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Cultural Transformations in Germania Secunda

A Holistic Approach to 'Barbarian' Migrations

Berber Sanderijn van der Meulen-van der Veen

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Chapter 1
Introduction

The depiction of the Late Roman Empire has often been one of decline and fall.[1] One key aspect that often features is the influence of 'others' in the frontier provinces: 'barbarian' or 'Germanic' tribes raiding, invading, and ultimately settling in the Roman provinces.[2] Both archaeological and historical research have frequently focused on invasions and other destructive events,[3] especially as part of the migration and invasion debate. More recently, new theoretical frameworks and scientific advances have begun to paint a more nuanced picture of cross-border interactions, of the identities of both 'Romans' and 'barbarians'[4] and of the very notion of decline.[5] These include the study of rural settlements as locales of migration,[6] burial rites,[7] isotope and mDNA analysis to trace mobility across the frontiers[8] and issues of (dis)continuity of provincial-Roman occupation of the rural hinterland.[9]

Academic debates have gone back and forth over the last 50 years on whether migration or mobility can be proven through archaeological data, and if so, how.[10] During this same period, a number of studies focused on identifying Germanic or migrant identities in the archaeological record through material culture,[11] burial rites,[12] settlement features,[13] coin hoards,[14] marriage law,[15] figurative depictions[16] and scientific methods.[17] This monograph addresses broader questions about the archaeological analysis of migration and social dynamics through a case study of the Lower Rhine frontier zone, which includes the *limes* itself, the provincial hinterland of Germania Secunda and the bordering areas of Germania Magna (North Rhine-Westphalia and Lower Saxony west of the Elbe; figure 1.1). The area was chosen because there has been a large influx of archaeological data that has become available in recent decades for the Lower Rhine frontier. Several large and important cemetery sites have been published,[18] modern rescue archaeology has led to an increase in excavated settlements[19] and the structural registration of finds from private collections in the Netherlands has unearthed a large number of stray finds (Portable Antiquities of the Netherlands; PAN).[20] The Late Roman period is defined here as AD 270-470, with a focus in this thesis on the 4th and 5th centuries. The Early and Middle Roman are defined as 53 BC-AD 69 and AD 70-269 respectively.[21]

The central theme of this thesis is the perceived Germanicisation of the province of Germania Secunda, specifically where it concerns the rural settlement landscape, the organisation of the Lower Rhine frontier and concurrent changes in military and civilian dress accessories. Below, a historiography of the main archaeological datasets will be presented, which is preceded by a brief overview of ethnic identities and migration in archaeological theory. I will review theoretical approaches to migration, exploring issues around mobility and identity and considering specifically how Germanic identities have been researched. The final section sets out my

[1] Gibbon 1776-1789; MacMullen 1988; Heather 2005; Heather 2009; Ward-Perkins 2005; Gerrard 2013.
[2] Von Rummel 2007; Heeren 2017; Jäger 2019; Böhme 2009.
[3] Such as the Limesfall of the Lower German frontier in the mid-late 3rd century; see for criticism Heeren 2016.
[4] Brather 2000; Brather 2004; Swift 2006; Halsall 2007; Mathisen 2018; Geary 1988; Harland and Friedrich 2021; Effros 2012; Pohl and Reimitz 2000; Pohl *et al.* 2000; Gardner 2007; Taayke *et al.* 2003; Mathisen and Shanzer 2011; Bowden *et al.* 2006; Martin 2014; Kulikowski 2011; Wells 1999.
[5] Webster and Brown 1999; Bowersock 2000; Heeren and Roymans 2021; Roymans *et al.* 2020; Dodd 2021; Annaert *et al.* 2012; Van Ossel 2006.
[6] Lenz 2005; Heeren 2017; Kaspyrzk 2017; Jäger 2019; Roymans *et al.* 2020.
[7] Pirling 1993; Böhner 1963, Böhme 1974; Böhme 2009; Halsall 1992; Werner 1958; Werner 1962; Schulze-Dörlamm 1986a.
[8] Kootker *et al.* 2022; Kootker and Heeren 2022.
[9] Gechter and Kunow 1986; Heeren 2017; Roymans *et al.* 2020; Bender 2001; Van Thienen 2016; Van Thienen 2020; Bridger 1994; Gilles 1994; Brulet 1994; Lenz 1999; Lenz 2001; Louis 2004; Van Ossel and Ouzoulias 2001; Van Ossel 2006; Brüggler *et al.* 2017; Van Enckevort *et al.* 2017; Dodd 2021; Janssens 2010.
[10] Adams *et al.* 1978; Härke 2004; Hakenbeck 2008; Anthony 1990; Anthony 1992; Anthony 1997; Hawkes 1987; Härke 1998; Chapman and Hamerow 1997; Hamerow 1997; Burmeister 2000; Halsall 2014.
[11] Böhme 1974; Böhme 1999; Böhme 2009; Bernhard 1999; Van Thienen *et al.* 2020; Van Thienen and Gelfert 2022; De Paepe and Van Impe 1991; Von Rummel 2007.
[12] Werner 1958; Böhner 1963; Böhme 1974; Schulze-Dörlamm 1986a; Seiller 1992.
[13] Henning 1989; Lenz 2005; Heeren 2017; Kaspyrzk 2017; Roymans *et al.* 2020; Jäger 2019.
[14] Martin 2009; Roymans 2017.
[15] Sivan 1996; Mathisen 2009, 140.
[16] Von Rummel 2007.
[17] Kootker *et al.* 2022; Kootker and Heeren 2022.
[18] E.g., Krefeld-Gellep (Pirling 1966; Pirling 1974; Pirling 1979; Pirling 1989; Pirling 1997; Pirling and Siepen 2000; Pirling and Siepen 2003; Pirling and Siepen 2006); Hürth-Hermülheim (Gottschalk 1999; Gottschalk 2008); Tongeren (Vanvinckenroye 1984; 1995ab); Rhenen-Donderdberg (Wagner and Ypey 2011); Nijmegen (Steures 2013); Hambach 132 (Brüggler 2009); Eschweiler-Lohn (Gottschalk 2015); Nettersheim-Ob der Kaul (Gottschalk 2015); Übach-Palenberg (Siegmund 1998b); Cologne-Luxemburgerstrasse (Von Boeselager 2012); Jülich (Pöppelmann 2010); Cologne-Jakobstraße (Friedhoff 1991); Dortmund-Asseln (Könemann 2010; Könemann 2015); Deventer-Colmschate (Verlinde and Erdrich 2006); Sievern (Aufderhaar 2016); Flögeln-Vossbarg (Schön 1988a; Schön 2001); Gudendorff (Schön 2017); Issendorf (Häßler 1994; Häßler 2001; Weber 2000; Weber 2004); Liebenau (Cosack 1982; Häßler 1983; Häßler 1985; Häßler 1990; Brieske 2001).
[19] Van Enckevort *et al.* 2017; Van Thienen 2020; Brüggler 2021.
[20] https://portable-antiquities.nl/pan/#/public.
[21] Vos 2009, figure 1.6.

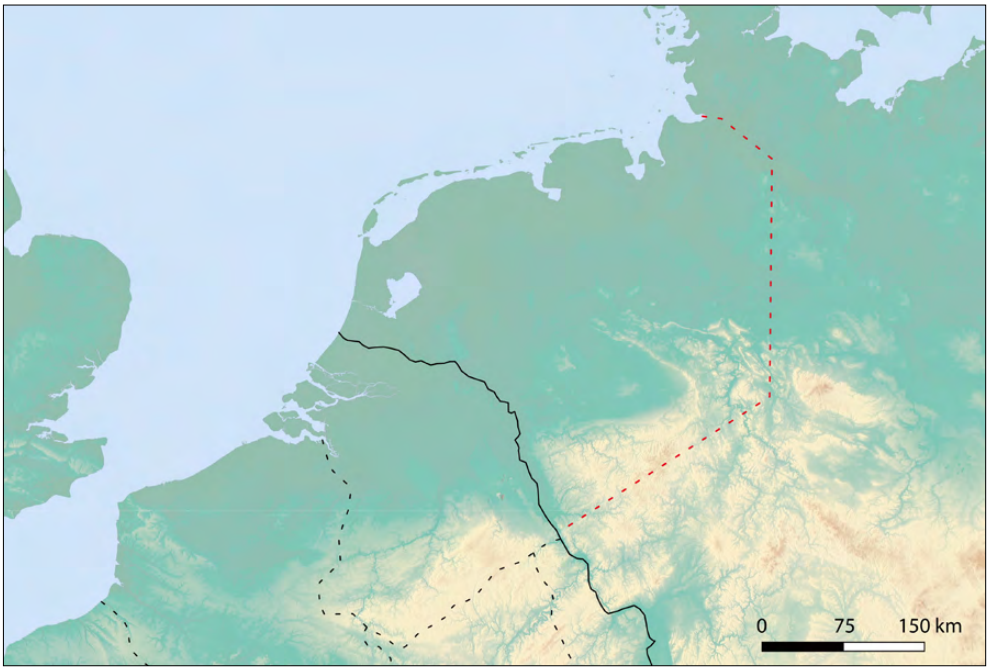


Figure 1.1. Map of the research area. Black: *limes*. Dashed line: provincial borders Germania Secunda. Red dashed line: area of Germania Magna included in this study. Frontier and provincial borders after Roymans *et al.* 2020; Brulet 2017a.

own approach, drawing on the issues identified in the preceding sections before setting out research aims and thesis structure.

Migration theory and ethnic identities in (Late Roman) archaeology

Recently, migration has enjoyed renewed interest in archaeological theory[22] although for the Late Roman period the topic has never completely been off the table. Much of the archaeological data for this period in the Western Empire has been viewed through the lens of 'Germanic' identities and migrations and their role in the shaping of the Late Roman World ('Migration Period'). In archaeology, migration theories often take a very pragmatic approach, identifying and explaining anomalies in the archaeological record.[23] Migration is most commonly evoked as an explanation for cultural change in cases of '*sharp discontinuity in the sequence of cultural development*',[24] with ideally a traceable area of origin of any 'intrusive traits'.[25]

More broadly, migration as an interpretative framework has drifted in and out of academic fashion several times throughout the 20th and 21st centuries,[26] often seemingly coinciding with political and intellectual trends.[27] This section is not meant as an exhaustive overview of theoretical models of or approaches to migration and identity in archaeological theory,[28] but as a brief introduction to some aspects of the debate that are especially useful for the interpretation of the Lower Germanic frontier. The aim of this monograph is to critically engage with the archaeological material itself and re-assess the changes in rural settlements and material culture in the Germania Secunda viewed against the background of migration, ethnic identities, and long-term social and cultural changes. It is in the processes of mobility and migration that discussions on cultural change, ethnicity, gender and social identities and material culture converge.

Historical overview and ethnicity in archaeology

The discussion below summarises some of the main points in the debates surrounding migration and ethnic identities in archaeology, as both concepts are often studied through the same methods and materials, e.g., 'intrusive' finds'.[29] The association of material culture with specific communities or groups has been a long subject of debate in (pre)historic archaeology.[30] The *ethnische Deutung* of material culture was a key component of the cultural historical approach,[31] which relied largely on the equation of archaeological cultures to clearly defined ethnic groups,[32] with migration, invasions and diffusion used to explain archaeologically observable changes or anomalies. Under the New Archaeology, archaeological theory became more

[22] Hingley 2017, 78; Chapman and Hamerow 1997; Van Dommelen 2014; Heeren 2017; Eckardt 2014.
[23] Adams *et al.* 1978, 487.
[24] Adams *et al.* 1978, 487.
[25] Eckardt and Müldner 2016, 207; Adams *et al.* 1978, 487.
[26] Härke 2004, 456.
[27] Megaw and Megaw 1992, 255-256; Anthony 1997, 21. See for a more exhaustive overview Harland 2021.
[28] See Prien 2005; Manning 2005; Chapman and Hamerow 1997; Brather 2004; Jones 1997.
[29] Adams *et al.* 1978; Eckardt 2014.
[30] Fulford 2010, 68.
[31] See summary in Hakenbeck 2008, 12; Curta 2014.
[32] Hakenbeck 2008, 9, 14; Jones 1997, 15.

'immobilist'[33] and British scholarship especially began to focus on changes in identity and ideas to account for changes in material culture.[34]

Migration again became more fashionable as a framework in the late 1980's,[35] although with less emphasis on ethnicity. Instead, migration was increasingly framed in archaeological theory as a process, with dynamics of movement that needed to be addressed,[36] including '*which sub-groups tended to move, which groups tended to stay, how destinations were chosen, how routes were selected and the archaeological consequences of all of these constraints on movements*'.[37] Interest in migration theory in archaeology has been increasing again in recent years.[38] Definitions of ethnicity have also shifted considerably over time, and the concept is now more commonly understood as a social construct that is fluid and context-specific.[39] Jones defined ethnicity as '*all social and psychological phenomena associated with a culturally constructed group identity*'.[40] Wallace-Hadrill has also applied the linguistic concept of code-switching to cultural expressions in different social contexts,[41] which can be applied to archaeological materials and their use in expressing identity.

Brather has pointed out that both individual and group identities may exist concurrently[42] and Petts has noted that cultural identities are formed through day-to-day activities.[43] As a socially constructed form of expression, ethnic identity is difficult to define and identify.[44] While some have approached the topic largely from a theoretical point,[45] some have opted to work from the archaeological materials up.[46] Especially in Late Roman archaeology, we often rely on a tacit or explicit dichotomy between Romans and non-Romans. Such linear thinking is also a central component in the decline and fall narrative.[47] Expressions of ethnicity may also be difficult to distinguish from other expressions of social and collective identities such as gender or class,[48] or they be may largely invisible. According to Eckardt, the link between '*ethnic formations and material culture is highly problematical, and there is no longer a simplistic correlation between particular aspects of material culture, such as pottery types or house forms, and ethnic identity*'.[49] Material culture may not just reflect expressions of ethnicity but may have been used as an '*active element in its negotiation*'.[50] Material culture may also be used to invent or revive traditions, often in times of military conflict or political upheaval.[51]

Eckardt has also pointed out that ethnic groups may not be visibly defined in the archaeological record[52] and material culture with possible regional or ethnic connotations may not necessarily have been experienced in the past as 'alien', but could also have been seen as unique or desirable status symbols.[53] Any observed change or variation in material culture may thus be due to a number of factors, including social, political, cultural or ethnic identities, or a combination of these.[54] Expressions or indicators of ethnic identities may include displays of material culture or habitual practices.[55] In their review of archaeological approaches to ethnicity, Reher and Fernandez-Götz state that ethnicity may be most likely expressed in domestic and ritual contexts.[56] Distinguishing between the various nuances and meanings of the archaeological record requires a 'contextually detailed analysis'.[57]

This thesis supports the definition of ethnicity as a social construct and aims to offer a reinterpretation of the archaeological material from the Late Roman West that has traditionally been viewed through the lens of ethnic, Germanic identities. This is done by including theoretical perspectives on cultural change such as globalisation and creolisation and by moving from concepts of *Tracht* to fashion and applying a multi-disciplinary, 'contextually detailed analysis' to this material.[58] An extensive analysis of object use and deposition in different contexts is needed to extract the various meanings objects could have in different social contexts, including but not limited to meanings associated to ethnic or group identities or regional origin.

Migration as a process

Apart from an explanatory framework for observable cultural change, migration in the past may also be studied as a phenomenon of its own. Besides the act of moving from one area to another and settling there, it may also be defined as a social process with motives, decisions, information exchanges and consequences

[33] See Hawkes 1987, 203; Härke 1998, 19; Chapman and Hamerow 1997, 1.
[34] Hakenbeck 2008, 17; see Härke 2004.
[35] Anthony 1997, 21.
[36] Hakenbeck 2008, 16.
[37] Anthony 1997, 21.
[38] Hingley 2017, 78; e.g., Chapman and Hamerow 1997; Van Dommelen 2014; Heeren 2017; Eckardt 2014.
[39] Eckardt and Müldner 2016; Jones 2009, 8; Brather 2004, 158; Eckardt 2014, 26-27; Härke 2004, 454.
[40] Jones 1997, xiii; cf. Grahame 1998, 156.
[41] Wallace-Hadrill 2008, 63-64.
[42] Brather 2004, 158.
[43] Petts 1998, 79.
[44] Pohl 1998; Curta 2013.
[45] E.g. Jones 1997.
[46] E.g. Martin 2014.
[47] Miller 1996, 161.
[48] Curta 2011, 537; Eckardt 2014, 26.
[49] Eckardt 2014, 28.
[50] Curta 2007, 170.
[51] Eckardt 2014, 29; Curta 2007, 182.
[52] Eckardt 2014, 28.
[53] Eckardt 2014, 28.
[54] Eckardt 2014, 27; Grahame 1998, 159.
[55] Eckardt 2014, 28; Lucy 2005, 97; Petts 1998, 79.
[56] Reher and Fernandez-Götz 2015, 402.
[57] Reher and Fernandez-Götz 2015, 402; Jones 1997.
[58] Cf. Reher and Fernandez-Götz 2015, 402.

for the communities involved (see above). Migration theory is based on the premise that cultures can move from one area to another through the movement of humans,[59] although its visibility in the archaeological record has been met with some scepticism.[60] Most migration efforts in the past will have involved small groups of people, individuals or family units[61] and it is questionable how strong an archaeological footprint such small-scale movements would have left. When possible evidence for non-locals is ascertained, interpreting whether it reflects a one-time visit, temporary movement or a permanent move may also be difficult.[62] Furthermore, cultural identities may become blurred '*through acculturation and assimilation of migrants and natives*'.[63]

That last point targets an important idea, namely that apart from the act of moving from one place to another, migration also involves a number of social factors in both the emigration and immigration area. There needs to be motive to move, such as push and pull factors.[64] Then there are processes that take place during movement. Burmeister, for instance, has highlighted the role of pioneers (traders, mercenaries etc.) at the forefront of major migratory movement. Pioneers also tend to settle near already inhabited centres, which then become focal points for later migratory movements. These later movements are facilitated by the social networks and information exchanges between those who had already moved and those remaining home, leading to established routes of migration. These social networks also facilitated integration in the immigration area and resulted in spatial concentration of migrants and cultural/social enclaves.[65] Prien also defined several different types of migration, such as elite migration (a small sub-set of people who are not representative of the wider community moving into an area where they have political or economic power), mass migration (group of migrants so large it eclipses or equals the local population), specialist migration (i.e. career migration of a small number of people with a particular profession, such as trader, crafts person or soldier) and expulsion (or coerced migration).[66] In the Late Roman West, the *foederati* are often seen through the lens of career migration.[67]

Finally, there are the effects of migration to consider, on both the emigration and immigration area. Burmeister discussed the effects of migration on the emigration area, such as the return of some migrants to their area of origin, possibly resulting in changes there. He furthermore rephrased migration from an event to a long-term process and placed it in a social context, noting for instance that migrations were selective (with only some members of a society moving and selection criteria possibly changing over time) and that the greater the need to migrate (depending on the cause), the less selective migrations were. When migrants were primarily made up of a specific social group (i.e., defined by gender or age), migrations may have had an effect on the demographic make-up of the emigration area, which may have led to economic, social or cultural transformations.[68]

Burmeister's approach emphasises the complexity of the migration process and place it with the social context of the communities involved.[69] The transmission of information is a key factor, especially around destinations and routes and is especially important in in long-distance migration[70] and results in limited streams of migration towards known targets, rather than migrant communities taking over entire landscapes without discrimination.[71] Archaeologically, chain migration may be identifiable in the form of small pockets of settlements forming around so-called founder communities.[72]

Subheading Practical approaches

However, Burmeister's 2000 paper has been criticised for failing to unequivocally state an '*archaeological proof of migration*'.[73] It is also noteworthy that Burmeister's paper seems mostly concerned with proving migration to Britain in the 5th century, stating that '*the presence of Germanic mercenaries in northern Gaul from the 4th century on is well documented archaeologically*', citing Böhme's inventory of Germanic grave goods[74] without further critical discussion.[75] Although Bruun discussed how challenging it can be to identify the migration of women and children in the Roman world,[76] female burials and how they relate to notions of *Tracht* or native dress have always been central to the Late Roman migration narrative.[77]

As discussed above, burials have commonly been used to identify migrant communities on Roman soil.

[59] Adams *et al*. 1978, 484.
[60] E.g., Härke 2004, 456.
[61] Adams *et al*. 1978, 488.
[62] Bruun 2016, 177.
[63] Härke 2004, 453; cf. Halsall 2012, 32.
[64] Anthony 1997, 22. For example, negative conditions in the area of origin coupled with perceived positive conditions in the immigration area, the benefits of which outweigh the cost of transport (Anthony 1997, 22). See also Bruun's comprehensive list of motives, including military careers, colonisation and resettlement projects, commercial motives, the search for work, land, change or adventure, the need to escape natural disasters or war, persecution, and enslavement (Bruun 2016, 181-186).
[65] Burmeister 2000, 549.
[66] Prien 2005, 47-48; Anthony 1997, 27.
[67] Halsall 2014, 525; see also Miller 1996, 166.
[68] Prien 2000, 549-550.
[69] Hakenbeck 2008, 17.
[70] Anthony 1997, 27.
[71] Anthony 1997, 24.
[72] Anthony 1997, 27.
[73] Hakenbeck 2008, 18.
[74] Böhme 1974.
[75] Burmeister 2000, 548.
[76] Bruun 2016, 176.
[77] Cf. Böhme 2009.

