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The Production of Military Equipment – Fabricae, Private Production and More

Panel 9.1

Stefanie Hoss (Ed.)

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PREFACE

On behalf of the 'Associazione Internazionale di Archeologia Classica (AIAC)' the 19th International Congress for Classical Archaeology took place in Cologne and Bonn from 22 to 26 May 2018. It was jointly organized by the two Archaeological Institutes of the Universities of Cologne and Bonn, and the primary theme of the congress was 'Archaeology and Economy in the Ancient World'. In fact, economic aspects permeate all areas of public and private life in ancient societies, whether in urban development, religion, art, housing, or in death.

Research on ancient economies has long played a significant role in ancient history. Increasingly in the last decades, awareness has grown in archaeology that the material culture of ancient societies offers excellent opportunities for studying the structure, performance, and dynamics of ancient economic systems and economic processes. Therefore, the main objective of this congress was to understand economy as a central element of classical societies and to analyze its interaction with ecological, political, social, religious, and cultural factors. The theme of the congress was addressed to all disciplines that deal with the Greco-Roman civilization and their neighbouring cultures from the Aegean Bronze Age to the end of Late Antiquity.

The participation of more than 1.200 scholars from more than 40 countries demonstrates the great response to the topic of the congress. Altogether, more than 900 papers in 128 panels were presented, as were more than 110 posters. The publication of the congress is in two stages: larger panels are initially presented as independent volumes, such as this publication. Finally, at the end of the editing process, all contributions will be published in a joint conference volume.

We would like to take this opportunity to thank all participants and helpers of the congress who made it such a great success. Its realization would not have been possible without the generous support of many institutions, whom we would like to thank once again: the Universities of Bonn and Cologne, the Archaeological Society of Cologne, the Archaeology Foundation of Cologne, the Gerda Henkel Foundation, the Fritz Thyssen Foundation, the Sal. Oppenheim Foundation, the German Research Foundation (DFG), the German Academic Exchange Service (DAAD), the Romano-Germanic Museum Cologne and the LVR-LandesMuseum Bonn. Finally, our thanks go to all colleagues and panel organizers who were involved in the editing and printing process.

Bonn/Cologne, in August 2019

Martin Bentz & Michael Heinzelmann

The Production of Military Equipment: an Introduction and Overview

Stefanie Hoss

Research on the production of Roman military equipment has advanced much less in the last thirty years than one would have thought considering the number of new finds made and new research methods developed during that period. This is especially the case when compared to the advances made in the research on civilian production in the same time.[1]

In the last decades, archaeological research on production for the military was largely devoted to the production of food, centring on grain and meat. Here, large advances have been made, especially in Britain, the Netherlands and Switzerland.[2] The study of the archaeological evidence for the production by the military has often concentrated on the large-scale production of tiles.[3] And while several aspects of the production of military equipment have been addressed since the seminal 1993 and 2006 works by Bishop and Coulston, a thorough investigation into this subject remains a lacuna.[4] One of the difficulties of such an endeavour is the large scope in time and space that it covers – at least four centuries and a number of regions in varying stages of economic development, and with different traditions in and conditions for the production of weapons and armour. Another difficulty is the great number and high diversity of the sources, which encompass literary, epigraphic and more *ad hoc* written sources, archaeological findings (such as workplaces and *fabricae*) and the actual objects, that is weapons, armour and other military equipment.

This paper will not present the results of new research – that is left to the other papers in this session. The concern here is more about the *status quaestionis* and defining what we don't know – even though we think we know it.

With the *Notitia Dignitatum* and a number of literary sources – among them the works of Vegetius – the written sources on military production are most comprehensive for Late Antiquity.[5] The *Notitia Dignitatum* (AD 390/420) is a compilation of information about the structure of the late Roman army in the East and West. Among other things, it lists a number of arms *fabricae* in the Eastern and Western Empire, some of them specializing in particular items (shields, spears, mail, etc.).[6] Vegetius, the most prolific of the Late Antique writers on military matters, claims in his *Epitoma rei militaris* (II, 11), that the legions were 'always' self-sufficient in their production of military equipment. This has been held to mean that the production always had been entirely in the hands of the military or the state during the Empire. However, according to James, while the sources do indeed indicate a planned system of centralized state arms factories, this was only implemented after Diocletian had reorganised the provinces; and continued to develop under the Tetrarchy.[7] It seems plausible that some of these state factories were situated in specific cities because of the existence of earlier legionary production centres

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for arms (*fabricae*, see below) there or because they had been arms production centres since before the Roman conquest.[8] This would ensure that the necessary craftsmen were available and that the raw material supply networks were already in place.

We have to be careful, however, to assume that the same circumstances to have applied earlier. Like other historical sources, the *Notitia Dignitatum* and the other literary sources are representative only of their own period.

Moreover, a certain 'practical uniformity' was necessary in the army, for instance in the size of the shields that would form the famous legionary shield 'wall' or in the average length of a sword (both within a certain tolerance).However, it would also be mistaken to think that it was an aim in itself to equip soldiers in a uniform manner before the advance of guns made it necessary in the modern period. During the Roman period, uniformity was both impossible for practical reasons of logistics and production as well as counterproductive: soldiers wished to be identifiable in battle, in order to be noticed when performing daring actions and thus be able to reap the rewards for them in the form of honours and promotions.[9] This was only possible if they wore arms and armour at least slightly different from each other and recognizable to their peers.

In order to determine who produced military equipment, it is helpful to look at the ownership of the various items. There is much evidence, most of it from papyri, that points towards the soldiers owning at least part of their equipment. Among these papyri is a loan agreement, offering unspecified "weapons" as a security against the quite substantial loan of 50 denarii.[10] These weapons must have been owned by the person asking for the loan, or it would have been impossible to use them as a security. We can also find hints about soldiers owning their weapons in the literary sources: during the revolt of Vitellius in Germany, Tacitus mentions that the usurper had the soldiers collect money to finance his campaign. As some soldiers had not enough ready money with them, they gave their belts decorated with phalerae, their decorations and their silvered armour in the place of money "*loco pecuniae tradebant*".[11] This would hardly have been possible if they had not owned their belts. In a similar vein, the finds of weapons and armour in temples and graves also are proof that these weapons must have been owned by those dedicating them.[12]

Further proof can be found in the many inscriptions of ownership we can find on armour.[13] Some of them, mainly helmets, carry several inscriptions. Up to five inscriptions of different owners are known from horsemen's helmets, proof of the longevity of helmets of horsemen, who seem to rarely have suffered hits to the head. However, these inscriptions are also proof of the practice of re-selling functioning equipment – either when the soldier left the army or when he upgraded his equipment.[14] We can thus conclude that is seems likely that the soldiers owned at least some of their equipment.

Herz organises military equipment into two groups according to ownership:[15]

(a) items that could not be allocated to an individual soldier, such as the large-scale equipment (*ballista*, wagons and carts, etc.) and the missiles (arrows, javelins and *pila*),

which were used in such large amounts that they also were not personalized – these were owned by the larger units (*cohortes*, *alae* and legions)

(b) equipment personally owned by the soldiers, such as the weapons and armour, entrenching tools (*dolabrae*, turf cutters, etc.) and a share of the tent of the *contubernium*.[16] In addition to that, the eight soldiers of a *contubernium* seem to have shared a hand mill and probably several cooking pots, just as the mule to carry it all and perhaps also the slave to take care of the mule and the baggage, all of which was probably paid from a shared kitty.[17]

While one reason for the personal ownership of these items certainly was the expectation that the soldiers would take better care of items paid for by themselves, another reason may well have been that many of these items (the sword, helmet, armour and belt) also had to conform at least roughly to the individual soldier's body. The armour was worn with a padded under-tunic and the helmet with a padded cap; while these offered possibilities of some adjustment if the armour or helmet were slightly too big or small, this was curtailed by practicability: too much padding hindered the ability to move quickly while too little would not protect against the blunt trauma that also came with a hit by a sword or other weapon. The belt could of course easily be adjusted with the help of further holes in the strap, but the sword needed to have a length and heft that suited the strength of the soldier and the length of his arm.

Some Egyptian papyri seem to indicate that cavalry soldiers even personally owned their horses and horse gear.[18] This probably is the reason why cavalry soldiers were paid so much better than infantry soldiers: they had extra expenses, having to buy and maintain several horses plus their gear. Much of this was paid for by deductions from the soldier's pay, as we know from pay-lists, which have mainly survived in Egypt and neighbouring regions.[19]

Rather surprisingly, it seems that shields were not among the equipment owned by the individual soldiers, as shield covers bear inscriptions that indicate their being owned by the unit – the legion or the cohort.[20]

So, what we have here is a very mixed bag: some elements of the equipment are owned by the individual soldier, some by the *contubernium* and some by the cohort or legion.

It is very likely that the production of these various items was just as mixed as their ownership. We have to consider the size of the army and the variability of the territories across which it was spread out – both in terms of the development of surplus production and in the availability of craftsmen.

In the Mediterranean, the Roman army could rely on an accessible system of production and an existing network of trade for the raw materials already present in the different *poleis*. Here, both craftsmen and a surplus production to feed them were available.

But as soon as the army ventured away from the densely populated areas of the Mediterranean littoral, these conditions changed. While all of the regions north of the Alps were far less able to produce surplus than the societies of the Mediterranean, some regions within North-Western Europe had a more developed economy that produced *oppida*, settlements often described as 'proto-urban centres'. While the concept behind this description of *oppida* is difficult in itself, one can at least state that the surrounding regions were able to produce enough surplus to feed these and other settlements, as well as support the craft production within them.[21] This is far from true for other regions, which offer little evidence of an economy that would have been able to sustain large amounts of craftsmen. And although much of the surviving Hallstatt and LaTène metalwork was of a brilliant quality, it seems that this was reserved for a small number of important men and thus was not produced on a mass scale.

Consequently, in large parts of the Balkans and north of the Alps, the Roman army was completely reliant on its own craftsmen and supplies, at least initially. Archaeological evidence of this self-sufficient production in the early military settlements can be found in the melting ovens discovered at Dangstetten's mixed camp from between 15 and 9 BC, for instance.[22] Other finds that prove production are crucibles, semi-finished products, and bonze scrap collected for re-melting, such as were found at Magdalensberg in Austria from roughly the same period.[23] Here, evidence for the production of helmets, *lorica segmentata* and the decorations for the scabbards of sword and daggers, as well as military belts were found.

Another consideration is the difference in the products: the production of a shield is much different from that of a sword belt and that again differs from the production of the sword itself.

As we have seen, it seems that this is also reflected in their ownership. The production of shields involves a complicated laminating process requiring a lot of time and space and probably quite a number of skilled and unskilled labour.[24] But to be effective, especially the *scuta* have to be roughly the same size, as they are deployed in a long unbroken line at battle. It would thus make sense to produce the shields in great numbers by the unit that used them, the legion.

The swords however – while no less difficult to make – are much less standardized, as they have to fit the owners arm length and muscle power. So these were probably made to order, if the soldier could afford it at all. If not, he could choose one from the legion's stock of swords sold to them by retiring soldiers or the heirs of soldiers killed in action, as proven by a papyrus from Egypt.[25] It seems likely that each unit would have had enough different swords to accommodate most recruits. This would also apply for the swords made in the large *fabricae* attached to each legion's winter headquarters (see below).

It seems likely that the decorative parts of the equipment, such as the belt mounts, sword scabbard decorations, decorated cheek-pieces for the helmets, and perhaps also the more decorated helmets themselves were made in private workshops. The

decorations on them were chosen by the future owners and must have reflected their personal tastes (even if that taste was influenced by their peers).[26]

Accordingly, when we look at the production sites, we find several possibilities. Because of the Late Antique sources named at the beginning, the famous *fabricae* are often seen as the only source of military equipment. But the mere word is already a problem: do we really mean the workshops found in forts and legionary fortresses? The buildings often named as such are within the walls of forts and legionary fortresses and have such widely differing sizes and forms that one is left with the impression that any building without another obvious function is named a '*fabrica*' by the excavators, regardless of whether or not there is any true evidence for metalworking.

The examples deemed more plausible have large interior courtyards with aisled halls or a number of smaller rooms situated around it.[27] But even with those, evidence of metalworking such as ovens, timber-lined pits and troughs, and finds of crucibles, semi-finished products and bronze scrap is often quite thin on the ground, with the legionary fortress of Inchtuthil and the forts of Exeter and Oberstimm being among the notable exceptions.[28] And even in Inchtuthil, under the almost ideal circumstances of a wooden building with a short occupation period, just a single furnace and a single timber-lined pit were discovered.[29] Considering the thousands of soldiers on the site for several years (between three and five years), this seems to be more consistent with repair than mass-fabrication. Even if these buildings seem big – and many of them are – their size and the many smaller rooms seem to point towards the storage and repair of equipment and perhaps the production of assorted missiles: javelins, spears, arrows, and ballista bolts do not require large amounts of space to produce and were used in large amounts. The regular production of large amounts of the more complicated items such a shields, armour or swords, would have needed quite a lot of ovens and working stations; this seems to me to be beyond the capacities of these buildings.

But perhaps, *fabricae* means something else entirely, namely production sites on an almost industrial scale often situated in the hinterland of the garrison. Excavated examples are the production site of the *legio* Prima Minerva at the Bonner Berg, or the Sheepen site less than a kilometre from Camulodunum.[30] These sites have produced a large amount of scraps and other remains of workshops indicating that here, arms and armour were produced in very large amounts.

