Detail of late roman military belt selts of the Archaeological Society of Namur
Namur, Coll. Fond. SAN, inv. A09167. Photo : M.Leboutte © Ville de Namur.

PRODUCTION ORGANISATION OF LATE ROMAN MILITARY BELT SETS

Berber. S. van der Meulen-van der Veen

In May 2022, I had the opportunity to visit the collection of the Archaeological Society of Namur as part of my doctoral research[1].This project investigates the changes in military occupation in the province of *Germania Secunda* in the 4th and 5th centuries by investigating changes in settlement patterns (potential migration by Germanic communities) and the material culture specifically associated with Roman soldiers and Germanic *foederati*. One aspect of this research project concerns the production of military belts in the Late Roman period. The importance of the belt for military identity can be surmised from the strong archaeological correlation of the Late Roman belt with military sites and crossbow brooches.

A wide variety of belt types existed[2], which could consist of numerous decorative plates, stiffeners and fittings in addition to the buckle and strap end. In *Germania Secunda*, the most common buckle type in the 4th century was the Sommer *Sorte* 1, which consisted of a closed buckle frame with a separately attached plate. In the 5th century, Sommer *Sorte* 3 buckles dominate, which were cast as one piece with the plate attached. Much work has already been published on the decorative and typological styles of these

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1. *The role of "barbarian" migrations in the fall of Rome. Changing identities in a transforming world* supervised by prof. dr. John Hines (Cardiff University) and prof. dr. Hella Eckardt (University of Reading). This PhD project was funded by a grant from the Arts and Humanities Research Council; grant nr. 2115976. Data access statement: All data supporting this study are included within the article.

2. See for typologies for Northwestern Europe : H. W. Böhme, *Germanische Grabfunde des 4. bis 5. Jahrhunderts zwischen unterer Elbe und Loire. Studien zur Chronology und Bevölkerungsgeschichte*, München (Münchner Beiträge zur Vor- und Frühgeschichte Band 19), 1974 ; H. W. Böhme, *Die spätantiken Gürtel mit Kerbschnittverzierten Metallbeschlägen. Studie zu Militärgürtlen des 4.-5. Jahrhunderts*, Mainz (Kataloge Vor- und Frühgeschichtlicher Altertümer Band 50), 2021 ; M. Sommer, *Die Gürtel und Gürtelbeschläge des 4. und 5. Jahrhunderts im römischen Reich*, Bonn (*Bonner Hefte zur Vorgeschichte*, 22), 1984.

belts. My project aims to add a new dimension to the study of Late Roman belts by collecting data on their metallurgical composition and physical dimensions to study how they were produced. A similar approach has proved successful for Late Roman crossbow brooches[3] but has not yet been attempted at a large scale for Late Roman belts.

The aim of my visit to the collection of the Archaeological Society of Namur was to collect measurements of the object dimensions of the Late Roman belts from Wallonia. These form a small sub-set of the data collected for my thesis, which also include finds from Flanders, Germany and the Netherlands. As the full results of my study are still in preparation, this paper explains some of the methodology and gives a preliminary description of some of the Namur finds. This will give a first indication and proof of concept of how archaeometry can help our understanding of the production methods and organisation of Late Roman belt sets.

1. INTRODUCTION

Very little is known about the production of Late Roman belts. Sommer has argued for a production organisation of military belts in smaller, regional workshops, citing a number of production-related finds that are known from frontier zones of the Western Empire[4]. Most of these are semi-finished products and models, so may not all be direct indications for production taking place as items may have been distributed in their semi-finished stage. A clay mould of an *Astragalröhre* with plate from Emmerich-Praest[5] is the clearest evidence so far for local production of military belt accoutrements on the Lower Rhine frontier.

Stylistic approaches have recognised the regionality of certain types of belts, which may indicate regionally operating workshops[6]. Böhme argued, based on the stylistic characteristics of belts from his *Stufen* I and II, that clear differences in style were visible between the Gallo-Belgic and Danubian regions, indicative of different workshops[7].The uniformity of the *Kerbschnitt* decoration, the large number of recurring decorative schemes and the complicated technological process of producing these belts were indications for him to originally suggest production of those belts by highly skilled workers in "factory-like", state-run workshops in the 4th century[8]. Whereas he initially proposed the weapon *fabricae* as described in the *Notitia Dignitatum*

3. V. Van Thienen, S. Lycke, *From commodity to singularity: The production of crossbow brooches and the rise of the Late Roman military elite* in J*ournal of Archaeological Science,* 82, 2017, pp. 50-61.