Prien has emphasised that burial customs tend to change gradually and that when a 'foreign' burial rite suddenly appears, migration is a likely factor. However, chronological development is not enough, and the new and pre-existing rites need to be significantly different.[78] This closely mirrors Halsall's observation that a combination of well-known geographical origin, significant deviation from the norm and chronological differences in regionality is necessary for burial rites in Late Roman Gaul to be proof of migration.[79] However, as will be discussed below, many aspects of the supposedly Germanic burial rite in the Late Roman period were rooted in and derived from provincial-Roman customs and cannot be securely placed as originating in Germania Magna. Furthermore, Eckardt and Müldner have highlighted the need to place 'intrusive' finds in their historical context and to consider their relation to other forms of personal or group identity, such as gender or the military, with especially the latter a key component of frontier culture.[80]

Burials may be seen as inherently performative, showing us how the deceased and their families wished to be represented.[81] Through thorough analysis of the Late Roman burial rite, Theuws has also critiqued many of the ethnic interpretations of the grave goods buried with the deceased, instead reframing them as expressions of other forms of social status and identity.[82] Settlements may be useful in studying community identities[83] as well as the personal and public displays of identity, adaptation and assimilation.[84] Several scholars have presented evidence for migration in settlement contexts.[85] Burmeister in particular has been influential in how settlement evidence may be used in the migration debate, distinguishing between aspects of day-to-day life that may adapt very quickly to new environments (such as subsistence strategies and architecture), while other, more 'internal' aspects of life remained traditional longer (such as the inner partitioning of houses and pottery making) as they were less likely to be influenced by their new locality and interaction with the local population.[86]

Recognising such distinctions relies on a careful analysis of domestic architecture: Prien has noted that building features related to function and use (such as stables or workshop areas) are not suitable for these types of arguments.[87] Whether migrants kept elements that they were familiar with in new areas may depend on a number of factors, including economic necessity and the possibility to even do so.[88] Modifications to building traditions may appear at the earliest after one generation, as the old ways of doing things may turn out not be a good fit with the local environment, although this needs to be assessed on a case by case basis.[89] The formation of new types of settlements that are recognisably different in function and use from what came before are the best-case scenario for identifying migration in the settlement record, although according to Prien when this is not accompanied by new house types, internal migration or an increase in the existing population are also probable explanations.[90]

Approaches to non-Roman and military identities in Late Roman archaeology

For the continental western provinces and their frontier regions, two main strands of evidence with two corresponding social groups have been central to the discussion of a Germanic presence on Roman soil. Changes in burial rites, namely the introduction of furnished burials in the northern provinces have long been associated with Germanic identities, based on perceived commonalities with burials in Germania Magna.[91] So-called 'jewellery graves', richly furnished burials of women with hairpins and brooches,[92] are often seen as indicative of the presence of (high-status) Germanic women[93] in the Roman frontier provinces. Recruitment and dispersion of Germanic *foederati* is typically approached through the distribution of the weapon burial rite[94] and more recently the distribution of gold *solidi*, predominantly from hoards and stray finds.[95]

The study of Germanic-style material culture, including dress accessories and handmade pottery has enjoyed a long research history in the study area.[96] Additional data have come in the last few decades from the study of rural settlements and their architecture, material culture and subsistence economy.[97] Most recently, the application of scientific methods (mDNA and isotopes)

[78] Prien 2005, 305. Prien also suggests particular types of migration can be identified based on the presence of absence of certain age groups or genders in cemeteries but the archaeological data for the study area were not sufficient to work with on that level of detail.
[79] Halsall 2000, 169.
[80] Müldner and Eckardt 2016, 207; see also Clark 1975, 52-53.
[81] Prien 2005, 304; Theuws 2009, 295ff.; Theuws 2013.
[82] Theuws 2009.
[83] Kruse 2019; cf. Reher and Fernandez-Götz 2015 on domestic practices.
[84] Burmeister 2000.
[85] Henning 1989; Lenz 2005; Heeren 2017.
[86] Burmeister 2000, 541-542; cf. Prien 2005, 306.
[87] Prien 2005, 306.
[88] Prien 2005, 306-307. Prien suggests keeping traditional building styles when moving is less likely in the case of forced deportations and more probable in the case of mass migration (2005, 307).
[89] Prien 2005, 307-308.
[90] Prien 2005, 308.
[91] Werner 1958; Böhner 1963; Günther 1971; Böhme 1974; Schulze-Dörlamm 1986a; Seiller 1992; James 1979; Pirling 1993.
[92] Böhme 1974.
[93] Böhme 2009; Klapp 2013.
[94] Böhner 1963; Böhme 1974; see also Werner 1958.
[95] Martin 2009; Roymans 2017.
[96] Böhme 1974; Böhme 1999; Böhme 2007; Böhme 2009; Bernhard 1999; Van Thienen *et al.* 2020; Van Thienen and Gelfert 2022; De Paepe and Van Impe 1991; Von Rummel 2007.
[97] Henning 1989; Lenz 2005; Heeren 2017; Kaspyrzk 2017; Roymans *et al.* 2020; Jäger 2019.

has been used to trace mobility.[98] A brief literature review of these strands of evidence is presented below in order to highlight areas where this work can make a contribution.

The Germanic burial rite and associated dress accessories

The Late Roman female burial rite included several brooch and hairpin types that are also found in contemporary contexts in Germania Magna, leading to the suggestion that these burials belonged to high-status Germanic women (as these graves tend to feature elaborate grave gifts).[99] More specifically, it has been suggested that some form of ethnically informed dress or *Tracht* was used by these communities to express their non-Roman identities in their new environment. This narrative takes inspiration from the 19th-century invention of a national dress in many north-western European countries during the formations of the nation states.[100] Empirical bases to suggest material culture was used to express ethnicity in early Anglo-Saxon burials were found to be lacking.[101]

The ethnic interpretation of clothing styles is often based on a strictly dualist system, with sharply defined and homogeneous ethnicities ('Roman' vs. 'Germanic') presented as opposing parties.[102] The occurrence of multiple brooches per grave, often in matching sets, is commonly interpreted as reflecting a female dress style,[103] which at the time might have included up to five brooches. Although Böhme links this style of multiple brooches to a shift from a Roman *tunica* to a Germanic *peplos* in Belgica Secunda and Lugdunensa Secunda,[104] it can in fact be found in Early and Middle Roman graves in the northern provinces as well, as provincial-Roman female dress was also characterised by the wearing of multiple (matching) brooches.[105]

Rejecting ethnic labels, Halsall interpreted the lavishness of the Late Roman 'jewellery grave' as a reflection of a social group displaying its high status, without necessarily specific ethnic connotations.[106] Drinkwater has emphasised that Germanic-style material culture was not necessarily made by or belonged to 'ethnic Germans'.[107] The exclusive association with women as the main wearers of these brooches may also be challenged. This is largely based on the fact that Armbrust, supporting-arm and tutulus brooches sometimes appear in sets, but this is not always the case (and in some regions of Germania Magna, multiple brooches are found in burials of men).[108]

Table 1.1 summarises Böhme's seminal 1974 book listing all the object categories found in Germanic burials (on both sides of the frontier). Some objects are gendered, while others are found with both men and women. Many of these are not particularly culturally or socially exclusive and many of the tools and non-gendered items are poorly datable outside of closed grave contexts. It is a challenge, therefore, to distinguish from table 1.1 between objects that were deliberately placed in the grave to express regional origins or ethnic identities of the deceased and objects that were not.

What further complicates these narratives are the regional differences found in the distribution of 'Germanic' material culture, on both sides of the frontier. Between Sion and Strasbourg, lavish jewellery graves are known that do not contain brooches, indicating a different way of dressing women for burial.[109] Brooches are relatively rare in Germanic settlements in West-Frisia while hairpins are fairly common, which has been interpreted as a regional preference.[110] Female dress was far less idealised in the Roman world compared to men's clothing and was subject to frequent changes in fashion.[111]

Furthermore, Böhme already highlighted the specific regionality of some of these items, most notably the Wijster hairpins. Although these are found relatively widely across the northern Netherlands and northern Germany,[112] their main distribution appears to have been the central Dutch river area. In his original 1974 publication, Böhme already emphasised both the restricted distribution and the large amount of stylistic variation found in hairpins in the river area.[113] Based on these two factors, he argued that Wijster hairpins were likely produced in the Dutch central river area.[114] The development of a new type of object in a Germanic style in the frontier zone underscores the interactive nature of the frontier zone and its function as a 'cultural facilitator'.

Similar regionality can be found in the brooches. It is an undeniable fact that both the male and female-gendered brooches listed in table 1.1 are found, in

[98] (Kootker and Heeren 2022; Kootker *et al.* 2022.
[99] Böhme 2009.
[100] Gerrard in prep, see Harland 2021 for a discussion and critique of the *Tracht* concept.
[101] Harland 2019.
[102] Von Rummel 2007, 304.
[103] Böhme 2009, 41.
[104] Böhme 2009, 42; Böhme 1997, 93.
[105] Böhme 1972, 48; Riha 1979, 42; Heeren and van der Feijst 2017, 336-337; Van der Veen 2021, 347-348; Croom 2000, 137.
[106] Halsall 2000, 177.
[107] Drinkwater 1996, 24.
[108] Böhme-Schönberger 2008, 144-145; Von Richthoven 2000; Caselitz 2005.
[109] Halsall 2009, 99.
[110] Hagens and Siers 1999.
[111] Von Rummel 2007, 93.
[112] Böhme 1974, Abb. 13; *Karte* 9; Van Es 1967; Verlaeckt and Proos 1996.
[113] Böhme 1974, 38.
[114] Later echoed by Halsall 2000, 171-172 who labelled them as a Late Roman frontier style.

Brooches (female)	Brooches (male)
einfache Armbrustfibeln mit gleichbreitem, facettierten Fuß	crossbow brooch
Armbrustfibeln mit Trapezfuß	Stützarmfibeln mit stabförmigen Bügel und Rechteckfuß (mit Achensträger)
Stützarmfibeln mit Trapezfuß	bow-knob brooches
Stützarmfibeln mit gleichbreitem, bandförmigen Fuß (ohne Achsenträger)	
Gleicharmige Kerbschnittfibel	
tutulus brooch	
composed and cast saucer brooch	
Other jewellery (female)	Weapons (male)
hairpins	spatha
earrings	lances/spears
beaded necklaces (glass, amber and gold beads)	axes
pendants	arrowheads and javelins
bracelets	Shields
buckles and belt fittings	buckles and belt fittings
Tools (female)	Tools (male)
keys	razorblades
spindle whorls	fire strikers
needle boxes	bag handles
mirrors	carved horn
iron and bronze rings	
wooden chests	
Non-gender specific grave gifts	
wire necklaces and finger rings	
grooming tools (bone combs; iron shears/scissors) and toiletries (tweezers, ear spoons)	
iron knives; bronze and silver spoons	
shoes	
vessels (wood, ceramic, glass and metal), including handmade urns	
Coins	

Table 1.1. Overview of funerary goods in Germanic burials (after Böhme 1974).

varying degrees of rarity, on both sides of the frontier. The key problem is that unequivocally linking these brooches, when found on Roman soil, to non-local individuals undervalues wider, supra-regional stylistic developments. Based on the distribution maps of the individual subtypes of tutulus brooches, for example, (discussed in more detail below in chapter 3), Halsall proposed that some types were produced in the provinces and others outside the Empire.[115]

The male-associated supporting-arm brooches have been labelled frontier style,[116] while Heeren has suggested that both Armbrust brooches and some variants of supporting-arm brooches may have developed within the provinces.[117] The Armbrust brooches in table 1.1 were most exhaustively studied by Schulze,[118] who traced their origin back to the north-eastern Germany and Scandinavia in the Early and Middle Roman period, while later types in the 3rd to 5th centuries appeared more frequently in southern and western Germany and the Netherlands.[119] Large amounts of data have been published since 1977, which gives the opportunity to update distribution maps, dating and the arguments for gendering these brooches as female-associated.

Weapon graves and the foederati

The second key component of many discussions around the Late Roman West is the identification in the archaeological records of the so-called *foederati*. They are commonly represented as mercenaries, fighting under their own leaders whilst being temporarily attached to the Roman army and returning home afterwards. However, the legal definitions of the *foedus* in the Late Roman period are very broad and include a number of possible terms of service.[120] Troops may

[115] Halsall 2000, 171-172.
[116] Halsall 2000, 172; see also Halsall 2009, 135-136; cf. Swift 2006, 100.
[117] Heeren 2017, 171, figure 11a.
[118] Schulze 1977.
[119] Schulze 1977, Karte 1-36.
[120] Heather 1997, 66; Southern and Dixon 2009, 48-50, 52, 64-65, 71-72; Schwarcz 1995.

have been raised among communities living both inside or outside of the Empire or could consist of men from various communities and regional origins gathering around a single leader.[121] The precise nature of their relationship to Rome was likely negotiated individually for each group.[122] Occasionally, *foederati* might have been recruited as full-time members of the Roman army to bulk up recruitment, or entire warbands would have been turned into official units under Roman officers.[123]

Roymans suggests that it is unlikely for Germania Secunda that Germanic mercenaries served a lengthy service in a regular Roman army unit before returning home and suggests they were recruited by local warlords who distributed their pay from Rome.[124] It is also possible that there were a small number of regular Roman units in Germania Secunda in the early 5th century, which would have influenced how federate groups might have been paid.[125] Their leaders would have been supported and subsidised by Rome to ensure their future cooperation and provide a safe buffer along the frontiers.[126] Whereas initially payments for service (*annona foederatica*) may have been in kind, later this was turned into yearly payments,[127] presumably in coin.[128] In some cases, *foederati* were invited to settle across the Roman provinces as *gentiles* after their military service,[129] for instance under Julian when *foederati* settled left of the Rhine.[130] In the Lower Rhine frontier area, the emergence of the *foederati* has been dated to the late 4th and early 5th centuries,[131] specifically as a result of Stilicho's renewal of contracts with the *gentes* of the Rhine and withdrawal of the standing army in AD 401/402.[132]

The identification of Germanic *foederati* has often been built on the occurrence of graves in the Late Roman West, which contained weapons and military belt sets.[133] Weapon burials are most commonly found outside of the study area, in France and southern Belgium,[134] and are only found rarely in the more immediate frontier zone and outside of the Empire.[135] The rite itself developed in the Roman provinces from the late 2nd century onward.[136]

The Germanic connotation of weapon burials is based on the notion that as Roman citizens were not allowed to bear arms in public, their deposition in graves must have been a non-Roman practice[137] and is implied to reflect the increased Germanisation of the Late Roman army already underway before the reign of Theodosius I.[138] Others have linked the deposition of weapons in graves to martial identities those associated with the Roman army, as they were also allowed to possess weapons[139] and the Frankish nature of the *francisca* or axe has been questioned.[140] Besides containing a variety of weapons (including *spathae* and *franciscae*), belt sets and military-associated brooches are also frequently included.[141] It has been suggested that the weapons these men were buried with were produced in Roman factories,[142] indicative of a link between weapon burials and those serving in the Roman armies.[143]

Much like the distribution of female-gendered dress accessories, the weapon grave rite was far from uniform across north-western Europe. It is mostly found in Gallia Belgica and Gallia Lugdunensis[144] and it is rare in Germania Secunda.[145] Weapon graves are relatively closely associated with fortifications in the hinterland[146] but less so with frontier fortifications. In Germania

[121] Southern and Dixon 2009, 48-49.
[122] Heather 1997, 66.
[123] Southern and Dixon 2009, 48-49; see also Schwarcz 1995, 294 on their occasional inclusion in the *limitanei* units.
[124] Roymans 2017, 69.
[125] Roymans 2017, 69.
[126] Southern and Dixon 2009, 48.
[127] Southern and Dixon 2009, 71.
[128] Cf. Guest 2008 on *solidi* payments as part of treaties; Martin 2009; Roymans 2017; cf. Esmonde Cleary 2013, 350 on army payments in the Late Roman period in coin and/or bullion.
[129] Schwarcz 1995, 292-293.
[130] Schwarcz 1995, 293.
[131] Böhme 1974, 204-205; Lenz 2005, 368ff; Heeren 2017, 164; Roymans 2017, 66ff.; Roymans and Heeren 2022, 145-148.
[132] Kulikowski 2000, 326; Roymans 2017, 66; Schwarcz 1995, 295; Claudianus, *De Bello Gothico* 429-432.
[133] Böhner 1963; Böhme 1974; see also Werner 1958. Although originally interpreted as belonging to the historically known *laeti*, the elaborate burial rite associated with these graves was later deemed to be at odds with their relatively low social status; see discussions in Böhner 1963; Roossens 1968; Böhme 1974.
[134] Böhme 1974, 357-375; Theuws 2009.
[135] Böhme 1974; Theuws 2019, 130, figure 8.2; Hamm 2022.
[136] From the mid-4th century onwards, depositions of belt sets, brooches, and weapons for men (mostly lances, bows and arrows and axes) and brooches, hairpins and jewellery for women appear (Theuws 2009, 286-287). From the late 4th century onwards, a small number of male graves begin to include swords and shields (Theuws 2009, 287), although these are extremely rare. Finally, swords start to appear in graves in significant numbers from the second half of the 5th century onwards (Theuws and Alkemade 2000), which is considered the final step in the development towards the early medieval tradition of the *Reihengräber* or row graves (Halsall 1996; Brather 2014).
[137] See citations in Halsall 2009, 120.
[138] Southern and Dixon 2009, 50-55. Halsall 2014, 102-109, claims depictions of the barbarisation of the Late Roman army tend to be exaggerated.
[139] Hamm 2022; Swift 2006, 109-110.
[140] Halsall 2009, 135 claims they were used extensively by the Late Roman army and adopted by the Franks through military service, not the other way around; see Theuws 2009 on axes as woodworking tools.
[141] See for overviews Günther 1971; Geary 1988; Schulze-Dorlämm 1986a; Böhme 1996; Böhme 1999.
[142] Halsall 2000, 174; see also Kazanski 1995.
[143] Halsall also associated the deposition of knives with high-ranking military officials, as knives are often found with military belts in British cemeteries such as Lankhills and Gloucester (Halsall 1996, 201; see also Cooke 1998, 199 for the same theory).
[144] Böhner 1963, 146.
[145] Although finds from the Lower Rhine are known such as from Krefeld-Gellep (Pirling 1966-1997 and Pirling and Siepen 2000-2006) and Rhenen-Dondersberg (Wagner and Ypey 2011). However, since Böhme's 1974 inventory, the number of known Late Roman weapon burials has not increased significantly (Theuws 2009; Hamm 2022).
[146] Theuws 2009, 287, 312; Böhme 2008. Such as in the Ardennes (Furfooz, Samson and Vireux-Molhain; Brulet 1990; Dasnoy 1988; Lemant 1985) and along the Channel coast (Vron; Seiller 1992).

Secunda, most weapon graves in the immediate frontier zone are found in rural or urban cemeteries. Weapon graves in northern France and southern Belgium also date earlier (second half 4th century) than those in northern Belgium and the Netherlands (first half 5th century).[147] Weapon graves were not particularly well-established in Germania Magna as a burial,[148] while they are incidentally found across Northern Gaul in the Early and Middle Roman period,[149] suggesting the Late Roman examples may be continuations of a provincial-Roman practice.

For the weapon burial rite specifically, two camps seem to have formed:[150] those who view it as not inherently Germanic and more likely to express elite identities and potentially a development of pre-existing Roman practices[151] and those who interpret them as evidence for Germanic identities, usually *foederati*.[152] Several aspects of the weapon grave rite appear to have been rooted in provincial-Roman practices,[153] including the choice of inhumation, the deposition of pottery, glass and bronze vessels, and the placement of a coin in the mouth for an obol.[154]

Theuws has reframed the gift of weapons in graves as a symbolic gesture, rather than a sign of martial identity. He pointed out that axes, besides being used as weapons, could also function as tools; and he therefore links axes predominantly to the activities of wood-cutting and land-clearing.[155] He also rebranded lances, spears, and arrows as potential non-weapons, linking them instead to hunting activities,[156] with only the sword considered to have been purely a weapon. The relative rarity of weapon graves in the study area means that a re-evaluation of this particular burial practice can only achieve so much.[157] Some types of Late Roman military belt set, however, have also been linked to Germanic male identities, in particular the 5th-century types.[158] Finds of weapons and military belts outside of the Empire are commonly interpreted as evidence for Germanic veterans who had returned home after the end of their service.[159]

Military belt sets

Although military belt sets are linked to the weapon grave rite, they appear far more frequently in burial contexts and are found in fortifications, settlements, and as stray finds. This allows for a far wider range of find contexts to be included in their analysis. The Late Roman belt set also has an additional set social connotations attached it, namely the military community.[160] Belts were part of the Late Roman military dress, which also included a crossbow brooch and was meant to convey a soldier's identity when not wearing full armour.[161] Written sources refer to their *habitus atque habitudo* or their manner and dress.[162] From depictions on gravestones, it becomes clear that unarmoured soldiers would have been recognisable by their belted tunics, hob-nailed sandals and cloaks fastened on the right shoulder with a brooch.[163] Of these, the cloak and tunic are usually not preserved in the archaeological record and hob-nailed sandals are known to have been worn by civilians as well in the frontier zone.[164] We are left, therefore, with the brooches and belt sets.