A similar site is possibly alluded to in a papyrus held in Berlin and dating from the 2nd or 3rd century AD.[31] It contains a list of products finished and men deployed during a two-day period in a *fabrica*, possibly belonging to the *legio* Secunda Traiana Fortis, stationed in Egypt at that time. For a single day, 100 workers are listed, in four groups: *Immunes* – soldiers exempt from fatigues because of their expertise, *Cohortales* – usually interpreted as normal soldiers, *Galliari* – interpreted as slaves, and *Pagani* – probably free men, whose connection to the army is open to interpretation: they may have been paid workers, day labourers, or indentured servants.[32]

The list of products contains *spathae*, two kinds of shields, iron plates, bows, and torsion springs for catapults. Another interesting fact is that the list makes a difference between '*fabricatus*' a product and '*peractus*' an article just "finished" at the site, probably from pre-produced elements, for instance a wooden laminated shield being fitted with a shield boss or a sword with a hilt.[33]

At least one writing tablet from Vindolanda seems to indicate similar arrangements in place, as it lists men by century and their employment as *scutarii* and *gladiarii*.[34] In Vindonissa, a writing tablet and a dedication also name a *scutarius* and a *gladiarius*.[35]

In addition to this state production, the excavations demonstrate that we have private workshops of all sizes clustered around the garrisons of the cohorts and legions and also situated in the larger cities. We also must not forget that private citizens were allowed to own weapons as well. From the 2nd century AD onwards, evidence becomes overwhelming for the production of military equipment in the cities and towns next to the fortresses and forts – the *canabae legionis* and military *vici*. But whether this production was civilian or military in character is not quite clear. It seems likely that veterans, who had settled near their old units in the *canabae* and *vici*, kept practicing the trades learned in the army. [36] But it is open to debate whether their workshops were truly private or only 'outsourced' from the fort or fortress, in order to reduce the risk of fire. It is quite possible that these craftsmen were partly under contract for the army, but could also accept private commissions.[37]

The existence of private workshops has only been systematically looked into for the province of Raetia.[38] Here, the moulds for bronze mounts for belts and horse gear excavated in several military *vici* and *canabae* demonstrate that items belonging to military equipment were made by private workshops. Private workshops can also be recognised through manufacturer's stamps on some military equipment, for instance on the hilt of a dagger found in Oberammergau in Germany (C. ANTONIVS FECIT).[39] In the Mediterranean basin, private workshops seem to have continued to play a major role in the production of military equipment until the Tetrarchy, both for civilians and soldiers.

Wars with a major loss of life also meant a major loss of equipment, as the enemy tended to strip the dead or dying Roman soldiers of their equipment to either use it or the materials.[40] After a larger armed conflict, the legions and auxiliary units not only had to be filled up with new recruits; large amounts of new equipment were necessary as well. During the Principate, this may have been the time for large orders from private workshops. But in Late Antiquity, the armies were defeated in a fairly rapid succession and the various units had to be quickly re-filled with recruits and re-equipped with arms and armour. This may have been at least one reason for the institution of the large state *fabricae* whose locations are listed in the *Notitia Dignitatum*. Another reason could have been the rampant inflation, which made it impossible for soldiers to pay for their arms and would have made private armourers turn to other products; this move could be intercepted by the Emperor by turning the armourers into members of the imperial service.[41]

To conclude this short overview of the production of military equipment, we can certainly state that this subject is much more complicated than often thought. From what we can see now, there are no grand strategies in production and supply, but rather a mix-and-match approach, in which we have a combination of private enterprise and state production. The proportion of each part in the total production varies according to the circumstances, from almost complete state production when the army ventures into territories without ample production possibilities to large amounts of private production whenever possible. This approach only changes with Diocletian, who, through changed circumstances, was forced to heavily invest into a much larger amount of state production. However, even that did not completely exclude private production, but must have reduced it to the production of luxury items for the wealthier classes in the army.

Notes

[1] A first overview was given by the contributions in Bishop 1985, followed by chapters in Bishop – Coulston 1993 and 2006. See also Herz 2010. For research on civilian production, see for instance the books published in the framework of the Oxford Roman Economy Project <http://www.romaneconomy.ox.ac.uk/> (18.08.2020).

[2] See Groot et al. 2009; Groot – Deschler-Erb 2017; Stallibras 2009, the contributions in Stallibras – Parker 2008 and Vandorpe et al. 2017.

[3] See for instance Dolata 2000.

[4] Seminal works: Bishop – Coulston 1993 and 2006. Examples of studies in partial fields are Gschwind 1997; van Driel-Murrray 2002; Armstrong 2017.

[5] James 1988, 259–260.

[6] N.D. Or. IX, 18–39, Oc. IX, 16–39, see James 1988; Bishop – Coulston 2006, 238–239; Fischer 2012, 81–82.

[7] James 1988, 265–266.

[8] James 1988, 266. 268–269.

[9] Hoss 2016, 115–116; Hoss 2017.

[10] P Fuad 45 (= CPL 189, Cairo, Egyptian Museum JdE 72083). See the Online Database Trismegistos Nr. 20991 <http://www.trismegistos.org/text/20991> (18.08.2020).

[11] Tacitus, Hist. I, 57.

[12] Breeze et al. 1976. For weapons in temples, see for instance van Driel Murray 1994 and Bödecker 2010. For finds of *militaria* in graves see Mackensen 1987, 158–159 and the relevant contributions in Sanader 2013.

[13] Pfahl 2012, 72–77.

[14] Breeze et al. 1976, 93; Nicolay 2007, 166–171; Rathbone 2007, 163. 168.

[15] Herz 2010, 111–112.

[16] Herz 2010, 111–112.

[17] Indicated for the mills at least by an inscription on a handmill from the Saalburg, which reads "CON(tubernium) BRITTONIS", see CIL XIII 11954a and Junkelmann 1997, 117 fig. 58.

[18] Letters documenting the inspection of future cavalry horses for specific horsemen, see Stauner 2004, 40–43.
[19] For instance P.Hamb. I 39=RMR 76, listing pay deductions for horses' hay; see Alston 1995, 97 and Brunt 1950, 60–61. Another document lists amounts of barley (for the horses) and wheat (for the men) given to the 10 *turmae* of the *ala Gallorum Sebosiana*, see Stauner 2004, 52–53.
[20] Van Driel-Murray 1988, 53; Nabbefeld 2008, 54.
[21] Woolf 1993; Moore 2017.
[22] Oldenstein 1977, 74.
[23] Oldenstein 1977, 71–73; Bishop/Coulston 2006, 234.
[24] Nabbefeld 2008, 27–29.
[25] Phang 2001, 187.
[26] Hoss 2014, 54–56. 292–315.
[27] Reddé et al. 2006, 116–119.
[28] Inchtuthil: Pitts – St. Joseph 1985, 105–115; Exeter: Bidwell 1980, 31–35; Oberstimm: Schönberger 1978, 30–57.
[29] Pitts – St. Joseph 1985, 105–115.
[30] Bonn: Driel-Murray – Gechter 1984; Sheepen: Niblett 1985.
[31] Papyrus Berlin 6765, see <http://berlpap.smb.museum/11833/> (18.08.2020) and Herz 2010, 121–122.
[32] Bishop 1985, 3; Herz 2010, 122–123.
[33] Bishop 1985, 3.
[34] Vindolanda Tablet 160 [see <http://vindolanda.csad.ox.ac.uk> (18.08.202)] Vindolanda Inventory No. 82i; Bishop 1985, 3.
[35] Bishop 1985, 5.
[36] Van Driel-Murray 2002, 111–113.
[37] Van Driel-Murray 2002, 111.
[38] Gschwind 1997
[39] Scott 1985, 177. 197.
[40] Deschler-Erb 2000, 389. – Fischer 2012, 76.
[41] James 1988, 269–271.

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The Tools of Production: A Case Study of the Metal Tools Used for Leather- and Metalworking in Albaniana, The Netherlands.

Leida van Hees

Introduction

When considering the production of military equipment such as armour and weapons, one might think of *fabricae,* large scale production, or maybe of a local blacksmith crafting a sword for a young soldier setting off to war, paid for with the family savings. Soon the thoughts may turn to the armies stationed in *castella*, fighting local enemies in remote locations, and in constant need of maintenance, repairs and new equipment. Could these armies repair and produce the equipment they needed themselves? Or did they have to depend on the import of these products, with the added risk of it being too slow in times of crisis? This paper looks at these questions with the help of the tools of this production.

Military equipment consists mainly of leather, metal, and textile items. These are materials generally worked by a trained artisan with a specific toolset. In order for these armies to produce these items they must have had artisans and their tools at their *castella*. Tools can be very versatile however, a blacksmith usually has a good set of hammers, but so would a stonemason as well as a carpenter. Luckily a tool is tailored to its task. The hammers used by carpenters generally look different from those used by stonemasons, which look different again from those used by blacksmiths. This means that understanding the tools and their exact types and shapes found at a site can give great insights into the artisans that used to work there.

A small *castellum* in the west of The Netherlands, named Albaniana, is located in the modern town of Alphen aan den Rijn, and it is perfect for the purpose of understanding the production of military equipment at *castella*. This fort was part of a series of small forts guarding the river Rhine. What is special about it is the sheer amount of metal finds excavated here, among them many tools; the wet environment is great for the conservation of metal. Figure 1 shows a metal tool from the site that has a working edge still sharp enough to be used, which is not uncommon for the site, although rust has not been kind to all objects. The fort was excavated during two expeditions (1998–1999 and 2001–2002), although part of the site could not be excavated. The material from this last part originated mostly from the riverbank and was discarded near the city. These finds were recovered by metal detectorists and published in the book 'Gered uit de Grond' (*Rescued from the ground*).[1] Although their exact provenance could no longer be determined, they must have come from the *castellum* or its surrounding *vicus*. In total, 218 Roman metal tools were recovered from Alphen aan den Rijn, when we combine those from excavations and those from 'Gered uit de Grond'.

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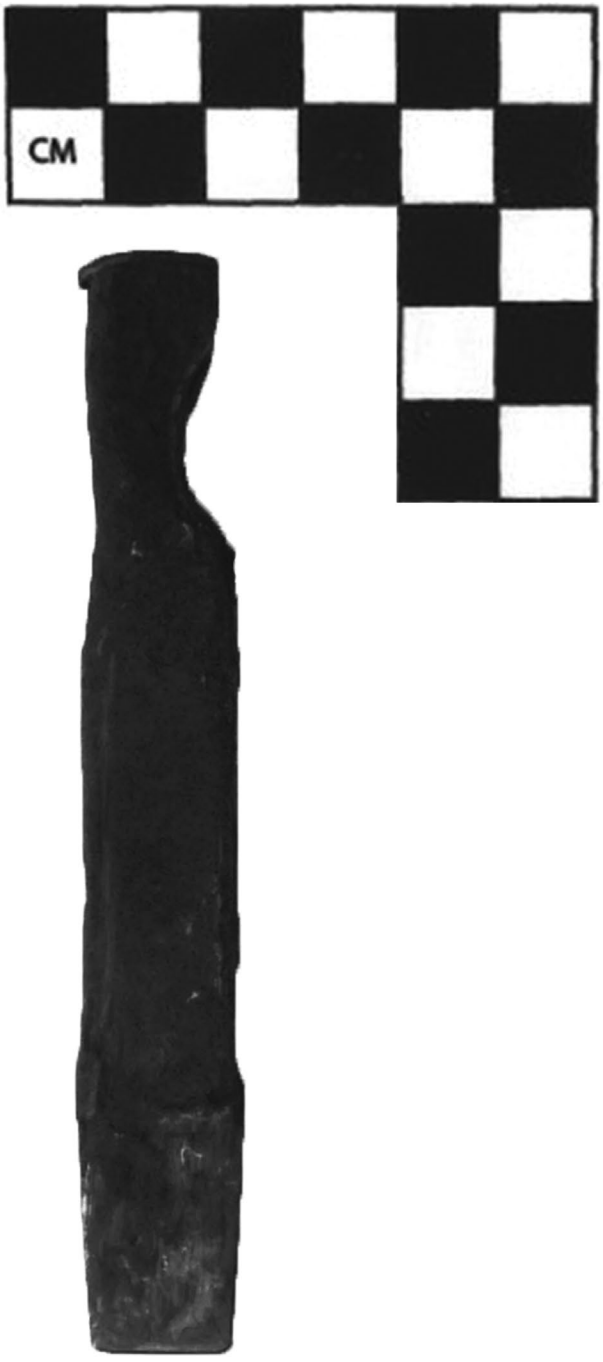

Fig. 1: A well preserved chisel (C58) for metal working found at Albaniana.

This paper builds upon the MA thesis of the author, which compared all metal tools from all crafts in Albaniana to finds from thirteen other *Limes castella* in The Netherlands, Germany, and Britain.[2] Accordingly, the catalogue numbers given in this paper refer to

the catalogue presented in the thesis, which can be consulted online. Numbers starting with a "C" are tools found during the excavations, and descriptions as well as pictures of these finds can be found in the thesis mentioned above. Numbers starting with a "G" refer to finds recorded in the book 'Gered uit de Grond' and include a chapter number for easy reference: a description of these finds can also be found in the thesis.

If the soldiers stationed at Albaniana were producing military equipment, there should be tools used for this purpose among these finds. As mentioned above, the equipment consisted mostly of metal (iron and copper alloys, simply referred to as bronze throughout this paper) leather, and textile items. Sadly however, the production of textiles is virtually invisible when focussing on metal tools. Needles (made of metal or other materials such as bone) were essential in the production process of textile and a few metal ones have been recovered from Albaniana, but most tools used for textiles were made from other materials. One cannot suitably consider textile production without incorporating tools such as the weights used for spinning and weaving. As the MA thesis was restricted to metal tools, tools made from other materials were not incorporated and consequently cannot be discussed here. This is the main reason that this paper will focus on the tools used for leather- and metalworking.

The Tools of Albaniana

Of the 218 metal tools found at Albaniana, 23 can be assigned to leatherworking and 4 can be assigned to the production of metal objects. These assignments are based on tool types described by Manning and Gaitzsch.[3]

Leatherworking

Most leatherworking tools are interpreted as awls (19), although some punches (3), a lunette's knife, and a bone skin scraper were also found. The lunette's knife (G10.36) is 6,9 by 4,7 cm long. Its small size may partially be due to corrosion, however, as it has maintained most of its crescent shape, it is likely that this tool had a rather long use life, and was worn down by sharpening. A similar knife to this one was found in Pompeii.