4. M. Sommer, *Die Gürtel und Gürtelbeschläge ...,* p. 102 ; see also H. W. Böhme, *Die spätantiken Gürtel mit Kerbschnittverzierten ...,* Abb. 72 for additional finds.

5. M. Sommer, *Die Gürtel und Gürtelbeschläge ...*, p. 102, Abb. i.5.

6. H. W. Böhme, *Germanische Grabfunde* ..., pp. 92-97; M. Sommer, *Die Gürtel und Gürtelbeschläge ...*, p. 102 notes the overlap of these areas with civilian prefectures.

7. H. W. Böhme, *Germanische Grabfunde* ..., p. 97.

8. *Ibid*., pp. 95-97.

as potential production sites, he later suggested the provincial workshops of the *comes sacrarum largitionum* would be a more suitable interpretation[9]. However, archaeological evidence for many of these historically known workshops is lacking which means we have little information on how production of armour and weapons was actually organised. Some 4th-century *papyri* from Egypt also show the involvement of the state in production and procurement of tunics and fabrics[10] and it may be assumed that belt sets were also included in this system of army provisions.

For the 5th century (*Stufe* III), Böhme deemed the material to display too many individual traits to suggest centralised production, and he also noted the appearance in this period of much more simplified production methods[11]. In later years, he also proposed the possibility that in addition to workshops in the Roman Empire, workshops in Free Germany might have produced some 5th-century military belt fittings[12].The working hypothesis starting this project was that a possible move from production in state-run workshops in the 4th century to increased local production in the 5th century might be reflected in the levels of standardisation in these objects. The Archaeological Society of Namur curates a large number of excellently preserved belt buckles and assorted fittings that were very well suited to this type of analysis. These finds originate from a range of sites within the province of Namur.

2. METHODOLOGY

Standardisation of material culture and how it relates to production organisation and craft specialisation have long been studied by archaeologists keen to understand past economies. The degree to which certain material culture categories appear to be standardised can be taken as a reflection of the size and scale of the production and the degree to which craft activity was specialised[13]. We can imagine that the fewer people working in a workshop, the less specialised they could be, being responsible for multiple sections of the *chaîne opératoire*. In larger workshops with a higher production turnout, craftspeople may have been more likely to be able to specialise in one particular aspect of the manufacturing process, which in turn may have introduced a certain level of standardisation into the process. An assessment of standardisation can include looking at material composition, manufacturing techniques, forms, dimensions and surface decoration[14].

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9. *Ibid.*, p. 97; H. W. Böhme, *Die spätantiken Gürtel mit Kerbschnittverzierten ...*, p. 136.

10. K. Dross-Krüpe, *Purchase orders of military garments from papyri of Roman Egypt* in L. Nosch (ed.)*, Wearing the cloak. Dressing the soldier in Roman times* (*Ancient Textiles Series,* 10), Oxford, 2012, pp. 16-17.

11. H. W. Böhme, *Germanische Grabfunde ...*, p. 97.

12. H. W. Böhme, *Die spätantiken Gürtel mit Kerbschnittverzierten ...,* p. 137.

13. V. Roux, *Ceramic standardization and intensity of production: quantifying degrees of specialization* in *American Antiquity,* 68 (4), 2003, pp. 768-782.

14. *Ibid*., p. 768.

In my thesis I also discuss the chemical composition, typology and surface decoration of Late Roman copper alloy dress accessories, but in this paper I would like to specifically address object dimensions as a tool to study standardisation and craft specialisation. The method used in this paper is based around the statistical concept of the coefficient of variation (CV), which is calculated by dividing the standard deviation of a variable or dataset with its mean. The resulting value expresses the extent of variation present in a dataset. Its use in archaeology stems from the idea that humans are often unable to accurately judge sizes, areas or weights without using external measuring aids[15]. For archaeological studies, this concept is of great importance, as talking about the level of variation within groups of objects can help us understand production mechanisms. A low CV value may imply the use of automation or measuring aids and a range of 2.5-4.5% variation has been estimated as the typical minimum degree in manual production[16].

