disability on the job (Wallis 2008, 838). Punishments for misbehaviour or unsatisfactory work were

potentially severe. Masters were viewed as being well within their rights to use corporal punishment to discipline their apprentices, and there are numerous instances of apprenticeship contracts in which the master agrees not to punish their apprentice "beyond what was necessary for the youngster's instruction" (Goddard 2013 167). Nevertheless, abuses did happen. In these instances, the apprentice, or more likely their parents if the student was below their majority, would bring the issue before the guild or the municipal courts and the apprentice could be released from their bond (Bergart 1997, 21-22).

In the case of Thomas and William Sewale of London, the court found their master guilty of "cruelly" beating the brothers and removed them from his workshop, releasing both from their indenture (Goddard 2013, 167). An apprentice purser named Joan Jurdan and her father John brought the pursers Thomas and Joan Hertford to court in 1416, claiming that the apprentice "Joan had been unduly castigated by her mistress, Joan Hertford" (Bergart 1997, 21). The mayor and alderman found the Hertfords guilty and Joan Jurdan was released from her contract with them (Bergart 1997, 21). It is impossible to say for certain how common such abuses were, but the frequency of the limitations on how much a master could discipline their apprentices seems to indicate that these were not uncommon occurrences.

S. Stanley 58.)

The Role of the Family

Thus far, we have been examining apprenticeship contracts of apprentices who were not members of their master's immediate family. While these contracts offer valuable insight into the lives of masters and apprentices, they do not provide the complete picture. In reality, many masters trained their own children to serve as apprentices in the workshop (Epstein 1991, 105). In these instances, there would have been no need for the parent to have contracts drawn up, as they already had legal authority over their children, and therefore few records of this early training would have existed (Epstein 1991, 105). For the children of craftspeople, training would have commenced at a very early age with the child being expected to participate in the work of the household and workshop as soon as they were physically able to do so (Wallis 2008, 846). The apprentices who only studied with their families and were not contracted out to other masters faced many long years working in the workshop, "waiting to succeed to a parent's estate and trade" (Epstein 1991, 105).

As previously stated, parents would still have been expected to register their male children with their guild by the age of fifteen (Epstein 1991, 105), and it was at this point that some parents opted to send their child to study with another master, perhaps a relative or friend of the family, in order to continue the child's training in a more official capacity, which would have allowed the individual to apply for citizenship later in

S. Stanley 59.)

life. In provincial towns and smaller villages, the ability to grant citizenship rested solely with the municipal authorities who "sold this privilege to whomsoever they liked" (Swanson 1988, 33), therefore the need to register apprentices and put them through official guild training was a non-issue outside of the larger towns and cities. The guilds actively encouraged craftspeople to enrol their sons into the guild, "giving preferential admissions to the mastership to sons of existing masters" (Rosser 1997, 17) and offering a reduced entry fee or even waiving the fee altogether (Epstein 1998, 691).

The role of the household in craft production cannot be stressed enough as it was the most basic unit of production in the medieval marketplace (Loats 1997, 15). The household was made up of the master craftsperson, their family, apprentices, journeymen, and sometimes servants, who were all involved in the production process in various ways (Loats 1997, 15-16). However as discussed above, households and families were not limited to only one source of income, despite the best efforts of some guilds to limit a craftsperson's ability to branch out (Richardson 2002, 3). Craftspeople often pursued several occupations to maximize their earning potential (Richardson 2002, 3), and members of the household tended to take whatever work came to them in order to supplement the family's income (Swanson 1988, 47). This is especially evident when we examine the role of women in the medieval marketplace.

Women and Gender in Medieval Craft Training

The role of women in medieval guilds and craft training has only come into focus within the last thirty or forty years. This oversight cannot be blamed solely on previous cultural and academic biases, however. The exclusion of women from public and professional spheres in the medieval marketplace was something that was actively endorsed by both civic and guild authorities and only worsened as the medieval period drew to a close (Pappano and Rice 2013, 479).

Women and their role in craft training and production were typically ignored by the guilds until the late 15th century, at which time "discrimination against female workers became overt" (Swanson 1988, 40), an attitude that was reflected in the highly organized journeyman's guilds in Germany who shaped a large part of their identity around the exclusion of women and the virtues of being single males (Pappano and Rice 2013, 478). Perhaps this was an attempt to reduce competition in towns and cities that struggled to deal with increasing "economic contraction" (Swanson 1988, 40). However, there is no way of knowing for certain what the motivations behind this male-dominated move were. Likely the reasons were complex and multifaceted, and such a problematically difficult topic would deserve a full-length study of its own.

Despite their statuses as "false workers" (Epstein 1998, 689) and "'illicit' independent artisans" (Pappano and Rice 2013, 479), female

S. Stanley 61.)

craftworkers made substantial contributions to both their household incomes by producing high-quality goods, as well as the training and management of apprentices and journeymen (Pappano and Rice 2013, 479). Regarded as "repositories of knowledge" (Pappano and Rice 2013, 479), the wives of guild craftsmen often participated in the instruction of apprentices right alongside their husbands (Pappano and Rice 2013, 477) or even worked as masters who went unacknowledged by the guilds, as evidence by the records of women working "as employers and skilled labourers" (Swanson 1988, 37). There is however an exception found in the draper's guild of Chartres, in which women could be recognized as *mestresse,* and daughters of guild members were offered the same advantages and preferential treatment as sons (Epstein 1991, 91). The double standard of women being knowledgeable enough to be considered masters, but being refused guild sanctioning is most evident in the rules that allowed men who married the widow of a craftsman to become an official member of his guild and take ownership of the business (Pappano and Rice 2013, 479-480).

Widows were also permitted to take on and train apprentices in their husband's craft. Jeanne Plateau, whose husband had been a master shoemaker, entered a contract with a thirteen-year-old male apprentice for three years, promising to teach him how to make shoes "and all other work in which she was involved" (Loats 1997, 19). Similarly, the wills of two weavers, one for Robert Hutton dating to 1426, and John Kendale

dating to 1492, made provisions that assured their apprentices' training contracts would be fulfilled by the masters' widows after their deaths (Swanson 1988, 45). In a document that recorded Jeanne Desmares taking on a male apprentice to train in hosiery, Jeanne was initially recorded as "'*maistresse bonnetiere* (mistress hosier),'" but then someone crossed out the title, "denying her the trade in her own right" (Loats 1997, 20). Unfortunately, the ability to inherit a husband's business as a *feme sole* and train apprentices was typically reserved for wealthy families whose husbands had been able to leave their wives with enough money to keep the business afloat, and even then, these women were very rarely recognized as master craftspeople in their own right (Fitzgerald 2007, 15).

Officially, most female craftspeople worked under the direction of their fathers or husbands (Pappano and Rice 2013, 479), but the evidence for female craftspeople being just as skilled, knowledgeable, and potentially successful as their male counterparts is readily available when one looks for it. Wills and inheritance records like those of Robert Hutton and John Kendale offer volumes of evidence supporting the role of female craftspeople in the marketplace. In York, for example, Agnes Hetche inherited "all (of) her father's tools and materials for the making of chainmail, whereas her brother was left the instruments for the making of plate armour" (Swanson 1988, 39). This will is particularly interesting

given how blacksmithing and the making of arms and armour in particular are typically viewed as exclusively masculine arenas.

It could be argued of course that the tools and materials Agnes received were a form of dowry, ensuring that she would be able to attract a husband who would thus be able to provide for her and take over her father's business after his death. I however think this is less likely, given that the will did not specify anything of that nature, and that Agnes's inheritance was comparable to that of her brother. I believe that it was her father's intent for his two children to jointly inherit the shop, implying that Agnes was just as much an active, productive member of the craft as her brother.

Based on the above, it would not be an exaggeration to state that the role of women in medieval crafting traditions has been vastly undervalued and overlooked, both by the guild and society in their own times, and in modern academia until fairly recently. While apprenticeship records show that the number of male apprentices vastly outnumbered female, it cannot be denied that women played an integral role in the medieval marketplace (Goddard 2013, 168). Though they lacked the recognition and official sanctioning of the guilds and municipal authorities, women shared many of the same responsibilities in their roles as apprentices and master craftspeople as their male colleagues, namely production and the training of apprentices.

S. Stanley 64.)

Journeymen

The last group of craftspeople we need to consider are the journeymen; individuals who had completed their apprenticeship training but were not recognized by the guilds as master craftspeople. The term "journeyman" itself is mildly problematic as it implies an all-male group, an assumption that is strengthened by groups like the highly organized German journeymen who "turned the exclusion of women into a constitutive element of their identity" (Pappano and Rice 2013, 478). Journeymen should also not be confused with wage or day laborers who were not affiliated with the guilds, and whose ranks often included women (Epstein 1991, 115). Epstein states that "journeyman status was the great dividing line of labour," and while it is true that many apprentices who set out to learn a trade never reached the status of master, "for women this was an unusual and increasingly rare feat" (Epstein 1991, 115). For this study, therefore, we shall limit the definition of journeymen to male individuals who completed their apprenticeships.

For those individuals who did manage to complete their apprenticeships and decided to continue on in their craft, the road to attaining the status of master was not easy, nor was success assured. The medieval concept of the journeymen differed slightly from that which would develop in the early modern period. Rather than being required to undergo two to three "*Wanderjahre*" or "walking years" (Demuth 2015, 341), medieval journeymen in some instances had to produce a

"masterpiece" to show that they had attained the skills necessary to be recognized as master craftsmen, or pass a test administered by the guild if making such a piece was not practical (Epstein 1991, 125). This usually took place after several years of working further in a master's shop- this time earning wages- and required the individual to give gifts, pay fees, and make other payments to the guild and other urban authorities (Wallis 2008, 838). It would have taken several years of working for low wages to do this, and many never managed to save enough money to earn this status.

Even for those who did, becoming a master was not a guarantee of financial success, and becoming a master was not necessarily a permanent boost to one's status. As Rosser explains, the 1272 *Livre des métiers* from Paris references several masters who reverted to journeymen status "'either on account of poverty or by choice'" (Rosser 1997, 15-16). While a master craftsman might be the head of his own shop, their standing in the community and guild would fluctuate with their fortunes, and an independent master might find themselves working "for others and not simply the abstract customer" (Epstein 1991, 102). For some journeymen, it was simply more practical not to become masters. For example, there were some journeymen who managed their own shops that the Parisian statutes dating to the same period as the *métiers* acknowledged as something more than simply journeyman, but less than masters (Rosser 1997, 16). Thus, it is prudent to bear in mind that not

every apprentice or journeyman who signed a contract with a master did so solely with the intent of eventually becoming masters themselves (Epstein 1991, 208).

Journeymen did not enjoy the same stability and job security that apprentices did. A journeyman's contract with a master may have only lasted for a few months or for the duration of a project, though they typically averaged between six months to two years (Epstein 1991, 114). A master was also not required to provide room and board for their journeymen like they typically were for their apprentices (Epstein 1991, 115). Once a journeyman's contract was fulfilled, they may have been required to find work elsewhere, although some journeymen continued to work for the same master who they had been apprenticed under, and maintained long-term working relationships (Epstein 1991, 115). For a journeyman craftsperson who earned a daily wage but was paid weekly (Epstein 1991, 115), consistency of work was a make or break problem. Both journeymen and masters tended to move where they could find work, and in the wake of the Black Death in the mid-14th century and the resulting labour shortages, we begin to see increased mobility and organization amongst the journeymen (Epstein 2013, 29). This rise in traveling craftspeople would have caused an increase in "technological transfer" (Epstein 1991, 702), exposing craftspeople to new ideas and production methods which would have been reflected in the

archaeological record and provides a basis for exploring how learning networks grew and spread.