Three punches (C31, C36, C38) were used to create decorative patterns in leather, while the 19 awls were used to puncture the leather. Some of the tools interpreted as awls may in fact have been punches – the distinction lies in the tip, which is sensitive to corrosion. Two awls are of Manning type 2 (G10.25–6), five are of type 3 (C29–30, C32, G10.30, G10.34), three are of type 4 (C34, G10.33, G10.35), and one is of type 5 (C33). The other eight (C35, C37, C39, G10.27–9, G10.31–2) cannot be assigned to a certain type. The different types of awls have parallels at multiple sites in Austria as well as in Britain and Germany. Notable is the fact that both C34 and G10.35 of type 4 have the same type of round, bone handle with incised lines perpendicular to the longitudinal direction. Similar scratches have also been found on the wooden handles of two parallels from

Fig. 2: Detail of the teeth of the metal working file (C15).

Britain. The lines are too uniform in the same direction to be caused by use, yet are too irregular to be decorations, perhaps they were incised into the handles to create a better grip. The two thicker needles found at the site may also have been used for leather (C77–8). However, this cannot be known for sure, except perhaps through use-wear analysis, as they could also have been used for thick textiles. A skin scraper made from bone was also found.

Metalworking

The four metal tools for metalworking are a pair of tongs, a file, and two chisels (C58, C65). The pair of tongs (G10.1) is 30 cm long and thus falls into the larger category (ca. 25–65 cm). These must have been used for larger pieces and for putting pieces of metal in and out of the fire. Generally, smaller pairs of tongs (< 20 cm) are used for the finest work.[4] The tongs from Albaniana are on the smaller side of the large category. This means that although they were not used for the finest of work, they also were not heavy-duty tongs. Their size might mean they were used mostly to create iron objects, as bronze objects tended to be smaller. Extraordinary are the bent legs of the tongs. This seems to be an original feature of the tongs as the legs are bent very similarly and in a very fluent line. No example from known literature has bent legs like these; they were all either straight or mangled. Similar shapes of the beak and hinge are known from Britain and Pompeii.

Files were used for both metals and wood. There are many different known types, such as flat, half-round, square, and triangular files. It is not always clear for which craft a file was used, but the square file of Alphen aan den Rijn (C15) has teeth that are very close together (fig. 2). This indicates that the file was used for metal, not wood. The file likely has parallels in Vindolanda, Britain, but the file is so corroded along most of its length that the original shape is impossible to determine.

In addition to these metal tools, a fragment of a crucible was also found.

The Craftsmen of Albaniana

Leather

The finds of tools show that leather was worked. The awl is the most commonly found tool, which is not surprising, as a leatherworker often uses a large array of awls of different shapes and sizes. The bone skin scraper shows that fresh hides were cleaned of dirt/hair at Albaniana. There is no evidence for the actual tanning of the leather, which may mean that the hides were transported to another location to be tanned after they had been cleaned (which keeps them from rotting). This fits very well in the model constructed by Van Driel-Murray in 1985.[5] She supposed that hides were not tanned at Roman *castella* but were instead cleaned to diminish the effects of rot and then sent to specialised tanneries in central locations. The model was based on a few sites only, but the evidence found at multiple sites investigated since then support this model, as does the evidence found at Alphen aan den Rijn.[6] Together the tools are proof of the presence of one or several trained leatherworkers. As the conservation circumstances of the site are remarkable, some leatherworking waste was also found. This waste indicates repair work on military equipment and small-scale production of shoes.[7]

Metal

Although the crucible fragment and the metal tools show that metal was being worked at Albaniana, they do not show which metals were worked. However, additional evidence gives insight into this, which will be discussed below per type of metal.

Only a few objects made from gold or silver are known from Alphen.[8] The near absence of these objects suggests they were not locally produced; out of a total of 3675 metal finds (not counting coins) from the 2001–2002 excavations, only two were made from silver and none were made from gold.[9] This is consistent with the type of metalworking tools found. They are not of the smaller types associated with the working of delicate pieces, which silver and gold objects tend to be. It can therefore be assumed that these metals were not worked in Alphen, which is consistent with evidence found at other *Limes castella*.[10] As the working of lead does not require the use of specialist tools, the metal tools found must have been used to work either bronze or iron, or both.

Many objects of iron and bronze were found at the site. However, the objects themselves are not evidence for their local production. Bronze production is evidenced by finds of semi-finished decorative nails, a semi-finished pendant and two semi-finished unknown objects, as well as over sixty pieces of bronze casting waste (such as bronze drops) and bronze repair fragments. A concentration of these pieces of evidence for bronze production was found in the right *retentura* of the *castellum*. This is the part of the *castellum* where a *fabrica* is thought to have stood.[11] Evidence for bronze production has also been found at a fair number of other *Limes castella*.

The production of iron is evidenced by semi-finished nails, as well as by repaired fragments of iron. At multiple locations within the *castellum* and its surrounding *vicus*, iron slag was found. In the *castellum* alone 480 pieces of slag were found, mainly in the supposed *fabrica* and in the river. All this slag is forging waste: it was not produced by melting iron from ores but by forging iron.[12] This means that iron is unlikely to have been extracted from ores locally. The presence of forging slag is not direct evidence for the forging of iron at a site, because iron slag has special physical and chemical properties, such as the capacity to absorb water. This makes it very suitable for road construction, and the roads become sturdy as well as dry. The Romans already used iron slag for this purpose and it is still used in some countries today.[13] Slag was often moved from its original location for this purpose, which therefore means that iron slag is not direct evidence for local forging of iron. Excavations in Alphen also unearthed fragments of clay-forging hearths. In contrast to slag, these fragments are very unlikely to have been moved far. These finds, combined with the other evidence means it is likely that (at least part of) the slag from Albaniana was also produced there. It seems therefore that the inhabitants regularly repaired and produced both bronze and iron objects. Clues for iron working have also been found at a significant part of other *Limes castella*.

Crafting Locations

The *castellum* existed through three periods, each with different building phases. Period 1 consists of the wood building period of the mid first century A.D.; Period 2 comprises the wood building period after 70 A.D., and period 3 is the stone building period of the late second century A.D. Most of the datable features and finds come from the first two periods. Only little is known of the third period, as these features have been almost completely erased by later habitation.[14] Figure 3 shows a map of Albaniana including interpretations of its features and structures. The structures in green are a *horeum* (grain storage), a supposed *fabrica* (workshop), and a barrack zone (barakken) with two or three barracks. The excavated bank of the river Rhine (Rijnoever) has also been indicated in green, as the bank continues in the southern and northern directions.

The supposed *fabrica* has been recognised by hearths and metal working waste from period 1, although an alternative interpretation as a barracks is also given. The locations may have kept their functions throughout the second period, but evidence from the third period is too scarce to draw conclusions.

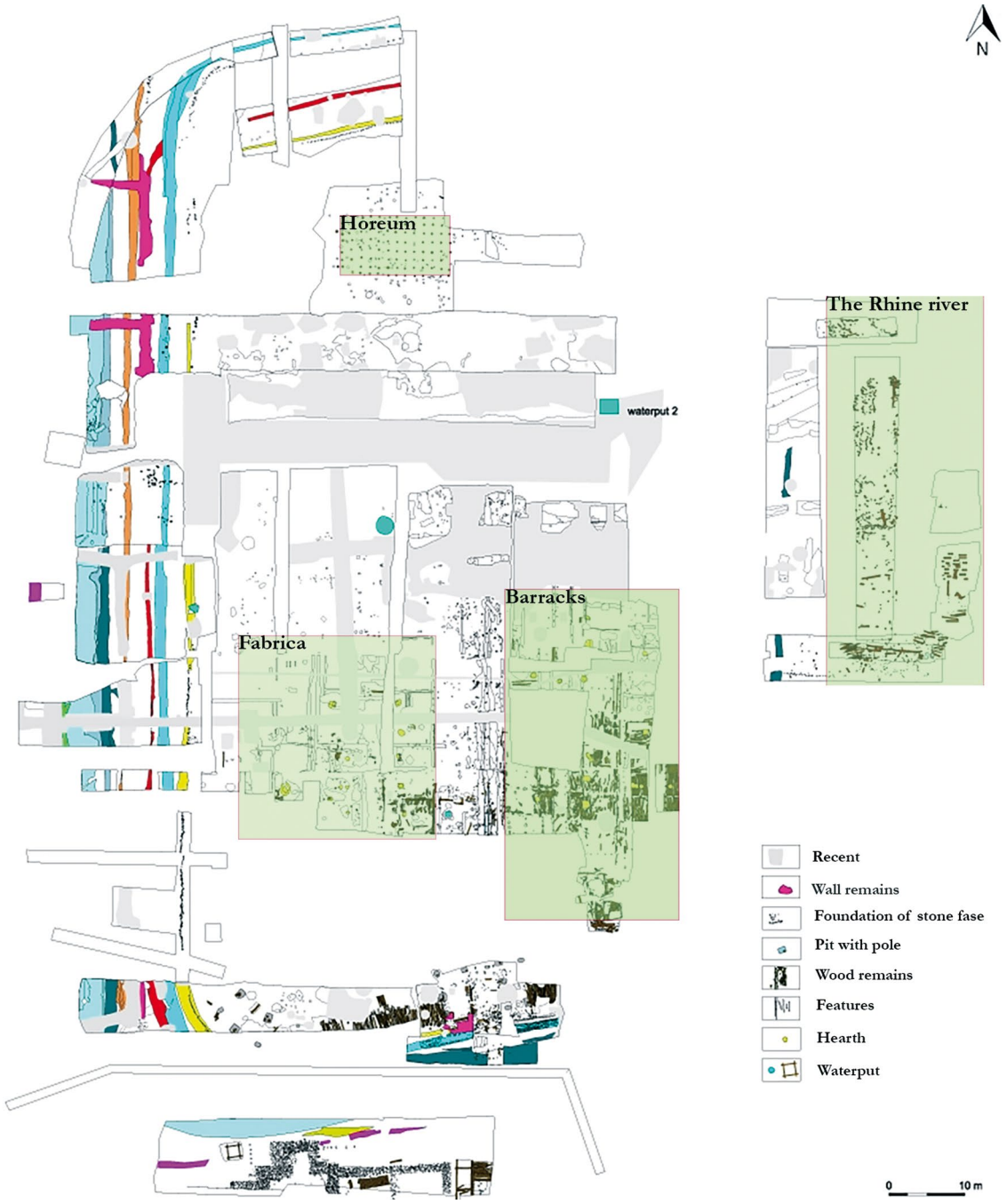

Fig. 3: Excavation map of the *castellum* Albaniana, including interpretation of the features.

Figure 4 shows the distribution of all 218 metal tools (not just those for leather and metalworking) per excavation pit from the excavations of 1998–1999 and 2001–2002. These are the same pits as in figure 3, with the addition of a pit underneath the current

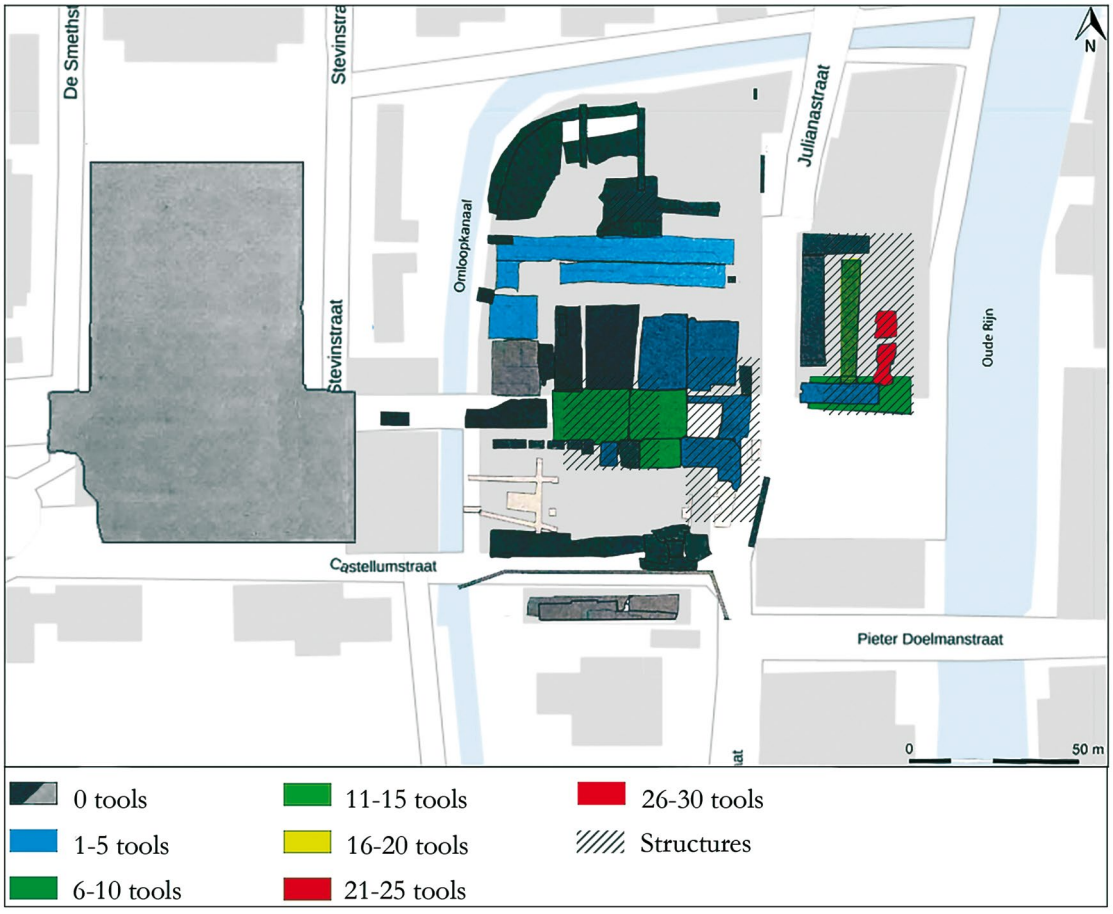

Fig. 4: Known distribution of tools per excavation pit. Lighter pits are from the 1998–1999 excavations, darker ones from the 2001–2002 excavations. The two red planes together form one pit.

city hall. The structures (green in figure 3) are indicated with shading. The tools from 'Gered uit de Grond' have been excluded, as their exact provenance is unknown. Immediately noticeable is the number of finds recovered from the western bank of the river Rhine. In some cases, these may have been lost during use, such as fishhooks and boat hooks, but this cannot be the case for most tools. They are likely to have been dumped in the river with other waste as part of repair work on the riverbank. A second concentration of tools is located near the supposed *fabrica*, the rest was found spread throughout the *castellum*.