For Roman copper-alloy dress accessories, certain tools and measuring aids will have been available to the smiths. These will have included scales for the weighing of alloying ingredients, but also the use of moulds for casting objects, although in some cases the *cire perdue* method could have been used[17]. Reusable moulds, however, would potentially not have had particularly long life spans, introducing potential for variation[18]. The impact of any of these factors will have been heavily influenced by the intensity of production: the size and scale of production of any given workshop. Division of labour, for instance, may be assumed to have more common in more centralised production centres and will have been a contributing factor in increasing standardisation of the finished products. Other factors to consider would be the amount of replication taking place (copying objects), the cost to run production, preferences of the consumers, quality controls, and access to resources[19] and each will have been differently organised in differently sized workshops.

In their study on crossbow brooches, Van Thienen and Lycke also highlighted the factor of decoration[20], which has the potential to introduce significant variation, as decoration is often added after the object is cast. Measuring errors both by the ancient smiths and the modern-day researcher will inevitably introduce further variation into the dataset, as well as corrosion processes and post-depositional damage to the objects. For crossbow brooches, Van Thienen and Lycke propose that a CV score of

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15. J. W. Eerkens and R. L. Bettinger, *Techniques for assessing standardization in artifact assemblages: can we scale material variability?* in *American Antiquity* 66 (3), 2001 p. 494

16. *Ibid.,* p. 496.

17. H. W. Böhme, *Germanische Grabfunde* ..., p. 92 ; H. W. Böhme, *Die spätantiken Gürtel mit Kerbschnittverzierten ...,* p. 134.

18. H. W. Böhme, *Germanische Grabfunde* ..., p. 92.

19. J. W. Eerkens and R. L. Bettinger, *Techniques for assessing standardization* ..., p. 494.

20. Van Thienen, S. Lycke, *From commodity to singularity: The production of crossbow brooches and the rise of the Late Roman military elite* ..., pp. 50-61.

10-15% would signify significant control over production[21], a number that may be higher for belts given the vast variety and complexity of forms, types, construction methods and decorations. The data collected at the Archaeological Society in Namur alone included at least 10 different object categories and 18 distinct typological groups. This diversity also means that the variation methodology described above will only be meaningful using a big data approach so that enough data is collected for each object type or subtype. Based on the methodology used by Van Thienen and Lycke, I took measurements at fixed places on the objects, usually their maximum height and width so that ratios of the object dimensions could be calculated. Some preliminary findings are presented below.

3. RESULTS

In total, 112 belt buckles and fittings in the Archaeological Society of Namur collection were measured, which included belt buckles, strap ends, decorative plates and fittings. The strength of the standardisation/variation methodology lies in using large datasets, in which statistical outliers and measuring errors can be smoothed out. As outlined above, the wide variety of styles, decorations and forms found in Late Roman belts means that a very large dataset is needed to obtain enough data points for each typological or stylistic group. However, some first indications of production organisation can be gleaned from just the small number of finds analysed at the Archaeological Society of Namur.

For instance, the collection included two very elaborate and well-preserved complete belt sets (figures 1 and 2), which clearly illustrate what a Late Roman belt set looks like when all parts may be assumed to have been manufactured during the same production moment. Both of these sets feature propellor-shaped belt stiffeners. Because these were all designed to be similar, the CV calculations of all the measurements are incredibly low (table 1), falling almost exclusively below 5%. The individual measurements show that there is indeed some very small variation in overall length or width, but never more than 1-3mm, which fits within estimates of human error cited above. The heights of the backplate of the buckle and the strip-like belt stiffener in grave 137 from Treignes closely matches that of the propellor fittings (48 and 46mm. respectively).