The personal importance of the belt to the soldier is well attested in both the written sources and the archaeological evidence.[165] They are often found in graves and were likely kept by veterans after the end of their service as a sign of honourable discharge (*honesta missio*). As such, they would have functioned as a much more visual marker of someone's social status (and its associated benefits) than for instance the military diploma.[166] Stripping soldiers of military belts as a form of disciplinary measure dates back to the very Early Roman Empire and was also performed in some cases after capitulation, desertion or dishonourable discharge.[167] That the importance of the military belt was still felt in the Late Roman period is illustrated by several references to Christian soldier-saints who renounced their military status by publicly throwing off their belts.[168]

Some scholars have argued for the adoption of military-style belts by the civilian population in the Late Roman

[147] Böhme 1974, 204-205. Although Böhme originally linked the first group to Germanic settlers (the practice of depositing partial weapons, such as swords without scabbards etc. was seen as especially indicative), he only interpreted the weapon graves from 400 AD onwards as *foederati* graves (Böhme 1974, 203-204).
[148] Halsall 1992, 174.
[149] Van Doorselaer 1963/1964.
[150] Swift 2006, 105.
[151] E.g., Halsall 2010; Brather 2004; Theuws 2009; Theuws and Alkemade 2000.
[152] E.g., Böhme 1974; Böhme 2021; Siegmund 1998a; Bierbrauer 2004; Schmauder 2003; see for discussions Halsall 2010; Theuws 2019.
[153] Fehr 2008, 96.
[154] Böhme 1997, 93; Halsall 1996, 199-200; Halsall 2000, 168. Although some have suggested that using a gold or silver coin as an obol indicates a Germanic identity of the deceased; Böhme 2007, 7; Böhme 2021, 144; Gottschalk 2008, 243, Abb. 14). In fact, Böhme has argued that the adoption of Roman burial rites, material culture, dress style and subsistence strategy were all signs of assimilation of migrant communities into the Roman Empire (2003, 55-58).
[155] Theuws 2009, 301-303.
[156] Theuws 2009, 303-307.
[157] Furthermore, a superregional analysis of weapon graves is currently being undertaken by Benjamin Hamm at the University of Freiburg.
[158] Böhme 1974, 191.
[159] Böhme 1974, 194; Halsall 2009, 138.
[160] Sommer 1984; Hoss 2012; cf. Swift 2000a, 2-3.
[161] Hoss 2012, 29.
[162] Hoss 2012, 29; cf. James 2001; James 2004, 253.
[163] Speidel 1976, 124; Bishop and Coulston 2006, 253.
[164] Van Driel-Murray 2016, 140-141; Coulston 2004, 142.
[165] Coulston 2000; Hoss 2010; Hoss 2017ab; Speidel 2009.
[166] Hoss 2012, 31.
[167] See Woods 1993; Hoss 2012 for citations.
[168] Woods 1993, 55-60.

period,[169] although a predominantly army-related interpretation of these graves fits well with their distribution area, which is largely focused around the heavily militarised frontier zone,[170] in which military identities must have been an important currency. Bullinger also lists a number of depictions of Late Roman soldiers and emperors showing belt sets and elaborate buckles.[171] Swift argued that not all belts may have been exclusive to the Roman military, that those belts worn by civilians could have a different distribution and that social connotations may have been time-specific.[172] She also proposed that types with the widest and most universal distribution may be more likely to have been military associated.[173] Böhme has linked the appearance of late 4th and early 5th-century belt sets in Germania Magna to Germanic soldiers.[174]

Although Late Roman military belts are found throughout the Western Empire, some regionality in style has been identified. Simpson has studied the distribution of simple buckles and associated plates and loops in the eastern provinces of the Roman west, suggesting they were produced in *fabricae* in Pannonia or Illyricum, parallel to the crossbow brooch.[175] Hawkes and Dunning on the other hand, developed a detailed typology for animal-headed (especially dolphin-headed) belt buckles from Britain.[176] The vast diversity of forms and decorative styles have also led some to suggest that these belts could not have been part of the official military uniform.[177] However, the idea that the Roman army maintained any kind of enforced uniformity in its dress comparable to modern standards has been rejected in more recent studies.[178] The clustering of graves containing belts in the frontier zones has also been interpreted as a unique type of provincial rite that included burying the dead in full attire.[179] Their frequent appearance in Roman forts is checked by the understanding that those places were not only visited by soldiers, but also by members of the rural local population, soldiers' families, and crafts- and tradespeople.[180] Sommer furthermore pointed out that changes in legal status after AD 313 meant that the difference between military and civilian population became increasingly negligible in the frontier zone[181] and ultimately concluded that the belt set had lost all its military and governmental status in the Rhine and Danube provinces in the Late Roman period and that they were worn by civilians and military personnel alike.[182]

Sommer also suggested that the shift in social status of the belt from military to civilian was brought about by the increasing numbers of 'barbarians' enlisting in the Roman army, who may have used their own gear in the periods following the reigns of Diocletian and Constantine.[183] As evidence to support this, he notes the presence of 'barbarian' elements such as combs, scissors, tweezers, fire strikers and iron buckles and brooches.[184] Combs, tweezers, razors and scissors are not unusual occurrences in provincial-Roman rural cemeteries through the 1st-3rd centuries (e.g., Tiel-Passewaaij).[185] More generally, however, it should be emphasised that the appearance of certain objects in a non-Roman grave does not automatically make them inherently non-Roman: Böhme also listed crossbow brooches in his inventory of Germanic funerary gifts,[186] which are commonly seen as a key marker of Late Roman military power.[187]

Apart from typological differences between 4th- and 5th-century belts, distinctions in quality and production technology have also been highlighted. Böhme's analysis of elaborate *Kerbschnitt*-decorated military belts found close stylistic similarities between belt fittings found in the 'Gallo-Belgian' area and the area around the Danube.[188] At the very least, this seems to suggest the existence of a provincial style of military dress.[189] Böhme went one step further, however, in arguing that these provincial style similarities, together with the common occurrence of a limited number of decorative schemes and the highly complex and technical nature of producing these objects, are sufficient argument to suggest production by highly skilled workers in 'factory-like', state-run workshops in his *Stufen* I and II (AD 350-420).[190] He later proposed the workshops of the *comes sacrarum largitionum*[191] as locales of production.[192] In his discussion of later material, the *einfache Gürtel* of his *Stufe* III (AD 400-450), Böhme argued that these displayed so many individual styles as well as a simplified production method (open-sand

[169] Sommer 1984, 102ff.; see for a more elaborate discussion chapter 4.
[170] Swift 2006, 105; Sommer 1984, 87.
[171] Bullinger 1969, 68-69.
[172] Swift 2000a, 2.
[173] Swift 2000a, 201.
[174] Böhme 1974, 193-194.
[175] Simpson 1976, 196-198.
[176] Hawkes and Dunning 1961.
[177] Sommer 1984, 2, 101; cf. Böhme 1974, 54.
[178] Bishop and Coulston 2006, 266-267; Coulston 2013, 464.
[179] Cf. Koch 1965.
[180] Sommer 1984, 87; cf. Reuter 2008.
[181] Sommer 1984, 88.
[182] Sommer 1984, 100.
[183] Sommer 1984, 100. However, this is not necessarily a Late Roman phenomenon: the auxiliaries of the Early and Middle Roman period also used their own gear (Nicolay 2007).
[184] Sommer 1984, 101. See also Böhme 1974, 114ff. on a comparable list (reproduced below in table 1.1), which also includes, for men at least, razors, bag handles and carved horn or ivory objects).
[185] Aarts and Heeren 2012.
[186] Böhme 1974, 51. Cf. Allason-Jones 1999,1 on a similar argument regarding non-military finds from military contexts.
[187] Van Thienen 2017; Van Thienen and Lycke 2017; Swift 2000a, 3; Heeren and Van der Feijst 2017, 182.
[188] Böhme 1974, 94-97.
[189] See also discussion in Swift 2000a, 185-186.
[190] Böhme 1974, 97.
[191] Responsible for payments and precious metal revenues; Esmonde Cleary 2013, 350.
[192] Böhme 2021, 136.

casting instead of moulds, fixed backplates instead of hinges) that smaller, local workshops were behind their manufacturing.[193] Originally, he placed these in the Roman provinces and frontiers,[194] later also suggesting some production may have taken place in Germania Magna.[195]

Sommer also pointed out that although Late Roman buckles are depicted in the *Notitia Dignitatum* (on the pages concerning the *comites largitionum* and the *rerum privatorum*,[196] these are not found on the pages related to the *fabricae* themselves, making it less likely that the *fabricae* were involved in their manufacturing. Several *Halbfabrikaten*, a casting model and a mould of a belt fitting are also known from the Lower Rhine frontier,[197] so the possibility of small-scale production and repairs cannot be excluded. It has also been noted that due to errors and omissions in the *Notitia Dignitatum*, it does not offer an accurate list of the western *fabricae* in the 5th century.[198]

Further stylistic arguments have been put forward by Simpson, who pointed out that the amphora-shaped strap ends show a certain amount of uniformity in appearance and design, raising the possibility that these were produced in a limited number of workshops in a relatively short period of time.[199] Hoss has suggested that due to the relative frequency with which the Late Roman armies were defeated, new recruits needed to be equipped more quickly, potentially necessitating the introduction of the *fabricae*.[200] *Papyri* from the mid-4th century indicate that the production of linen for military outfits was also strictly state-controlled,[201] so it is not unreasonable to imagine the Roman state to be involved in the production of other gear for its soldiers. The Late Roman *fabricae* as mentioned in the Notitia Dignitatum are usually thought to have been positioned somewhere close to the stationed armies, behind the Rhine and Danube frontiers, most likely growing out of existing military and/or civilian industries.[202] James describes how the Roman government was able to exercise a significant amount of supervision over the production of military equipment, dictating quality control and regulations, accounting for material costs and setting production quotas.[203]

However, the link between belts as opposed to weapons or other forms of armour and the *fabricae* is largely assumed. Swift has pointed out the general lack of archaeological evidence for production, as most studies rely on stylistic features to suggest workshop groups.[204] In addition to this, most of the attention has always gone to the *Kerbschnitt* belt sets, despite them making up only a minority of the material in the study area (see chapter 4). Böhme has argued for more localised production for the simpler belts of the 5th century,[205] but has offered little interpretation for the non-*Kerbschnitt* material of the 4th century.

A similar discussion has revolved around the production of the military crossbow brooch. Production in state-run manufacturing centres has been suggested,[206] although again concrete workshop evidence is lacking.[207] Very little is known about the inner workings of these workshops. It may be expected that each man worked individually to produce finished pieces from scratch or that there was division of labour in the production of some items; for example, metal and wooden parts of shield may have been made by different workmen.[208] However, given the expected size of these workshops, it is equally imaginable that labour was specialised and divided, with each step of the production process delegated to a specialist worker, rather than object types. James also raises the unanswerable question of whether, and to what extent, army units repaired their own gear and if items would be sent back to the *fabricae* for refurbishing.[209]

Focusing on attaching labels such as *fabricae* or *comes sacrarum largitionum* do not really tell us all that much about the actual production organisation. It is much more fruitful to discuss these objects in terms of standardisation of production and the possible indications for state control over various stages of the production process. Böhme has suggested that more metallurgical analysis and study of Late Roman belts is necessary to understand their production more accurately,[210] and recent work on crossbow brooches may serve as an inspiration.[211]

Rural settlements

Alongside changes in burial rites and object styles, rural timber-built settlements also underwent a marked development in Germania Secunda and adjacent provinces in the Late Roman period. These include the introduction of three-aisled longhouse types similar

193 Böhme 1974, 97.
194 Böhme 1974, 97.
195 Böhme 2021, 137.
196 Sommer 1984, footnote 116.
197 Sommer 1984, 102, Abb. 1 on *Halbfabrikaten*; cf. Oldenstein 1985, 89; Hoss 2018, figure 8.7; Böhme 2008; Böhme 2021.
198 O'Hara 2013, 137.
199 Simpson 1976, 200.
200 Hoss 2021, 6.
201 See references in Liu 2012, 21; Dross-Krüpe 2012.
202 James 1988, 262, 269; cf. Böhme 2021, 135ff.; see also Glad 2018.
203 James 1988, 271, 275.
204 Swift 2000a, 1.
205 Böhme 1974, 97; Böhme 2021, 137.
206 Especially in Pannonnia; e.g., Riha 1979, 171; Van Thienen and Lycke 2017, 51.
207 Swift 2000a, 3; Van Thienen 2021, 48. Although some lead models are known from Socchieve, Italy (Giumlia-Mair *et al.* 2007).
208 James 1988, 275.
209 James 1988, 275.
210 Böhme 2021, 136.
211 Bayley and Butcher 1981; Bayley and Butcher 2004; Van Thienen and Lycke 2017.

to those common in Germania Magna, sunken feature buildings (SFBs), evidence for rye cultivation and handmade pottery in Germanic styles.[212] Handmade pottery is common in Late Iron Age and Early Roman sites in the province of Germania Inferior, although it would become significantly less important over the course of the Middle Roman period in rural settlement contexts.[213] As a result, various studies have aimed to define Late Roman Germanic-style handmade pottery on Roman soil more precisely.[214] Pottery in a non-local style, when made in local fabrics, may indicate the movement of their makers and consumers, and this may be especially true for vessels associated with particular ways of preparing and consuming food.[215]

Timber-built rural settlements were the most common settlement type throughout the Iron Age and Roman period on the sandy soils of Flanders and the southern Netherlands as well as the river deltas of the Meuse and Rhine and are also known, albeit more rarely, from the villa landscapes of the German Lower Rhine area.[216] There are clear similarities in ways of life between the provincial-Roman and Germanic rural settlement landscapes.[217] However, studies into Late Roman timber-built settlements tend to focus on the differences, rather than similarities.

Heeren has drawn a distinction between the stylistic developments of house plans on either side of the Rhine frontier.[218] He interprets the presence of three-aisled longhouses in the 'northern tradition' in several Late Roman settlements in Germania Secunda as evidence for migration from the north,[219] despite the fact that each house plan is unique and some deviate quite strongly from northern typologies.[220] Heeren sees their presence in Germania Secunda as a sign that '*the house-building traditions of the region of origin remained virtually unchanged and recognisable in the immigration area*',[221] citing the similarities of the sandy subsoil, climate, and vegetation in both the emigration and immigration areas as well as the abandonment of the immigration area as contributing factors.[222] However, others have suggested that not just the similarities, but the clear structural differences also need to be explained.[223] Bender has furthermore warned against interpreting the development of the Late Roman rural settlement landscape along the Rhine in too simplistic terms, arguing that there were no single patterns or tendencies or supra-regional causation behind the changes.[224]

The argument for rye as a cultural signifier is based on the link between cultural or social identities and food habits[225] and the general absence of rye in the areas south of the Rhine before the Late Roman period, while it played an important role in the diets of communities living in the sandy regions north of the Rhine from the 1st century AD onwards.[226] However, rye is mentioned in some Roman sources[227] and some previous studies have suggested it was at least consumed by inhabitants of the western provinces.[228] Furthermore, changes in dietary

[212] Henning 1989; Van Ossel 1992; Whittaker 1994; Lenz 2005; Heeren 2017; Kaspyrzk 2017; Jäger 2019; Hamerow 2012; Steuer 2021. Other, less easily quantifiable criteria are also occasionally used, such as evidence for iron and bronze working (which is indeed commonly found in settlements in Germania Magna but can hardly be called culturally specific) and the proximity of some settlement sites to cemeteries with graves containing Germanic-style grave goods (also rather open to vagueness and circular arguments). Finally, Lenz (2005, 386, 432) lists epigraphical evidence as a tool for identifying Germanic occupation of provincial-Roman *villae rusticae*.

[213] Vos 2009, 88; cf. Van Enckevort 2012, 317. See also Hendriks 2023, 628 on its disappearance and later reappearance in the Meuse valley. Elsewhere, however, more continuity was found. In the Lys-Scheldt area, it made up 80-90% in contexts dating up until the Flavian period, after which it declined to around 40% in the late 2nd to mid-3rd century (Vermeulen 1992, 103-113 in Van Thienen 2016, 171). In terms of functionality, handmade wares would be well-suited to processing heat due to their form, large pores and inclusions (Van der Veen 2018; Rice 2005, 368), perhaps explaining why this local/regional practice did not completely cease when wheel-turned import wares became available.

[214] De Paepe and Van Impe 1991; Van Thienen *et al.* 2020; Opsteyn 2003; Verhoeven 2003.

[215] Eckardt and Müldner 2016, 206; Prien 2005, 311; Eckardt 2014, 30.

[216] Brüggler *et al.* 2017.

[217] Elton 1996a, 130; Elton 1996b, 109.

[218] Heeren 2017, 160-162. Arguing that longhouses north of the Rhine were predominantly three-aisled, charting their development from the Hijken type in the Late Iron Age to the Wijster B and Peelo A types in the Late Roman period (see for this development also Huijts 1992; Waterbolk 2008; Van der Velde 2014). In contrast to this, he cites several instances of house plans part of the building traditions south of the Rhine, namely the shorter two-aisled Haps and Oss-Ussen 5A houses of the Late Iron Age and the two-aisled Alphen-Ekeren house, which became the standard house type for the southern Netherlands and northern Belgium from the 1st to late 3rd century (Heeren 2017, 162).

[219] Heeren 2017, 162.

[220] Heeren 2017, 162; cf. Theuws 2008, 876, Abb. 12.

[221] Heeren 2017, 162.

[222] Cf. Heeren 2015.

[223] Van Ossel and Ouzoulias 2001, 238. See in particular their discussion of Gennep, Donk, Neerharen-Rekem and Sint-Gillis-Waas, questioning the homogeneity of these 'Germanic' settlements (Van Ossel and Ouzoulias 2001, 238).

[224] Van Ossel and Ouzoulias 2001, 194.

[225] Heeren 2017, 162; Eckardt and Müldner 2016, 206; Cool 2006a, 172ff.; Cool 2006b, 75.

[226] Heeren 2017, 162, citing Hiddink 1999, 157-162 and table 3; see also Van Zeist 1968.

[227] Mills 2006, 176. Pliny writes in his Natural Histories about the versatility of the crop, as well as its high yields and unpleasant flavour (*Plin. Nat.* XVIII.XL.141). Atheneaus mentions rye bread (*Ath.* III.74) and the price of rye is also listed in Diocletian's price edict of AD 301 (Mills 2006, 182).

[228] Helbaek suggested that rye was introduced in Britain by the Romans (1964, 163), while Kooistra has suggested that the presence of small amounts of rye in some pre-Flavian military fortifications could indicate that farmers from north of the frontier supplied the Roman army with cereals (Kooistra 2009, 227). Van Zeist also noted the presence of small amounts of rye from Roman sites in the southern Netherlands while it was completely absent from several contemporary sites from the northern Netherlands (Van Zeist 1968, 160). He argued that it was unlikely that weed rye confined itself only to those regions conquered by the Romans, suggesting the possibility of cultivation in a rotating crop system that also included other cereals like barley and wheat (Van Zeist 1968, 160) as well as the likelihood that it was the Romans who introduced rye as a crop to the southern Netherlands (Van Zeist 1968, 161).

habits by introducing new crops could also be the result of economic crises[229] or contact with other groups (such as the introduction of the potato from the Americas to Europe).[230] Apart from these considerations, there are methodological complications in distinguishing rye in crop and weed form in archaeobotanical samples,[231] further complicating the interpretation of archaeological data.

The available evidence for migration-related settlements also dates quite broadly, extending in some cases to Germanic-style handmade pottery into the 2nd or 3rd century.[232] Other migration-related settlements appear to have been founded in the early 4th century or were not newly founded sites but formed later phases in provincial-Roman native settlements (see for examples chapter 2). Fitting the characteristically complex and ambiguous archaeological record in a narrow chronological window strips away the longer cultural processes of exchange, adaptation, acculturation, and cross-frontier mobility that lay at their root.