Metal and leatherworking tools specifically were found in the river as well as near the *fabrica*. The metal file was found in a feature that also held bronze working waste in Zone "J", which was rich in iron working waste as well, leading to the assumption that this zone was used as a metalworking location. Large amounts of iron slag and

fragments of hearths were also found to the south in the *vicus*. Perhaps the location for metalworking was moved outside of the *castellum* at a certain point, or they tended to dump their waste there.

Thanks to Julia Chorus, a few of the tools could be dated with the help of the other finds in the feature in which they had been excavated. Three of those tools were used for metal or leatherworking. One of the chisels as well as an awl could be dated to the first period. A second awl could be dated to the second period, but none of the metal or leatherworking tools could be dated to the third period. However, there are barely any features that could be dated to the third period to start with. The dating of these tools (and the dating of tools from other crafts) does suggest that the *fabrica* was indeed situated where the excavators concluded it may have been, at least in the first two periods; it also suggests that leather and metals were worked inside the *castellum* in the *fabrica* area.

Conclusions

The leatherworking tools and waste found at Albaniana indicate that leather was worked in the *fabrica*; it seems that most activity was involved the repair of personal military equipment, but not their actual production. Untanned hides were cleaned using skin scrapers, but there is no evidence for the tanning of hides. The metalworking tools and waste indicate that bronze as well as iron were also worked in the *fabrica*, but possibly in the *vicus* as well. Semi-finished products show that these activities did not only involve repair work but also the local production of certain objects. It is unclear if this local production also involved the production of personal military equipment. The production of military gear seems most efficient when a smith and a leatherworker cooperate, as many pieces of gear consist of both materials; it is also possible that the leather pieces were imported and adorned locally with metal attachments. However, it seems likely that the metalworking followed a similar trend as the leatherworking regarding the personal military equipment. The equipment may have been repaired locally, but was not (regularly) produced in Albaniana. The large amount of metalworking waste does not interfere with this interpretation, as the smith may have produced a range of other types of metal products used throughout the *castellum* and *vicus*, such as materials for building and tools.

The inhabitants of Albaniana must have relied on import for new military equipment, but they actively maintained and repaired the equipment in their possession. The presence of dedicated smith and leatherworker tools in such a small fort shows their dedication to quality, and great care must have been given to the equipment. This likely allowed for a long use-life and little imports of new equipment to this small fort at the edge of the empire.

Notes

[1] Bakker – Bron 2013.
[2] Van Hees 2017.
[3] Gaitzsch 1980; Manning 1985.
[4] Manning 1985.
[5] Van Driel-Murray 1985.
[6] Van Driel-Murray 2002.
[7] Van Driel-Murray 2004.
[8] Bron 2013a; Polak et al. 2004.
[9] Polak et al. 2004.
[10] Van Hees 2017.
[11] Bron 2013b; Nieuwenkamp 2013; Polak et al. 2004.
[12] Kok 2000; Polak et al 2004.
[13] Oluwasola et al. 2014.
[14] Polak et al. 2004.

Image Credits

Figure 1–2: photo: L. M. A. van Hees. – Figure 3: after Polak et al. 2004, appendix map B. – Figure 4: after Haalebos – Franzen 2000; Polak et al 2004.

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Clockwise or Anti-clockwise? A Method for Distinguishing Roman from Medieval Mail Armour

Martijn A. Wijnhoven

Abstract

Seemingly insignificant details in material culture can be highly informative, especially when studied from a long-term perspective. The direction in the overlap of riveted mail rings is one such detail. This feature can determine whether mail armour is Roman or Medieval. Roman mail has riveted rings with a clockwise overlap, while Medieval mail is invariably anti-clockwise. In addition, the direction of the overlap, together with the type of rings used in a mail coat, confirms the existence of an autonomous mail production in the Barbaricum, beyond the Roman Empire.

Workshop Traditions

At first glance, the rings on a coat of mail may look the same across any period or region, but on closer inspection it becomes clear that there are minute, unique differences among them. Some of these observed variations in ring characteristics can actually point to specific periods or provenance.[1] This may prove very useful, as many mail armour specimens lack archaeological (or historical) context, hindering our understanding of these artefacts.

The main mechanism underlying the observed differences is the way in which the mail maker approached his work. As any craftsperson can attest, there are several ways of making an artefact. The steps in the making process, the choices of manufacture, and the tools of production will all affect the final product. This is partly a mixture of conscious decision-making and creativity. However, most human decisions are subconscious,[2] and in the case of a craftsperson, these are often based on previous experience, particularly on how their craft was learned. That is, certain steps or tools are used simply because the craftsman as a pupil was taught to proceed in this manner. Individuality can come into play, especially whenever non-standardised items challenge the creativity and ability of the craftsperson. This applies much less to mail making, which is a highly repetitive task involving a predetermined set of steps and tools which are applied tens or hundreds of thousands of times to single garment, and many millions of times during a working lifetime.

Small variances in the *chaîne opératoire* of mail making and the tools used produce rings with slightly different characteristics. Because the production of mail was probably taught from a master craftsman to apprentice over many generations, it should be possible to recognise workshop traditions. This does not mean that we can identify

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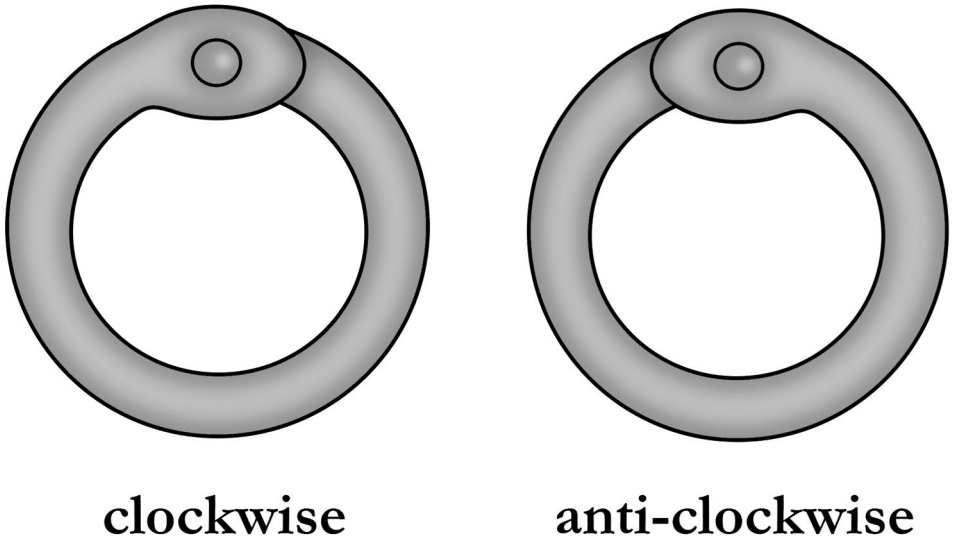

Fig. 1: The overlap of riveted rings can be positioned clockwise or anti-clockwise.

objects from a specific workshop, but that it may be possible to trace some styles of mail production to certain periods or regions.

When analysed from a comparative long-term perspective, the variations mentioned above can be highly informative. In this paper, I examine the available evidence from the invention of mail, around 300 BC, to the Middle Ages, circa AD 1000. Although the primary focus is on the first millennium AD, later mail will also be discussed.

Ring Types and Direction of the Overlap

Most of the mail coats from the period of interest are constructed out of a combination of two ring types arranged in alternating rows. The first type are the riveted rings, made from a small piece of metal wire, shaped into a circle with overlapping ends, and closed by a rivet. The second type are the solid rings, and as their name suggests, cannot be opened or closed and resemble metal washers. Although there are some examples of mail made entirely from riveted rings, for evident reasons there are none made solely of solid rings which cannot be interlaced.

The overlap in riveted rings can go in two directions, clockwise or anti-clockwise (fig. 1). There is no advantage whatsoever of one direction over the other, nor does it have any effect on the strength or construction of the final product. Hypothetically, a single coat of mail could be constructed from a combination of clockwise and anti-clockwise rings; however, that is never the case. All the rings in a single coat of mail always overlap in the same direction. Considering that one garment contains between 10,000 and 350,000 rings, this is hardly coincidental.

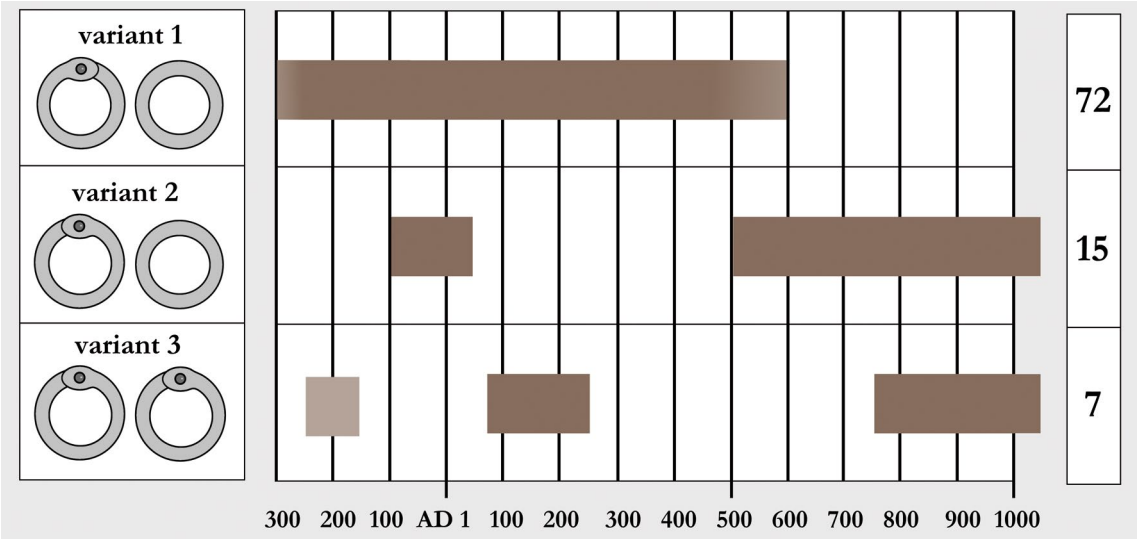

Fig. 2: Occurrence of the three observed mail variants through time. The number of finds of each variant is also shown.

The types of rings used in a mail coat, together with the direction of the overlap in riveted rings, turn out to be highly informative. As discussed below, these features allow us to: 1) distinguish Roman from Medieval mail; and 2) confirm the presence of an autonomous mail production beyond Rome's borders, in the so-called Barbaricum.

Available Data

The present information on ring types and the direction of the ring overlap has been gathered through the direct examination of mail artefacts by the author, complemented by a systematic review of the available literature. In total, I was able to record these features in 94 samples dating from the 3rd century BC to the 10th century AD.[3] Considering the importance and prevalence of mail armour on the battlefield during such a long period, this number may seem relatively low. In part, this is due to conservation (i.e. many finds are so corroded that the ring properties can no longer be observed), and in part because good descriptions and photographs of mail artefacts are often missing in the literature. Furthermore, the direction of the ring overlap has never been deemed important enough to be reported in publications and is generally absent in descriptions of mail.

The following variants were observed among the 94 examined specimens of mail:

- Variant 1) mail made from solid rings and riveted rings with a clockwise overlap.
- Variant 2) mail made from solid rings and riveted rings with an anti-clockwise overlap.
- Variant 3) mail made solely from riveted rings with an anti-clockwise overlap.

Fig. 3: Left: mail from Fluitenberg in the Netherlands (300–115 BC) made with solid and clockwise riveted rings. The rivets protrude several millimetres from the overlap. Right: fragment of mail from Piquía in Spain (100–50 BC) with solid and anti-clockwise riveted rings.

So far, no specimens of only riveted rings with a clockwise overlap have been observed, despite them being completely feasible. The majority of the finds (n=72) belongs to variant 1. Variants 2 and 3 are less common for the period under study, with 15 and 7 examples respectively. Figure 2 plots a timeline for each of the three variants. The finds are not evenly distributed over time, with most of them (72%) dating between the 1st and 5th centuries AD. Only a small part of the finds are from before (12%) or after (16%) that period.

3rd to 1st Century BC

Variant 1, made from solid and clockwise riveted rings, is already found during the 3rd century BC. It is also the most common variant (n=8) between the 3rd and 1st centuries BC, although not the only one (fig. 3). During the 1st century BC, variant 2, consisting of solid and anti-clockwise riveted rings, is observed three times (at Radovanu in Romania, Piquía in Spain and Hedegård in Denmark).[4] Variant 3 is only observed a single time and remains uncertain as it concerns a fragment of mail without provenance that was attached to a Medieval helmet in the Veliko Tarnovo Museum of Archaeology, in Bulgaria.[5] It is clear that the helmet and mail do not belong together, but how they came to be associated is still unknown. The mail fragment has several fixtures attached to it, including a wheel-shaped fastener. Based on an iconographic analogy of this type of fastener, the mail has been tentatively dated to 250–150 BC.

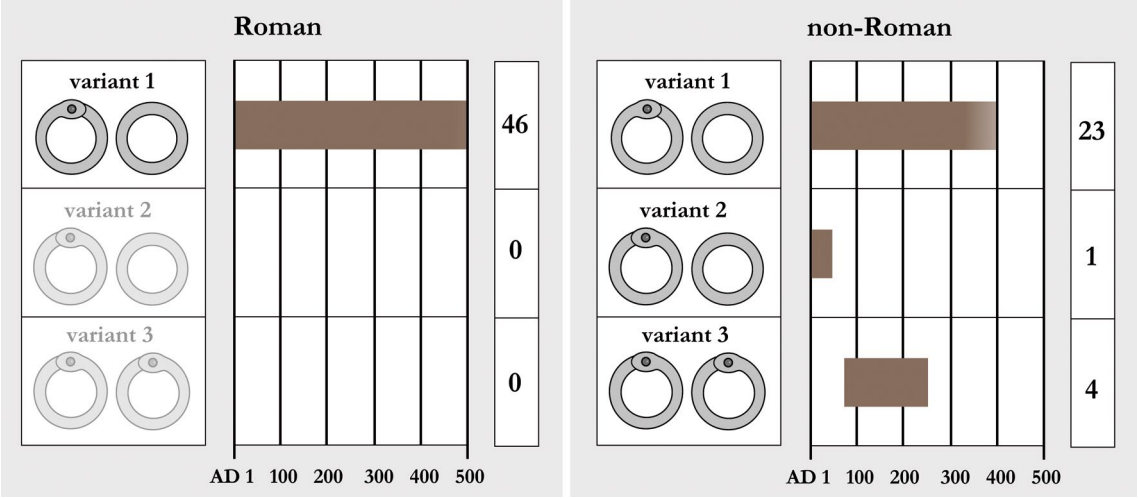

Fig. 4: Occurrence of the three mail variants observed during the 1st to 5th century AD in Roman (left) and non-Roman (right) contexts.