Discussion

In this chapter, we have seen that medieval workshops were first and foremost a family business in which a craftsperson, their spouse and children, and often apprentices and journeymen from outside the nuclear family were all involved in the production of not only the particular type of objects the craftsperson was known for but also other goods and services that could bolster the household's income. While apprentices were often the master's children, it was not unusual for a craftsperson to take on apprentices from outside the family whose parents practiced the same craft, or even completely different crafts than the master.

Apprentices therefore would have been exposed to a wide array in technologies, production methods, and ways of thinking about objects not only in the homes of their parents but also during their time apprenticing for other masters and later on in life working as journeymen. Such a varied and eclectic education would have been a natural catalyst for innovation and multi-specialization, particularly in rural communities where limited resources and materials would have made the separation of crafts and the "demarcation of industrial practices" impractical if not outright impossible (Miller and Hatcher 1995, 55).

This propensity towards multi-specialization and innovation would likely have resulted in craftspeople who were comfortable working in more than one medium, enabling them to maximize their income and appeal to a larger customer base. Furthermore, we find that it was not uncommon for craftspeople from different crafting traditions to collaborate on large projects as Rosser illustrated with his example of the 14th-century altarpiece (Rosser 1997, 15).

We also see that the image of crafting traditions as an exclusively male domain was an illusion. Though largely ignored or outright banned by the guilds, women played a significant role in producing goods and training the next generation of craftspeople. Indenture contracts and wills point to the agency and influence of women within the workshop despite their limited representation and recognition by the guilds.

Lastly, this study has shown that once an apprentice had completed their training and earned the status of journeyman, they frequently moved from workshop to workshop, or even from one city or region to another, further building their social networks and repertoire of crafting knowledge. In doing so, they would have also been disseminating their own skills and experience into a new learning network. Lastly, we have found that the line between journeymen and masters was not an absolute division. Masters could, and occasionally did, revert to journeyman status in response to changing markets and economic needs.

The question then becomes how much, if any, of this information can be applied to Viking Age craftspeople?

The assumption that a workshop was primarily comprised of a central craftsperson, their spouse, and their children, and that individuals were equally involved in production and training, regardless of their gender, appears to be a logical conclusion. If a family and workshop were to succeed, everyone in the household would have needed to contribute. It is also likely that the children of the craftsperson would have been intimately involved in the business from a very young age and would have been given tasks suited to their capabilities. The crucible with fingerprints made by small hands that was found at Kaupang mentioned in the previous chapter seems to confirm this conclusion (Pedersen 2016, 202). Viking Age children would likely have been required to perform many of the same tasks young apprentices were required to, namely making deliveries, collecting raw materials, and assisting the more experienced members of the household with their work.

Viking Age adolescents may have even gone on to train with members of their extended family or others in the community to learn a trade different from that of their parents or to expand their skill set. As with rural medieval communities, outside of the major settlements such as Kaupang or Birka, Viking Age communities would have lacked the quantity and variety of raw materials that typically encouraged craftspeople to specialize in only one medium. We see this diversification

of craft knowledge when we consider how craftspeople working with metal and glass needed to understand and exploit the properties of ceramics, and how beadmakers needed to understand how the metal would contract as it cooled.

Finally, the comparison between medieval journeymen and the question of whether itinerant craftspeople existed during the Viking Age must be addressed. This is a complicated and challenging topic to pursue given the nature of the evidence either supporting or rejecting the possibility, and I feel that it is best approached by examining each crafting tradition individually. To do this and to gain a better understanding of how each discipline would have trained their students, we need to look at craftspeople in other cultures who work in pottery production, antlerworking, hornworking, glass beadmaking, and non-ferrous metalworking. Through this cross-cultural examination of the *chaîne opératoire* of each of these crafts, we can identify parallels between them and Viking Age craftspeople.

Section 3: Ethnographic Comparisons

Drawing analogies from ethnographic studies to better understand how Viking Age craftspeople trained their students allows us to understand how the training process worked in far more detail than surveying artefacts alone, but this method must be employed with caution. No analogy is ever perfect, and over the last century, the validity of relying on ethnographic comparisons to make sense of early and prehistoric cultures has been called into question (Wylie 1985, 63). Nevertheless, the use of ethnographic analogies can still be a useful approach, provided that those who use it understand that there are limitations to its application (Wylie 1985, 64).

For this study in particular, we must be mindful not only of the obvious geographical and chronological differences that exist between our Viking Age craftspeople and the cultures that will be examined, but also of the technological and sociocultural differences that could potentially change the *chaîne opératoire* of their respective crafts, and the reasoning behind the choices each craftsperson makes. In an attempt to ensure that the conclusions being drawn from the following analogies are valid, rather than taking a direct historical approach and attempting to project the methodologies of any one specific culture back onto Viking Age craftspeople, I will be examining the *chaîne opératoires* and practices of several different cultures for each of our five crafting traditions to find similarities in methodology. In this way, we can avoid basing our

conclusions solely on the typical assumptions western scholarship has drawn about craft training, and instead focus on methods that have proven effective in the instruction of novices across dissimilar cultures.

I.) Pottery Production

According to Crown, a novice potter's training would mirror the production sequence, that is to say, that the individual would begin by learning to shape the pots before moving on to decorating, and would then learn to fire the pieces (Crown 2001, 455). While this is true in some cases, particularly in workshops where formal apprenticeship structures exist, it leaves out many details of the novice's instruction and experience that are equally important to their overall education and does not accurately reflect how a novice who was also a child would have learned their craft. In particular, this summary overlooks many of the peripheral and informal lessons that a novice potter would have been expected to absorb early in their training.

Singleton's view of the folk model of pottery apprenticeship provides a much more thorough understanding of how a potter passed on their craft to the next generation, particularly when that novice was a child (Singleton 1998, 124-125). Singleton's model breaks the training into five stages: observation, self-initiated experimentation, guided learning, the beginning of productional work, and lastly, productive labour to repay the master (Singleton 1998, 124-125). This model, though it was initially

crafted around modern Japanese folkcraft pottery shops, is also a workable framework for how the training process in some prehistoric and modern non-industrial communities operated.

Singleton outlines the progression of novices in Mashiko pottery workshops to illustrate how this framework operates. In stage one, novices spend long periods of time doing menial labour and unobtrusively watching the more experienced potters work (Singleton 1998, 124). As they become more confident with their understanding of how the shop functions and of the qualities of the raw materials, the novices progress to stage two, in which, by their own initiative, they begin experimenting with the potter's wheel in their free time (Singleton 1998, 124). Stage three begins when the teacher starts assigning the novice to produce specific forms when their menial tasks have been completed (Singleton 1998, 124). Singleton points out that these trial pieces are never fired, but rather that the raw material is recycled (Singleton 1998, 124). Once the teacher is satisfied that the novice has a thorough understanding of how to produce the assigned forms, the novice progresses to stage four in which their pieces are glazed and fired so that they might be sold in the shop (Singleton 1998, 124). Finally, at stage five, the novice is recognized by the teacher to have mastered the necessary skills to produce quality pottery and is acknowledged as a full, productive member of the shop where they continue to work (Singleton 1998, 124). This stage serves as a means for the novice to repay the teacher for the time

and materials needed to train them, as the sales of their products often go to benefit the teacher and workshop in addition to earning the student a wage (Singleton 1998, 124).

To determine whether Singleton's framework could provide an applicable lens to understand how Viking Age potters received their education, we must examine each stage individually and see how it applies to potters from multiple cultures and times. To do this, I have selected potters not only from the modern Japanese pottery shops that Singleton references, but also potters from the Pasil River Valley in the Philippines (Stark, Bishop and Miksa 2000), the Dii, Duupa, Doayo and Fali peoples of Cameroon (Wallaert-Pêtre 2001), and several prehispanic First Nation tribes in the American southwest including the Pueblo, Mimbres and Hohokama (Crown, 2001). Culturally and geographically speaking, these cultures have very little in common with Viking Age potters, but by analysing the training processes and the *chaîne opératoire* of each of these potting disciplines, we may begin to recognize methods and traits that they have in common, which likely would have been present in Viking Age workshops as well.

These groups were selected not only based on how thoroughly documented their training processes were but also because of how culturally different they were from Viking Age craftspeople. If such diverse groups of craftspeople shared similar techniques and training methods with each other, then it is also likely that such methods and techniques

may have also been used by Viking Age craftspeople as well. Of course, no analogy is perfect, so we must also consult the archaeological record as much as possible to verify whether or not these assumptions are accurate.

Stage One: Observation

Singleton's first stage, the observational stage, is arguably one of the most important. At this phase of their training, the novice receives little to no formal instruction, and in many cases does not even attempt to make pottery at all (Singleton 1998, 124). They are often expected to assist the more experienced potters by preparing and gathering materials needed, cleaning the workspace, and generally doing anything they can to free up the elder potters to focus solely on producing pots. This assignment of menial tasks can also be viewed as a way for the more experienced potter to test the novice's dedication and ensure that the elder potter will not be wasting their time teaching a student who would leave in the early stages of their training (Singleton 1998, 124).

For Bill Haase, an American potter who went to study pottery production in Japan, this was a time of learning how to be an apprentice (Haase 1998, 108). Haase came into the workshop after having completed an art degree focusing on ceramics and after serving one apprenticeship already in a pottery studio in Pennsylvania (Haase 1998, 108). Despite this, or indeed perhaps because of his prior training, Haase

had to learn that many of the assumptions he had formed about what it meant to be a potter's apprentice were not applicable in his new environment, and he had to relearn what it meant to be an apprentice in this pottery tradition, which included doing the menial, unskilled tasks the shop required (Haase 1998, 108).

Haase describes in great detail a typical day in the early stages of his apprenticeship. His morning started with cleaning up the workshop where the expectation was that he would clean his *Sensai*, or teacher's, workstation by dumping out the old water, emptying ashtrays, cleaning out the slip container, wiping down the wheel deck, taking pots finished the night before out to dry, stocking the kilns, and preparing the glaze that would be used that day (Haase 1998, 110). Haase was also expected to clean the workstation *Sensai*'s father used as well (Haase 1998, 110).

Preparing the clay, wedging it for use, and making sure that *Sensai* always had an adequate supply on hand were among the most important duties Haase and his fellow students had to fulfil throughout the day (Haase 1998, 111), and these tasks remained his responsibility for the full duration of his apprenticeship, even after he had progressed to the next stages (Haase 1998, 112). Once these tasks had been completed, however, Haase was allowed to stand beside his teacher's wheel deck and watch the older potter work, though his presence was largely ignored (Haase 1998, 119). His teacher never directly explained what Haase was expected to do, and most of Haase's training at this point came from

observing what another student who had been there longer was doing (Haase 1998, 109). This expectation that Haase would learn by watching, rather than having things explained to him, set the tone for his entire apprenticeship (Haase 1998, 119).

For novice potters among the Pueblo, Mimbres, and Hohokama First Nation peoples, the learning process was less structured than the training programs in Japan that Haase and Singleton experienced. Nevertheless, most of the same tasks were carried out by young Mimbres and Hohokama children, who were also tasked with grinding the clay and temper, removing foreign particles from the raw clay, and burnishing the finished pots (Kamp 2001, 430). Crown also points out that for the young Pueblo potters "formal direct instruction was rare, although adults sometimes corrected children who were imitating them and gave brief instructions" (Crown 2001, 455).

During her time studying pottery with the Dii, Duupa, Doayo, and Fali peoples of Cameroon, Wallaert-Pêtre noticed that the potters of each village could produce sequences of clay balls, all of the same weight and volume necessary to make vessels of specific sizes, a skill that was not possible for other members of their communities who were not potters themselves to replicate (Wallaert-Pêtre 2001, 481). Furthermore, when the potters were given a ball of clay that they had not made themselves, they were still able to accurately estimate what forms and sizes of pots they could produce with the clay provided without needing to add more

clay or leaving excess waste (Wallaert-Pêtre 2001, 481). This skill most likely was developed during the early observational stages of their training when the novices were expected to prepare balls of clay for the more experienced potters to use.