The scientific revolution

Despite criticism that ethnicity is best understood as a constructed identity, not as a matter of biology[233] and some studies criticising answering cultural historical questions with modern techniques,[234] methods such as stable isotope and ancient DNA are increasingly being used to identify and study migrations in the past. Recent works have highlighted both the existence of mobility in the (Late) Roman period and a distinct lack of simplicity and linearity in how mobility took place.[235] In a triple-isotope analysis of burials in the Dutch central river area, almost all sampled burials from the Early-Middle Roman period displayed strontium levels consistent with the local or regional range, including in samples related to childhood.[236] Half of all Late Roman burials provided indications that the deceased had spent their childhoods elsewhere.[237] This group included strontium signals that are non-regional (outside of the river area) and non-local (somewhere else within the river area.[238] Definitive areas of origin were not identifiable based on the strontium spectra. Two individuals possibly originated from Hungary, based on their carbon isotope signals; ancient mDNA from a male in Tiel-Medel with a local strontium signature showed a genetic link with regions where millet and sorghum are staple cereals, namely the Near and Middle East, the Caucasus or Northwest Africa.[239] Some buried individuals were found to have moved more than once during the first 16 years of life.[240]

Data collected from north of the frontier showed that mobility was equally common there,[241] with some samples displaying strontium and oxygen signatures found outside of the Netherlands, including Italy, France and Britain.[242] Non-Dutch origins and intra-individual mobility were also found in several Late Roman burials from Germania Secunda.[243] It seems that in the Late Roman period, high degrees of mobility, occasionally over long distances were normal occurrences both inside and outside the Empire.[244] A clear movement of people from outside the Empire to the frontier zone or further into the provinces was not evident from the isotope signals.[245] Burials with Germanic-style material culture at the Late Roman cemetery at Hürth-Hermülheim yielded identical isotope signals to those in contemporary graves without Germanic indicators.[246] The strontium samples of four burials were found to be comparable to samples from across the frontier (three women, one man) but none of those graves contained Germanic-style material culture.[247]

Some methodological issues may be raised that need to considered when combining artefact studies with isotope analysis. First of all, best practice for securely identifying local origins of people is a multiple-isotope approach.[248] Furthermore, most studies cited above are relatively small-scale, and a much more rigorous dataset is needed before any definitive statements about movement, migration, or the scale thereof can be made. Finally, extreme care should be taken in linking

[229] Cf. Squatriti 2016.
[230] Prien 2005, 314.
[231] Behre 1992; see chapter 3 for more discussion.
[232] Opsteyn 2003; Vermeulen 1992; cf. Van Thienen 2020, 9-10.
[233] Jones 2009, 5; Halsall 2014, 518-519.
[234] Crellin and Harris 2020.
[235] Killgrove 2010; Montgomery *et al.* 2010; Swift 2010, 238; Gretzinger *et al.* 2022; Antonio *et al.* 2019; Kootker and Heeren 2022; Kootker *et al.* 2022; Schweissing and Grupe 2003; Evans *et al.* 2006; Redfern *et al.* 2016; Martiano *et al.* 2016; Budd *et al.* 2004; Eckardt *et al.* 2014; Eckardt and Müldner 2016; Eckardt 2010; Leach *et al.* 2009; Prowse 2016.
[236] The authors note that based on the data, mobility between isotopically similar regions cannot be excluded (Kootker *et al.* 2022).
[237] Six out of 12 burials sampled (Kootker *et al.* 2022), which is a limited dataset. A more large-scale study into isotopes from human burials is currently ongoing (De Coster in prep.).
[238] Kootker *et al.* 2022, 6.
[239] Kootker *et al.* 2022, 7; Altena in press. This burial also contained a Late Roman belt set, which raises questions around the regional origin of those displaying military identities in the Lower Rhine frontier zone.
[240] Kootker and Heeren 2022, 59.
[241] Kootker and Heeren 2022, 48.
[242] Kootker and Heeren 2022, 49.
[243] Kootker and Heeren 2022, 60.
[244] Apart from the complexity of the results themselves, some have also argued that these types of projects for failing to appreciate that migration never happened in discrete periods but was constant (Halsall 2012, 33), while others frame this development as introducing objective data to a largely subjective argument (Härke 2004, 456; Hakenbeck 2008, 9).
[245] However, Kootker and Heeren propose that based on similarities between contemporary settlements on either side of the frontier and the occurrence of gold coin hoards in the area, north-south migration would still be the most likely scenario (Kootker and Heeren 2022, 67-69). It is not entirely clear from their synthesis how the large number of Late Roman 'non-Dutch' samples fit into this narrative.
[246] Gottschalk 2008, 144.
[247] Gottschalk 2008, 144.
[248] Madgwick *et al.* 2021; Kootker *et al.* 2022.

isotope signals to perceived regional origins of material culture. Although Kootker *et al.* claim that in their preliminary results, the correlation between stable strontium, oxygen and carbon isotopes and material culture is 'evident', the wide range of signals in their samples, the difficulty in interpreting the oxygen and carbon signals in their dataset and the varying levels of evidence for regional origins of material culture[249] should caution us against using material culture to narrow down regional origins from isotope analysis or vice versa. As Crellin and Harris point out writing on aDNA, the introduction of new (scientific) data does not remove the need for a thorough theoretical framework for interpreting material culture.[250]

Discussion and themes

Several themes can be extracted from the very brief overview of Late Roman archaeology presented above. Underlying everything is a perceived dichotomy between the 'Roman' 4th century and the 'Germanic' 5th century.[251] Halsall argued that the 5th-century migration debate needed '*to be placed in a longer-term perspective looking at both sides of the divide between the 'Roman' fourth century and the 'migration-period' fifth century*'.[252] The archaeological remains of the rural and military communities on both sides of the Lower Germanic Rhine frontier in the Late Roman period are an ideal case study for exactly that rethinking. A data-led, holistic approach was taken in order to include as many facets of Late Roman society as possible.

The growing amount of data available for this region has already been touched upon. This provides the opportunity to update distribution maps and potentially upset conceived wisdom about the regional origins and developments of object types. The publication of new closed contexts also means dating evidence and typo-chronologies (many of which were founded in the 20th century) can be reviewed. Focusing on one province means all the evidence comes from one area that was in the eyes of the Roman state a cohesive whole, even though it might not have been culturally homogeneous. By restricting the geographical scope, a more in-depth analysis of the finds and settlement features may be presented: although superregional studies are great tools for drawing comparisons between patterns found in other regions, a larger research area and subsequent increase in data means less space can be devoted to detail. The comparison with Germania Magna is also very important, as the arguments for labelling certain finds categories or styles of architecture as 'Germanic' have often relied on simplistic references to evidence from outside of the Empire. The available evidence for the Lower Rhine frontier and its surrounding area is extensive and much of the raw data has already been published in regional studies before.[253] However, there is room for new interpretations and treatments of much of this evidence and there are several next steps that can be taken in the migration debate using the archaeological data from this area.

In term of themes and datasets, several may be taken from the literature review. First is the transformation of the military occupation of the region in the 4th and 5th centuries and the increased deployment of Germanic *foederati* in the Lower Rhine area from the late 4th century onwards.[254] Secondly, there is the simultaneous transformation of the rural settlement landscapes, which is typically described in terms of abandonment by and replacement of provincial-Roman habitation through Germanic migration.[255] Thirdly, there is the development of new styles of material culture in the form of brooches and hairpins. The appearance of military elites or *foederati* and female-associated high-status dress accessories in the frontier zone cannot be seen as separate from the emergence of migration-related settlements in Germania Secunda. In my view, these three phenomena are part of a wider cultural shift taking place along the Lower Rhine frontier and its hinterland. In order to facilitate a fresh approach, it is key to use a variety of datasets. This monograph does not include an integrated approach of both historical and archaeological sources. As outlined in the literature review above, this often results in attempts to fit ambiguous archaeological data in a linear historical narrative. For that reason, it was decided to focus for this dissertation on a critical analysis of the archaeological data first (for material culture and settlements), as well as the creation of a new archaeological dataset (XRF), which in future may reinvigorate the debate.

Migration, assimilation, and adaptation: settlements

A fruitful approach to changes in the Late Roman rural settlement landscape in Germania Secunda is to take a *longue durée* perspective to the most important developments (changing architecture, diet and material culture) on both sides of the frontier to allow long-term interactive processes such as trade, exchange and mobility to play a role and move away from an event-based narrative.[256] Migration and mobility are a constant and predictable aspect of human existence,[257] and this must have been especially true in the Roman frontier

[249] Kootker *et al.* 2022, 6-7.
[250] Crellin and Harris 2020, 38.
[251] Swift 2006, 105; Halsall 2012, 29.
[252] Halsall 2012, 29.
[253] Böhme 1974; Lenz 2005; Van Thienen 2016; Heeren 2017; Kaspyrzk 2017; Mirschenz 2013; Bérenger 2000; Brieske 2001.
[254] Böhme 1974, 204-205; Heeren 2017, 164; Roymans 2017, 66ff.; Roymans and Heeren 2022.
[255] Henning 1989; Lenz 2005; Heeren 2017; Kasprzyk 2017; Jäger 2019; Hamerow 2012.
[256] See Bruun 2016, 192 on the differences between trade, travel, mobility and migration.
[257] Halsall 2014, 519; Anthony 1997, 22.

zones.[258] A characterisation of Late Roman migration-related settlements needs to focus not only on potential markers for the presence of Germanic identities, but also take into account the survival of provincial-Roman settlement characteristics and identify concrete signs of interaction and hybridisation. This allows the study of long-term interactive processes such as trade, exchange and mobility to play a role and move away from an event-based narrative.

It will also aide in incorporating these 'migration-related' settlements into wider discussions on settlement continuity in the Late Roman period. Miller has argued that the formation of a frontier culture that was not the direct result of peoples living across the Roman frontier or the '*Germanised Roman army*', but instead the result of a millennium of interaction between the Mediterranean and the inhabitants of northern Europe.[259] 'Barbarisation' should instead be understood as a much more complex process: '*the emergence of a culture-type that is of the frontier but that is not necessarily produced by a floodtide of barbarian intrusion*'.[260] That what we refer to as provincial-Roman in the frontier zones always was a hybrid of sorts[261] and far from static throughout the Roman period. Styles of pottery, material culture and architecture changed significantly throughout the Early and Middle Roman period.

Timber-built houses in Germania Inferior/Secunda were far from uniform or static. Some types dated to the Early and Middle Roman period show influences from outside of the Empire,[262] while others are more hybrid[263] and yet others appear more widely across multiple provinces.[264] The pottery assemblages from these sites feature a wide area of geographical origins, including wheel-turned pottery from regional and provincial production centres as well as handmade pottery rooted in Iron Age traditions.[265] At the same time, dress accessories originating outside of the Empire are occasionally found within Germania Inferior as well.[266] This constantly shifting, developing settlement landscape is referred to by terms such as 'provincial-Roman' or 'native-Roman', with adoption of new types of material culture or architecture a key part of the fabric.

Studies on the Late Roman period, however, have usually portrayed the changes in settlement landscape in that period as distinct from this broader process, and solely related to Germanic migration. The chapter on settlements has the opportunity to put Late Roman settlements with Germanic features into a broader perspective, both chronologically and spatially, and investigate how these settlements developed and may be placed in this long history of frontier hybridity and adaptation. This will aide in breaking down the Roman: Germanic dichotomy that underpins so much of the discourse around the Late Roman period in the West, allowing additional interpretative frameworks for cultural change such as globalisation and glocalisation to be considered.[267]

A long-term approach also allows for the social impact of mobility to be addressed. Goffart has highlighted questions about the effects migration-related settlements may have had on the areas where they were founded and the relationships between newcomers and established inhabitants.[268] In this light, he noted that the '*social and proprietary order*' and economies of many provinces in southern Europe did not seem to have been significantly disrupted by the arrival of Goths, Vandals or Burgundians.[269] Van Ossel and Ouzoulias have also noted that many settlements linked to Germanic settlers look very different from each other, which has not been adequately addressed.[270]

Germanic-style dress accessories and changing fashions

The discussion of the jewellery grave tradition showed that although Germania Magna and Secunda shared many styles of dress accessories, a detailed typological differentiation has led to the recognition of some brooch and hairpin types that may have been produced in the provinces or outside the Empire. Böhme has also suggested that many of the Late Roman Germanic brooches and hairpins found in Gaul had 'older' forms circulating in Germania Magna,[271] suggesting a clear chronological north-south movement of material culture that may be further examined. Besides pure geographic distribution, find context can also be considered more fully. Some objects may have had a specific site-type profile or social distribution: occuring in some types of sites, but not in others.[272] The focus has often been on the burial evidence as these are a clear artefact trap but finds from settlements and other contexts are increasingly numerous.

To reframe Germanic-style material in the study area, I have elected to take a longer-term perspective and study a number of brooches and hairpins dating from the late 3rd to the 5th century, choosing those types which have

[258] Whittaker 1994.
[259] Miller 1996, 169.
[260] Miller 1996, 163.
[261] Cf. Pitts and Versluys 2015b on this term.
[262] E.g., Rijswijk; Bloemers 1978; Vos and Lanzing 2000.
[263] Dutch river area; Kodde 2014; Van Renswoude and Boreel 2014.
[264] E.g., Alphen-Ekeren type houses; Van Hoof 2007, 256-259; Van Enckevort and Hendriks 2014, 240.
[265] Van den Broeke 2012.
[266] Heeren and Van der Feijst 2017.
[267] Pitts and Versluys 2015b; Van Alten 2017.
[268] Goffart 2010, 75-76.
[269] Goffart 2010, 88.
[270] Van Ossel and Ouzoulias 2001, 238.
[271] Böhme 2009, 39-40.
[272] Swift 2010, 239; Eckardt 2005, 142-149.

well-established typologies and that are common in the study area. This *longue durée* presentation will allow the mapping of material culture styles and highlight periods or regions of brooch and hairpin diffusion, innovation or adoption. Combining the stylistic developments of all these objects throughout the Late Roman period, the case will be argued in chapter 3 that these changes in Late Roman material culture may be less indicative of Germanic identities and more of the formation of a unique, Late Roman regional style of dress accessory that incorporated Germanic-style elements. Again, studying brooch developments on both sides of the frontier is critical in establishing the social and cultural environment in which these brooches existed. To bridge the gap between the 4th and 5th centuries, a series of closely datable brooches and hairpins were selected that appeared in sufficient numbers in the study area. Some of these date to the 4th or 5th century exclusively, others circulated in both centuries.

Production organisation of military dress accessories

Finally, the literature review indicated the research potential of analysing the chemical composition of copper-alloy dress accessories alongside typological and stylistic descriptions as well as in-depth analysis of regional distributions and depositional patterns. Most of the objects, tools and weapons associated with 'Germanic' burial contexts are not inherently military or Germanic in nature,[273] limiting the potential of mapping them outside of a limited number of contexts.[274] Several are also not closely datable on typology alone, excluding much of the settlement and stray finds. The focus was therefore placed on personal dress accessories with well-defined chrono-typologies, namely crossbow brooches and military belt sets. [275] These have been strongly correlated to military identities and are therefore suitable as a proxy for studying the development of the Late Roman Rhine frontier over time.[276]

Late Roman *Kerbschnitt* belts have in the past been associated with Germanic identities,[277] sometimes linked to the barbarisation of the Late Roman army,[278] despite some *Kerbschnitt* schemes featuring classical motifs that do not occur outside of the Empire.[279] They are more generally thought to have been worn by Roman government officials, and soldiers within the army, be they Roman or Germanic.[280] The presence of military belts outside of the Empire has been interpreted as Germanic men returning home after service in the Roman army.[281] While *foederati* have sometimes been portrayed as independent bands of mercenaries only kept loyal through gold payments,[282] their use of recognisable military insignia in the form of belts may be an indication of a more embedded position within the Roman military apparatus. Belt sets are common in graves, but also in other contexts, in both the 4th and 5th centuries. This chronological longevity allows us to study the military and ethnic connotations of belt sets in the study area. Some have already used the distribution of different buckle styles or belt sets to discuss changes in frontier policy and defence[283] and this may be expanded upon with the inclusion of more recent finds, especially those from settlement contexts and by exploring their distribution in Germania Magna.

The macro-political developments around the organisation of the Late Roman Lower Rhine frontier may be connected to Böhme's original observations that some 4th-century belts were centrally produced, while later material showed more indicators of localised production,[284] an interesting pattern considering the recent dating of the *foederati* in the study area around the turn of the 5th century.[285] Böhme's later proposal that production may even have moved out of the Empire is also worth exploring further,[286] as is Elton's suggestion that soldiers on the Late Roman frontiers were partially supplied in a centralised fashion, but also collected supplies themselves.[287] Working from

[273] Cf. Allason-Jones 1999, 1.

[274] Of the tools and weapons, *spathae* would make the most sense to include, but these are so rare that they provide only limited opportunities to add new perspectives. Also, a much broader study into weapon burials in Europe is currently ongoing (Hamm in prep.).

[275] A further selection criterion for the dress accessories was whether they occurred in significant numbers within Germania Secunda. This excluded the composite crossbow or bow-knob brooch (*Bügelknopffibel*), which although included in Böhme's 1974 inventory is only very rarely found in Germania Secunda and its distribution in Germania Magna also falls largely outside of the chosen study region. Their main distribution area lies between the Upper Rhine and Upper Danube, East Germany and the Czech Republic between the Elbe and Oder rivers. The handful of finds recorded in southwest Germany and the Netherlands may be seen as outliers on the edge of this main distribution region (Bemman 2008). They are generally seen as Germanic imitations of the proper crossbow brooch and circulated from the second half of the 4th century to the early 6th century (Heeren and Van der Feijst 2017, 194; Schulze-Dorlamm 1986b, 630; see also Voß 1998).

[276] This period saw great political changes affecting the region, with general Stilicho withdrawing troops in AD 402 to fight in the civil war (Kulikowski 2000, 326; Roymans 2017, 66; Schwarcz 1995, 295; Claudianus, *De Bello Gothico* 429-432). The standing army is assumed to have been replaced in the following years by Germanic *foederati* (Roymans 2017; Heeren 2017; Southern and Dixon 2009), but the impact of these historical developments on how the frontier and its garrisons was maintained as well as the size and organisation of these new border forces long remained underexplored.

[277] Cf. Elton 1996a, 129; Hoss 2012, 40.

[278] See for criticism Halsall 2000, 174.

[279] Bishop and Coulston 2006, 223; Hoss 2012, 40.

[280] Bishop and Coulston 2006, 224; Swift 2000a, 2; Sommer 1984, 87-101; James 2004, 251. Buckles with animal-headed terminals, which are common in the Western provinces, may have originated in Iran and the Roman East (James 2004, 251).

[281] Böhme 1974, 204-205; Halsall 2014, 525.

[282] See discussion in Roymans 2017.

[283] Swift 2000a, 199-204.

[284] Böhme 1974, 97; Böhme 2021, 135.

[285] Heeren 2017, 164; Roymans 2017, 62; Heeren and Roymans 2021, 145-148.

[286] Böhme 2021, 137.

[287] Elton 1997, 47.

the hypothesis that the military organisation was at least partially separate from local civilian workshops, we may also ask whether objects with a different social label (related to the wearer) also show consistent differences in chemical composition (related to the producer). This could focus on whether particular objects show a preferred alloy or mix (either related to look or function) and whether particular trace element signals show up consistently in either group, which could indicate a different supply line of material.

Swift has shown how combining stylistic analysis with alloy composition of dress accessories can successfully identify non-local material and relations with manufacturing groups.[288] Archaeometric analyses including dimensional measurements to tackle production standardisation and metallurgical composition to map technology and metal use have successfully added to our understanding of contemporary crossbow brooches[289] and a similar approach to belt sets may be insightful. Although a great number of metallurgical studies of Roman dress accessories are available, some of which include Late Roman material, no large-scale supra-regional dataset of Late Roman military dress accessories has yet been collected. Swift has observed that dress accessories associated with the military may have been produced to different standards and under a certain amount of control compared to civilian items[290] and that these may be identifiable in the archaeological record.

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.[291] 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.[292] This includes understanding the role in society of domestic/part-time or specialised/full-time production, specifically the notion 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 were more likely to be able to specialise in one particular aspect of the manufacturing process, introducing a level of standardisation into the process. An assessment of specialisation and production intensity can include looking at material composition, manufacturing techniques, forms, dimensions and surface decoration.[293] Low variability in any of these categories may be assumed to reflect a 'high number of hands' involved in the production sequence.[294]

The term workshop also needs further defining in this context. Very little archaeological evidence is available on actual Late Roman state workshops or on where different parts of the *chaîne opératoire* took place. Activities such as primary metal smelting, primary alloying, scrapping and recycling may have happened in different production centres or workshops than casting, finishing, decorating and repairing. A study of the standardisation of dimensions and the chemical composition of Late Roman military belts has the potential to unveil much about the first part of the *chaîne opératoire*, while a detailed analysis of decoration and typology may reveal more about the organisation of the latter half of the production stages.

Based on previous studies, some expected outcomes of the metallurgical experiment may also be outlined. The closest, geographically speaking, comparative available dataset consists of invasive EDX readings taken from military belt fittings from the Late Roman cemetery at Linz, Austria.[295] Much of the material found there appears to be best characterised as a highly mixed, quaternary alloy (containing zinc, tin and lead).[296] Mixed alloys tend to be associated with higher rates of recycling.[297] This means that for Late Roman material, rates of recycling need to be taken into account and the extent to which smiths were even able to choose specific materials for specific purposes.

Any patterns that this thesis may find in military dress accessories, therefore, need to be embedded in a wider discussion of copper alloy use in the Late Roman period. For this purpose, a literature review was carried out of chemical studies into copper alloys from the 1st-3rd centuries AD to investigate how Late Roman alloys may have differed. Although the focus of the dataset lay firmly on the military belt fittings, a smaller comparative dataset of contemporary civilian-associated dress accessories (brooches and hairpins) was also gathered to allow further comparing and contrasting of metallurgical developments between 4th- and 5th-century material. This gave more certainty to any interpretations of chronological patterns: is the composition of 5th-century material different from earlier material because of a marked shift in production organisation, or is this development reflective of wider changes in metal use?

Broad developments in alloy use and metallurgy are best studied using large datasets which encompass multiple

[288] Swift 2010, 239; cf. Swift 2000a 81-88.
[289] Bayley 1998; Bayley and Butcher 2004; Van Thienen and Lycke 2017.
[290] Swift 2000a, 2.
[291] Longacre 1999.
[292] Roux 2003, 768.
[293] Roux 2003, 768.
[294] Costin and Hagstrum 1995, 622.
[295] Presslinger and Gruber 1999.
[296] Presslinger and Gruber 1999, tables 1 and 2.
[297] Pollard *et al.* 2015, 703.

variables, such as typo-chronology and geography.[298] Because of the need for a large number of objects, the choice was made to use non-invasive surface pXRF, a technique that allowed a large amount of high quality data to be gathered without the need to take destructive samples. Locations on the object surface of decorative treatments such as tinning or gilding may also inform about metallurgical technology. These data can then be correlated to other archaeological information, namely typology, social connotations and regionality. A more in-depth discussion about this technique and its suitability to archaeological metals is presented in chapter 5.

Research objectives and structure

This book addresses four main research objectives, each of which were split out in several specific research questions.

Objective 1. Bridge the gap between the 4th and 5th centuries in the migration debate, focusing especially on the rural settlement landscape

A great deal of high-quality archaeological data on rural settlements in the Late Roman provinces has been made available in recent years. Yet still, these are often interpreted in a highly ethnicised perspective (Germanic migration-related settlements) and dated to a narrow time frame (late 4th-early 5th century). Two research questions were formulated to dissect and reinterpret the data:

1. How do specific aspects of the settlement landscapes (architecture, diet) develop in Germania Secunda and Germania Magna alongside each other and what role did they play in the development of the Late Roman rural settlement landscape in Germania Secunda?