In spite of the relatively few finds from the period between the 3rd and 1st centuries BC, we can draw some preliminary conclusions. Variant 1 is the earliest and most prevalent during this time. Even if in small numbers, the presence of variants 2 and (possibly) 3 demonstrates there was room for other traditions. The occurrence of all three variants may point to moderate standardisation in the mail making tradition at this point.

1st to 5th Century AD – Roman and non-Roman

Roman mail diverges from the pattern of the previous centuries (fig. 2 & 4). There is absolutely no variation among the 46 Roman specimens, all corresponding to variant 1, made from solid and clockwise riveted rings (fig. 5 left). This observation serves as a very useful criterion for determining whether a piece of mail is Roman or not. As a rule of thumb we could say that, if a mail garment consists of solid rings and clockwise riveted rings, then it *may be* Roman. However, if it is made of a different combination, then it *certainly is not* Roman. The fact that that only variant 1 is found in the Roman Empire further attests to a high(er) level of standardisation as compared to the centuries BC.

There are a significant number of finds (n=28) from the same period that come from beyond Rome's borders. Unfortunately, the non-Roman finds from the 5th century AD could not be examined in person and the existing literature is not detailed enough to determine the mail ring variants. Among the remaining examples that were observed, variant 1 was once more prevalent, although not unique. Variant 2 was only found in the find from Hedegård in Denmark already mentioned above and dated to 50 BC – AD 50.

Fig. 5: Left: Roman mail always consists of solid and clockwise riveted rings: an example comes from Künzing 2 in Germany, dated to AD 200–244. Right: mail fragment from Thorsberg 14 in northern Germany (AD 200–250) made entirely of anti-clockwise riveted rings.

More revealing is the presence of 4 objects displaying variant 3, made completely of anti-clockwise rings, without any solid rings (fig. 5 right). The earliest of them, dated to AD 70–260, comes from a grave at Gränby in Sweden and was deposited along with a shield boss and two swords.[6] The other three come from a bog deposit at Thorsberg in northern Germany, and date to AD 200–250.[7] Many of the thousands of military items deposited there were purposely destroyed,[8] and it is possible that these three fragments actually originated from the same garment.

The provenance of mail in the Barbaricum has been widely discussed. It has frequently been attributed to Roman production, and its presence beyond the Empire's borders has been explained as cases of war booty (notably during the Marcomannic Wars), trade, or gift exchange.[9] However, the occurrence of variant 3 in northern Germany and Sweden suggests that contrary to these ideas, the Barbaricum had its own workshop tradition, different from the Roman. This discovery provides the first solid evidence for an autonomous regional mail production in northern Europe. This does not mean that Roman mail was not found in the Barbaricum, but that there was a distinctively local production of mail as well. Neither does it mean that all examples of variant 1 beyond Rome's borders are Roman imports. As discussed in the previous section, the workshop tradition of variant 1 was already present during the Iron Age outside the territory of Roman Empire.

Fig. 6: Mail from the 6th century AD onwards has anti-clockwise riveted rings, whatever its origin. Left: close-up of a 15th century German coat of mail (inv. no. 29.156.68), made entirely from riveted rings. Right: close-up of a Turkish or Syrian mail coat probably from the early 16th century (inv. no. 14.99.28). This shirt is made of riveted and solid rings, each of them decorated with a concentric pattern.

6th to 10th Century AD, and beyond

Entering the Middle Ages, there is a radical change in the direction of the ring overlap in mail armour (fig. 2). Whereas the clockwise direction had been dominant up to that moment, suddenly all mail turned anti-clockwise. After this moment there is not a single find of variant 1, which had lain at the heart of the Roman mail making tradition. The latest possible occurrences of variant 1 are two mail neck guards, one attached to a Spangenhelm from Vézeronce in France, and another associated with an unprovenanced banded helmet from Egypt.[10] The helmet from Vézeronce is an isolated find that holds no clues to its age, but Spangenhelms generally date between AD 480 and 610. The unprovenanced helmet from Egypt is more problematic: it has been dated between the end of the 4th and the 7th centuries on stylistic grounds, but it is uncertain whether the mail and the helmet originally belonged together.

It is tempting to link the demise of variant 1 to the fall of the Western Roman Empire. The appearance of a new mail making tradition could, in such case, indicate the incursions of new peoples and/or ideas from outside the Empire. However, there

are currently not enough finds from the 4th to 7th centuries, from either within or outside the Roman Empire, to solidly test this idea. Especially lacking are finds from the Eastern Roman Empire dated to this period. If correct, one would expect variant 1 to have persisted at least somewhat longer in Byzantium. The mentioned mail guard from the Vézeronce helmet may have been made in Byzantium; indeed a substantial part of surviving Spangenhelms is assumed to have been produced by Byzantine workshops.[11] It, and the unprovenanced helmet from Egypt do indeed hint at the possibility that variant 1 survived longer in Byzantium, but their ages and origins are not clear enough to support a final conclusion.

Although this study only looked at the material evidence up to the 10th century AD in detail, something can also be said about the following period. The riveted rings in all historical mail specimens (i.e. those passed down and preserved in armouries, churches, and other places) are always anti-clockwise (fig. 6). This applies not only to European mail but is a worldwide pattern, seen also in Asia (Minor) and Northern Africa.[12] Given that the same is observed in mail from the 6th to 10th centuries, it is fair to assume that the overlap in riveted rings has invariably been anti-clockwise since the 6th century AD, up to the demise of mail in the modern period. This offers a second strong criterion for distinguishing Roman from Medieval mail. Whereas Roman mail has clockwise riveted rings, Medieval mail has anti-clockwise rings.

The Reason for the Consistency

It remains to be answered why mail makers chose to consistently place the overlap of riveted rings in the same direction. This was not the decision of every single person who worked on a coat, but of generations of mail makers, allowing us to distinguish various traditions.

The answer must be sought in the *modus operandi* of the mail maker. The ring overlap must have been such an integral step to the mail-making process that, without thought, it always led to the same result. The first in-depth study to address the mail making process and the tools used in it was done by E. Martin Burgess, who also hypothesized about how the overlap might have been made.[13] He suggested that the individual rings were driven through a tapering hole in a steel block using a punch whose head was shaped so to facilitate the ends of the ring to overlap. Burgess published his study in 1953 and since then modern mail makers, most of them active in re-enactment, have proven that such tools are not necessary. The rings can be overlapped simply by placing them vertically on a hard surface, like an anvil, and tapping on them lightly with a hammer. With practise, it is easy to make an overlap while leaving the outline of the ring round.

The only factor that actually compels the direction of the overlap is the direction, in which the metal wire is coiled. When the coil is cut into loose rings, one can see

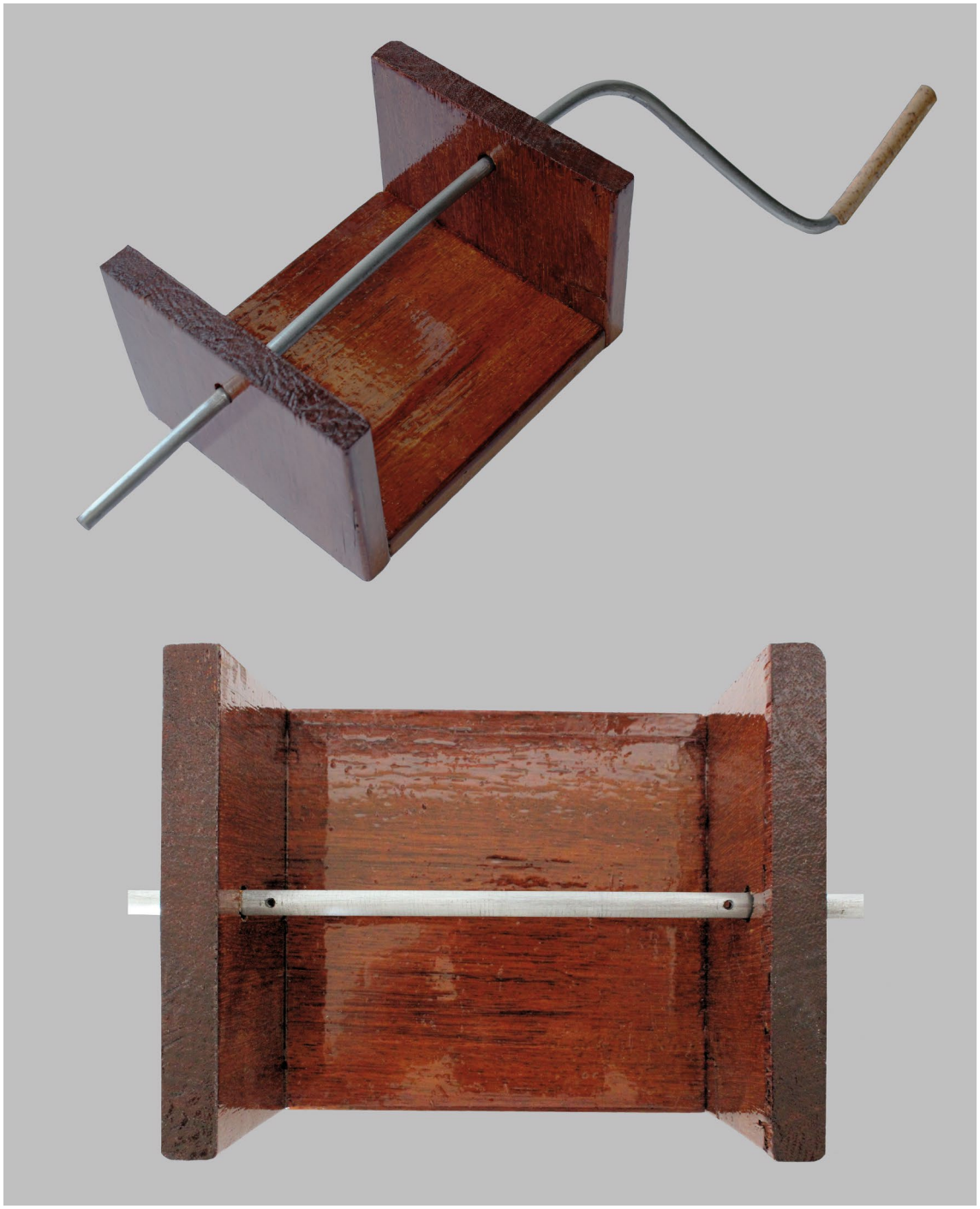

Fig. 7: A modern mandrel for winding coils made by the author. The rod contains two holes, one on each side of the mandrel. These holes help the metal wire to engage with the mandrel. The wire can be coiled from left to right or worked from right to left.

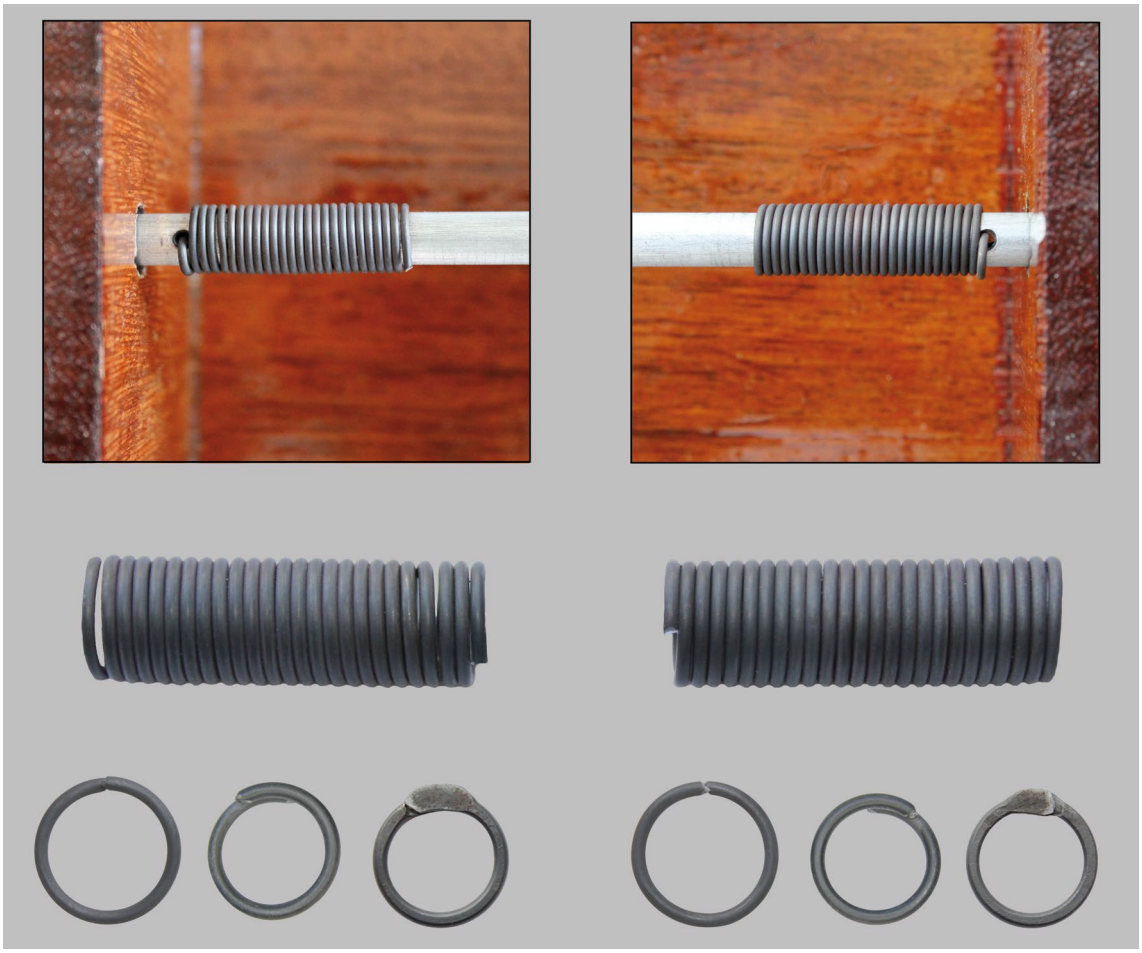

Fig. 8: The direction of the overlap depends on the direction in which the coil is wound. Top and middle: when the wire is wound from left to right on the mandrel, the result is anti-clockwise rings. When wound from right to left, the rings are clockwise. Subsequently, the coil is clipped into loose rings. Bottom: the ends of the rings are slightly out of line, which facilitates them sliding on top of each other. Next, the overlaps are flattened.

that the ends of each ring (seen from the side) are slightly out of line (fig. 8 bottom). This is essential for making the overlap as it allows the ring ends to slide onto each other with very little force. Contrastingly, rings with perfectly aligned ends will only butt together when tapped on from the side or pushed through a tapering hole, but will not overlap.