This similarity between each individual piece of the set is remarkable, given the fact that each part would be cast, finished and decorated individually. Different moulds for the buckle and fittings would also be used, but despite this their dimensions are incredibly close indicating that the production of moulds was also closely monitored. This is a clear indication of some of the concepts outlined in the introduction, in particular the degree of speciali-

21. Van Thienen, S. Lycke, *From commodity to singularity: The production of crossbow brooches and the rise of the Late Roman military elite* ..., pp. 50-61.

sation that we might expect in larger, supra-regional workshops. Different steps of the manufacturing process were all executed to the same standards, resulting in a high-quality product with very standardised dimensions.

Fig. 1. *Belt set (catalogue A09167) from grave 1 in Jambes, Écoles Communales.*
Namur, Coll. Fond. SAN, inv. A09167. Photo : M.Leboutte © Ville de Namur.

Fig. 2. *Belt set (catalogue number A06587) from grave 17 in Treignes.*
Namur, Coll. Fond. SAN, inv. A06587. Photo : M.Leboutte © Ville de Namur.

Table 1. Measurements (in mm.) and coefficient of variation values of two belt sets from the Archaelogical Society of Namur collection

	height	width top/bottom	height:width	Ø disc
Treignes, grave 137				
propellor fitting 1	48	17	2,82	18
propellor fitting 2	53	20	2,65	19
propellor fitting 3	48	17	2,82	19
propellor fitting 4	47	18	2,61	18
propellor fitting 5	50	18	2,78	17
propellor fitting 6	51	18	2,83	17
Coefficient of variation	4,16	5,56	3,21	4,53
Jambes, Écoles Communales				
propellor fitting 1	incomplete	incomplete	incomplete	14
propellor fitting 2	41	17	2,41	17
propellor fitting 3	incomplete	incomplete	incomplete	incomplete
propellor fitting 4	40	16	2,50	15
propellor fitting 5	40	17	2,35	16
propellor fitting 6	41	18	2,28	18
propellor fitting 7	incomplete	incomplete	incomplete	17
propellor fitting 8	incomplete	incomplete	incomplete	incomplete
propellor fitting 9	incomplete	16	incomplete	17
Coefficient of variation	1,23	4,45	3,39	7,85

4. DISCUSSION

This paper describes a first attempt to understand Late Roman belt buckles and fittings in an experimental way. The Namur finds discussed here are a small dataset and more data is needed to understand these patterns more clearly (a dataset of more than 600 buckles and belt elements is currently being prepared for publication). However, the finds from Namur have already thrown up some interesting results that allow us to assess whether this experimental approach to studying the potential standardisation of Late Roman military belt buckles was useful. The two complete belt sets confirmed the high standard of manufacture that was already evident from the decorative and technological analysis offered by previous scholars. Each individual piece of the complete sets closely matched the other parts in size and decorative scheme, clearly representing a singular production moment and highlighting the extremely high level of skill and control over the manufacturing process that Late Roman smiths could exercise.

The next step in the project, which is outside the scope for this brief paper, is to compare the measurements of buckles and other fittings from dif-

ferent belts from different sites. A possible avenue for data analysis would be to investigate whether all objects of a particular type share a common shape or size that would indicate the use of standardised moulds, or whether form and typology have too great an effect on overall dimensions. It will also be interesting to investigate whether there are any indications for copying objects, with smiths using already existing objects or models to make new moulds.

Fittings such as suspension mounts or belt stiffeners are also smaller and thinner than the robust buckle frames, so might have needed more frequent replacing. It would seem more likely that smaller fittings were produced to individual order when a soldier needed to have them replaced, close to the frontier forts by local smiths. The *Astragalröhre* mould from Emmerich-Praest would also fit in this narrative of more locally arranged production of belt fittings. A broader comparison of the standardisation levels of buckles and mounts and fittings can potentially shed light on whether buckles may have been manufactured in a more centrally controlled environment. This last point will be one of the hypotheses to be tested in my thesis.

A further hypothesis to be tested will be whether significant differences in standardisation values may be found in 4th-century vs. 5th-century belts. It may be stated that the high level of standardisation of belts shown above for the two 4th-century sets is indicative of some form of production control. It will be very interesting to see if the full dataset gives any indications on standardisation in 5th-century belt sets and what that tells us about production organisation in the 5th century.