2. How do the 'migration-related settlements' compare to each other in terms of (dis)similarity of the archaeological evidence?

Potential indications of non-Roman inhabitants of rural settlements in Germania Secunda are analysed in chapter 2. This chapter aims to study the variety of settlements and their features, place these in a chronological framework that straddles both the 4th and 5th centuries and provide an in-depth comparison with contemporary settlements and Germania Magna to allow long-term interactive processes including exchange and mobility tobe considered. Features that will be discussed are changes in architecture (house plans and sunken feature buildings), changes in diet (cultivation of rye) and changes in material culture (Germanic-style handmade pottery).

[298] Pollard and Heron 2008.

Objective 2. explore whether differences in material culture can be attributed to migration or wider developments

Research objective 1 will be tackled in chapter 3, through two specific research questions:

3. How can we trace the typological development of dress accessories typically associated with Germanic women (brooches; hairpins) in the study are from the late 3rd to the 5th century?

4. Can the spatial distribution and depositional patterns of these objects challenge the various identity labels traditionally attached to them (including 'Germanic' and 'female') and inform us about the adoption and adaptation of dress accessories in a Germanic style in the study area?

Chapter 3 involves a typological overview and spatial analysis of the most commonly found 'Germanic' dress accessories. This includes an assessment of their social or cultural connotations based on their distribution and find contexts as well as dating discrepancies between Germania Magna and Germania Secunda from the late 3rd to 5th century. This longue durée presentation will allow the mapping of movement in material culture styles and highlight periods or regions of brooch and hairpin innovation or adoption. Combining the stylistic developments of all these objects throughout the Late Roman period, the case will be argued that these changes in Late Roman material culture may be less indicative of Germanic identities and more of the formation of a unique, Late Roman regional style of dress accessory that incorporated Germanic-style elements.

For the late 3rd and 4th centuries, footless Armbrust brooches with high catch-plate and Fécamp hairpins were selected. The 4th/5th-century transition is covered by simple and elaborate Armbrust brooches and tutulus brooches while the 5th century is represented by Wijster hairpins and supporting-arm brooches. The discussion of each of these will include their chronology, regional distribution, depositional patterns, decorative styles and social connotations.

Objective 3. Bridge the gap between the 4th and 5th centuries in terms of frontier policy and the relationship between the Roman state and Germanic foederati

This objective targets the workings of the Lower Germanic frontier in the Late Roman period in terms of frontier defense and personnel and was approached through two research questions:

5. Can the spatial distribution and depositional patterns of Late Roman military- associated dress accessories

(crossbow brooches; military belt sets) inform us about the organisation of the Late Roman Lower Germanic frontier, specifically regarding the role of Germanic foederati?

6. Can changes in form, style and decoration inform us about the organisation of production of Late Roman military belt sets?

For this objective, a detailed description of the various items associated with the Late Roman military belt is given in chapter 4, including presenting regional circulation dates for specific types of belt parts in Germania Secunda. Secondly, the distribution of different types of belt accoutrements and contemporary crossbow brooches will be used to draw a social history of the Lower Rhine frontier and its military fortifications. This also includes a discussion on the distribution of Late Roman military belt fittings in Germania Magna, which traditionally are seen as reflective of returning veterans.

Included are all main identifiable parts of the Late Roman belt: buckles, strap ends, belt plates, belt stiffeners, tubular mounts and suspension mounts. Following the structure of chapter 3 on civilian dress accessories, chronology, regional distribution, depositional patterns, decorative styles and social connotations will the addressed.

Objective 4. Characterise production environments for Late Roman copper-alloy dress accessories

It has been suggested that while some 4th-century belts may have been produced in the state-run fabricae or provincial workshops, 5th-century belts were increasingly produced locally or even outside of the Empire (Böhme 1974, 97; ibid. 2021, 137).

This question was targeted in two research questions:

7. Can a study of object dimensions and chemical composition of Late Roman dress accessories identify a significant difference in production organisation between objects associated with civilian identities and those associated with military identities?

8. Can a study of object dimensions and chemical composition of Late Roman military dress accessories identify significant differences related to production organisation between objects dated to the 4th and 5th centuries in correlation to perceived changes in frontier defence?

An experiment was designed using object dimensions and chemical composition (using non-invasive pXRF and dimensional measurements) to reconstruct aspects of the production organisation of Late Roman military dress accessories. Chapters 6 and 7 aim to identify any potential shifts in technology and metallurgy that may inform us about the nature of military and state-run production organisation.

Chapter 2
Migration-related settlements in Germania Secunda

This chapter focuses on the themes of identity, movement and migration by analysing the settlement landscape of Germania Secunda in the Late Roman period. Exploring these themes through material culture (chapter 3) requires a thorough understanding of the society and settlement landscapes in which these objects were worn, displayed and eventually deposited. Furthermore, settlement contexts and architecture often seen to be well-suited to studying group identity,[1] providing additional background for the discussions of identities often ascribed to burials or dress accessories. The main aim of this chapter is to provide an overview of the available archaeological evidence for rural settlement systems in Germania Secunda in the Late Roman period that feature characteristics traditionally associated with Germanic identities to assess their role in migratory processes. By focusing on these features exclusively, their usefulness in the migration debate can be assessed, for instance through chronological mapping (i.e. identifying a clear north-south movement). Issues in methodology may be also be discussed and these settlements may be further contextualised within the settlement landscape. This is necessary, as rather than a homogenous group of identical settlements, these settlements form a highly diverse set of sites.

Broadly speaking, the main categories of archaeological finds that are typically associated with Germanic settlers[2] are: architecture (sunken feature buildings, short houses and three-aisled long houses), dress accessories (hairpins and brooches, see chapter 3), handmade pottery and rye consumption.[3] This chapter aims to chart provincial-Roman settlement continuity in the 4th century across the entire province and examine the uniformity or lack thereof of these migration settlements, which are often lumped together in a single category with little regard for the variety of the archaeological findings. Specifically, the occurrence of SFBs, rye, Germanic-style handmade pottery and Germanic style house architecture will be discussed, with attention paid to chronology and style/typology. The final section of this chapter will aim to reconfigure the interpretation of these cultural elements from a purely migration-focused narrative to one that allows more room for *limes*-specific processes such as cultural adaptation and exchange as well as reframing event-based narratives to a *longue durée* understanding of cultural interaction between 'native' Romans and 'Germanic' migrants.

Settlement (dis)continuity

Part of the argument for migration as a factor in the repopulation of the Meuse-Demer-Scheldt (MDS) region[4] or the northern part of Germania Secunda[5] is a noted lack of settlement activity from the early 4th century, which has lead some to argue that any new settlements appearing in the late 4th and 5th centuries are the result of migration.[6] Rural settlement numbers are widely accepted to have dropped across the province in this period, especially from the late 3rd century onwards and the settlement development in the northern part of Germania Secunda is typically characterised by a gradual decline in the late 2nd and 3rd centuries.[7] A scarcity of evidence for activity in the early to mid-4th century has been noted, such as in the form of dendrochronological dates on wells, built structures, coins, brooches and pottery[8] which are plentiful in that period north of the frontier.[9] The sudden abandonment of the northern part of Germania Secunda is explained by Roymans and Heeren as the result of forced deportation of groups into interior Gaul,[10] as other factors such as soil degradation would cause a more gradual decline in settlement numbers. However, they also noted evidence in the form of brooches and coins for activity at some military fortification on the Dutch Lower Rhine, as well the area south of Xanten.[11]

There are also some other signs of continuity of habitation in Germania Secunda, however. A significant

[1] Kruse 2019; Hamerow 2012; Eriksen 2019, 6-7; cf. Reher and Fernandez-Götz 2015, 402 on domestic contexts and ethnicity.

[2] For the main study area, see Van Zeist 1968, 160-161; Van Ossel 1992; Opsteyn 2003; Lenz 2005; Heeren 2017; Heeren 2018; Roymans *et al.* 2020; Roymans and Heeren 2022; Brüggler *et al.* 2017; Brüggler 2018; Van Ossel and Ouzoulias 2001, 238. In neighbouring regions see also Kaspryzk 2017; Goffioul *et al.* 2016; Steuer 2021; Jäger 2019.

[3] Tipper 2004; Henning 1989; Heeren 2017; Opsteyn 2003; Vermeulen 1992; Lenz 2005; Roymans *et al.* 2020. Other, less easily quantifiable criteria that are occasionally used (e.g., in Lenz 2005) are epigraphical evidence, evidence for iron and bronze working and the proximity of some settlement sites to cemeteries with graves containing Germanic-style grave goods.

[4] Heeren 2017, 158-160.

[5] Roymans and Heeren 2022, 135.

[6] Heeren 2017, 158-160.

[7] Roymans and Heeren 2022, 135, cf. Heeren 2015, 281-283; Heeren 2018, 138-141.

[8] Roymans and Heeren 2022, 135.

[9] Roymans and Heeren 2022, 137.

[10] Roymans and Heeren 2022, 138.

[11] Roymans and Heeren 2022, 139. For Late Roman fortification on the German Lower Rhine also see Brüggler 2018; Brulet 2017ab.

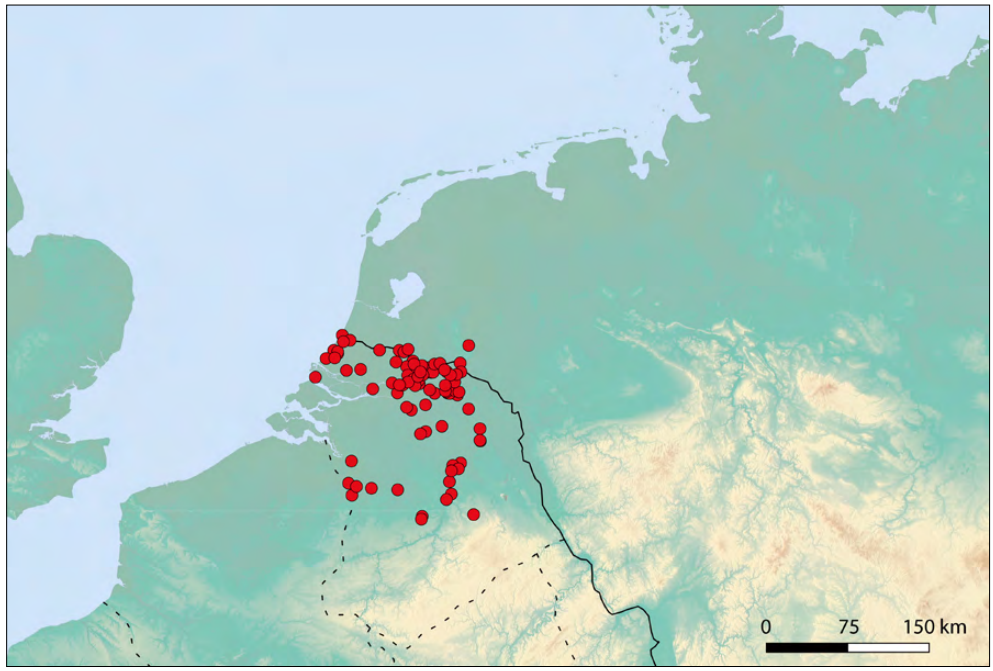


Figure 2.1. Presence of coins minted AD 250-350 (data after Aarts 2000).

number of rural sites still yielded coins minted between the mid-3rd and mid-4th centuries (figure 2.1).[12] The consistent presence of coins in the river area especially does seem to indicate some form of continuity of occupation. Vos lists 18 sites with Late Roman material in the Kromme Rijn area, 15% of the total number of sites known from the Middle Roman period.[13] He further specifies that these are not newly founded settlements but potentially signal continued habitation from the Middle Roman period.[14] Continuity between the late 3rd and early or mid-4th century is also attested at several sites compiled by Van Enckevort *et al.*[15] and some sites appear to have been founded in the early 4th century.[16]

Furthermore, a recent overview of Late Roman archaeology in Flanders[17] has provided additional arguments for (partial) continuity of activity there. Distribution maps of Roman and Late Roman sites compiled by Van Thienen[18] show that although the overall number of sites decreased,[19] the same regions generally remained occupied.[20] Based on his sequencing of radiocarbon dates from the early 3rd to late 6th century, Van Thienen also identified an uninterrupted chronology, noting that there was no evidence for a large number of end dates for settlements in the second half of the 3rd century, with any abandonment dated to the mid-4th century instead.[21] Van Thienen's work on Flanders clearly identifies a significant number of sites that were actively occupied during the 3rd/4th-century transition,[22] including the Roman city of Tongeren.[23]

In the surrounding areas, the evidence for settlement continuity is more mixed. The Belgian coastal area became too wet for activity and habitation from the second half of the 3rd century onwards, in some sub-areas possibly even earlier.[24] Dijkstra noted a drop in population numbers in the Dutch southern coastal area from the Middle Roman period onwards, which he linked to several social-economic and military-political factors, including the exhaustion of farmland, waterlogging and increased threats from across the frontiers.[25] Pollen diagrams from the area show a strong regeneration of forests in this period.[26] For the *civitas*

[12] Although it is possible of course that these continued to circulate for a prolonged period and were deposited later (Boehmer 2020).
[13] Vos 2009, 207.
[14] Vos 2009, 207. In some cases, however, these sites are not excavated settlements, but stray finds or field survey finds (Vos 2009, appendix 16), further limiting our ability to interpret these finds.
[15] Most notably Breda-Steenakker/Huifakker/Heilaar, Nijmegen and Cuijk (Van Enckevort *et al.* 2017 (table 7.12).
[16] Rural sites from Van Enckevort *et al.* 2017, table 7.12: Asten-Prins Bernhardstraat; Baexem-Haelensche Beek; Wijchen-Centrum; Nijmegen-Kops Plateau; Kerkrade-Holzkuil; Maastricht-Heukelstraat; Borgharen-Daalderweg/Pasestraat; Geleen-Geleenderveld vindplaats 23; Katwijk aan Zee/Zanderij/Westerbaan; Voorburg-Arentsburg; Naaldwijk-Hoogwerf/Hoogeland; Tiel-Medel; Ewijk-Keizershoeve-Grote Aalst; Empel-De Werf; Geldermalsen-Hondsgemet/Rijs en Ooyen; Beneden Leeuwen-De Ret; Arnhem-Schuytgraaf; Zetten-Den Hartog; Bergharen-De Weem; Lent; Cuijk-De Beiaard en 't Riet; Houten-Loerik/Zuijt; Grijpskerke-Aagtekerke (see references in Van Enckevort *et al.* 2017).
[17] Van Thienen 2016; Van Thienen 2020.
[18] Van Thienen 2016, figures 4 and 5.
[19] Van Thienen 2016, 61.
[20] Van Thienen 2016, 54; Van Thienen 2020, 5, table 1.
[21] Van Thienen 2016, 61. Outside of the study area, Van Ossel and Ouzoulias (2001, 233) dated a decline in settlements in the Alf valley near Trier similarly late, to the mid-4th century based on coin series.
[22] Van Thienen 2016, figures 15 and 16.
[23] Van Thienen 2020, 10; cf. Vanderhoeven 2017.
[24] Dhaeze 2011, 31, 192.
[25] Dijkstra 2011, 70-71; see also Brulet 2017, 120-121, figure 1.
[26] Dijkstra 2011, 70.

Cananefatium, De Bruin showed that many settlements were still actively inhabited in the second half of the 3rd century,[27] but that the region was largely abandoned between AD 250 and 300,[28] citing factors including increased waterlogging for the lower lying areas and civil unrest and forced movement.[29]

Regeneration of forests from the mid-3rd century onwards has also been noted in pollen diagrams from the loess soils in the German Rhineland[30] and the surrounding area of Xanten.[31] Many villas in the German loess area were abandoned by the late 3rd century, although some were re-used in later periods, for instance for the production of glass.[32] Brüggler *et al.* also note that settlement numbers already declined in the Kempener Lehmplatte from AD 200 onwards,[33] while the depopulation of the area between the Meuse and Rhine was deemed to 'not seem quite so complete' based on several stray finds and a coin hoard from the area.[34] Site numbers dropped precipitously in several parts of the German Rhineland from the mid-3rd century onwards, but some continuity of activity can be seen.[35]

Dodd observed 'repeated abandonment' of the villa landscape in Germania Secunda in the 3rd century, but also a stabilisation and slight recovery in the 4th century, with early 4th-century occupation at a 63% lower level compared to the early 3rd century based on the total number of sites occupied.[36] He also noted that the abandonment of villas was offset by reoccupation of several sites for reuse,[37] in some cases as fortifications, and in other cases for industrial activity such as glass production or metalworking. Continued urban and villa activity were also found in several regional studies of Northern Gaul and the Rhine area.[38]

Van Ossel and Ouzoulias also questioned the validity of total abandonment of the rural landscape in Northern Gaul,[39] citing among other arguments an uneven decline in settlement numbers in different subregions and arguing for a survival rate of at least 75% of settlements in the Rhineland plains west of Cologne as well as the surrounding area around Paris from the 3rd century into the 4th.[40] Similarly, they cite good continuity of habitation on the Aldenhovener Platte and Hambacher Forst areas,[41] while observing an 80% decline in settlement in northern Belgium and the vicinity of Nijmegen.[42] In addition, severe decline of rural settlements was also found between Cologne and Tongeren from the beginning of the 5th century onwards.[43] Other regional disparities were observed in North Rhine-Westphalia, where the Kempener Lehmplatte and Hürtgen Highlands yielded relatively low numbers of Late Roman settlements, while the Niederrheinische Bucht yielded relatively many.[44]

Roymans and Heeren argued that depopulation of the northern part of Germania Secunda happened fairly suddenly and proposed that this might have been caused by forced deportations.[45] Van Ossel and Ouzoulias, however, identified a great deal of regional variability in settlement numbers across the whole of Northern Gaul and argued that any decline must have been gradual,[46] while linking the most rapid instances of decline to areas with the least fertile soils (such as the Hunsrück and Ardenne regions).[47] They also proposed that a decrease in observed settlements could be due to a move from intensive to extensive agricultural practices.[48] With all this in mind, the new settlements of the 4th and 5th centuries in Germania Secunda and the role or impact of migration can be put into more context. Provincial-Roman activity in the area did not completely cease, although the evidence for continuity varies across the region. Brulet's overview of Late Roman infrastructure in the Western provinces[49] has, for example, identified a number of road networks that were still maintained in this period,[50] which are reproduced in figure 2.3. Continuity of urban activity is attested at Nijmegen, Xanten, Cologne and Tongeren.[51]

Late Roman activity in Nijmegen is well attested in the burial evidence, with various burials and cemeteries dating to the 4th and 5th centuries throughout the city.[52] Civilian occupation also continued around the

[27] De Bruin 2019, 281.
[28] De Bruin 2019, 282-283.
[29] De Bruin 2019, 282-284; cf. Heeren 2015, 294 for similar relocations in the MDS-area.
[30] Meurers-Balke 2002, 762.
[31] Kalis *et al.* 2008, 36.
[32] Brüggler *et al.* 2017, 30.
[33] Brüggler *et al.* 2017, 30; cf. Bridger 1994, 87, note 148 on several sites with Late Roman activity there.
[34] Brüggler *et al.* 2017, 31.
[35] Heeren 2018, figure 12.3.
[36] Dodd 2021, 91; see Dodd 2021, figure 4.1 for discontinuity in the study area.
[37] Dodd 2021, figure 4.4.
[38] Gilles 1994; Brulet 1994; Brulet 2009; Kaspyrzk 2017.
[39] Van Ossel and Ouzoulias 2001, 232-237.
[40] Van Ossel and Ouzoulias 2001, 232.
[41] Cf. Lenz 2001.
[42] Van Ossel and Ouzoulias 2001, 232.
[43] Hendriks 2023, 625; cf. Lenz 2001.
[44] Van Ossel and Ouzoulias 2001, 233; cf. Gechter and Kunow 1986. See also Gottschalk 2003 on Late Roman burial evidence from the Niederrheinische Bucht.
[45] Roymans and Heeren 2022, 138; cf. Heeren 2015, 294.
[46] Van Ossel and Ouzoulias 2001, 233.
[47] Van Ossel and Ouzoulias 2001, 234.
[48] Van Ossel and Ouzoulias 2001, 235; cf. Heeren 2015 and Dijkstra 2011 on environmental factors in their respective regions.
[49] Brulet 2017ab.
[50] E.g. Brulet 2017a, figure 1.
[51] Otten and Ristow 2008, 567; Vanderhoeven 2017; Van Enckevort and Thijssen 2003. Van Enckevort *et al.* 2017, 127-128 also list two wells dated to the late 3rd or early 4th century in Voorburg-Forum Hadriani.
[52] Such as those at the Hugo de Grootstraat and Burchtstraat and cemeteries B and OO; Van Enckevort and Thijssen 2003, 99-105, Steures 2013.