The direction of the coil thus directly determines the direction of the overlap: clockwise coils make for clockwise rings. While any rod could be used to coil wire, given the number of rings a mail maker would produce during a lifetime, it is likely that a specialised tool was employed, most likely a mandrel. This could be easily made

of vertical wooden blocks mounted on a base through which a rod was inserted. The modern mandrel shown in figure 7 has two small holes that engage the wire with the rod, facilitating the coiling process. The direction of the coil is determined by the starting point. When winding from the right side of the mandrel towards the left, the coil will be clockwise and so will the rings; when the coil is wound from left to right, both will go anti-clockwise (fig. 8). Therefore, it seems apparent that among the Romans, the choice of the starting point on the mandrel was on the right side, while in Medieval times it was on the left side.

There must have been some reason for the mail maker to always coil his wire in the same direction. Although it is very easy to change the starting point on the mandrel, the mail maker made sure that it stayed the same. The best explanation may have to do with the repetitive nature of making mail. After overlapping and piercing the overlap, the rings need to be opened again in order to weave them into the mail fabric. If the direction of the overlap is the same in all rings, these can easily be inserted into one another by the mail maker using the same motion, in a repetitive action that could (almost) be done with one's eyes closed. However, if the direction changes from ring to ring, the mail maker needs to be alert and adjust his movements accordingly. This is not impossible, but considering that a single mail coat contains at least tens of thousands of rings, it is unlikely, as it would slow the work down. There clearly is an advantage to having a consistent overlap in all the rings. When relying on another person, like an apprentice, to make the coils, the maker would have made sure that the right direction was preserved.

In theory, each mail maker could have chosen the direction in which to work, as long as it was consistent, but the archaeological record shows that, in practice, this was not the case. The answer to this probably lies in workshop traditions and the apprenticeship system. The importance of consistency was probably stressed during the training process, as well as the 'proper' way of doing things and making sure it is kept to, resulting in a tradition carried on from master to apprentice across generations and centuries.

Conclusion: Roman or Medieval?

The direction of the overlap of riveted rings, paired with the type of rings used, gives valuable insights into mail making traditions. It has allowed us to identify traditions, and also to tell material apart. Simply put, our formula reads: Roman mail has clockwise riveted rings, while Medieval and later mail contains anti-clockwise rings.

Appendix: Finds Included in the Study

Variant 1: Alternating Rows of Clockwise Riveted and Solid Rings

Austria
Biberwier (AD 300–400): Miks 2014, 223, pl. 70–72. Enns-Lorch (AD 180–450): Hansen 2003, 77, 173 (cat. no. C65); Matešić 2015, 211–212.

Bulgaria
Novae (AD 44–450): Wijnhoven 2015b, 4–15.

Crimean Peninsula
Gurzuf Saddle Pass 1 and 2 (2 finds from 30 BC–AD 50): Novichenkova 2009.

Croatia
Sisak (Roman period): Hansen 2003, 172 (cat. no. C56); Radman-Livaja 2004, 78–79. 130, fig. 18–19 (cat. no. 133–134).

Denmark
Agerholm (AD 210–320): Hansen 2003, 83. 175 (cat. no. C81). Brokær (AD 150–200): Hansen 2003, 83. 85. 175, fig. 27 (cat. no. C85); Jouttijärvi 1995; Waurick 1982, 115–116 (cat. no. 1). Vimose 1 (AD 150–220): Gilmour 1997, 32–33; Hansen 2003, 82–83. 175 (cat. no. C87); Jouttijärvi 1995, 103; Waurick 1982, 112–113. 115–116. 121, fig. 17 (cat. no. 4); Wijnhoven 2015a; 2015b, 1. 7–8. 13. Vimose 2 (AD 100–200): Engelhardt 1869, 12, pl. 4.4; Hansen 2003, 83–84. 175–176 (cat. no. C88). Vimose 3, 4, 5 and 6 (4 finds from AD 1–120): Engelhardt 1869, 12, pl. 4.2; Jouttijärvi 1995, 102.

Egypt
Unprovenanced (AD 395–700): Grancsay 1949, 276.

France
Chalon-sur-Saône (Roman period): Beck – Chew 1991, 45; Hansen 2003, 169 (cat. no. C28). Corent (130–120 BC): Demierre 2015, 157–160, pl. 14. Pontoux (100 BC–AD 100): Bailly 1978, 56; Beck – Chew 1991, 45. 163; Hansen 2003, 34. 42–43. 55. 162 (cat. no. B8). Sarry (AD 300–400): Chew 1993, 313, pl. 3.3; 4.3. Vézeronce (AD 480–610): Grancsay 1949, 276; Vogt 2006, 37–38. 271.

Germany
Bertoldsheim (AD 80–250): Garbsch 1984; Wijnhoven 2017, 186. 188. 193, fig. 8–9. Ellingen (AD 100–250): Hansen 2003, 167 (cat. no. C16); Matešić 2015, 218. Feldberg

(AD 150–250): Beck – Chew 1991, 163; Hansen 2003, 166 (cat. no. C5). Gnotzheim (AD 100–300): Herramhof et. al. 1986/1987, 286–287. Harzhorn (ca. AD 235): Fabian 2018, 40–41. Kalkar (Roman period): Janssen 1836, 126–127. Künzing 1 (AD 240–260): unpublished; Prähistorischen Staatssammlung München, inv. no. 1966, 1273b. Künzing 2 (AD 200–244): Hansen 2003, 53. 168 (cat. no. C25); Schönberger 1963/1964, 83. Sörup (AD 70–220): Drescher 1981, 186–190; Hansen 2003, 83. 179 (cat. no. C120); Jouttijärvi 1995, 103; Matešić 2015, 213; Waurick 1982, 115 (cat. no. 6). Thorsberg 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 (12 finds from AD 200–250): Hansen 2003, 179, fig. 30.6–7 (cat. no. C123, C124); Matešić 2015, 208–221. 512–521, pl. 104–109 (cat. no. M 1142–M 1148, M 1157, M 1158, M 1163, M 1168, M 1172, M 1173, M 1180, M 1181); Raddatz 1987, 59–62, pl. 34.3–4, 94–96 (cat. no. 407, 407.1, 413.1, 417–419). Xanten 1 (AD 50–120): Lenz 2006, 19–20, pl. 17–18 (cat. no. 132A–B). Xanten 2 and 3 (2 finds from AD 1–120): Lenz 2006, 20, pl. 18 (cat. no. 133, 134).

Netherlands
Alphen aan den Rijn (AD 41–275): Hagedoorn 2013, 52 (cat. no. 3.16). Den Haag (AD 190–240): Beck – Chew 1991, 37; Hansen 2003, 53. 172 (cat. no. C61); Matešić 2015, 211; Waasdorp 1989, 159. 161, fig. 2; Wijnhoven 2017, 186. 188. 193, fig. 1. Empel – De Werf (AD 100–200): Nicolay 2007, 21–22. 121, pl. 7 (cat. no. 82.1). Fluitenberg (BC 250–100 BC): Sanden, van der 2003/2004; Wijnhoven 2010. Leiden (AD 80–300): Hazenberg 2000, fig. 25e; Wijnhoven 2017, 186. 193. Nijmegen – Canisiuscollege (AD 80–96): Wijnhoven 2017, 186. 193. Nijmegen – Rooie dorp (AD 70–104): Wijnhoven 2016, 77. 79, fig. 4. Nijmegen – Ubberseveldweg (19 BC–AD 97): unpublished; Gelders Archeologisch Centrum Museum G.M. Kam; put I, vondst 137. Nijmegen – Kloostertuin (19 BC–AD 125): unpublished; Gelders Archeologisch Centrum Museum G.M. Kam; put 1962-I, vondst CA.1962.834. Ouddorp (AD 35-180): Wijnhoven 2009; 2010, 150, fig. 12; 2016, 79, fig. 7. Vechten 2 and 3 (AD 5–270): Hessing et al. 1997, fig. 50; Wijnhoven 2017, 185–186. 187. 193, fig. 5.

Serbia
Bijele Crkve (Roman period): Hansen 2003, 166 (cat. no. C1); Matešić 2015, 211. 214–215. 218; Vujović 2017, 244; Wijnhoven 2017, 186. 193. Gamizgrad (ca. AD 311): Savić 2017, 42–43. 116, pl. 33.2; Vujović 2017.

Sweden
Öremölla (AD 70–220): Arwidsson 1934, 256–257; Hansen 2003, 83. 188 (cat. no. C213); O'Connor 1992, 1183, fig. 589g–h; Waurick 1982, 115–116 (cat. no. 5).

Switzerland
Vindonissa (AD 1–100): Hansen 2003, 173 (cat. no. C71); Unz – Deschler-Erb 1997, 63, pl. 83 (cat. no. 2428); Wijnhoven 2017, 185–187. 193.

Turkey
Dülük Baba Tepesi (AD 35–250): Fischer 2011, 107–108. 116, pl. 27.2; 2012, 71; Matešić 2015, 211; Wijnhoven 2016, 78–79. 85.

Ukraine
Mala Kopanya (100 BC–AD 100): Hansen 2003, 189 (cat. no. C219); Kotyhoroshko 2015, 211, fig. 41.19–20.

United Kingdom
Baldock 1 (AD 20–35): Gilmour 1997, 26. 28. 30–31; Hansen 2003, 34. 38–39. 43. 47. 49–50. 161 (cat. no. B6). Caerleon – Prysg Field (AD 200–300): Chapman 2005, 87 (cat. no. Ma01); Hansen 2003, 170–171 (cat. no. C46); Matešić 2015, 212. Caerleon – Amphitheatre (Roman period): Wijnhoven 2017, 186. 193. Caerleon – British Telecom Site (AD 200–220): Wijnhoven 2017, 186. 193. Carlingwark Loch (AD 80–200): Burgess 1955, 50, pl. 2; Capwell 2003, 23; Hansen 2003, 53, fig. 22.3 (cat. no. C33); Matešić 2015, 218; Piggott 1955, 8. 11. 38–40, pl. 2. The Lunt (AD 50–100): Beck – Chew 1991, 37; Hansen 2003, 170 (cat. no. C44); Hobley 1969, 116. 118, fig. 21.13; Matešić 2015, 211. 218; Wijnhoven 2016, 84; 2017, 186. 193. Newstead 1 (AD 80–180): Beck – Chew 1991, 163; Burgess 1955, 50; Capwell 2003, 23; Matešić 2015, 218; Piggott 1955, 11. 40; Waurick 1982, 111; Wijnhoven 2017, 186. 193. Newstead 2 (AD 138–161): Capwell 2003, 23; Hansen 2003, 59. 169–170 (cat. no. C36); Matešić 2015, 211; Wijnhoven 2009, 36–37; 2016, 78–79, fig. 2-3. Richborough Castle (AD 260–295): Biek 1963, 162–163, pl. 21; Wijnhoven 2017, 183. 186. 193. South Shields (AD 280–320): Croom 1998; Matešić 2015, 209. 218. St. Albans (ca. AD 55): Gilmour 1997, 26–30; Hansen 2003, 72. 171, fig. 22.1–2 (cat. no. C51); Matešić 2015, 209.

Variant 2: Alternating Rows of Anti-clockwise Riveted and Solid Rings

Czech Republic
Prague (AD 900–1000): Checksfield et al. 2012; Edge 2004, 22; Wijnhoven 2015b, 3.

Denmark
Hedegård (50 BC–AD 50): Hansen 2003, 83. 175 (cat. no. C82); Jouttijärvi 1995, 102–103; Kalsbøll Malfilâtre 1993; Matešić 2015, 218.

Germany
Gammertingen (ca. AD 570): Adams 2010, 96; Arwidsson 1934, 255–257; Böhner 1994, fig. 14; Checksfield et al. 2012, 233; Gröbbels 1905, 34–35, pl. 7; Riemer – Heinrich 1997, 54–55. 58–60; Stein 2003, 44–45, fig. 2; Vogt 2003, 27; 2006, 215, fig. 79. Planig (ca. AD 510): Adams 2010, 96; Böhner 1994, fig. 10; Hilgner 2010, 55, pl. 8.2; Vogt 2003, 11, 29; 2006, 37–38. 245–246.

Netherlands
Rhenen 1 (AD 575–600): Wagner – Ypey 2011, 381–382, fig. 80.

Norway
Gjermundbu (AD 900–1000): O'Connor 1992, 1185; Vike 2000, 8–18; Wijnhoven 2015b, 1. Smedenga i Ullensaker (ca. AD 600): O'Connor 1992, 1184.

Romania
Radovanu (100–1 BC): Borangic 2011, 185–186. 190–191. 223; Hansen 2003, 61–62. 69. 164 (cat. no. B25); Vulpe 1976, 208. 212, fig. 18.6–8; Wijnhoven 2015b, 1.