This knowledge of how to assess the quality and potential of raw materials was one of the most important skills that a novice potter, or indeed any craftsperson, needed to master early on in their education. This understanding of where to find raw materials in the environment, how to process them into a usable state, and how their physical properties would affect the production process and final characteristics of the pots was likely the primary reason for assigning these tasks to novices so early in their training. This awareness of the materials would become the foundation upon which the rest of their craft knowledge would be built.

Lastly, the age of the novices we have been investigating is also worth noting here. Whereas Haase was an adult apprentice, Pueblo, Mimbres, and Hohokama novices were primarily female children who underwent their training between the ages of five and fifteen (Crown 2001, 455). In Cameroon, girls usually begin studying pottery with their mothers between the ages of seven and nine, and continue until they are of marriageable age, around fifteen (Wallaert-Pêtre 2001, 475). Such close proximity to older members of their community making pottery naturally gave rise to the novice potters entering the second phase of

their training, in which the children began experimenting with making pots of their own.

Stage Two: Self-initiated Experimentation

One of the main ways children learn is by observing and mimicking the behaviour of the adults and older children around them, even when they are not actively being encouraged to do so (Wileman 2005, 9; Ferguson 2008, 63). This natural inclination to copy was what likely prompted the second stage of pottery training in individuals who were not enrolled in a formal apprenticeship. As children played around the periphery of the adults' workspace and assisted the potters in small tasks, they were constantly watching the older potters and were therefore beginning to learn the *chaîne opératoire* of pottery by observation (Kamp 2001, 446). In many instances, these early self-initiated projects would be treated as little more than play by the children, and even perhaps by the adults around them (Kamp, 2001). Nevertheless, the children were learning, and starting to build up the physical skills they would need to start making "proper" pots of their own.

Young Pueblo girls would often "play at pottery-making, shaping small pots and actually firing them out of doors" while their mothers or other women of the village were making pots (Kamp 2001, 430). Even though pottery making was not a full-time activity, the girls would often make their small pots themselves and fire them, even when the adults

were not engaged in the activity (Kamp 2001, 430). Kamp also cites Donley-Reid's observation that the daughters of Swahili potters would frequently start making small pots between the ages of three and five that they would use as toys, and later use as tools while they were learning to cook (Kamp 2001, 429).

This self-initiated practice was not only reserved for children playing around adult potters. During his formal apprenticeship in Japan, Haase was expected to take initiative and practice throwing and shaping pots on the wheel not only after the morning chores had been completed, but also in the evening after the shop had closed for the day and the more senior potters had gone home (Haase 1998, 110). This expectation was never communicated to Haase however and by not continuing to work after hours, Haase inadvertently damaged his relationship with his *Sensai*. In Japan, it was assumed that a serious apprentice would have been motivated to practice as much as they possibly could, and by not doing so, Haase was seen as less dedicated (Haase 1998, 110). Singleton also mentions that students in Japanese pottery shops typically practice on their own in the evenings and during "holidays when no one else is in the shop" (Singleton 1998, 124).

Stage Three: Guided Learning

Once a novice had taken the first steps and began experimenting on their own, it often was not long before the more senior potters would

begin providing the novice with closer instruction. Singleton cites Japanese apprentices being instructed to make 10,000 copies of the first form of pot they are taught before they are permitted to learn the second and that each of these practice pots is recycled so that the clay can be used again (Singleton 1998, 124).

For Haase, this process seemed to be equally frustrating. For five months, Haase followed the more senior apprentice's suggestion and practiced making one particular cup before their *Sensai* finally gave him his first real assignment and instructed him to make a tiny sake cup instead (Haase 1998, 118). Haas stated that his *Sensai* only ever gave him a cup that had already been fired and the vague instructions to "'make them with as little trimming as possible'" (Haase 1998, 118). Haase observed that the more senior student was always provided with freshly thrown pots to practice making, whereas he never was; nor was Haase ever shown the proper way to throw the sake cups (Haase 1998, 118), though this was perhaps due to the fact that he had fallen out of his teacher's favour earlier in his training.

After six months of struggling to make the tiny cups to his teacher's vague specifications, Haase's *Sensai* told him to move on to making teacups, which were larger than the sake cups Haase had previously been making (Haase 1998, 119). After the gruelling practice of making the much smaller sake cups, however, Haase "felt like he was throwing huge pots" when making the teacups (Haase 1998, 119). While it is impossible

to fully understand his teacher's motivations, one could argue that the assignment was following a logical progression in Haase's training. Typically, it is easier for a beginner to make smaller vessels and work their way up to larger ones as they gain more confidence and control, though "miniature shapes such as jars can be very hard to produce as well" (Kamp 2001, 431). It is possible then that Haase's teacher was merely trying to save clay and giving Haase the usual training to get him comfortable working the wheel before assigning him a more difficult task.

The size of the vessels being made by the novice is important to consider when examining how novices who were also children were trained, though children would have devoted longer periods working on small vessels before moving up to larger forms than Haase did. Because of this longer focus on specific sized forms, the novices would have not only have had more time to gain experience making each form, but they would also have physically and mentally matured as their training progressed, making larger shapes easier for them to manage. When we consider a novice's length of training from this perspective, we can see that there is a correlation between the duration of a novice's training period and the age at which they began their training (Wallaert-Pêtre 2001, 472). If a novice began studying at a younger age, then it would have been necessary for them to have a longer training period than a novice who began their training at an older age so that they would have had time to physically mature enough to handle the full production

process. This matches what we have observed in the length of contracts with medieval apprentices.

For novice potters who were also younger children, their training also doubled as childcare, enabling the adults to keep a close eye on the children while also exposing them "to skills needed for adult life" (Kamp 2001, 446). This implies that the children were likely allowed to help in the tasks the adults were focused on rather than being taught forms and tasks in sequential order as the children drifted in and out of the work area as their attentions waxed and waned. A remarkable example of this can be seen in several Mimbres vessels that show "faint well-executed lines" of paint beneath messy designs that had been clearly painted by children (Crown 2001, 463). These faint lines offer evidence that the adult potters were providing templates for the novices to follow (Crown 2001, 463). By doing this, the more experienced potters were encouraging the children to begin developing the fine motor skills needed to paint neatly, as well as which designs and motifs were culturally significant, and how those images should be used together (Crown 2001, 463, 456).

The development of fine motor skills and automatic processing is the most important aspect of this stage of training. Ideally, a novice will want to develop actions or motions "that no longer requires conscious control," which Minar and Crown refer to as automatic processing, or in layman's terms, muscle memory (Minar and Crown 2001, 373). Automatic processing allows an individual to execute tasks quickly in a way that

demands little conscious focus, while also producing high levels of consistency in their products (Minar and Crown 2001, 373). Singleton borrows the Japanese term *karada de oboeru*, or "learning by the body," which captures the essence of these skills rather well (Singleton 1998b, 16).

Skills that have been developed through automatic processing are resistant to change and take a great deal of effort to relearn or modify, as an individual is in essence readapting the neural pathways that were formed when learning these skills, requiring them to slow down the process and intensely focus on performing the task a new way (Minar and Crown 2001, 373). For potters, throwing and shaping pots are the two main skills learned through automatic processing and the most resistant to change, as these skills are learned early on in their training and are typically the skills that novices spend the most time learning (Wallaert-Pêtre 2001, 490). Once the teacher is satisfied that these skills have been adequately assimilated, the novice may move on to the next or final stages of their training.

Stage Four and Five: Guided Learning and Production to Repay the Teacher

The last two stages of Singleton's outline will be addressed together as whether or not the potters are working in a commercial setting will determine if the final stage applies to that situation. This phase involves

the novice producing pots largely on their own, either for their family or community, or to be sold by the workshop, earning the novice "below-market (or no) wages" (Wallis 2008, 833). However, in his examination of medieval apprenticeship contracts, Wallis points out that this is not the only stage in their education in which apprentices were repaying their masters for the opportunity to learn their craft.

As mentioned above, during the first stage of a novice potter's training while they are expected to observe and learn, they are also engaged in completing menial tasks that streamline the production process for their teacher. While these tasks do indeed teach the novices valuable skills and knowledge about the materials they are working with, in commercial workshops the tasks are also a means for the novice to repay the teacher for potential economic and time investments that go into training a new potter. In essence, the novice is earning "the right to observe and learn by doing the menial tasks of the master and the workplace" (Haase 1998, 14; Wallis 2008, 849). In this way, even if the novice does not complete their training due to death or job abandonment, the teacher's lost time and effort, not to mention the materials used, can be recouped (Wallis 2008, 849-850). Once the teacher was satisfied that the appropriate amount of pottery had been made, the novice was free to pursue pottery production as they chose.

In non-commercial pottery workshops, the fifth stage was not necessary, as the novice was likely a child or other relative of the potter,

and their wares would be used for the benefit of the family, their community, or even in the novice's own household as some young potters completed their training once they had reached a marriageable age (Wallaert-Pêtre 2001, 475).

Discussion

Singleton's framework provides an ideal lens for understanding how novice potters received their training in both home production and commercial pottery workshops. Beginning their training by being assigned menial tasks to assist the teacher and workshop, novices were able to learn how to recognize quality raw materials, understand how the physical properties of those materials affected the production process and quality of the final product and placed them in positions to observe the more senior potters at work so that they might learn skills that they could then take away and practice on their own. This in turn freed up the teacher to increase production, potentially offsetting the incurred cost of training a new novice. As the novice began experimenting on their own, the teacher could begin offering more guidance to steer the novice's learning in ways that were appropriate to their age and skill level until the novice was ready to begin producing acceptable pots of their own.

Next, we will take Singleton's framework and apply it to the other craft traditions, to see if the same training method is used across disciplines, or if this method is specific to pottery production only.

S. Stanley 87.)

II.) Antlerworking

The overall morphology, hardness, and internal macrostructure of antler heavily influenced how the material needed to be processed by the antlerworker, particularly when constructing composite combs (Rijkelijkhuizen 2011, 199). As such, this led to a fairly standardized *chaîne opératoire* across the Germanic and Roman regions (Hrnčiarik 2018, 135). While there is a wealth of information available about how raw antler was broken down and how composite combs were constructed as illustrated above, there has yet to be a study that explores how an antlerworker might have trained a novice combmaker to make these objects.

There is however a reference to a late 3rd to early 4th-century Roman combmaker that may shed some light on the matter. In 1991 during the excavation of Halmyris in modern-day Scythia, three fragments of an *epistula commendaticia* written on a tile were recovered (Rafailă-Stan and Nuţu 2018, 145-146). The document was sent on behalf of a man named Valerius Valerinus Constans of Legio I Iovia to his friend, but on the back of the tile, the writer implores a woman named Valeria of Diocletianus, "'the one who process the bone objects to give something to the one who is perforating the bones'" (Rafailă-Stan and Nuţu 2018, 146). While the exact meaning of the message is unclear, it has been suggested that Valeria was either an owner, of or a worker in, a workshop that traded in

bone and antler objects, and that she likely handled the initial processing of the raw materials needed for the business, which would have included cutting the raw materials into workable sections and boiling or soaking them (Rafailă-Stan and Nuţu 2018, 146-147).

While we cannot say for sure what Valeria's position in the workshop was, preparing the bones and antlers for another craftsperson to use, and managing correspondence between a potential customer and the workshop appears to be in line with the early stages of Singleton's framework. It is also worth noting her gender here. Even in the Roman Empire, which had fairly rigid gender roles, women played a part in craft production, even in some traditions that were traditionally male spheres, though it is hard to know for certain how large a part they played (Rafailă-Stan and Nuţu 2018, 147-148). Valeria could have been the wife or daughter of the piercer (the master craftsman?) or potentially even a novice in training.