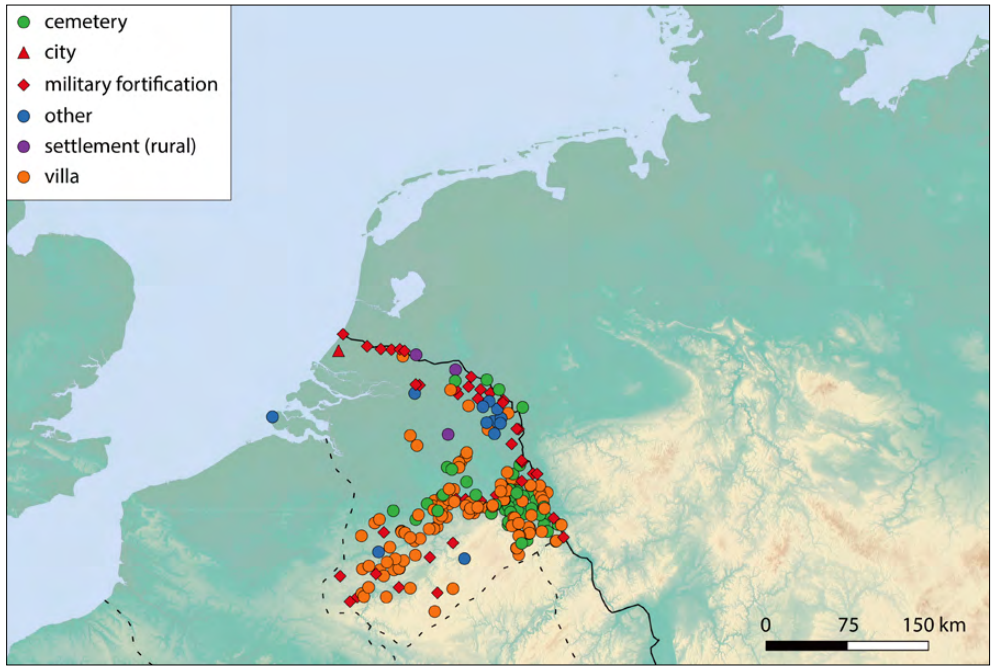


Figure 2.2. Distribution map of various site types with activity sometime during the Late Roman period in Germania Secunda (data after Dodd 2021; Van Enckevort *et al.* 2017; the Mapping the civitas Tungrorum project Gallo-Roman Museum Tongeren; Gottschalk 2003; Brüggler 2017).

Late Roman fortification at the Valkhof.[53] A synthesis of the Late Roman town of Tongeren and its excavation history was recently published by Vanderhoeven.[54] Coin series from excavations around the city show continued activity throughout the 4th century,[55] both within and without the city walls.[56] A Late Roman basilica was found,[57] which was maintained into the early medieval period. The burial evidence is also particularly rich for Tongeren, with several cemeteries with 4th-5th century graves found in the southwestern, northern and eastern parts of the city.[58] The city of Xanten continued into the Late Roman period at a reduced size.[59] Apart from a stone defensive wall, various stone building phases are presumed[60] and pottery dates suggest activity until at least the early 5th century.[61] Several burial sites are linked to the city,[62] which continued into the mid-5th century.[63] Burial evidence is also particularly strong for Cologne.[64] Eck dates the end of Roman occupation at Cologne until at least the mid 5th century[65] and cites construction activity of houses and public buildings including a praetorium, church, bath houses and canals in the late 4th century.[66]

Mapping rural settlements in Germania Secunda is a bit more complicated, due to the varying levels of details in some regional studies (see above) as well as issues surrounding dating and settlement (dis)continuity. The datasets of several previous regional studies charting activity throughout the Late Roman period may be mapped in figure 2.2, however.[67] The foundation of new settlements in the 4th and 5th centuries therefore cannot be taken as *a priori* proof of migration. It is also necessary to move beyond lumping them together as a single, homogenous group reflective of a single event. It is possible that these new sites are signs of a recovering and growing native rural population or of a more complex process altogether in which multiple social groups interacted. To further dissect this, the following four sections will analyse several categories of archaeological evidence that are most commonly cited as reflective of the Germanic identity of settlements founded in Germania Secunda in the Late Roman period: architecture (SFB and house architecture), rye cultivation and handmade pottery.

In total, 41 Late Roman settlement complexes from Germania Secunda were included in this discussion (see figure 2.4; table 2.3). Most of the 'migration-related settlements' were not actually found in the

[53] Van Enckevort and Thijssen 2003, 107-108.
[54] Vanderhoeven 2017.
[55] Vanderhoeven 2017, figure 1.
[56] Vanderhoeven 2017, 130.
[57] Vanderhoeven 2017, 136-140.
[58] E.g. Vanvinckenroye 1984; Vanvinckenroye 1995ab; see also Vanderhoeven 2017, 131, figure 2.
[59] Otten and Ristow 2008, 555.
[60] Bridger 2003, 18-19.
[61] Otten and Ristow 2008, 557; Bridger 2003, 24.
[62] See Bridger 2003, 15-6 and 25-27; Otten and Ristow 2008, 571 for an overview.
[63] Bridger 2008, 587-592.
[64] See for instance the 4th-5th century cemeteries excavated at Cologne-Luxemburgerstrasse; Von Boeselager 2012 and Cologne-Jakobstraße; Friedhoff 1991.
[65] Eck 2004, 691.
[66] Eck 2004, 655, 664; see also map in Eck 2004, 684.
[67] Villae and timber-built settlements were sourced from Dodd (2021), Van Enckevort *et al.* (2017) and the Mapping the civitas Tungrorum project (Gallo-Roman Museum) as well as cemeteries from work by Gottschalk (2003).

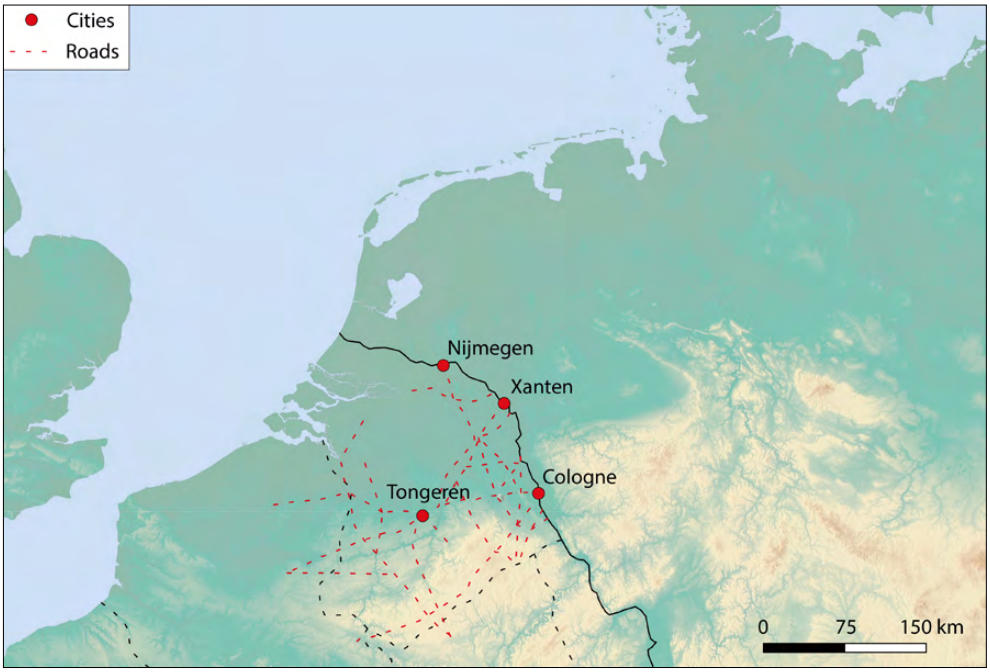


Figure 2.3. Late Roman cities and road network in Germania Secunda (after Brulet 2017a, fig. 1).

central MDS area, but instead clustered around the frontier zone, the Meuse trajectory and the Cologne-Bavay road, areas that were still inhabited in the Late Roman period. This suggests that either migration was targeting settled areas or that habitation was extending from the surviving nuclei into more marginal areas.

Sunken feature buildings (SFB)

A sunken feature building (SFB; also referred to in the literature as *Grubenhaus* or *fond de cabane*) consisted of a lowered floor, with an upper structure supported by a number of posts, usually two, six or eight.[68] They are most typical of settlements of the early Middle Ages,[69] but are found in northwestern Europe from the Roman period onwards.[70] SFBs can sometimes appear in settlements in very high numbers in relation to the number of house plans and although in some cases repairs or rebuilding has been found,[71] it is likely that their lifespan was relatively short.[72] SFBs appear in a variety of sizes, and it has been suggested that this may be indicative of a differentiation of function.[73] It is said that settlements with smaller SFBs (such as Wijster) tend to have more of them compared to settlements where larger SFBs are prevalent.[74]

Archaeological indications for the function of SFBs include hearths, loom weights, scrap metal and charcoal and pottery wasters, supporting the interpretation of use for craft activities.[75] It has also been suggested that SFBs may have been used as storage facilities, as their unique construction allows for a certain amount of temperature control.[76] However, care needs to be taken in relating the material found in SFBs directly to their function as some backfill could be a secondary deposit.[77]

The presence of SFBs on Roman soil is frequently associated with Germanic identities, although some have urged caution in labelling any and all SFBs in the Roman Empire as direct signs of migration.[78] Van

[68] See for typology Leube 2009. There are no indications in the literature that there are functional differences between two- and six-post SFBs (Zimmermann 1992, 216).
[69] Kasprzyk 2017, 266.
[70] Hiddink 1999, 92.
[71] E.g., Wijster; Van Es 1967, 77-83.
[72] Hiddink 1999, 90-91; Van Es 1967, 370-71; Van Es *et al.* 1985, 572-573.
[73] Zimmermann 1992, 216.
[74] Such as Flögeln-Eekhjölten; Zimmermann 1992, 216.
[75] E.g., Hiddink 1999, 21; Zimmermann 1992, 189; Aufderhaar 2016; Bischop 2000; Mirschenz 2013. Their subterraneous nature made these structures highly humid environments, apparently ideal for spinning and weaving flax (Zimmermann 1992, 211-217) and Pliny's Natural History describes the production of linen in underground structures in Germany and northern Italy (*Plin. Nat.* 19.2.11), which may indicate their use as weaving huts (Tipper 2004). Indications for their use in metal working have been found in the form of slag deposits or cut metal objects in several SFBs found in Bochum-Harpen and Soest-Ardey (Mirschenz 2013; Eggenstein 2003) and Ede-Op den Berg/Paasberg (Van Enckevort *et al.* 2017, 79). In some settlements, they are located some distance away from the main buildings (Flögeln-Eekhjölten; Zimmermann 1992, 212-214 and Warburg-Daseburg; Günther 1990), use as metalworking workshops and associated risk of fire may be a factor here (Hiddink 1999, 92). In his *Germania*, Tacitus also describes the presence of '*subterranean caves [...] as a shelter from winter and as a receptacle for the year's produce*' (*Tac. Ger.* 16; translation by Church 1942).
[76] Zimmermann 1992, 215-216. This is most clear from a Roman period example from Leuben, Kr. Oschatz, where roughly 40 kg. of charred cereals (a mix of barley, oats and wheat) was found within the backfill of a SFBs (Zimmermann 1992, 215; Baumann and Kroitzsch 1984, 218ff).
[77] Tipper 2004, 7ff.; Kaspyrzk 2017, 266.
[78] Opsteyn 2003, 138; Van Ossel and Ouzoulias 2001, 238.

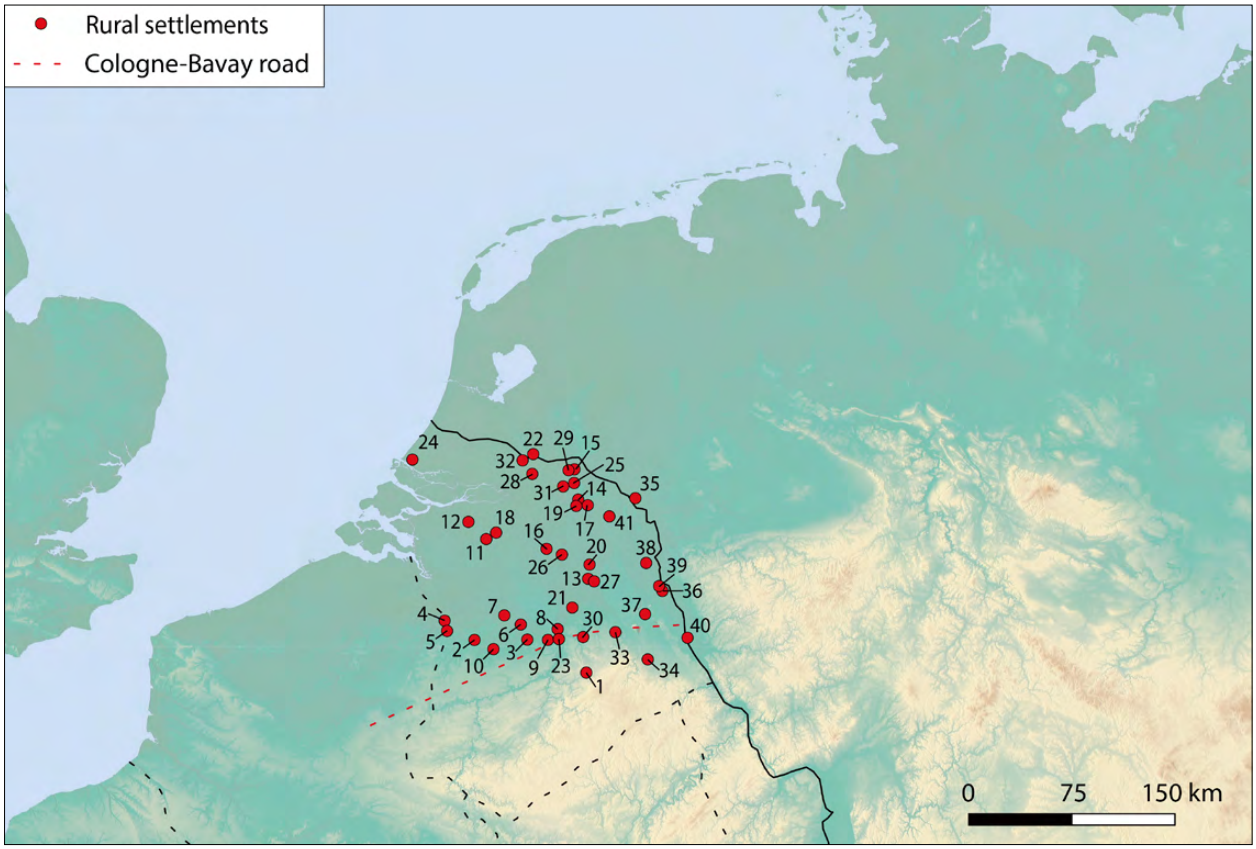


Figure 2.4. Distribution of Late Roman 'migration-related settlements' (data in table 2.3). In red: schematic reconstruction of the Cologne-Bavay road (after Brulet 2017a, figure 1). 1: Baelen-Nereth; 2: Boutersem-Boskouterstraat; 3: Donk; 4: Elewijt; 5: Erps/Kwerps-Lelieboomgaarden; 6: Kuringen-Rode Rokstraat; 7: Meldert-Zelemsebaan; 8: Neerharen-Rekem; 9: Rosmeer; 10: Wange-Damekot; 11: Alphen-Kerkakkers; 12: Breda West-Steenakkers; 13: Buggenum-Wijnaerden; 14: Cuijk-De Nielt; 15: Elst-Galgenplek; 16: Geldrop 't-Zand; 17: Gennep; 18: Goirle-Huzarenwei; 19: Haps; 20: Helden-Schrames; 21: Holtum-Noord; 22: Leersum-Middelweggebied; 23: Maastricht; 24: Naaldwijk; 25: Nijmegen; 26: Someren Lierop-Steemertseweg; 27: Swalmen; 28: Tiel-Passewaaij; 29: Valburg-Molenzicht; 30: Voerendaal-Ten Hove; 31: Wijchen-Tienakker; 32: Wijk bij Duurstede-De Geer; 33: Aldenhoven-Niedermerz; 34: Froitzheim; 35: Haffen-Mehr; 36: Harff; 37: Kaster-Hasselberg; 38: Krefeld-Gellep; 39: Neuss-Hochneukirch; 40: Rodenkirchen; 41: Weeze-Knappheide.

Ossel and Ouzoulias argued that while SFBs are perhaps the most typical feature of Germanic settlements in Northern Gaul, they are also found in settlements without any other clearly identifiable Germanic features and they urge care should be taken when interpreting these as Germanic or migration-related.[79] Furthermore, they appear in Northern Gaul over the course of the 4th century (with some earlier outliers from the third quarter of the 3rd century),[80] only becoming widespread in Gaul in the 5th century.[81] Van Ossel and Ouzoulias also state that SFBs were almost completely absent in the north-western parts of Germania Magna before the 3rd century.[82] Kossack *et al.* argued that the number of SFBs known from the area between the Weser and the Ems increased significantly in settlements from the 4th and 5th centuries onwards,[83] although Wüstebude later claimed that this was not evident.[84]

Chronological overview

The tradition of SFBs is generally accepted to have started in the Iron Age and Early Roman period alongside three-aisled houses in Germania Magna,[85] only becoming more common in Germania Magna from 1200-800 BC onwards.[86] Most of the SFBs dating to the transitional period between Late Prehistory

[79] Van Ossel and Ouzoulias 2001, 238.
[80] De Boe 1977, 42.
[81] Van Ossel and Ouzoulias 2001, 238.
[82] Van Ossel and Ouzoulias 2001, 238. However, SFBs appear in Drenthe from the 1st century AD onwards, while in Overijssel and Gelderland they seem to date predominantly from the 2nd century AD onwards (Hermsen 2007, 75).
[83] Kossack *et al.* 1984, 220.
[84] Wüstebude 1996, 47.
[85] Tipper 2004, 4.
[86] Tipper 2004, 4. An additional problem when making an inventory of SFBs is the sheer number in which they are sometimes found (on mid-sized settlements they can run into double or triple figures). As a result, many (preliminary) site reports offer little in terms of description or illustration. For several sites, it is only reported that multiple SFBs were found, but not how many exactly or how many per settlement phase. Wüstebude also lists a number of Stone and Bronze Age specimens from Germany, the Netherlands and Denmark, but these are not very great in number (1996, 46)

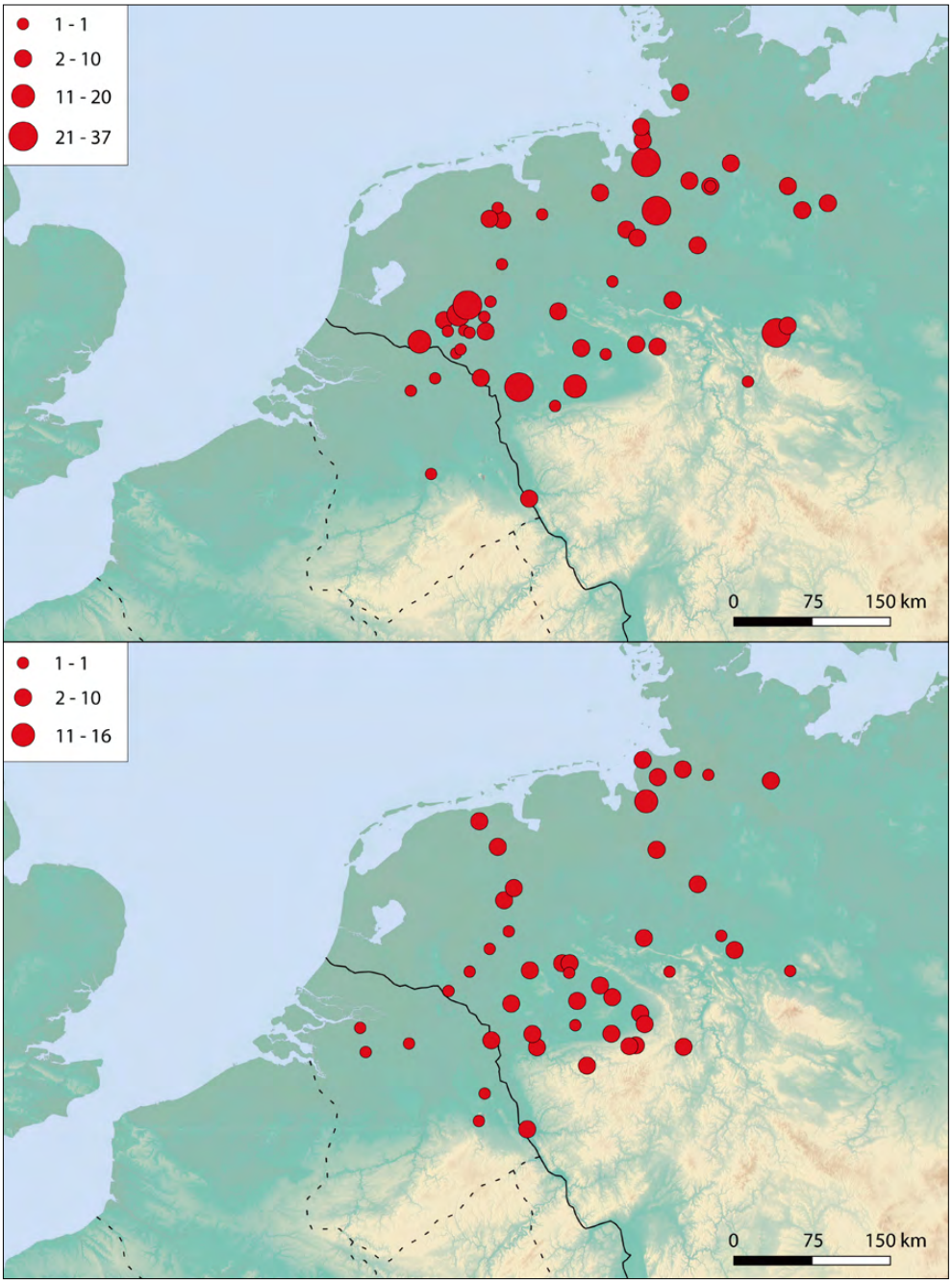


Figure 2.5. SFBs in the study area that could not be dated more closely than 'Roman period' (top) and SFBs dated to the Late Iron Age and Early Roman period (period 1; bottom).

and the Early Roman period are from Germany and are located just east of the river Rhine (figure 2.5, bottom) in the Lippe and Ruhr area.[87] Only a handful of SFBs are known from the Roman provinces in this period, most of which are located in the immediate *limes* zone.[88] Further inland, early instances of SFBs are scarcer.[89] The number of SFBs increases significantly in the Middle Roman period[90] and the form also spread further to the west and south (figure 2.6, top). There is also a certain amount of continuity within sites, with settlements yielding SFBs in each occupational phase from the Early Roman to the Late Roman period.