Spain
Piquía (100–50 BC): Quesada Sanz et al. 2018.

Sweden
Birka 1 (AD 900–1000): Ehlton 2002/2003. Birka 2 (AD 750–1000): Arwidsson 1934, 356. Helgö (AD 550–790): Fredman 1992, 23. 28. 44. Slite (AD 780–1100): O'Connor 1992, 1185, fig. 589l–m. Vendel (AD 520–600): Arwidsson 1934, 353; O'Connor 1992, 1183–1184, fig. 589a–e.

United Kingdom
York (AD 750–775): Böhner 1994, 545, fig. 43.1; Tweddle 1992, 929–935. 999–1009. 1057–1081.

Variant 3: All Anti-clockwise Riveted Rings

Bulgaria
Milhailovo (AD 900–1100): Petrov et al. 2015, 576; Zlatkov 2014. Unprovenanced from the Veliko Tarnovo Museum of Archaeology (250–150 BC): Dimitrov 2009/2010.

Germany
Thorsberg 13, 14 and 15 (3 finds from AD 200–250): Hansen 2003, 179–180 (cat. no. C125); Matešić 2015, 212. 215. 223. 513–514, pl. 104–105 (cat. no. M 1152–M 1156); Raddatz 1987, 61 (cat. no. 408).

Sweden
Gränby (AD 70–260): Arwidsson 1934, 256, fig. 12; Fredman 1992, 24. 48; Hansen 2003, 188 (cat. no. C212). Tuna (AD 780–1100): Arwidsson 1934, 256; Fredman 1992, 23. 41; O'Connor 1992, 1185.

Notes

[1] Edge 2004, 24.
[2] E.g. Morsella et al. 2016.
[3] The 94 finds, their age, and some of the key literature are summed up in the appendix.
[4] Borangic 2011, 185–186, 190–191. 223; Malfilâtre 1993; Quesada Sanz et al. 2018.
[5] Dimitrov 2009/2010.
[6] Arwidsson 1934, 256, fig. 12.
[7] Matešić 2015, 212. 215. 223. 513–514, pl. 104–105 (cat. no. M 1152; M 1153; M 1154).
[8] Lau 2010, 137–140.
[9] E.g. Adler 1993, 105; Kaczanowski 1994, 216–219; Raddatz 1959/1961, 52–54; Waurick 1982, 114–116.
[10] Grancsay 1949, 276; Vogt 2003, 11. 29; 2006, 37–38. 271.
[11] E.g. Adams 2010, 96; Böhner 1994, 472–507; Stein 2003, 45–56; Vogt 2003, 25; 2006, 185–187. Stein (ibid.) has determined, by looking at the decoration of Spangenhelms, that the helmet from Vézeronce likely comes from the Eastern Roman Empire.
[12] This is based on my own observations. Examples can be seen in: Alexander 2015, 20-55; Bottomley – Bowstead Stallybrass 2000; Krogh 2016; Wood et al. 2013.
[13] Burgess 1953, 49–50, fig. 2.

Image Credits

Fig. 1–2: drawing M. A. Wijnhoven. – Fig. 3: Left: photograph M. A. Wijnhoven. Right: photograph Fernando Quesada Sanz. – Fig. 4: drawing M. A. Wijnhoven. – Fig. 5: Left: photograph M. A. Wijnhoven. Right: photograph M. Höflinger, Archäologisches Landesmuseum, Stiftung Schleswig-Holsteinische Landesmuseen, Schloß Gottorf. – Fig. 6: photographs Metropolitan Museum of Arts. – Fig. 7–8: photograph M. A. Wijnhoven.

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State Control, Regionality or Guidelines? The Production of the Crossbow Brooch

Vince Van Thienen

Introduction

Many debates on the production of military metal items juxtapose Roman state or military controlled production (*fabrica*) with observable regional differences across the provinces. Yet, distilling an exact provenance from metal artefacts is very difficult due to the high chance of recycled materials, a potentially large distance between the ore-extraction site and production site, as well as the high mobility of military items. Furthermore, given the large geographical extent of the activities of the Roman army, very few production sites have been excavated or production waste and semi-finished goods found *in situ* that can provide us with valuable insights into the nature of military production workshops.

In this paper, the case of the late Roman crossbow brooch will be put forth to revisit the debate on its production. Certain observations made on both the object and context information suggest new lines of thinking to approach Roman military productions. Various analyses have uncovered that, instead of regarding uniformity in contrast to variation, standardisation can be present in the shape of the brooch, while maintaining stylistic freedom in the decorative details. Furthermore, the degree of standardisation or variation can even allow us to investigate different ways in which the production has been organized. Moreover, the evidence provided by typological, stylistic, morphometric and compositional analyses on the crossbow brooches from the Low Countries illustrates that perhaps a *fabrica* could conceptually be seen as a fluid production environment and as a changeable concept over time. It was subjected to changes in military organisation and the larger transformations in the Roman Empire.

Production Models of the Crossbow Brooch

The crossbow brooch is a well-known type of late Roman metal artefact that has been found across the entire Roman territory, although mainly clustering in the frontier regions.[1] It emerged as a separate type from a wide range of bow brooches in the 3rd century as a simple military item and knew a non-linear development until the 6th century, when it symbolised the former power and authority of the Roman state.[2]

Throughout the 20th century, typological brooch studies subdivided the crossbow brooch into various subtypes based on regional stylistic patterns.[3] Most typologies assumed a chronological development from one subtype into the next until Swift's

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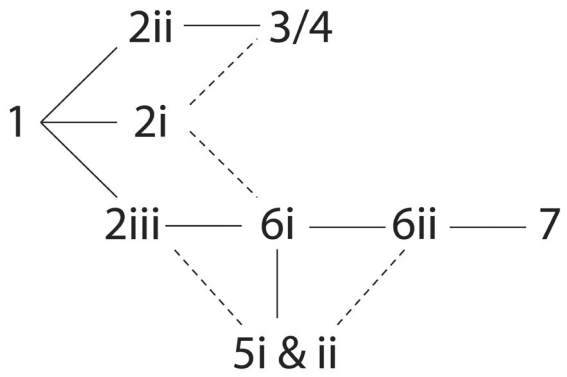


Fig. 1: Swift's non-linear typological model of the crossbow brooch development.

interregional study[4] introduced a non-linear evolution model (fig. 1), illustrating the existence of chronological overlap and regional diversity.

Nevertheless, scholars used style-based typological models to answer questions concerning the social, economic, and symbolic value of the crossbow brooch[5], as well as to create production models based on the distribution of subtypes and specific stylistic elements. Throughout various studies, one idea emerges constantly: the crossbow brooches were manufactured in a large state-regulated production centre in Pannonia. As Swift states, this notion is not based on any concrete evidence[6] and can be traced to the desire to connect the large numbers of brooches found in Pannonia to a production in the *fabricae* mentioned in the *Notitia Dignitatum*.

Furthermore, this idea is supported by the assumption that the crossbow brooch marks an officer's rank and their standardised appearance. However, none of the typological studies in the 20th century assessed the degree of standardisation in and between regional distributions. While it has been confirmed that the crossbow brooch did mark military and state officials, the socio-historical evaluation of the crossbow brooch[7] demonstrated the complex social transformation of these objects and their symbolic values. This necessitates differentiation based on the specific societal and chronological contexts.

Scholars have held a regional production model in contrast to a central production model: the former using the style-distribution evidence as an argument for multiple local and/or regional workshops or *fabricae*,[8] and the latter arguing for a single state-run *fabrica*.[9] The creation of a non-linear typology offered Swift the opportunity to introduce a more complex narrative, which combines some elements of regionality and centrality.[10] She observed a mainstream trend throughout all types, while simultaneously noting smaller distinct subgroups with a more limited distribution. From this, a dominant production in Pannonia was suggested, as well as several regional manufacture centres in the Danubian and north-western provinces along the Rhine and in Britannia.

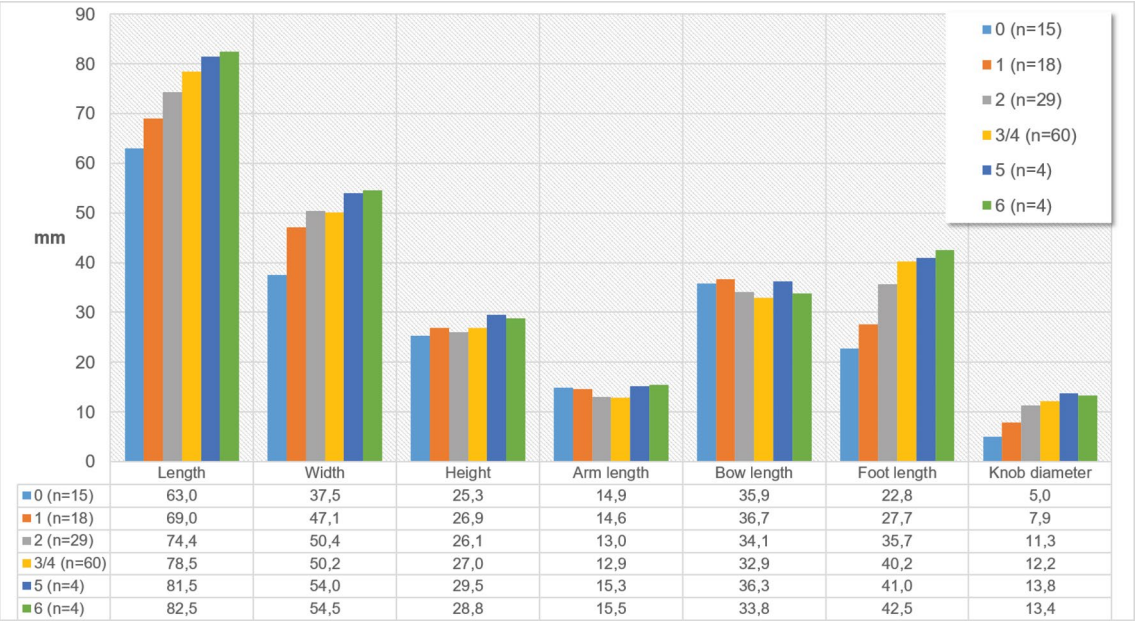
However, this new model still emerged from the distribution patterns of a style-based typology, which is governed by consumption behaviour and the presence of the

social classes associated with it (i.e. the military and late Roman officials), and as such is not an ideal singular proxy to investigate production. Moreover, it can be argued that locating production centres or *fabricae* by distribution patterns of style and typology is an archaeological construction, in which these facilities too often become rigidly fixed in time and space. Furthermore, it assumes a close source-to-site relationship between the production place and the place of burial, loss, or discard. This, however, has been supported by the few compositional studies, which revealed analytical evidence for local brooch productions on sites that have yielded crossbow brooches: in Richborough,[11] Socchieve,[12] and Oudenburg.[13] While this is still not direct evidence, a local production of crossbow brooches is already more likely, especially for the 3rd and early 4th century types. Swift also used some analytical results,[14] although only a distinction between a possible British or continental origin could be made, due to the lack of comparative studies.

Composition as a Reflection of Access to Raw Materials

The idea of using compositional signatures to distinguish between continental and British products, or to identify state-produced brooches from the Pannonian *fabrica*, was investigated by the non-destructive analysis of crossbow brooches from Belgium and the Netherlands by means of X-Ray Fluorescence spectroscopy.[15] Overall, the compositional signal throughout all types of brooches appeared mainly influenced by fluctuations in tin and lead (representing (leaded) bronze), and less so by zinc (representing brass and gunmetal). No distinct alloys could be tied to stylistic traits. Although, some type 2 and a large part of the type 3/4 brooches deviate from the main compositional fluctuations by an increased number of brooches with more zinc and less tin. This observation supports Swift's notion of the introduction of a main central continental brass/gunmetal production in addition to the British (leaded) bronze brooches.

However, given the manufacture methods, metal flow, and recycling practices that accompany metal production, repairs and modifications, it seems unlikely that exact metal alloy recipes would have existed to manufacture these brooches. While certain material properties are needed for functional objects, it can be argued that the composition of the hinge and pin would be the most important to obtain the desired flexibility and durability. The access to raw materials and fresh metal ores, however, would have been a much more decisive factor in the alloy composition of local or regional brooch productions. Access to zinc is sometimes considered to have been monopolised by the Roman army,[16] but even if this is not the case, the noted decline in brass products in late Roman Britain[17] does argue in favour of the use and control of brass by a privileged group, such as perhaps the military. When a similar situation is observed among the composition of the brooches from northern Gaul as in Britannia, the distinction does not lie between a regional British production and a central continental



	Length	Width	Height	Arm length	Bow length	Foot length	Knob diameter
0 (n=15)	63,0	37,5	25,3	14,9	35,9	22,8	5,0
1 (n=18)	69,0	47,1	26,9	14,6	36,7	27,7	7,9
2 (n=29)	74,4	50,4	26,1	13,0	34,1	35,7	11,3
3/4 (n=60)	78,5	50,2	27,0	12,9	32,9	40,2	12,2
5 (n=4)	81,5	54,0	29,5	15,3	36,3	41,0	13,8
6 (n=4)	82,5	54,5	28,8	15,5	33,8	42,5	13,4

Fig. 2: The averages (in mm) of the general brooch dimensions (length, width, and height) and feature measurements (arm, bow, foot length, and knob diameter), sorted per type of crossbow brooch (subtype 0–6).

production. However, this could work as an argument in favour of associating the brass/gunmetal brooch groups that have a centralised production with access to fresh zinc sources, and aligning the (leaded) bronze groups with local and regional productions across the Roman west. The results of the stylistic and dimensionality evaluation below further support this idea.