The next question to consider is how novice antlerworkers would have learned to obtain and recognize quality raw materials. While the discussion of whether Viking Age craftspeople obtained raw antler by collecting it locally or through trade is beyond the scope of this paper (see Ashby et al. 2015, Ashby 2013b, and Ulbrich 1978), it is worth briefly examining how a craftsperson might have procured antler if they were beyond the range of such trading networks.

As Ashby pointed out, knowing how to locate shed antler came from an understanding of the behaviours and habitat of the local deer population, which could only have been achieved by spending long hours in the forest (Ashby 2013b, 20). Someone looking to collect shed antlers would have needed to know where the deer were feeding, where they bedded down for the night, and places where they might have needed to jump over obstacles, which would have knocked the already loose antlers free upon landing (Ashby 2013b, 20; Carpenter 2017). Modern American hunters have noticed that looking for antlers in pairs increases their success rate and that children in particular seem to have a natural ability to locate shed antlers, possibly due to their height (Ashby 2013b, 21; Carpenter 2017). This suggests that if an antlerworker had needed to collect their own raw materials, it would have been beneficial for them to take their student into the forest with them to learn the habits of the deer, and to aid in locating antlers, especially if their student was a child. Given how time-consuming searching for antlers would have been, and the probability that an antlerworker would have needed more material than they and their students alone could gather to supply them throughout the rest of the year, it seems almost certain that combmakers would have needed to purchase or trade to obtain a large enough supply of raw materials for production beyond the most basic household industry.

Though the physical characteristics of antler made it a superior material for the construction of composite combs, by the high middle ages, both the material and construction style had fallen out of usage in most of Europe to be replaced with combs constructed of a single piece made of bone, wood or ivory (Choyke and Kováts 2010, 117). It was also around this time that craftspeople had begun to diversify their production, expanding beyond working with one type of material and instead, focusing on a range of products (MacGregor 1988, 34). This means that antlerworkers were producing a variety of objects, including different comb forms, out of not only antler but also wood and bone and (MacGregor 1988, 34). It is unlikely, however, that the average Viking Age combmaker would have worked with ivory. Combmakers primarily worked in urban settings with the goal of making products to be sold in the market whereas ivory was a much more expensive raw material that was typically worked in monastic settings with the final products ending up in the possession of the elites (Ashby 2020a).

This means that the training process likely differed between the combmakers and the brothers who worked with the ivory, especially considering how much more intricately carved and decorate most ivory pieces were (Ashby 2020a). Likely the brothers would have placed a greater emphasis on drawing ability during their training process as we shall discuss below. Nevertheless, it is worth examining ivory and bone carvers from other contexts to understand how Viking Age combmakers

learned their trade as the tools used by those who worked in ivory would likely have been similar to those used in antlerworking. This also provides an opportunity to see if Singleton's framework accurately reflects the training process in a broader context beyond pottery making.

The training processes of two groups of ivory carvers in Punjab, India was documented in 1902 by T. P. Ellis. The age of this account is problematic, but it does seem to match Singleton's model. Each of the groups that Ellis observed typically began training novices between the age of ten to twelve years old (Ellis 1902, 48-49). The novices, who were all boys, were generally the sons or nephews of the master carver or were related to him in some way (Ellis 1902, 48).

The first group of boys began by learning to draw figures freehand, with a pencil or with chalk on a slate (Ellis 1902, 48). Once he had gained sufficient skill in this, the novice was provided with a file and a rough block of ivory and was taught how to smooth the ivory to make it workable for the elder craftsmen in the workshop to use (Ellis 1902, 48). After several years of this, he was then allowed to draw the forms he had previously learned onto the smoothed ivory with pencils, before being gradually supplied with inferior quality ivory to practice filing these designs onto (Ellis 1902, 48). The next stage was for the novice to begin carving block figures from the ivory before he was promoted onto the final and most challenging lesson, which was perforation (Ellis 1902, 48). For this group, the full training process took between 20 to 25 years

before the individual could be considered a master carver, and they did not begin to receive payment until they were able to produce sellable items (Ellis 1902, 48).

The second group of boys began their training at the same age, but they started off learning to carve on softwoods, gradually progressing to harder woods and then poorer quality ivory as their skills and manual strength improved (Ellis 1902, 49). Once they had begun to show progress, the master would begin to pay the novices a small allowance, gradually raising it as the novice's skills improved (Ellis 1902, 49).

Ellis does not explicitly state whether or not the novices of either shop were expected to contribute to the menial tasks around the workspace, though he does mention that each artisan had two "necessary minor helpers, those who… saw the tusk into the proper size for each kind of work before it is put into the hands of the craftsman, and the polisher to whom it goes afterwards…" (Ellis 1902, 50). He also states that the boys were expected to learn mostly by "intelligent watchfulness" and gradually attempting to mimic the skills of the elder craftsmen (Ellis 1902, 50). Given this, it seems likely that the novices would have been the ones cutting the raw tusks and polishing the finished objects as these tasks would not only save the more senior craftsmen time, but it would allow the boys an up-close look at the raw material and finished project. This sort of "before and after" view of the ivory would have let them begin to understand the physical characteristics of the raw material as they

learned to recognize good and poor-quality material. It would also have introduced the boys to the standards they should strive to emulate in their eventual products.

The most important detail to take away from Ellis's observations is the correlation between the skill level of the novices and the materials they were permitted to work with. Given the high value of ivory, it makes sense that a novice would not have been allowed to work with ivory at all in the earliest stages of their training, nor would they have been supplied with quality ivory during the intermediate stages when they began experimenting with blocks of ivory. This allotment of materials based on a learner's abilities was also observed by Rivero in her study of Palaeolithic Magdalenian portable art (Rivero 2016).

Rivero found that the skill level of an engraver could be determined based on microscopic tool marks left behind from the engraving process. These marks indicated how much ease or difficulty an individual had in deepening a single line, if the artist had been able to maintain tight control of the tool or if the tool "escaped" the line they had been incising, the precision of the gestures used to make the lines, or if there were any corrections to the design, along with several others (Rivero 2016, 90-92). The objects were scored using a Correspondence Factor Analysis and were sorted into three categories based on this quality index: individuals lacking in experience, individuals who possessed intermediate levels of

experience, and individuals with high levels of experience (Rivero 2016, 95).

Rivero discovered that the engravers who lacked experience primarily carved on scrap bone fragments that had no known function (Rivero 2016, 95). The intermediate group on the other hand worked with stone, particularly small slabs and pebbles (Rivero 2016, 95). The third group who Rivero assigned as having a high level of skill and experience made their engravings on antlers and bones that had a discernible use, such as objects of personal adornment or tools (Rivero 2016, 95).

Based on the groups above, it seems reasonable to conclude that individuals who worked in osseous materials such as antler, bone, and ivory likely trained their students in a manner similar to Singleton's framework and that of the ivory carvers in Punjab. In the early stages, novices would have been expected to perform menial tasks such as breaking down the raw materials and preparing them for use, all the while observing the more senior members of the workshop. Eventually, they would have started experimenting on scraps of bone and wood, or cast-off pieces of ivory or antler. Eventually, the more experienced craftworkers would have begun supplying the novices with instruction and gradually allowing them to progress to using more valuable raw materials until they had reached a sufficient skill level to be trusted to work with the highest quality materials available.

III.) Hornworking

Much like antlerworking, there has been little published with regards to hornworking and even less investigating how hornworkers trained their students (Yeomans 2008, 130). As previously discussed, the study of hornworking faces additional challenges as horn rarely survives in the archaeological record, meaning that it is highly unlikely that a study of toolmarks such as the one Rivero conducted would be possible (Rivero 2016). Furthermore, many historical records of the hornworking industry use the term "stag horn," which could refer either to the keratinous horns from deer imported from Africa and Asia, to cow horns that had been treated in such a way that they resembled antler, or actual antlers (Unwin 2018, 118). There are however a few clues that can be found by careful examination of the English horners' guild and the late 18th to mid-19th century American comb making industries.

The American comb industry got its beginning in the Montachusett Region of north-central Massachusetts in the 1760's (Murray 1999, 268). Started by Enoch Noyes in the town of West Newbury, the combs were initially made by hand from horn and tortoise shell in a one-man or one family industry (Musser 1950, 62; Murray 1999, 130). Shortly thereafter, Noyes's first apprentice moved to Leominster, which would become the centre for the American combmaking and plastics industry (Murray 1999, 130).

During this early phase, a craftsman could open his own workshop with minimal capital investment, needing only a hatchet, tongs, oil, a saw or jack-knife, and stones to press the horn into sheets (Musser 1950, 59, 62). The raw horn could be purchased cheaply from the local farms or tannery, and the cost of the materials could easily be recouped by selling horn buttons and knife handles (Musser 1950, 62). A man named Oliver Vose Hills reported that his father had been a combmaker from Leominster who would fill his bags with finished combs and take them to Worcester where he would sell the pieces and purchase new raw materials before returning home (Musser 1950, 62).

As the demand for Leominster horn combs increased, the combmakers began taking on more apprentices, training them for three years or longer (Musser 1950, 62). An ad placed in the *Lancaster Gazette* in April of 1828 illustrated the type of apprentice a comb maker likely desired: "'Wanted- A good Boy, about 18 years old, to learn the Comb Trade. None other need apply'" (Musser 1950, 62-63). This illustrates that individuals that were hired into a workshop from outside the family began their training later than most other groups we have thus far seen, though it cannot be overlooked that perhaps that particular combmaker simply desired an older student in the hopes that training them would be an easier task.

With the exception of holidays, apprentices were expected to work every day beginning in mid-September until mid-March (Doyle 1925, 79).

S. Stanley 97.)

Typically an apprentice did not receive a wage, however, he was occasionally allowed to work overtime in the evenings, known as working a stint, to earn a little extra spending money by grinding the backs and teeth of the combs with a foot-powered grinding wheel (Doyle 1925, 79). The rest of the boy's needs, including food and clothing, were provided for by the master combmaker (Doyle 1925, 79).

Though the ad from the *Lancaster Gazette* and the records of combmaking apprentices that Musser and Doyle consulted portray the American comb industry as a strictly male sphere, this is not an entirely accurate picture. I would argue that as in most single household industries, it is probable that women were involved in the production process from the beginning. As the Massachusetts combmaking factories began to become more industrialized, it was not uncommon for the combs to be distributed to the women of the village to be bent into their final shapes and polished with a mixture of charcoal ash and water (Doyle 1925, 26). We also have evidence at this stage that women were able to earn up to three dollars a week making combs, though their male counterparts made significantly more than that (Doyle 1925, 120). While we cannot definitively say that women played a significant role in early comb production, it is possible that while only male combmakers received a formal apprenticeship, women also played a role in the workshop.

While the English hornworking industry does not provide specific details about the daily lives and training processes that horners

S. Stanley 98.)

experienced, it does provide more insight than the American records and has a much longer history to investigate. In particular, the horners' guilds of London and York provide a wealth of apprenticeship contracts and guild records. Like many of the medieval guilds discussed in the previous section, many apprentice hornworkers were the sons of hornworkers, though in London nearly a quarter of these sons who began their training between 1731 and 1800 studied under a master horner that was not their father (Yeomans 2008, 133, 136). In York, these apprenticeships typically lasted for seven years (MacGregor 1991, 373).