A fair number of SFBs are known from this period within Germania Secunda, mostly from the 3rd

[87] There is also evidence outside of the immediate study area for 'early' SFBs within the Empire. Specimens dated from the 3rd century are known from eastern Gaul (Durost 2011) and they are found in the Picardie region as early as the first century BC (Kaspyrzk 2017, 266; Bayard and Lemaire 2014, 76-78).

[88] Aldenhoven (Wüstehube 1998, cat. 4); Jüchen-Neuholz (Iron Age; Mirschenz 2013); Rheinberg-Alten Landstrasse (1st century; Binding 1968, 122-124, Abb. 3, 7); Weeze-Vorselaer (Brüggler *et al.* 2017, 47); Jüchen-Neuholz (Andrikopolou-Strack *et al.* 1999, 146).

[89] Son en Breugel; Wüstehube 1998, cat. 532; Van den Broeke 1980 and slightly outside of the study area Wielsbeke-Vaarstraat; De Clercq 2009, 99. Wüstehube also lists a potential SFB from Rijckholt dated to the Stone Age (1998, catalogue number 529), but that is rather dubious.

[90] Cf. Van Ossel and Ouzoulias 2001, 238.

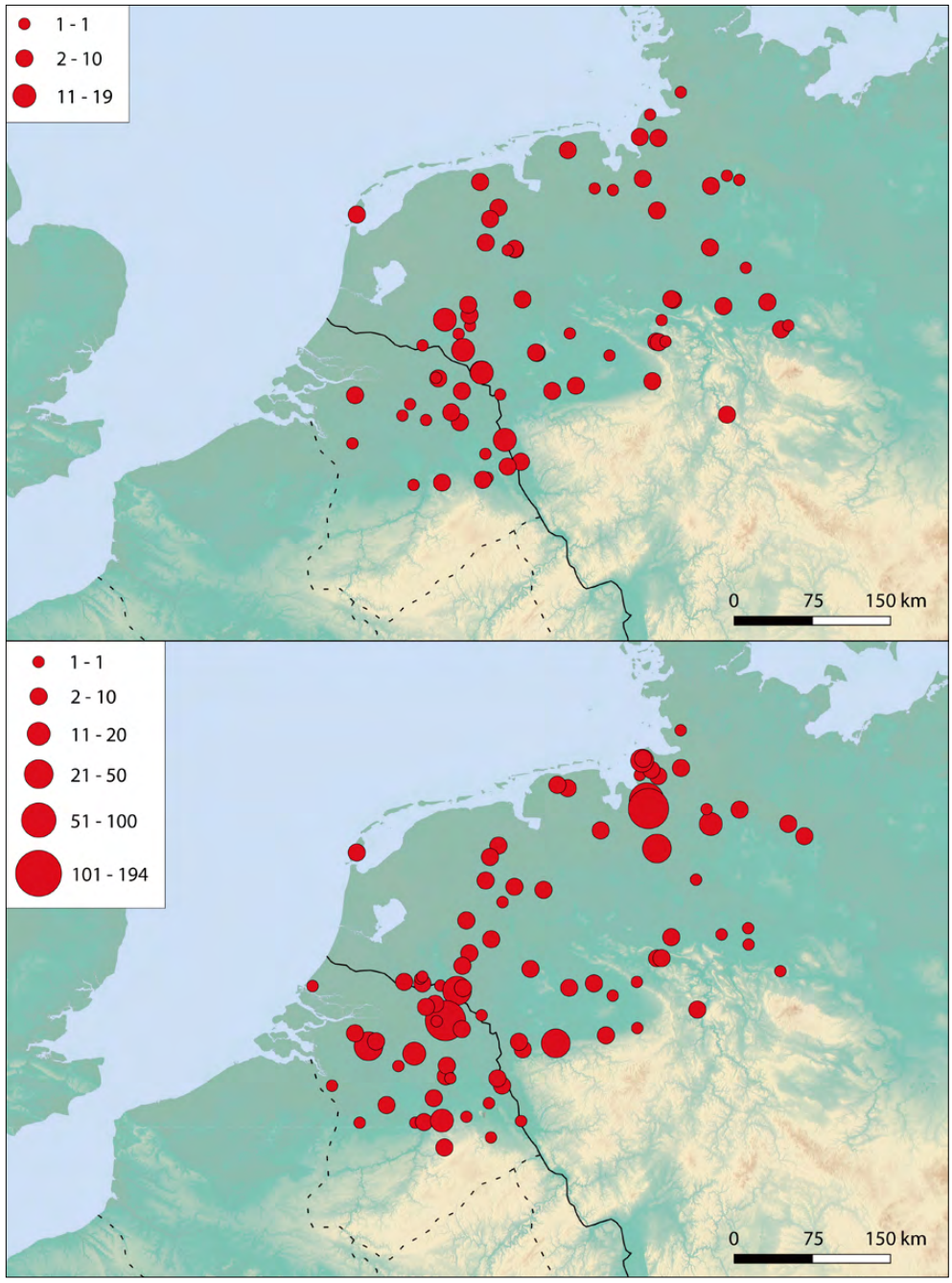


Figure 2.6. SFBs in the study area dated to the Middle Roman period (period 2; top) and Late Roman period (period 3; bottom).

century AD. Heeren has argued before that despite the early-3rd century material in the fill of SFBs from Cuijk-Heeswijkse Kampen, Herk-De Stad (Donk), Someren-Lierop and Horst-Hoogveld and the absence of later material, these should be dated to the late 4th and 5th centuries regardless.[91] Van Enckevort *et al.* already pointed out that this line of reasoning is difficult to maintain given the lack of late 4th- and 5th-century material.[92] Furthermore, additional 'early' SFBs can be reported from Germania Secunda to lend strength to the argument that SFBs were not a uniquely Late Roman feature.[93] Without doubt,

[91] Heeren 2015, 284. Heeren argues that these early 3rd century SFBs were all found in small-scale trial excavations, while late 4th-5th-century specimens are more generally known from large-scale open plan excavations (citing among others Breda West-Steenakkers/ Huifakker; 2015, 284). As such, he proposes that the earlier date of these four examples is due to post-depositional factors and excavation limitations and that there are no convincing examples of 3rd-century SFBs (2015, 284).

[92] Van Enckevort *et al.* 2017, 195.

[93] Venlo-Blerick Heierhoeve (Schotten and Machiels 1994, 85-86); Bonn-Vilich-Müldorf (Gechter-Jones and Kempken 2007); Heeswijk-Havenlaan (Ball and Heirbaut 2005, 119; Ball *et al.* 2001); Kevelaer-Grotendonk (Brüggler *et al.* 2017, 50); Kleine Spouwen Schildstraat (De Clercq 2009, 98); Son-Pastorie (Van der Weerden 2012); Weeze-Vorselaer (Brüggler *et al.* 2017, 48); Grobbendonk (De Boe 1977, 42); Morken-Kirchberg; Hinz 1969, 299; Voerde-Mehrum (Brand and Schönfelder 2008); Hambach 132 (Brüggler 2009, 52-53, figure 31); Pulheim-Brauweiler (Andrikopoulou-Strack *et al.* 2000, 430-431). The

however, the number of sites with SFBs in Germania Secunda increased starkly in the Late Roman period (figure 2.6; bottom). Several of these could be dated to the early and mid-4th century.[94] Some could be placed in the 5th century,[95] although due to the issues with dating outlined above, the majority were not more closely datable than the entire Late Roman period, with an emphasis on sites dated to the late 4th and 5th centuries. Kasprzyk has argued that after their introduction into Gaul in the 4th and early 5th centuries, SFBs spread south in the second half of the 5th century to settlements with no evidence for non-Roman occupants, but within Germania Secunda such a clear development could not be proven. Kossack *et al.* have posited that the number of SFBs increased in the area between Weser and Ems since the 4th and 5th centuries,[96] something which Wüstebude claims is not evident from his maps.[97] For my study area, there is indeed a clearly identifiable increase in a number of settlements with good stratigraphical evidence, where SFBs were found in larger numbers in the Late Roman period compared to earlier phases.[98]

Discussion

The nearest geographical origins of the SFB lay unequivocally in prehistoric Germania Magna, but its dispersion across the province of Germania Secunda does predate the Late Roman period. A small but significant number of SFBs in Germania Secunda were older than the Late Roman period, clustering mainly around the interactive frontier zone and spreading further south in the Middle Roman period. The SFB increased in popularity on Roman soil in the Late Roman period at a comparable rate to Germania Magna, where Early and Middle Roman SFBs are also less widespread than in the Late Roman period. This seems to suggest that rather than a purely 'Germanic' phenomenon, SFBs were more of a period-specific phenomenon.[99] This is supported by the fact that at several large key sites in the north with a long occupation history, SFBs only or mainly appeared in the later phases. This pattern can be traced throughout Europe, as SFBs became quite numerous in Early Medieval settlements, both in northwestern and Central Europe.[100]

SFBs are rarer in the river area, but not completely absent.[101] Together with the suggestion that SFBs could be interpreted as an evolution from small cellars as often seen in Roman settlements, Van Ossel and Ouzoulias suggest that their wide distribution in the Late Roman period does not necessarily have to be interpreted as the expansion of Germanic communities, but could also be seen as the development of a new style of settlement across Europe.[102] SFBs were also relatively frequently found without any other indication for non-Roman identities,[103] which could suggest that they were also adopted by other communities. Of course, the level of publication of some sites limits how much we know about some sites, but some sites with only SFBs as a Germanic indicator can be mentioned.[104] Other sites have yielded 'mixed messages', such as Venlo-Blerick Heierhoeve, Naaldwijk-Hoogeland/Hoogwerf, Wange-Damekot, Bonn-Vilich-Müldorf, and several villa complexes.[105]

features from Donk may also be interpreted as sunken litters, part of native Roman byre houses (Van Impe 1983, figure 7) and are not included here.

[94] Baelen-Nereth (Hanut *et al.* 2012); Naaldwijk-Hoogeland/Hoogwerf (Van der Feijst 2015a; cf. Van Enckevort *et al.* 2017, 196, table 7.4); Neuss-Hochneukirch (Keller 1997); Nijmegen-Mariënburg (Van Enckevort and Thijssen 2000, 19); Breda West-Steenakker (Koot and Berkvens 2004; Van Enckevort *et al.* 2017, 196, table 7.4). The SFBs at Cuijk-De Nielt (Habermehl and Van Renswoude 2017) and Harff (Van Ossel 1992, 196-197, 222) were dated to the second half of the 4th century.

[95] Geldrop-'t Zand (Bazelmans 1990, 25-29; Heeren 2017); Haps (Verwers 1998-1999); Maastricht (Bakels and Dijkman 2000; Wüstehube 1998, cat. 522; Stoepker 1990); Swalmen (Willems 1983; Wüstehube 1998, cat. 533; Milikowski 1986); Wange-Damekot (Opsteyn 2003); Wijchen-Tienakker (Heirbaut and Van Enckevort 2011).

[96] Kossack *et al.* 1984, 220; cf. Van Ossel and Ouzoulias 2001, 238 on the relative rarity of SFBs in the northwestern part of Germania before the 3rd century.

[97] Wüstebude 1998, 47, Karte 26-28.

[98] Of the 27 SFBs found in Midlaren-De Bloemert, for instance, two were dated to the 1st-2nd century, while the rest dated mostly to the 2nd-6th century, including 10 dated AD 300-550 (Nicolay and Waterbolk 2008, 135). At Deventer-Colmschate Skibaan, all SFBs were dated to the 3rd or 4th century (Hermsen 2007, 76), despite the presence of Iron Age and Early-Middle Roman phases (Hermsen 2007, 226-234). Similarly, the settlement at Dunum-Brill was dated generally to the 1st-4th century, but SFBs were only found from the period 4th-5th century (Wüstehube 1998, catalogue nr. 94). The settlement at Feddersen Wierde may be broadly dated from the 1st to the 5th century (Haarnagel 1979), but SFBs are only found in the 3rd-5th centuries phases (Wüstehube 1998, cat. 119; Haarnagel 1979, 109-113). A clear increase in SFBs was also found in Loxstedt-Littstücke, where 16 were dated to the 1st century AD, 27 to the 2nd-4th century and 85 to the 4th-6th century (Dübener 2017, 204; cf. Zimmermann 1992, 156-157). Of the 13 SFBs from Groß Meckelsen, 11 dated to the Migration Period and only two to the Roman period (Zimmermann 1992, 158). In Wijnaldum, SFBs only appeared after the early 5th century (Gerrets and De Koning 1999, 106; Tipper 2004, 5). Tipper (2004, 4) mentions that while Ezinge yielded extensive settlement remains from the Iron Age/Roman period to the Early Medieval period, SFBs were only found in those layers dating after AD 400, although Hiddink (1999, 109) has pointed out that the conservation of features of the AD 300-500 phases is poor and multiple SFBs existed in each occupational phase (see Nieuwhof 2020, 81-260).

[99] Cf. Van Ossel and Ouzoulias 2001, 238.

[100] Fusek 2007, 537.

[101] Heeren has argued that the absence of SFBs in the river area is likely due to the increased flood-risk there, as Wijchen and Nijmegen are two river sites with SFBs were situated on an ice-pushed ridge (2017, 163).

[102] One which would go on to develop into the Early Medieval settlement landscape; Van Ossel and Ouzoulias 2001, 238ff.

[103] cf. Opsteyn 2003, 138; Van Ossel and Ouzoulias 2011, 238.

[104] Grobbendonk (De Boe 1977); Kleine Spouwen Schildstraat (Fath and Wesemail 2008); Wielsbeke-Vaarstraat (Hoorne 2007); Kevelaer-Grotendonk (Brüggler *et al.* 2017, 50); Neuss-Hochneukirch Keller 1997); Weeze-Vorselaer (Brüggler *et al.* 2017, 42, figure 19); Middegaal (Stokkel 2008); Son-Pastorie (Van der Weerden 2012); Someren Lierop-Steemertseweg (Verwers 1991b, 200); Haps (Verwers 1998-1999, 265).

[105] At Venlo-Blerick Heierhoeve 10 SFBs were probably contemporary to several provincial-Roman Alphen-Ekeren houses. A three-aisled building with Frisian pottery was also found, but deviated in orientation from the rest of the features (Schotten and Machiels

Rye cultivation/consumption

For the study area, Behre's 1992 overview remains one of the most influential studies on the introduction and spread of cultivated rye (*Secale cereale*) in central and eastern Europe.[106] Behre notes that although rye is found almost everywhere in Europe from the start of the common era onwards, solid evidence for intentional cultivation (large finds of pure rye or with minimal admixture) is rare[107] and the earliest convincing evidence for rye cultivation comes from Noordbarge,[108] as low fragment counts in macro-botanical samples are more likely reflect of weed rye.[109] Low pollen frequencies may indicate nearby weed rye or cultivated rye in bordering areas.[110] Rye does not seem to have become a widespread staple crop in the study area until the (Early) Medieval period,[111] with settlements across the study area showing evidence for a varied diet of several cereals. Below, a brief overview of the evidence for rye cultivation as reported in the literature is given for both areas to test the usefulness of rye as a cultural or social identifier. This is based on several regional studies and individual site reports, tracing cereal cultivation from the (Late) Iron Age to the Late Roman period on both sides of the frontier.

Germania Magna

The communities living north of the frontier in the Roman period consumed a variety of cereal species and preferences were not uniform across the study region. Several studies have summarized the most common cereal crops in specific subregions of the study area in the Roman period (table 2.1). Rye was most commonly cited as a subsistence crop in northern Germany and the northeastern Netherlands.[112] Some finds from the 1st-3rd century are noted in Hamburg and Harburg[113] and possible evidence for small-scale cultivation in the Migration period is known from Flögeln.[114] For the Dutch terp region, Schepers noted that rye was rare.[115] There is also positive evidence for absence of rye in Early and Middle Roman settlements where high-quality macro-botanical samples did not yield any rye remains or very low counts.[116] Steuer also traced the introduction of rye in northern Germany in the first four centuries AD,[117] noting how it its introduction was linked to sandy soils.[118]

A very general presence/absence calculation can be made for the macro-botanical remains from the Netherlands based on the RADAR database.[119] 310 samples from north of the frontier could be dated exclusively to the Roman period (or a specific sub-period of that), 270 of which did not yield any rye remains. Most of the samples with rye (any amount and type of evidence) came from Drenthe and Overijssel (figure 2.7).[120] When presented per chronological period, (figure 2.8) the data show a clear skewing towards samples that could not be dated closer than Middle-Late Roman. However, most samples with large amounts of pure rye (with some minor admixture of other cereals) date to the 4th and 5th centuries.[121] The majority of Roman sites from the northern Netherlands with rye finds did not yield any rye seeds, fragments of

1994, 85). The settlement at Naaldwijk yielded an SFB and handmade pottery in the Frisian tradition, but no clear Germanic-style architecture (Van der Feijst 2015). he SFBs at Wange-Damekot were accompanied by one- and two-aisled houses (Lenz 2005, 404), but Germanic handmade pottery is also known from the site (Opsteyn 2003). The two SFBs from Bonn-Vilich-Müldorf were found alongside a byre house with one two-aisled and one three-aisled section (Gechter-Jones and Kempken 2007), a style common in provincial-Roman rural settlements. An SFB was found on the villa complex at Rodenkirchen (Van Ossel 1992, 222), but none of the other finds or features hinted at non-Roman occupants (Von Petrikovits 1968, 476-483; similarly, for Kaster-Hasselberg (Van Ossel 1992, 197; Hinz 1969, 273) and Froitzheim (Van Ossel 1992, 194; Barfield 1968).

[106] Behre 1992, 143.

[107] Behre 1992, 143.

[108] 100 BC- AD 100; Behre 1992, figure 1.

[109] Behre 1992, 141.

[110] Behre 1992, 149. A noted discrepancy between low rye counts in pollen samples dated to the Roman period and high counts in samples from the Middle Ages has also been interpreted as evidence for the growing of rye as a summer crop in the Roman period, while rye was grown as a winter crop (which produces more pollen) in later periods when it became the predominant cereal (Behre 2017, 63; Kirleis 2002, 56; the identification as summer rye has also been argued based on the accompanying cereal weeds; Behre 2010, 58).

[111] Van Zeist 1968, 161; Brather 2004, 435-436.

[112] Cf. Kossack *et al.* 1984, 267 on its absence in the marsh settlements, although some Roman-period finds are mentioned from the *Geest*.

[113] Behre 1976.

[114] Kossack *et al.* 1984, 267.

[115] Schepers 2016, 143, listing only three sites from the Roman period where rye was found, all only very low seed counts (Groningen-Friesestraatweg; Cappers *et al.* 2005; see also Vrede and Dopmeijer 2004 and Marssum-It Aldlân; Schepers 2015) or pollen (Wijnaldum; Groenman-Van Waateringe 1999).

[116] Such as Dortmund-Oespeler Bach, Hamburg-Marmstorf 68, and Midlum-Süd; where instead mainly *Panicum miliaceum*, *Hordeum vulgare* and *Triticum dicoccum* were found; Brink-Kloke and Meurers-Balke 2003, table 7; Behre 1998, 291. Kirleis (2002, 56) notes that rye was the predominant cereal in Rullstorf in the Roman period (samples dated to the 2nd century AD), making up 26% of all cereals, although the raw data show that the seed count in these samples is generally low. Of the four 2nd-century samples, one did not yield any rye, two yielded one fragment and one yielded four fragments (Kirleis 2002, table 30), with *Hordeum vulgare*, and *Triticum dicoccon* also yielding only 1-3 fragments. For the northern Netherlands, these sites include Langedijk, Uitgeest, Dalfsen and Wijster (Lauwerier *et al.* 1999, table 3) and Wijnaldum (Pals 1999). Cf. Groenman-Van Waateringe 1999 on the pollen evidence from Wijnaldum, which included some rye. The amount was deemed by Groenman-Van Waateringe to be too low to suggest local farming (1999). Instead *Hordeum vulgare* and *Triticum* were the main cereal crops there (Pals 1999).

[117] Steuer 2021, 410.

[118] Steuer 2021, 412. Although he also noted a decrease in rye cultivation there towards the Migration period; Steuer 2021, 160.

[119] This database collates archaeobotanical specialist reports and samples produced by academic researchers and commercial units in the Netherlands and was kindly made available by Dr. Otto Brinkkemper of the RCE. The version used contained all data entered up until 2017.

[120] Cf. Van der Velde 2011a, table 7.9.

[121] This mirrors Brather's conclusion that rye only appeared in significant amounts in the Roman period in the southern hinterland, becoming more common in Northern Germany in the Migration period (2004, 435; cf. Kirleis 2002, 56).