An Evaluation of Style and Dimensionality

Alongside the compositional study, the style and dimensionality of crossbow brooches from Belgium and the Netherlands were studied by multiple approaches to provide a more detailed understanding of the various processes that governed the production and consumption of crossbow brooches.[18]

Swift already claimed that, despite their generally uniform look and their role as a social identifier, it is very rare for two crossbow brooches to be exactly the same.[19] The various features are decorated with a myriad of styles, motifs, and shapes that are driven by processes of uniformity and regionality, as well as expressions of identity and craft expertise. Given the multidimensionality of a (crossbow) brooch, it is difficult to classify a specific style as a local/regional trait, or to decide whether decorative elements are markers of a specific social class or rather reflect the individual taste of the owner, gift-giver, or craftsman. Therefore, a multivariate stylistic evaluation was applied to develop

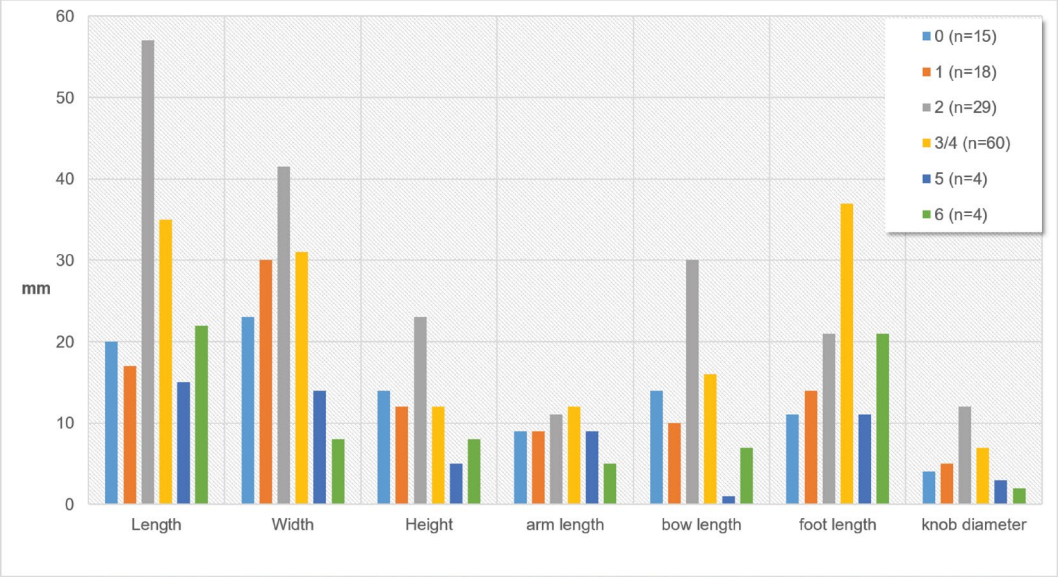


Fig. 3: The range (in mm) between the minimum and maximum values of the general brooch dimensions and feature measurements, per type of crossbow brooch (subtype 0–6).

a regional diachronic profile of the crossbow brooches, which recorded the frequency and variation of different traits of every feature (foot, bow, arm, knobs and cuffs).[20]

Additionally, a morphometric approach to determine the fluctuations and changes in size as a marker for standardisation, or lack thereof, was explored by measuring the total and partial dimensions of the brooch.[21] This technique provided a check on the style-based typological evaluation. And, while dimensionality is connected to style, it is considered that the brooch's proportions are more closely related to the shape and manufacturing process, and thus less subjected to fluctuations due to design or personal taste. The exploration of the range of brooch measurements (figs. 2–3) and the calculation of the coefficient of variation[22] proved a valuable addition to the stylistic evaluation to assess the relationship between production freedoms and requirements. Most useful for estimating the latter was the length/width ratio of the brooch (fig. 4), which was dictated by the need to have a fixed form that validated a crossbow brooch as an authentic marker of authority.[23]

Changes in the Life of the Crossbow Brooch

To fully unravel the stylistic changes of the crossbow brooch and their reflection on production models, it is necessary to place them in their proper archaeo-historical context.[24] The origin of the crossbow brooch can be placed in the 3rd century. The lack of direct iconographic and historical evidence, combined with their abundant archaeological

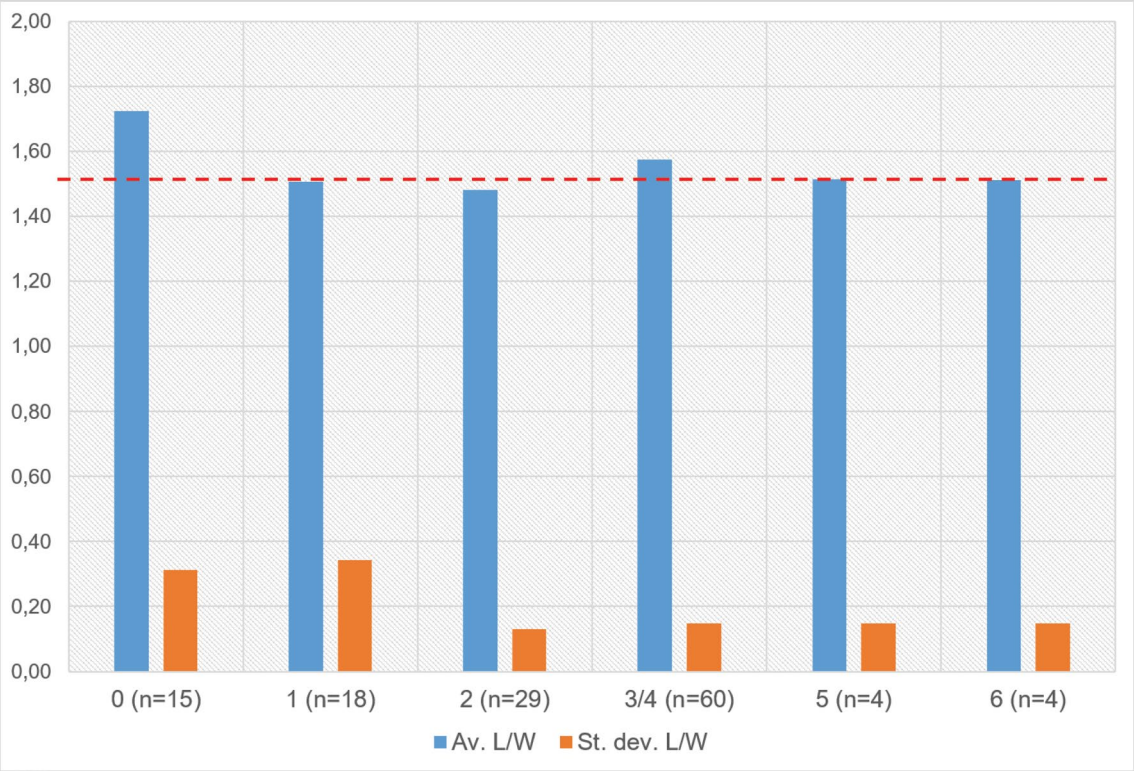


Fig. 4: Illustration of the length/width ratio per subtype, with indication of the 3 : 2 ratio (by the red dotted line).

presence in a military setting, suggests that their owners in the 3rd century belonged to a lower military class. This is supported by the simple design of these type 0 brooches,[25] which display the least variation in shape, style and size, suggesting a high degree of uniformity. The existence of three brooches from Oudenburg with the exact same measurements[26] supports the idea of batch production by the use of moulds in small local workshops.

A first significant change can be observed during the 3rd–4th century transition, corresponding with the Tetrarchy and the early Constantinian dynasty. Type 0 is replaced by types 1 and 2, although partially overlapping in chronology. Their main archaeological context is still military, although the appearance of iconographic evidence and the gradual shift to mainly burial contexts indicate a change in their symbolic value towards a dual social message. One the one hand, there are anonymous military members in the iconographic record that can be linked to the rather simple type 1–2 brooches, which probably still reflected a connection with (lower) military classes. On the other hand, the iconographic sources depict identifiable public officials with crossbow brooches. Here, the introduction of new shapes and styles can be viewed as the result of more wealthy individuals adopting a military dress-style, but still wanting to express their higher status and wealth in the highly decorated and inscribed brooches.[27]

Overall, there is an increase in decorative traits and dimensional variation. This can also be explained in part by a changed manufacture technique of assembling different parts that were cast or worked separately, giving more liberties to the workshops or reflecting the varying skills of craftsmen.

The type 2 brooches continued in the 4th century, although type 3/4 then became the dominant type of crossbow brooch. Swift proposed type 3/4 as the mainstream trend, associated with imports from the Pannonian *fabrica*, and the remaining type 2 products as parallel regional developments. In the Belgian-Dutch brooches, very few new traits are introduced in type 3/4. The large variation in the decorative styles is mainly due to the cross-combination of many different traits in a higher number of brooches. In addition to the diminished decorative variability, there is an increased dimensional standardisation. These observations conform to a more controlled production for or from the military, while there is still some small-scale imitation for prestige, presumably from a restricted number of workshops.

The final development traceable through the brooches from northern Gaul is the 4th-5th century transition. Iconographic evidence shows an increased preference to display individuals of power and prestige with crossbow brooches, often state officials performing their duties, as in the consular diptychs. In addition, the historical references give us an indirect indication that the former 'military garb' was widely adopted by the civilian official ranks while performing their tasks. In the archaeological record, we see a persistence of the type 3/4, while alongside types 5 and 6 develop separately, but somewhat parallel, tied to changes in production and workshops. Interestingly, no new shapes or styles emerge, only existing styles develop further. Furthermore, types 5 and 6 differ in the selection of stylistic traits to the point where they appear very much distinct from each other. Again, there is a noticeable shift in the manufacturing technique to mainly working sheet metal into the desired form. This might also be related to the more frequent use of precious metals or fine decorative traits, introducing the possibility that these brooches were custom-made, and adding to the overall increase in stylistic freedoms. However, the standardised base-form did continue, aligning types 5–6 with the controlled production of type 3/4. At this point, crossbow brooches were no longer associated with anonymous military members; they were intended to serve as identifiable symbols of state authority, which is the reason for the simultaneous expressions of uniformity and variation.

Fluid *fabricae*?

A number of considerations arose from this crossbow brooch study on the nature of production modes. By combining both production and consumption perspectives, it became clear that central production does not necessarily have to oppose regionality, as we can see aspects of both returning in most subtypes. Furthermore, the higher standardisation and restrictions in the overall shapes, in contrast to the highly varied

decorative freedoms, argues for the potential existence of guidelines to legitimise a crossbow brooch's authority. The length/width ratio has been used here to demonstrate the stability and relative degree of standardisation in the overall dimensions over time that would have been needed to identify the crossbow brooch as an *insignia*.

In general, the more functional military brooches (types 0–1, 3/4 and part of type 2) illustrate a higher restriction in style than the 'imitation' brooches (part of type 2 and types 5–6) for outside-military use by state officials and elites in the 4th century. However, the term "imitation" is not used here in the traditional sense, but rather to indicate that these brooches fall outside the conventional typological model that mainly represents the military brooches, although they contained the same symbolism of authority for their owners. The major difference lies with the reduced restrictions on appearance. These more luxurious brooches also served to display wealth and connections with powerful people; they most likely were part of the state-elite gift giving practice. Evidence of this can be found in the historical and epigraphical sources, which recount the donation of proper attire by peers when a new member joins the ranks.

Furthermore, the identification of potential guidelines or rules for production opens up the possibility to have 'local' central production workshops for each region. Additionally, the idea of traveling 'central' workshops or production 'masters' can also be entertained. Moreover, the differentiation between 'regular military' and 'elite imitation' introduces the option for long-distance production orders of commissioned custom-made items by elites to display their wealth and influence to each other.

In conclusion, it can be stated that the research on the different production modes of the crossbow brooch is far from finished. Nevertheless, some considerations can be introduced to revisit the idea of what a *fabrica* has to be: a state-controlled production centre or rather a (licensed) local/regional military workshop. Or could a military workshop have become a *fabrica* when a state-supported craftsman arrived to make *insignia*? Or were a certain set of regulations circulating among several production centres? In any case, the story of military productions has proven to be more complex than merely contrasting central vs. regional models.

Notes

[1] Swift 2000, chapter 2.

[2] Van Thienen 2017.

[3] e.g. Van Buchem 1941; Van Buchem 1966; Keller 1971; Ettlinger 1973; Jobst 1975; Riha 1979; Feugère 1985; Hull – Hawkes 1987; Pröttel 1988.

[4] Swift 2000.

[5] Keller 1971, 27; Jobst 1975, 93; Clarke 1979.

[6] Swift 2000, 3–4.

[7] Van Thienen 2017.

[8] e.g. Keller 1971; Jobst 1975; Clarke 1979.
[9] e.g. Riha 1979, 171.
[10] Swift 2000.
[11] Bayley – Butcher 2004.
[12] Giumlia-Mair et al. 2007.
[13] Van Thienen – Lycke 2017; Van Thienen – Vanhoutte 2012.
[14] Swift 2000, 81–88; Bayley 1992.
[15] Van Thienen – Lycke 2017.
[16] Dungworth 1997.
[17] Pollard et al. 2015.
[18] Van Thienen 2016, chapter 8.
[19] Swift 2000, 62.
[20] A complete overview of the stylistic study is forthcoming, for now see Van Thienen 2016, 314–347.
[21] Van Thienen – Lycke 2017, 56–58 table 3.
[22] Van Thienen – Lycke 2017, 56: method after Eerkens 2000; Eerkens – Bettinger 2001.
[23] Van Thienen 2016, 341–343.
[24] For a complete narrative and overview of the available evidence, see Van Thienen 2017.
[25] Type 0 is an addition to Swift's model to incorporate the crossbow brooches' direct predecessor, also known as the early light crossbow brooch or Armbrustscharnierfibel.
[26] Van Thienen – Vanhoutte 2012, 147 fig. 4.
[27] For examples, see Deppert-Lippitz 2000.

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Fig. 1: after Swift 2000, 27, fig. 11. – Fig. 2–4: by author.

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The production of military equipment is a subject that is much more complicated than often thought as Roman soldiers were not completely equipped by the state in an uniform manner. While a certain amount of 'near-uniformity' was necessary in the army, it was logistically impossible to ensure complete uniformity, even within a single unit. One reason for this was that Roman soldiers owned most of the equipment themselves, which allowed them to choose their own preferences (within limits).
After an introduction and overview of the subject, the three case studies look at what the tools found in a fort can say about the production of military equipment on the site, at the influence of workshop traditions on the making of mail armour and at whether state control or local production was the main impetus in the production of crossbow brooches.

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