Many horners began their careers as horn-breakers; individuals who removed the horn from the horncore, cut, and then pressed the raw horns into flat sheets that were then sold to other craftsmen (MacGregor 1991, 373; Yeomans 2008, 132-133). While the job of separating the cores, opening the horns, and flattening them into sheets was likely regarded as a foundational skill for hornworking, it was also a disgusting and putrid task (MacGregor 1991, 373-374; Yeomans 2008, 133) that the more senior members of the workshop would have been all too happy to pass off to their newer or younger members. An example of this can be seen in the records for a man named Richard Peele who first appears as a horn-breaker in 1657 (Yeomans,2008, 133). Yeomans suggests that Richard may have been the son of either Christopher or Clement Peele, who were recorded as horners in 1641 (Yeomans,2008, 133). By 1659, Richard himself had become a horner (Yeomans,2008, 133). Another record of a

task that was likely assigned to an apprentice was softening the horns. In the 1864 census records from Sheffield, there is one instance in which the job of softening horn was specifically stated, and it was attributed to a ten-year-old boy (Unwin 2018, 118).

If we agree with Singleton's first stage in which the apprentice or novice was required to perform tasks to prepare the raw materials for the more senior craftspeople to use, then the progression from softener or horn-breaker to horner makes sense. It is difficult to know what further tasks an apprentice would be assigned once they had mastered horn breaking. It is possible that they would have been assigned to punch or cut out various shapes from the flattened sheets of horn, which could then be shaped or assembled into various products by the more experienced horners. Until further studies have been performed, we have no way of knowing for certain how a hornworker's training might have progressed.

There is one last interesting piece of evidence to consider from Doyle's account of the American combmaking industry. Doyle reports that in the early stages of the industry's development, Journeymen combmakers, or "tramping jours", were not an uncommon occurrence (Doyle 1925, 84). The journeymen would travel from town to town in search of work and would stay until either the work ran out or they "were seized with the 'wanderlust' spirit" (Doyle 1925, 84). It was possible for journeymen to open their own businesses or enter into partnerships with

other combmakers, as we see with a man named Jonas Colburn who partnered with two other men after several years of being a journeyman (Doyle 1925, 86). Another journeyman named Jacob W. Walton, who, after working in David Noyes's West Newbury factory until 1852 or 1853, went on to partner with a man who owned a factory in Philadelphia (Doyle 1925, 135).

While the archaeological and historical evidence for the training process of apprentice hornworkers is disappointingly lacking, or as in the case of Doyle's 1925 account is rather dated, it is worth examining, and I would suggest visiting with renewed interest. Unfortunately, until such studies have been conducted, it is impossible to apply Singleton's framework to this crafting tradition with any reliability. To that end, we must next look at glass bead production to see if his model is still a viable tool to be used in the examination of Viking Age crafts training.

IV.) Glassworking

Unlike horn and antlerworking, the glass industry provides more details about what the duties of novice glassworkers were, though they are still relatively scarce. Purdalpur in particular has a long tradition of glass beadmaking using the same winding techniques that were employed in the Viking Age, making it an ideal place to start looking for how glass beadmakers received their training. Traditionally, these "country beads" were produced using local raw materials which produced poor quality

beads with varying chemical compositions (Sode 1995, 103). By the time Sode conducted his study in the mid 1990's however, the village had begun importing raw glass cakes from Firozabad which greatly improved the quality and consistency of the beads (Kanungo 2004, 142).

In Purdalpur, the economy revolved around the production and sale of glass beads, making beadmaking a community affair in which everyone participated (Kanungo 2004, 131; Sode 1995, 106-107). For example, while men were the only ones who handled the actual production process including constructing the furnaces, melting the glass, and shaping the beads, the women washed and prepared the glass, chalked the copper wires used to make the holes, and cleaned and strung the finished beads (Kanungo 2004, 131-132; Sode 1995, 106-107).

These activities naturally included the children of the families. Young boys assisted their fathers and uncles in the workshop by cutting the mosaic rods into 1cm pieces (Sode 1995, 105), cleaning the waste glass from the workshop floor and sorting it by colour, and checking the pots full of finished beads for imperfections, though they often received help from elders (Kanungo 2004, 131-132, 142). Children as young as seven were also permitted to help make the beads alongside the adults (Kanungo 2004, 142). Smaller children however typically assisted the women in their tasks outside of the workshop (Sode 1995, 106-107). All the while, they were learning the trade from the adults, particularly the

boys who studied with their fathers, uncles, and other male members of the workshop (Sode 1995, 106-107).

Another task that may have been assigned to the children was the preparation of the clay used to create the crucibles that held the melting glass. Kanungo only tells us that the clay was stored in a pit outside of the furnace house and that "every day one of the workers tramples on it while pouring water" (Kanungo 2004, 139). If we recall the potters from the Mimbres and Hohokama tribes, it was the children who were responsible for preparing the raw clay for use (Kamp 2001, 430). Likewise, Haase tells us that he was also expected to clean and wedge the clay for the older members of the workshop (Haase 1998, 111). We cannot say for certain whether the worker Kanungo references was an adult or a child, but it is worth considering that this type of task may have been given to one of the younger members of the workshop.

While Purdalpur provides many details about how a novice glass beadmaker might have received their training, it does not give us a full view of how that training may have progressed nor what other tasks may have been assigned to the learners. Therefore, we must expand our investigation beyond the production of beads alone and investigate the glassblowing industry of the United States during the end of the 19th century into the beginning of the 20th. These industries, however, look very different from the small Viking Age workshops at the centre of this study. While the turn of the century American workshops were

S. Stanley 103.)

industrialized machines of capitalism, the basic elements of the craft, such as heat control and proper handling of glass while it is on a punty rod, remain the same. Novices would have needed to learn how to master the same skills in both an industrialized setting as well as in a Viking Age workshop.

The glass bottle factories of Pittsburgh and Milwaukee at the turn of the 20th century illustrate a very different experience for novice glassworkers than those of the children of Purdalpur and likely the novices of the Viking Age workshops. Nevertheless, some key details can be distilled from these industrial workshops, enabling us to better determine how glassworkers might have been trained, regardless of the level of industrialization that existed in their work environment.

Referred to as "small help," child workers were commonplace in the United States, with an estimated 5,658 children under the age of 16 having been employed in the glassworks factories in 1880, though this census was not recorded until 1927 and the number was likely much higher than the records indicate (Larner 1965, 255-256). In the case of the Milwaukie factory during the summer of 1880, children were initially paid by the factory to bring in broken scrap glass that the factory could recycle into new items (Hoffman 2007, 4). When the factory opened for production the following September however, young boys were accepted onto the factory floor and enticed with the promise of wages and the opportunity to learn the glass working trade (Hoffman 2007, 4). Despite

the dangerous conditions in the glassworks (Hoffman 2007, 11), many rural families relied on the extra wages their children brought home from the glassworks (Hoffman 2007, 4). The fact that most of the children employed by the glassworks had fathers or uncles who were glassblowers and supervised the boys' training also likely normalized the arrangement (Hoffman 2007, 4).

Much like the other novices, we have examined, the first responsibilities of the children in the glassworks were to work as helpers and assistants to glassblowers. Their duties included opening the moulds the bottles were blown into, carrying the red-hot bottles to the lehr or annealer on wooden paddles, collecting broken glass off of the factory floor, and cleaning the used punty rods after use, to name a few (Larner 1965, 359, 361). Much like in Purdalpur, the factory needed someone to prepare the clay for crucibles. This task fell to the young boys who had not yet begun their apprenticeships (Hoffman 2007, 5). The pots were made of German fire clay, which the boys mixed with water over the course of three days by stomping on it with their feet (Hoffman 2007, 5). The clay was then passed off to potters who moulded it into containers where it would cure and dry for several months before they could be used (Hoffman 2007, 5).

When the boys reached their early teens, they were permitted to begin their apprenticeships, which typically lasted for three to five years (Hoffman 2007, 4). As apprentices, they were entrusted with gathering

molten glass from the furnace onto a punty rod for the blower and were given instructions in glassblowing (Hoffman 2007, 6).

It is important to mention that while we have thus far spoken only of male glassworkers and male assistants and apprentices, there were some women and girls who were employed in the glassworks. However, they were not permitted on the factory floor both due to how dangerous it was, and because the glassworkers would often "partially disrobe" due to the overwhelming heat of the factory (Hoffman 2007, 10). Instead, female glassworkers worked in the finishing room, decorating and packing the bottles for shipment (Larner 1965, 359).

While modern western society and labour laws no longer permit children to work in factories or under conditions like those of the glassworks, it cannot be stressed enough how integral a role they played in the industry at the time. The children had no representation within the unions and were paid a pittance, though they had some bargaining power when attempting to negotiate better wages (Hoffman 2007, 6). Strikes were frequent occurrences, particularly in Milwaukee after the factory cut the boys' wages from $3 per week to only $2.50 in 1885 (Hoffman 2007, 6). The strikes caused two of the three furnaces to shut down, putting intense pressure on the glassblowers who were paid by the piece (rather than by the week, like their younger colleagues) (Hoffman 2007, 7). Such a drastic upset to production illustrates just how necessary the jobs performed by the boys were. Without them preparing the clay and glass,

S. Stanley 106.)

cleaning used punties, carrying finished bottles, and collecting broken glass from the factory floor to be reused, production ground to a standstill (Hoffman 2007, 7).

V.) Non-Ferrous Metalworking

Though there has been more work done examining how non-ferrous metalworkers practiced their craft, the literature explaining exactly how novices learned the trade and what sorts of tasks they were assigned is still disappointingly limited (Bimbenet-Privat 1995, 28). To that end, we must look to two vastly different sources: the Parisian goldsmiths from the mid-16th to mid-17th centuries, and modern Hopi, Navajo, Pueblo, and Zuni silversmiths of the American Southwest who began crafting silver jewellery in the mid- to late-19th century.

A common theme that has emerged throughout this study, but is especially evident in non-ferrous metalworking, is the heavy preference for expert craftsmen to train their sons or the sons of other smiths in the craft. Novices whose fathers had been non-ferrous metalworkers would already have spent long hours watching their fathers in the workshop and learned the basics of the trade, as well as how to behave in such a dangerous environment (Bimbenet-Privat 1995, 24). This would have made them a preferable candidate for instruction over other potential novices. In the case of the Navajo and Pueblo silversmiths, Adair points out that if a man who did not have a father who was a silversmith wanted

to learn the craft, he would first approach an uncle or other blood relative, then an in-law if no one could be found among his own family (Adair 1945, 87). He would only approach an outsider for instruction as a last resort if there was no one in his extended kin group or village able to teach him (Adair 1945, 87).

Preferential treatment was also given for the sons of goldsmiths by the guild in Paris. These boys were able to skip the mandated eight-year training period which Bimbenet-Priavat explains was also a time for testing the character of the boys, ensuring that they were honest and trustworthy enough to be allowed to work with such valuable raw materials on their own (Bimbenet-Privat 1995, 24). Starting in the 16th century, only 300 master goldsmiths were permitted to work in Paris and when one of these individuals died, the sons of goldsmiths were promoted to master status favourably over apprentices who either did not have a family history of smithing or had come to Paris from the countryside to learn the trade (Bimbenet-Privat 1995, 24). It is interesting to note that the statutes that governed how apprenticeships were conducted required a boy to begin his training between the ages of 10 and 16; any younger and he would "be incapable of profiting from the instruction," but after the age of 16 he was viewed as too old to be "sufficiently submissive or docile" (Bimbenet-Privat 1995, 24).

Learning by observation, as we have seen with other crafting disciplines, was an important first step for novice non-ferrous

S. Stanley 108.)

metalworkers. Watson, the Hopi silversmith who Hellyer trained under, explained that he began his training by hovering around his uncles 'workshop during summer breaks from school (Hellyer 2013, 95). The older men put Watson to work polishing finished pieces, though they did not demonstrate how he was supposed to do it (Hellyer 2013, 95). Instead, Watson learned by watching the other silversmiths at the task and copied their techniques (Hellyer 2013, 95). As he became more proficient, Watson was permitted to watch and imitate the other jewellers as they put the finishing touches on the pieces they were working on, and then was eventually given the task to complete (Hellyer 2013, 150). Watson went on to say that when he was not occupied with finishing and polishing, he watched his uncles work, noting which tools the older men used and how they used them (Hellyer 2013, 151).

Adair's interviews with Navajo and Pueblo silversmiths also confirmed the importance of observation as a means of learning how to work with silver. He explained that many smiths learned their trade by watching their elders with little to no formal instruction (Adair 1945, 90-91). However, a novice who does not inform the silversmith he was watching that he wanted to learn the craft was viewed as dishonest, and that he was "stealing" the knowledge from the craftsman (Adair 1945, 90-91). One of Adair's interviewees, Atsidi Yazzie, said that he learned to work with silver by "stealing" the art from several different silversmiths (Adair 1945, 91). Another smith named Chai Begay stated that initially, he was

the only southern Navajo silversmith living in the Zuñi region, but a group of young men used to watch him work, and soon after, there were many new smiths in the area (Adair 1945, 91). The importance of being able to learn from another craftsperson by observing their methods does not end when a craftsperson completes their apprenticeship. Julian Lovato, one of the Pueblo craftsmen who worked with the renowned Italian silversmith Frank Patania Sr. explained that being able to work next to Frank and watch how he "shaped things and made his own tools" had a major influence on his own work (Hannah 2004, 110).

The next stage in Singleton's model, self-initiated experimentation, was only referenced in one of these studies. One of the men Adair interviewed who had claimed to have "stolen" his knowledge of silversmithing from several other craftsmen admitted that when one of the older silversmiths would leave for a day or two, he would go over to the older man's workshop and use his tools and solder to practice, melting his own dimes and quarters to make buttons and other objects (Adair 1945, 91). it is probable that other novices who were being knowingly trained by craftspeople also experimented with metalworking on their own, but without confirmation, it is difficult to know for sure.

In addition to learning, apprentice gold and silversmiths were also assigned tasks that would help streamline production for the workshop, as we have noted with previous crafting traditions and as Singleton's framework would suggest. Adair verified that apprentices helped melt and

pound out the raw silver to prepare it for use, as well as any repetitive or routine work that did not require a high level of skill such as blanching, brushing, or polishing finished products (Adair 1945, 80-81). Pounding silver into slugs that would be attached to make bracelets and shaping other components was also a task given to apprentices (Adair 1945, 85).

Around the age of 10, Frank Patania Jr began to help out in his father, Frank Sr.'s shop by running the stand and interacting with customers (Hannah 2004, 110). When Frank Jr. was not busy with those chores, his father would assign him simple metalworking tasks such as making large numbers of beads (Hannah 2004, 110). Each time Frank Jr. would complete a batch and show them to his father, who would direct him to make more, thus encouraging his son to improve his skills through repetition (Hannah 2004, 110).

Hellyer's teacher, Watson, explained that he spent an entire summer only doing the finishing work of the shop before he was permitted to learn any new tasks (Hellyer 2013, 150). This included using a jeweller's file followed by increasingly fine-grained sandpapers to wear away any large rough patches, firing scales, or imperfections, until the pieces were smooth and unblemished (Hellyer 2013, 150-151). Then, once all of the sanding marks had been brushed away, Watson had to buff and polish the pieces (Hellyer 2013, 151). Though tedious and demanding, this task gave Watson plenty of time to sit beside his uncles and watch them work (Hellyer 2013, 151). In addition to being valuable skills that an apprentice

would need, some tasks were given to the apprentices because they were filthy or undesirable, which the older craftsmen would have been all too happy to pass off to someone else (Hellyer 2013, 95). This was one of the reasons that Watson was assigned polishing for his first task (Hellyer 2013, 95).

For the most part, novices were assigned tasks that were fairly simple and easy to do, such as preparing raw materials for use. This helped free up the more experienced craftsmen to make items with minimal need to stop and were not too difficult or dangerous for someone with very little experience to perform. That is not to say however that novices did not learn dangerous or difficult tasks. Some of the contracts from Paris contained agreements that the master goldsmiths would teach their apprentices burnishing and gilding, two difficult tasks that were considered too dangerous for the average apprentice to handle (Bimbenet-Privat 1995, 29). Given the difficulty and risk associated with these tasks, it is probable that the apprentices in these instances were the sons of other goldsmiths and had better than average experience, though Bimbenet-Privat does not state whether or not this is the case. Among the Navajo and Hopi silversmiths, a novice is considered "skilled in the craft" once he is accomplished at soldering (Adair 1945, 90).

In addition to the ability to read and write, another skill that was important for novices to learn was drawing and draftsmanship. In Paris, there are numerous ink drawings done by goldsmithing apprentices from

S. Stanley 112.)

the 17th century that depict copies of engravings used to make silver objects (Bimbenet-Privat 1995, 30). There is also a record of the son of a Parisian goldsmith who had been apprenticed after his father's death to two other goldsmiths, and during this time had been taking portrait lessons from an art instructor (Bimbenet-Privat 1995, 31). After his apprenticeship had been completed, the boy's mother sent him to Rome to study art for a year, after which he made and submitted his masterpiece and became a master goldsmith (Bimbenet-Privat 1995, 31). Bimbenet-Privat also tells us that the Roman archives record 40 French goldsmiths in the city between the end of the 16th and beginning of the 17th centuries who also studied drawing (Bimbenet-Privat 1995, 31).

While trips to Rome for art lessons would have been a part of the education reserved for the wealthy, these trips and the sketchbooks of less affluent apprentices show how valuable the ability to draw and conceptualize designs was for the goldsmiths of Paris. Frank Patania Sr.'s son also stated that his father would "draw up the designs" that were used in his workshop (Hannah 2004, 109). Drawing, therefore, was a skill that was required for many non-ferrous metalworkers and would have had the added benefit of helping hone the fine motor skills and manual dexterity that would have also been beneficial to non-ferrous metalworkers.

The last skill a novice non-ferrous metalworker would have developed that needs to be addressed here is the acquisition of physical

strength and stamina. Hannah tells us that tasks such as hammering the metal, wire pulling, and milling metal sheets would have been assigned later in the novice's training once they had gained enough strength to handle such demanding tasks (Hannah 2004, 109). Adair also noted that when one of the smiths he had interviewed was making canteens, it took the smith's apprentice about twice as long to hammer the silver sheets into shape as it did the smith himself due to the senior smith's greater level of skill and strength (Adair 1945, 80). Lastly, when Hellyer was training with Watson, she found that she needed his help to close the links of the Hopi chain she had been making, as she did not have sufficient strength to do so unaided (Hellyer 2013, 118). Tasks such as working the bellows and carrying heavy materials around the shop, as well as hammering the metal during the early phases of training would have helped build up the muscles a novice would have needed for the later parts of their training. It also would have given the novice time to grow further, particularly in the cases of apprenticeship arrangements that lasted for several years.

Thus far we have only discussed male non-ferrous metalworkers and their male apprentices, which paints a misleading picture of how these workshops looked and operated. While the Parisian records only speak of these craftspeople in male terms, we see something different in the American southwest. As Adair explained, the more a silversmith could produce, the higher his income would be (Adair 1945, 89). To increase

production, he needed help handling the menial tasks of running the shop, but also more knowledgeable help making the products. Therefore, it makes sense for a metalworker to not only have trained his sons, but also his wife and any daughters he might have had as well, increasing his shop's production capacity and therefore income (Adair 1945, 89). Adair noted that many Navajo women had been trained in silversmithing by their husbands and fathers, and frequently worked as assistants in their husband's workshops, though only a few women worked as independent artisans (Adair 1945, 88). While their husbands assembled the final pieces, the women would cut the silver into shape, grinding and polishing the turquoise that would be used in the jewellery, and setting the stones.

While some of these tasks could be carried out by a novice, there are other tasks such as the ones done by the wife of Charlie Bitsui, one of the craftsmen Adair had been observing, that needed a more experienced hand. On the day Adair was observing, Mrs. Bitsui was helping her husband make rings. Mrs. Bitsui began by melting small scraps of silver that she'd placed in a series of grooves in a piece of charred wood with a torch and sprinkled the top of the silver with borax (Adair 1945, 85). As the silver and borax melted, it began to form small balls, known as raindrops, which could be set into the rings once they had cooled and hardened (Adair,1945, 85). She then began making the bezels for the rings and soldered them into place (Adair 1945, 85). Mrs. Bitsui then took the mounted bezels and soldered a twisted silver wire around their bases

S. Stanley 115.)

and trimmed the plate (Adair 1945, 86). She then passed the piece off to Charlie who would solder the bezels to the shanks before adding one of the raindrops his wife had made to the top (Adair 1945, 86). During this time, Charlie's apprentice pounded slugs of silver into shape for the bracelets they would make later in the day (Adair 1945, 85). Once finished, Charlie's apprentice blanched and polished the rings before handing them back to Charlie to set any additional stones (Adair 1945, 85).

This cooperation between the craftsman, his wife, and apprentice enabled the workshop to produce a far greater number of rings than Charlie could have made on his own, which naturally increased his family's earnings. By training and enlisting the help of his wife, or in the case of Hellyer's teacher Watson, his daughter (Hellyer 2013, 153), a craftsman can drastically increase his production capabilities more than if he had only trained his sons.

S. Stanley 116.)

Section 4: Discussion

Having investigated how medieval workshops were organized and how guild training functioned, and having compared various ethnographic accounts of how craftspeople learned their trade, we now are beginning to have a better understanding of how Viking Age workshops might have been organized and how novice craftspeople became accomplished at their craft. While the ethnographic analogies have provided many valuable insights into the possibilities of how these novices received their training, we still do not have all of the answers. Therefore, in the following chapter, the framework I am proposing is by necessity highly speculative, though it has drawn heavily from the medieval guild records and the ethnographic accounts discussed above to give it substance. It is my intention that this framework will initiate a larger conversation about who Viking Age novices were and how their training would have progressed and changed throughout the Viking Age.

There are several details that must be noted when discussing craft working in the Viking Age before we can proceed. The first feature that likely had an influence on how workshops functioned was the size and location of the workshop, as well as *when* in the Viking Age these workshops were in operation, had a direct influence on how the workshop functioned, and how craftspeople were trained. Rural workshops, particularly during the early stages of the Viking Age, would have been small industries that operated inside the home and would have drawn

S. Stanley 117.)

their labour from within the immediate family, including members of both sexes. Any novice that would have been trained in these workshops would almost certainly have been the children of the craftsperson and their spouse. These early Viking Age workshops would likely have had a smaller scale of production due to a decreased demand for their products and would have been less likely to specialize in only one type of crafting, much like the later medieval households. These workshops can be loosely described as somewhere between the household industries or individual workshops outlined in Peacock's model based on Roman pottery production (Peacock 1982, 8-9).

While craftworking would not have been the primary source of their subsistence, they would have had tools specific to their trade and would have required the labour of more than that which the primary craftsperson alone could have provided (Peacock 1982, 8-9). As we have observed with medieval guild workshops, there would have been a large amount of diversification in the types of objects being produced in these workshops, as well as the varieties of raw materials used. This can be seen in the frequency of cast-off pieces from antler and bone working being found alongside evidence of amber working in the same workshops in excavations at York, Åhus (Riddler and Trzaska-Nartowski 2011, 129; Callmer 2020b, 40; Callmer 2020a, 144), Kolobrazeg, and Staraja Ladoga (Ambrosiani 1981, 46). The potential for diversification was likely only

limited to the capabilities of the craftsperson and the suitability of their tools to work more than one material.

As the Viking Age progressed and craftspeople began moving into towns, the demand for their products would have grown, necessitating an increase in production capabilities. To keep up with this demand, craftspeople would have started to look outside of their immediate family for additional labour, taking on and training novices who were not their children. As we have observed in the previous ethnographic analogies, these novices would have most likely been the younger siblings or nieces and nephews of the craftspeople who worked in the shop, or other members of their extended kin group. Individuals who were not related to the craftspeople at all may have been accepted, though it becomes less likely the smaller the workshop was. At this stage, these urban workshops more closely match what Peacock describes as individual workshops and begin to form into nucleated workshops, which will be further discussed below (Peacock 1982, 9).

The age in which a novice began their training would have been influenced by whether they were trained by their parents or by someone outside of their immediate family. For novices in rural settings, they were almost certainly the children of the craftspeople who operated the shop and would have been required to contribute to the household workload at a very young age, particularly in crafting traditions such as antler working and pottery production where the danger of the child getting hurt is

lower. The act of caring for the child in itself would have exposed very young children to the crafting process as illustrated by Kamp (2001) in her observation that young Mimbres children often played in the area around where potters were working (Kamp 2001a, 446).

It is important to note that the modern, western view of childhood as a liminal state between birth and adulthood in which the primary focus is education and play, is not a notion that has been shared cross-culturally or throughout history (Kamp 2001b, 2, 15). Before the 1800's in the west and in many other parts of the world today, children have played a significant role in both economic and subsistence activities, and their labour often had a dramatic impact on the incomes and success of their families and communities (Wileman 2005, 9; Kamp 2001b, 2).

The age at which a child was considered to be an adult also varies from culture to culture and throughout time. 7th century Anglo Saxon legal documents record that children were legally considered adults at the age of ten, but by the 10th century, the age of majority was raised to 12 (Kamp 2001b, 4). We must therefore consider the probability that children would likely have been expected to assist their parents in craftworking and may have even been expected to perform tasks that would be viewed as too difficult or dangerous for individuals of their ages by modern western standards.

There are also historical accounts from Norway prior to the 12th century that reference children of about six years old being tasked with

the chores of gathering plants to make dye, and sorting raw materials for craft production (Cartwright 2015, 162; Larsen 2001). At this age, children of both sexes are more often assigned tasks that are usually regulated to women, though as they matured, female children were far less likely to assist in typically male tasks and differentiation between the tasks given to each sex possibly became more pronounced (Kamp 2001b, 16). Girls might also have received less formal craft training than boys, as the former would have been expected to fulfil the roles of wives and mothers later in life, with less free time to pursue craft working, as was the case with Keiko, the female pottery apprentice who studied with Haase (Haase 1998, 109). While sex would have played a part in determining what tasks a novice craftsperson would have been expected to do, age and capability would have also been a determining factor. To understand how age impacted the tasks given to both rural and urban crafting novices and, we can break their training into three phases: pre-craft training, early craft training, and full "apprenticeship".

Stages of Training

In the pre-crafting stage, children below the age of six would have been kept close to their mothers and been given small, safe tasks that would not have required much strength or manual dexterity. Helping gather raw materials, fetching specific items for their parents or other craftspeople in the workshop, and cleaning the floor are a few of the tasks children at such a young age could reasonably be expected to carry out,

S. Stanley 121.)

regardless of which crafting tradition they were a part of. Pre-crafting stage novices may also have been allowed to play with low-value raw materials such as clay or cast-off pieces of antler, bone, or horn. This stage of training would encompass the first two stages of Singleton's framework: unobtrusive observation and self-initiated experimentation.

As the children worked and played in the orbit of their mothers and other adults, they were able to observe the adults at work and likely began mimicking the activities they saw. For the children of potters, this might have included attempting to make pots of their own and perhaps even convincing the adults to fire the pots for them. For antler, horn, non-ferrous metalworking, and glass bead production, which required sharp tools or the use of a fire, it's possible that children might have been kept away from the actual crafting activities but may have been allowed to play with broken or cast-off components, much how the less experienced carvers in Rivero's study were permitted to use cast-off pieces (Rivero 2016, 95). It seems highly unlikely that the children of this age group would have come from outside of the immediate family as they would still have required a great deal of care, as well as supervision.

Children between the ages of six and twelve would have been recruited into the early stages of training and given more structured learning opportunities. This stage encompasses the first three stages of Singleton's framework as the novices were still expected to observe and experiment on their own, but they also began to receive formal

S. Stanley 122.)

instruction. They initially would have been encouraged to help in small ways and were given tasks that included minding the shop, helping prepare the raw materials, and generally fulfilling tasks that would have reduced the need for the adults to step away from the production process. Observation and imitation are still key parts of this stage, but as the children progress, they are given tasks that help them understand the qualities of the raw materials used or will help them build the dexterity or strength needed for specific tasks.

At this stage, novice potters would begin receiving formal instruction on the right type of clay to use and how to mix the clays if it was a blend of materials from different sources. They would also be taught how to make the correct forms, how to use the wheel, and how to build and fire a kiln. This would have also been the stage in which they learned the importance of tempering the clay correctly. Novice antler workers could have been expected to remove the tines and cut the beam of the antlers into usable pieces, while young horn workers would likely have been responsible for tending the soaking horns and removing them from the bone cores. At the later stages of their early training, novice horn workers may have also assisted in opening or breaking the horns as is implied in the medieval guild records (Yeomans 2008, 133).

For novices learning glass beadmaking and non-ferrous metalworking, this is the stage where they would be set to work the bellows of the furnace. From this position, the novices would be able to

observe how the various glasses and metals were melted, purified, and mixed, and most importantly, how to determine when the furnace had reached the right temperature based on the colour of the coals (Glazzard 2020a). The ability to recognize when the furnace had reached the appropriate temperature was one of the most important foundational skills a glass or metalworker would have needed to have mastered before they could have been permitted to start working with the glass or metals on their own. Once the novices had mastered this skill, they would have been permitted to begin practicing drawing glass into rods and casting lead pieces. This would have also been the stage that saw the greatest emphasis placed on developing procedural knowledge skills, particularly in pottery and glass beadmaking.

It is important to note here that the skill levels of the novice non-ferrous metalworkers would very likely have determined what materials they would have been permitted to work with. While any defective objects a novice might have made could have been melted down and used again, repeated recycling in this manner would have caused a build-up of impurities which would have required cupellation to remove (Glazzard 2020b). This would have not only slowed down production, but it would have also increased the chance of the novice spilling the molten metal as they transferred it from the crucible to the mould. Pedersen's comparison between waste droplets from casting and metal remains collected from crucibles collected from the Kaupang excavation indicate that there was a

S. Stanley 124.)

much higher spillage of inexpensive metals such as lead (78%) and copper alloy (20%) than of the more expensive gold (0.008%) and silver (2%) (Pedersen 2020, 235). However, the metal remains present in the crucibles indicate that gold and silver made up 51% of the metals being used compared to lead at 6% and copper alloy at 31% (Pedersen 2020, 235).

As Pedersen points out, the lower representation of gold and silver in the waste indicates that these more valuable materials were handled more carefully and were likely collected and reused after being spilled more often than the less expensive copper alloy and lead (Pedersen 2020, 235). However, I propose that this discrepancy may also be indicative of novice craftspeople only being permitted to work with inexpensive materials, while gold and silver were reserved for the most senior craftspeople in the workshop, as we saw in Fergusson's (2008) explanation of craft training, Rivero's (2016) analysis of Palaeolithic engravers, and Ellis' (1902) observations of novice ivory workers in Punjab. By limiting the novices to using lower quality/value materials, workshops were still able to give their novices a chance to experiment with their craft and learn more about the qualities of the raw materials themselves, without losing income by wasting or risking damage to valuable resources.

Finally, I believe that Viking Age antler and non-ferrous metalworking novices in this stage of their training would have been

encouraged to develop their drawing skills. The ability to draw well would have helped antler and metalworkers conceptualize and practice the designs they would have used in their craft and for metalworkers, it would have been a crucial skill for designing and making new moulds. A bovine scapula with several Trewhiddle style animals carved into it found during the Coppergate excavation in York has been accepted as such a practice piece (Fig 6).

Fig 6: Trewhiddle style motief practice piece from the Coppergate excavation. Reprinted with permission from the York Archaeological Trust.

It is also possible that wax tablets, which were common instruments of notetaking, writing practice, and record-keeping throughout the medieval period (Brown 1994, 1), may have been used to practice drawing. While the boxwood tablets found in York date to the mid- to late-14th century (Allen 2016, 2), a Viking Age example from Oslo does exist (Brown 1994, 4-5), and the 13th-century Parisian statutes *Livre des*

métiers d' Etienne Boileau credits metalworkers with making tablets (Brown 1994, 7). It is impossible to say with any certainty that Viking Age craftworkers would have used wax tablets to train novices, but it is within the realm of possibility, and trial pieces such as the Coppergate scapula certainly seem to indicate that drawing and carving would have been important skills for novices to develop. This may also explain some of the strange or nonsensical runic inscriptions that have been found as the inscriptions could be practice pieces or scrap pieces carved by bored novices (Ashby 2020).

Beginning around the age of 12, novices enter the final full "apprenticeship" stage of training. In this period the focus of their education shifts from observing whilst assisting the older members of the workshop into a more structured manner. This would have been a combination of Singleton's third and fourth stages as the novice's primary duties would have been assisting the more experienced craftspeople in the more delicate and demanding tasks and crafting objects on their own. They may also have been expected to oversee and instruct younger novices in the first and second stages of training in simple tasks, as childcare in general often fell to other children (Kamp 2001b, 14), and the older novices would more easily able to relate to the inexperience of the younger children than the adults in the workshop.

These older novices would have been trusted with the more difficult and dangerous tasks in the workshop, including creating new moulds,

pouring molten metal into moulds, shaping and decorating beads, flattening horn into sheets, operating the kilns on their own, and assembling antler components into combs. The best quality materials and most complex or dangerous tasks would still have been reserved for the more experienced members of the workshop, though novices at this stage of training would likely have been permitted to assist in these tasks and certainly would have been expected to watch.

The products made by these novices would also have been of a high enough quality at this stage to be made available for purchase in the shop, which is one of the features in the fourth and fifth stages of Singleton's framework. In cases where the novices were children or near relations of the craftspeople who operated the shop, the objects they made would not have been so much a means of repaying the craftspeople for their training, but rather would have been viewed as simply a normal part of daily life, and a means of contributing to the family. The novices would have probably continued either working in the workshop into adulthood, perhaps eventually taking over the workshop, or may have even set up their own nearby and continued to collaborate with their family. It has been suggested that long-term collaboration between novices and the individuals who taught them was the basis upon which long-standing regional styles in some Viking Age emporia were founded (Croix *et al*. 2019, 346), which strongly suggests that the relationship

between novices and their instructors did not simply end when their training concluded.

Multi-specialization, Collaboration, and Social Networking

Much like the artisans of medieval guild workshops, Viking Age craftspeople would not have focused on a single form of craft, particularly in the early Viking Age. Examples of multiple materials and crafts being worked in the same workshops have been discovered in multiple archaeological contexts across the Viking diaspora. In Staraja Ladoga, we find cast-off pieces from antler working, amber, crucibles, and moulds all in one house, as well as another find of antler and amber being worked together in Kolobrazeg (Ambrosiani 1981, 46). Non-ferrous metalworking in particular was a craft that required a wide array of knowledge, as we have seen, such as pottery production, leatherworking, bone and antler working, and woodworking (Pedersen 2015b, 55-56; Pedersen 2020, 244). While many craftspeople would have had the ability to work with more than one type of medium, especially in rural settings and in the early Viking Age, collaboration between specialists would have been necessary for more complex and elaborate pieces.

It has been suggested that this need for collaboration would have been a driving factor for the beginnings of urbanization (Croix *et al*. 2019, 345), I argue that the opposite might in fact be the case. Urbanization would have brought a multitude of craftspeople into contact with other individuals and crafting methods that differed from their own. Much like

S. Stanley 129.)

the potters of Dingshu, who frequently visited the shops of their colleagues for friendly conversations, Viking Age craftspeople would not have existed in a vacuum and would have shared techniques and design ideas even in the most casual of interactions (Gowlland 2012, 365). This casual "shop talk" would have developed into long-term friendships, and potentially even marriages, between families who practiced different crafting traditions. Those relationships between craftspeople and their families would have eventually given rise to the nucleated workshops (Peacock 1982, 9), and eventually to a new generation of novice craftworkers who would have benefitted from the crafting knowledge of both parents and their respective kin groups. This could be one explanation for the visible connection and style similarities between craftspeople in coastal communities (Callmer 2001, 147; Pedersen 2015, 61)

The Question of Itinerancy

The question of whether Viking Age craftspeople were itinerant or were long-term established members of a community is one that has been heavily debated for some time. If we subscribe to the idea that the workshop revolved around and was operated by the entire family, especially in the early rural phase, then it becomes unlikely that the majority of craftspeople were itinerant. I find it more likely that a craftsperson and their family would build up a surplus of product over the course of a year and then either take that inventory to a trading centre or

S. Stanley 130.)

arrange for an intermediary to do so for them. In the later urban phase, crafting families would have resided permanently in towns, and would have been able to arrange for their goods to be taken elsewhere for trade. That is not to say, however, that craftspeople never travelled to other locations to set up new workshops.

Evidence of the movement of craftspeople has been found in numerous sites. At Kaupang, a mould for pendants was recovered in a level dating to about the time Kaupang was established, along with a die for making decorative nails recovered from the ploughing layer above the same location (Pedersen 2015b, 62). Both items were made from a type of volcanic tuff not typically found in Scandinavia and were likely brought to Kaupang by the same person (Pedersen 2015b, 62). Kaupang also yielded evidence of tesserae and semi-manufactured glass rods that Gaut argues are indicative of an itinerant glass worker who came to Kaupang with their own materials (Gaut 2011, 169). It has also been proposed that evidence of the production of foiled glass beads could be a sign of an itinerant glassworker, as the rods and foil needed to make the beads would have been easy for a craftsperson to carry with them (Jönsson and Hunner 1995, 114-115). This may also explain the sudden appearance of high-lead glass in Britain (Bayley 2008, 16-17).

Some crafts however do not lend themselves well to an itinerant lifestyle. As discussed previously, antler workers relied on an expansive trade network to obtain the raw materials needed to supply such an

S. Stanley 131.)

"impressive volume of comb production" from the 8th to the 10th century (Callmer 2020a, 136). Likewise, horn workers would have needed a large supply of horns that could only be supplied by a large settlement (MacGregor 1985, 53), and would have also required large pits in which to soak their horn for two to three months by some estimates (Wendham 1964, 39; Ervynck *et al.* 2003, 68). Finally, given their reliance on their knowledge of the landscape to locate raw clay, as illustrated by Perry (2019), it seems more likely that Viking Age potters would also have remained established in one community.

A Case for the Invisible Novices

This study has shown that novice craftspeople played an important role in increasing the productivity of their workshops. However, until recently little work has been done to locate traces of novice participation in the archaeological record due to how difficult it can be to locate these individuals.

One reason for the lack of evidence in the archaeological record is the quality of materials that novices were permitted to work with. As we have observed, novices were frequently provided with either low value or poor-quality raw materials to practice with. The potential reusability of raw materials would have also played a role in obliterating traces of novice participation in the workshop. In instances where novices were provided with raw materials that could be recycled, such as clay, glass, or

metal, any trace of their work would have been destroyed when the material was reused.

Finally, many of the tasks assigned to novices would have left little to no evidence that they had been performed at all, let alone provided signs of who had fulfilled them. Tasks such as fetching water, sweeping the shop floor, working the bellows, and interacting with customers are all chores that almost certainly fell to young novices, but would not have produced any evidence. It is only through conducting ethnographic comparisons, such as the ones in this study, that we can begin to recognize these tasks (Wileman 2005, 58). The closest we can get to identifying Viking-Age novices performing these ancillary tasks is to look at medieval records such as several 13th-century accounts in which boys were charged with trespassing against manorial lands or royal forests to illegally collect firewood to supply the pottery kilns (Mellor 2020, 105-106).

While many tasks assigned to novices did not leave detectable traces, there are signs that archaeologists can look for, which may attest to the presence of novice Viking-Age craftspeople. The first and most obvious sign one can look for is the presence of technological imperfections. Misshapen or asymmetric pieces could be the markers of an inexperienced hand, as could simplistic designs or designs that deviate from the local norms (Kamp 2001a, 431). However, it must not be assumed that all mistakes of this type are the work of novices. What

archaeologists may classify as errors or imperfections might not have been viewed that way by the individual who made the object (Tweddle 1986, 221), and it has been suggested that old age and infirmities, such as declining eyesight or arthritis, especially in dimly lit workshops (Ashby 2020b), could mimic the types of mistakes one would typically associate with the artisan being a child (Kamp 2001b, 13).

One such example of an imperfect Viking-Age a group of artefacts was found in excavations in Bergen. In addition to a large amount of combmaking cast-off pieces and rejected or broken comb-elements, several misshapen pieces that seem to indicate that there was an inexperienced craftsperson working alongside the expert have been discovered (Hansen 2015, 38). A misshapen connecting plate that was too narrow and asymmetrical to have been considered a usable piece was recovered, along with two toothplates, one of which had had far too many holes drilled into it, and the other with very poorly sawn teeth (Hansen 2015, 38). These pieces may be evidence of an individual attempting to learn how to make these particular components (Hansen 2015, 38).

Numerous examples of defective beads have been discovered in Hedeby, Kaupang, Riba, and Staraja Ladoga that may also be the work of novice bead makers. Beads with either no perforation or with perforations that do not completely penetrate the bead are the most common production defects (Wiker 2003, 26). While Callmer previously attributed the frequency of this defect to mass production and importation, Wiker

S. Stanley 134.)

suggests that many of the beads were made locally, and attests that many defective beads were found alongside completed beads and raw glass, as well as beads that have been interpreted as semi-products (Wiker 2003, 26). One might also note bead 1171, which was found with numerous other defective beads recovered in the Parliament Street excavation at York, and which Tweddle describes as a fragment "covered with a layer of silvery and pale brown iridescence" (Tweddle 1986, 221). Tweddle's description sounds very much like an attempt to produce one of the counterfeit foiled beads that were discussed previously. It is possible that these fragments were the unsuccessful products of novice glassworkers, or perhaps even beads that were damaged during the annealing process.

Other qualities that could imply the presence of inexperienced hands in the workshop are the size of the artefacts being made and the size of the tools used to create them, which could also be indicators of young novices in particular. While it is typically assumed that small artefacts and tools were developed by and for small hands, this is not necessarily the case (Wileman 2005, 59). As children often lack the fine motor skills necessary for manipulating very small objects and creating fine details, they are often given larger tools to work with (Wileman 2005, 59). Children will also often use more force than is necessary when handling these objects, especially when percussive force is needed (Wileman 2005, 59), which leaves distinctive tool marks on the artefacts that can be

detected by archaeologists. It is also important to consider that miniature tools might not necessarily have been intended for use at all. It is possible that the presence of miniature tools in Viking-Age child burials were intended to be symbolic of tasks that the children would have been expected to carry out later in life rather than artefacts that were used by the individual while they were alive (Mellor 2020, 103).

Conclusion

While there is still much work to be done in the examination of Viking-Age craft training, we can now say with confidence that it is possible to begin understanding the types of tasks that would have been assigned to novices of various crafting traditions and how they would have progressed through their training. By re-examining the archaeological record for traces of novice participation, we should begin to see more frequent traces of products that had been made by novice craftspeople and develop a better understanding of the dynamics of the Viking-Age workshop as it progressed throughout the Viking-Age. In doing so, we will begin to develop a richer and more inclusive interpretation of how these workshops functioned, and the role women and children played in the Viking-Age marketplace.

Appendix A

Craft Training Phenomena	Source of Analogy	Applicable Crafting Traditions	Potential Archaeological Indicators
Small children playing with cast-offs	(Rivero 2016, 95) (Adair 1945, 91)	Pottery, Antlerworking, Hornworking	Fragments of bone or pottery with unusual or atypical markings.
Sweeping the floor/cleaning the workshop	(Haase 1998, 110) (Larner 1965, 359, 361)	Pottery, Antlerworking, Hornworking, Glass beadmaking, Metalworking	Likely would not leave any evidence.
Working the bellows	(Pedersen 2015b, 57) (Pedersen 2016, 201 & 202)	Glass beadmaking, Metalworking	Likely would not leave any evidence.
Drawing	(Ellis 1902, 48) (Bimbenet-Privat 1995, 31) (Hannah 2004, 109)	Antlerworking, Metalworking	Bone, antler, or wooden fragments with poorly drawn images. Possibly also the presence of wax tablets.
Gathering raw materials	(Kamp 2001, 430) (Ashby 2013b, 21; Carpenter 2017) (Hoffman 2007, 4)	Pottery, Antlerworking, Hornworking, Glass beadmaking	Likely would not leave any evidence.
Processing raw materials	(Haase 1998, 111) (Kamp 2001, 430) (Wallaert-Pêtre 2001, 481) (Rafailă-Stan and Nuţu 2018, 146) (Ellis 1902, 48) (Yeomans,2008, 133) (Unwin 2018, 118) (Sode 1995, 105) (Adair 1945, 80-81, 85) (Hannah 2004, 109) (Pedersen 2016, 201 & 202)	Pottery, Antlerworking, Hornworking, Glass beadmaking, Metalworking	Poorly broken-down antlers with uneven cut lines, small fingerprints in clay deposits, broken glass rods, spilled lead.
Cleaning/polishing final product	(Ellis 1902, 50) (Doyle 1925, 79) (Doyle 1925, 26) (Kanungo 2004, 131-132, 142) (Larner 1965, 359) (Hellyer 2013, 95, 150-1)	Pottery, Antlerworking, Hornworking, Glass beadmaking, Metalworking	Likely would not leave any evidence.
Gathering firewood	(Mellor 2020, 105-106)	Pottery, Hornworking, Glass beadmaking, Metalworking	Likely would not leave any evidence, though there may be mentions in legal documents.

Stanley 136.)

Appendix A

Assisting older craftspeople	(Hoffman 2007, 6) (Adair 1945, 85-86)	Pottery, Antlerworking, Hornworking, Glass beadmaking, Metalworking	Likely would not leave any evidence.
Making crucibles	(Kanungo 2004, 139) (Hoffman 2007, 5) (Pedersen 2016, 202)	Glass beadmaking, Metalworking	Crucibles with small openings or fingerprints.
Mind or train other children	(Kamp 2001b, 14) (Haase 1998, 109)	Pottery, Antlerworking, Hornworking, Glass beadmaking, Metalworking	Likely would not leave any evidence.
Practice making objects on their own	(Kamp 2001, 430) (Haase 1998, 110) (Ellis 1902, 48) (Rivero 2016, 95) (Adair 1945, 91)	Pottery, Antlerworking	Poorly made objects, uneven lines, unusual designs or motifs, overly large or small objects.
Fire pots	(Kamp 2001, 430)	Pottery	Smaller pots with irregular shapes.
Carrying and fetching	(Larner 1965, 359, 361)	Pottery, Antlerworking, Hornworking, Glass beadmaking, Metalworking	Likely would not leave any evidence.
Interacting with customers	(Hannah 2004, 110) (Goddard 2013, 166)	Pottery, Antlerworking, Hornworking, Glass beadmaking, Metalworking	Likely would not leave any evidence.

Stanley 137.)

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