Cereals	Germany		Netherlands	
	Coast/northwest	Ruhr area	Terp region	Northeast
Wheat species				
Triticum dicoccon	X		X	X
Triticum aestivum	X			
Triticum aestivum spelta		X		
Barley species				
Hordeum vulgare	X	X		X
Hordeum vulgare ssp. vulgare	X			
Hordum vulgare var. vulgare			X	
Millet, oat and rye				
Panicum miliaceum	X	X		X
Avena sativa	X			
Secale cereale	X			X

Table 2.1. Common cereals found in the Roman period in subregions of Germania Magna (data after Behre 2002, 459, figure 804; Behre 1998, table 12; Behre 1977, table 2; Kossack *et al.* 1984, 266-267; Van der Velde 2011a, 254, table 7.9; Van Haaster 2006b, 10; Hiddink 1999, 179; Schepers 2016; Mirschenz 2013, 43; Brink-Kloke and Meurers-Balke 2003, 87).

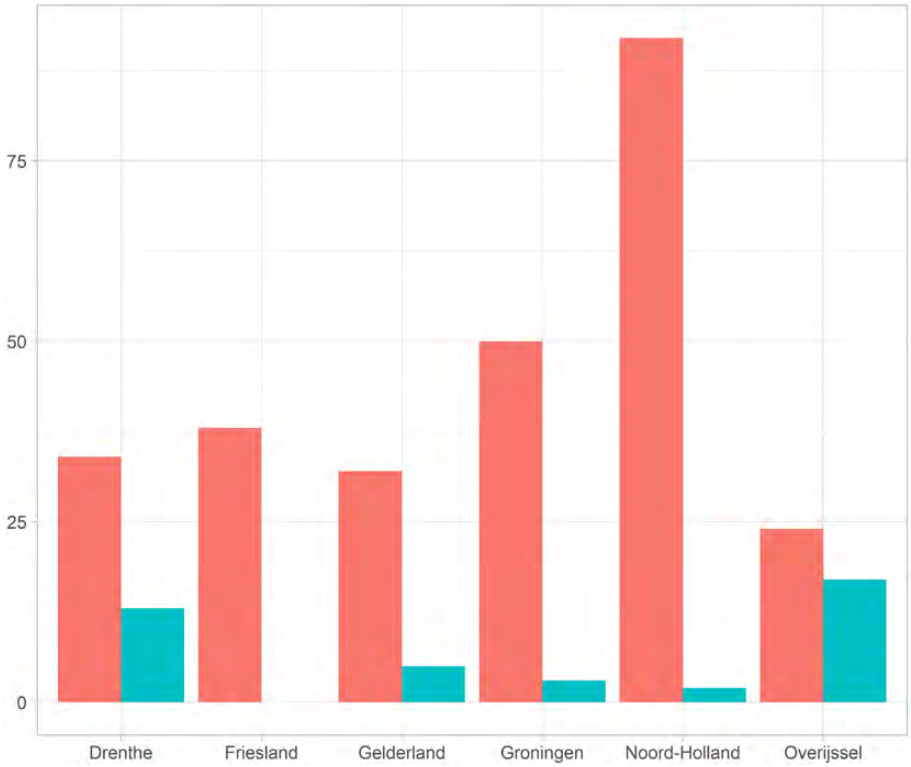


Figure 2.7. Presence/absence of macro-botanical remains of rye in samples dated to the Roman period in the northern Netherlands per province. Data from RADAR. Red: absent; blue: present.

chaff or rachis internodes in any significant amounts: usually single digits were counted, and other cereals were predominant.[122]

Looking closer at several individual sites with good chronological evidence also highlights further chronological patterns, namely an increased cultivation of rye at the cost of other cereals. At Groß Meckelsen and Loxstedt-Littstücke, rye was grown in the Roman and Migration period,[123] with *Secale cereale* and *Hordeum vulgare* the main cereals. In Groß Meckelsen, *Hordeum* was the more important crop in the earlier Roman period, while in later phases rye

[122] Namely *Avena*, *Hordeum vulgare*, *Panicum miliaceum* and *Triticum dicoccon*. Cf. Dalen-Westakkers (Van Zeist 1994); Enschede-Elferinkse Es (RADAR); Groningen-Friesestraatweg (Vrede and Dopmeijer 2004; Cappers 2005); Heeten-Telgen/Hordelman (Van Haaster 2005c); Heiloo-Stationsplein (Bakels 2007, 50, table 3); Lochem-Transportsysteem Zutphen (Moolhuizen 2013, 88, table 4.3.7); Texel-De Burg (Van Zeist 1997); Wehl-Norman Belvealstraat (Moolhuizen 2013, 131, table 5.32); Wierden-Enter Baanakkers (RADAR); Zwolle-Ittersumerbroek (Vermeeren 1991, table 1).

[123] Behre 1992; Behre 1998; Behre 2017, figure 4.

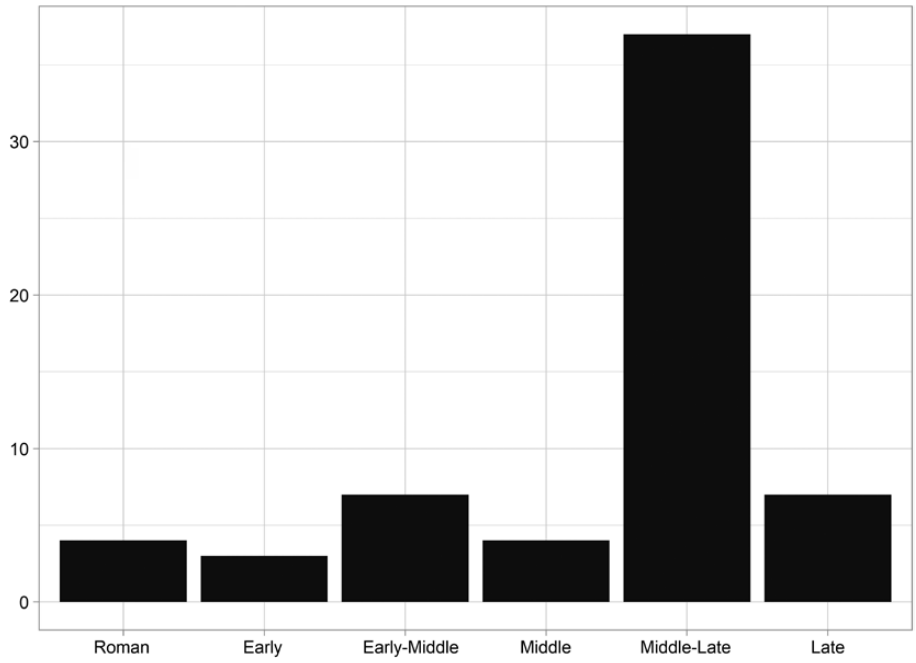


Figure 2.8. Dated samples from the northern Netherlands containing at least one fragment of rye. Data from RADAR.

became the predominant cereal of the two.[124] The four samples from Loxstedt-Littstücke dating 2nd-3rd century yielded a total of two fragments of rye, while the 41 samples dating 4th-6th century from the same site together yielded 1722 fragments.[125] The same pattern can be seen in the contemporary settlement at Flögeln, where three samples from AD 1-300 contained 806 seeds and one sample from AD 300-500 yielded 5012 seeds.[126] The later phases of Peelo-De Es also yielded more significant counts of rye compared to samples from earlier phases.[127] Middle Roman samples from Heeten-Hordelman yielded little to no rye remains, while rye was the predominant cereal in the majority of Late Roman samples.[128]

Despite the influx of more data in the last few decades, the earliest site with convincing evidence for rye cultivation in the study area still remains Noordbarge-Hooge Loo.[129] Large rye concentrations were found in Ede-Veldhuizen in the Middle Roman period.[130] This means that rye was clearly introduced in the surveyed part of Germania Magna in the Roman period,[131] although it seems from the discussion above that cultivation and consumption increased most significantly in the Late Roman period. In a significant number of macro-botanical samples from the Early-Middle Roman period, rye was not the predominant cereal crop. Generally, indications for cultivation (as defined above) based on the fragment count of the macro-botanical remains do seem to be stronger for the Late Roman period. In addition to Peelo-De Es, Heeten-Hordelman and Flögeln discussed above, there are also samples from Deventer-Colmschate Skibaan (AD 343-351) and Zwinderen-Kleine Esch (AD 270-450).[132] Of course, the data are skewed towards large-scale settlements that have been extensively excavated and more recent excavation reports are more likely to report on macro-botanical and pollen samples than older publications.

Germania Inferior/Secunda

In the German Rhineland, the predominant cereal crops found in Iron Age contexts are *Hordeum vulgare*, *Panicum miliaceum* and varieties of *Triticum*, such as

[124] Behre 2017, 63.
[125] Behre 1998, table 10.
[126] Behre and Kučan 1994. Additional samples dated more broadly, but generally support this pattern (18381 seeds from a sample dated AD 400-600), 625 from a sample dated 1-500 AD (Behre and Kučan 1994).
[127] 11 samples yielding 222 rye seeds came from contexts dated AD 100-400, while the seven samples dated AD 300-450 contained a total of 609 seeds (Van Zeist and Palfenier-Vegter 1994a, 290-291).
[128] Middle Roman: one seed in one sample out of six; Van Haaster 2005c, appendix 1; Late Roman: a total of 1937 seeds, rachis internodes and chaff fragments from a total of 14 out of 22 samples; Lauwerier *et al.* 1999.
[129] A sample dated to the site's phase IV (100 BC – AD 100), contained 290 fragments; Van Zeist 1983, table 2), although this somewhat of an outlier for this site Only two rye fragments were recorded from earlier phases. 12 out of 31 samples from phase IV (100 BC- 100 AD) contained rye. Besides the one sample with 290 fragments, the other 11 samples yielded a total of 129 fragments with an average of 12 fragments per sample (Van Zeist 1983, table 2).
[130] 1100 seeds from a single sample suggesting a single deposition; also containing five seeds *Hordeum vulgare* and 45 of *Panicum miliaceum*; sample carbon-dated to AD 120; Van Zeist 1976, table 1.
[131] Van der Velde 2011a, 265; Behre 1992; Hiddink 1999.
[132] One sample from Deventer-Colmschate Skibaan yielded dozens of rachis internodes, one seed and one fruit epidermis fragment, as well as dozens of *Triticum dicoccon* glume bases (Van Haaster 2006b, appendix 1). 12 Late Iron Age samples were reported from Zwinderen-Kleine Esch, none of which contained rye; all three Late Roman samples did, in one case 62 seeds (that same sample also yielded 31 *Hordeum vulgare* seeds; Van der Velde *et al.* 1999, table 9.4).

dicoccon.[133] This spectrum remains much the same in the Roman period, where additionally *Triticum aestivum* and to some extent also *Avena sativa* are also commonly found.[134] *Panicum miliaceum* was a common Iron Age crop in the Netherlands,[135] which is also found in Roman contexts, including on the Lower Rhine plains in Germany;[136] it was also farmed in the villa landscape.[137] In their inventory of rye remains in the German Rhineland, Zerl and Meurers-Balke note the consistent presence of insignificant ('homeopathic') amounts of rye in samples from the Bronze Age to the Roman period.[138] The authors note that the adoption of rye as a staple crop only happened in the German Lower Rhine area from the Middle Ages onwards.[139] In their overview of cultivated food plants in the Rhineland in the Roman period, Knörzer and Gerlach do list rye, but include it in brackets.[140] According to Knörzer, in most cases rye is only present in Roman samples in very low amounts and that samples reflecting storage have not yet been found, meaning cultivation in that period cannot be ascertained.[141]

Macro-botanical evidence from the Iron Age and Roman period in Belgium and the Netherlands show much the same spectrum of cultivated cereals as the German Rhineland. In the Roman period, much the same cereals appear to have been cultivated, especially *Tritricum spelta/dicoccum*, *Avena sativa* and *Hordeum vulgare*.[142] The cereal spectrum reported from a selection of sites in the Dutch river area in the Middle Roman period shows a range of crops, including barley, emmer, oat, millet, spelt, wheat and a small amount of rye.[143] In their overview of farming in the Dutch Lower Rhine delta, Kooistra *et al.* note that barley, emmer wheat, oat and occasionally millet were farmed.[144]

A range of sites from Germania Inferior/Secunda yielded small amounts of rye grains, chaff, rachis internodes or pollen dated to the Iron Age or Early-Middle Roman period.[145] In the vast majority of these cases, the amounts found are very small and could probably be interpreted as weed rye or unintentional admixture. A sample from Ewijk-Keizershoeve, which unfortunately could not be dated closer than Iron Age-Roman period, yielded some rye as well as associated weeds.[146] More solid evidence for rye cultivation in the Early-Middle Roman period within the Roman provinces has been established outside of the study area, especially in France, southwestern Germany and Switzerland.[147] Jacomet has also noted the introduction of rye in large amounts in the Roman period in parts of France, Germany and Switzerland, citing stocks of rye appearing from the 3rd century onwards and suggesting that rye must have been cultivated since then, 'at least in certain regions'.[148] The importance of rye increased from the Early Medieval period onwards, however, indicated for example by the appearance of the ergot fungus which grows on rye.[149] Rye cultivation in the north of France has been shown from the 1st century AD onwards, but not before the 4th century in the villas.[150] It has been hypothesised that rye may have been grown as fodder as a secondary crop to wheat,[151] although Mills asserts that rye is unpalatable to most species of livestock and that they do not perform well on it.[152]

[133] E.g., Knörzer 1987, table 2; Meurers-Balke *et al.* 2002; Knörzer and Meurers-Balke 2006.

[134] Knörzer and Meurers-Balke 2006, table 14-15; Meurers-Balke *et al.* 2016, table 2; Schamuhn and Zerl 2009, 245-246; Knörzer and Gerlach 1999, 102; Knörzer *et al.* 2009.

[135] Kooistra 1996, 258; cf. Knörzer 1971, 42 for the Rhineland.

[136] Brüggler *et al.* 2017, 82, figure 42; cf. Gerlach *et al.* 2017, figure 4; Knörzer 1971.

[137] Brüggler *et al.* 2017, 85.

[138] Zerl and Meurers-Balke 2013, 38.

[139] Zerl and Meurers-Balke 2013, 38. Behre 2002, 459 and figure 804 also lists the introduction of rye in southern and central Germany as largely post-Roman, with *Hordeum vulgare*, *Triticum dicoccum* and *Triticum aestivum* more common in the Roman period.

[140] Knörzer and Gerlach 1999, 102.

[141] Knörzer 2007, 427.

[142] Kooistra 2008. See examples: Amay (Laurent 1999, 80-81; Laurent 2002, 153); Waremme/Lantremange (Laurent 1996/1997, 102-103); Kuurne-Steenovenstraat: (Beke 2020, appendix 22); Dendermonde De Kier (Van der Meer 2021, 94, appendix 4); Gent-Thomas Edisonstraat (Vanhercke and Van Esbroeck 2021).

[143] Groot and Kooistra 2009, figure 43.

[144] Kooistra *et al.* 2013, 18; cf. Kooistra and Groot 2015, 149-150; Kooistra 2009, table 1.

[145] Iron Age: Brunssum-Henri Dunantstraat (Van Haaster 2014; also Roman period); Spijkenisse-De Dalle (Verbruggen 2011; also Roman period); Weert-WML terrein (Van Haaster 2007c) ; Remicourt; Laurent 1998, 83; Engis/Hermalle-sous-Huy; Frébutte *et al.* 2008, 120-122; Ath; Laurent 2003, 45-46). Early and Middle Roman period (or Roman): Altkalkar (Hopf 1963); Neuss (Mills 2006, appendix); Hombeek-Zemststeweg (Vander Cruyssen 2018, figure 97); Alphen aan den Rijn-Julianastraat (Kuijper and Turner 1992); Breda West-Steenakker (Koot and Bervens 2004); Brunssum- Amstenraderweg vindplaats 16 (Moolhuizen 2015); Budel-Duitseschool (Van Haaster 2010b); Cuijk-Dommelsvoort site 10 (Van Haaster 2006a); Cuijk-6000 (RADAR); Doorn-Driebergsestraatweg (Moolhuizen 2013); Heerlen-Trilandis (Kooistra 2013); Hoogeloon-Kerkakkers (Kooistra 2013); Houten-Doornkade (Buurman 1986); Huissen-Loostraat A (Hänninen and Kooistra 2006); Itteren-Emmaus (Van Haaster 2010a); Leersum-Middelweggebied (Van Beurden 2013); Leiden-Oostvlietpolder (Van Beurden and Lange 2017); Lieshout-Beekseweg (Van Haaster 2003); Maastricht-Markt (Van Haaster 2007a); Maastricht-Stokstraat (Van Zeist 1968); Maastricht-Pandhof (Bakels and Dijkman 2000); Nijmegen-Kelfkensbos (Buurman 1982, 83; Buurman 1984, 93); Oss-Ussen III (Van der Sanden 1987); Oss-Ussen Zomerhof (Bakels 1998); Den Haag-Hertenrade (Van Haaster 2007b); Den Haag-Hoge Veld (Brinkkemper *et al.* 2009); Valkenburg-castellum II (Van Zeist 1968); Venlo-Maasboulevard (Van Haaster 2007a); Venlo-Kwartelenmarkt (Verbruggen 2011); Voorburg-Forum Hadriani (RADAR); Weert-Kampershoek (Van der Linden and Van Beurden 2009); Boutersem-Boskouterstraat (In't Ven and De Clerq 2005); Fexhe-le-Haut-Clocher (Laurent 2002, 152); Neuss (Mills 2006, appendix); Tongeren-Grote Markt (Vynckier *et al.* 2016, table 2); Tongeren-Kielenstraat (Vanderhoeven *et al.* 1987). Unquantified remains were listed from a late 4th-century sample from Cologne (hearth 249; Meurers-Balke *et al.* 2002, 762).

[146] Blom *et al.* 2012, 33.

[147] Rosch 1992, 209; Behre 1992, 145; see also Mills 2006, appendix, including large deposits of Early Roman rye from Augst and Kaiseraugst.

[148] Jacomet 2014, 90.

[149] Jacomet 2014, 92.

[150] Lepetz and Matterne 2003, 25, 31.

[151] Lepetz and Matterne 2003, 25, 31, 34.

[152] Mills 2006, 146.

Site	Other features	Notes	References
Meldert-Zelemsebaan	SFBs; handmade pottery; longhouse		Smeets and Steenhoudt 2012
Holtum-Noord	SFBs, Germanic-style pottery	native-style houses found	Van Enckevort *et al.* 2017
Goirle-Huzarenwei	SFBs; Germanic-style pottery; longhouses		Bink 2005; Van Haaster 2005a
Geldrop-Genoeshuis	SFBs; Germanic-style longhouses		Bazelmans 1990, 25-29; Schotten 1991, note 4.
Maastricht	SFBs; Germanic-style pottery		Bakels and Dijkstra 2000, 25
Alphen-Kerkakkers	SFBs; longhouses; Germanic-style pottery	includes native-style houses; small amount of pottery	De Koning 2005

Table 2.2. 'Migration-related settlements' with good evidence for rye cultivation.

Although rye only became widespread in the provinces in the Late Roman period, this brief discussion also shows that it was not a completely foreign crop to the inhabitants of the Western Roman Empire before then. Most high-density rye samples in Germania Secunda date to the Late Roman period. The best evidence for rye cultivation in the Late Roman period in the study area was found in the central and western parts of the Dutch and Flemish sandy soils (furthest away from the frontier), where several sites yielded large numbers of rachis internodes as part of the macro-botanical remains. Excavations of rural settlements in the last two decades dominate the dataset, as more recent commercial site reports are more likely to include archaeobotanical analysis and are more likely to process multiple samples. The most convincing evidence for storage or cultivation of rye from Late Roman settlements in Germania Secunda came from Meldert-Zelemsebaan,[153] Holtum-Noord, Goirle-Huzarenwei, Geldrop-Genoeshuis, Maastricht-Pandhof and Alphen-Kerkakkers.[154] The correlation of rye with other potentially Germanic features in these settlements is quite strong (table 2.2).

Not all Late Roman samples from 'migration-related settlements' yielded significant numbers of seeds or rachis internodes[155] and it was completely absent at others.[156] The same cereal crops were found widely in Late Roman contexts in Germania Secunda that were common in the Early and Middle Roman period, namely *Hordeum vulgare*, *Triticum aestivum*, *spelta* and *dicoccon* and *Avena*.[157] In some key sites, those cereals made up a more significant portion of the Late Roman cereal spectrum than rye.[158]

Discussion

The brief chronological overview of rye distribution in the province of Germania Secunda and Germania Magna has shown that although rye was first grown in Germania Magna from the Middle Roman period

[153] A combination of rye pollen, seeds and chaff remains was found at Meldert-Zelemsebaan (Smeets and Steenhoudt 2012, 49, 155), which the authors interpreted as sufficient evidence for local cultivation.

[154] The excavations at Holtum-Noord resulted in a total of 15 samples from the Late Roman period, nine of which yielded rye. Remarkable about these samples is that some yielded rachis internodes but not seeds and the majority of samples contained both. The largest amount (127 rachis internodes and 15 seeds came from an SFB (Van Beurden 2009). Curiously, three granaries were also sampled but two did not contain any rye (only *Avena*, *Triticum dicoccon* and *Hordeum*), while the third only yielded three seeds (Van Beurden 2009). Seven further Late Roman samples from Holtum-Noord II were reported by Van Haaster (2009, appendix 1), five of which contained rye, totalling 22 fragments. Out of 10 Late Roman samples from Goirle-Huzarenwei, seven yielded rye fragments, including one sample containing 629 seeds (55% of the sample) and one containing 24 rachis internodes (Bink 2005; Van Haaster 2009). Seven macro-botanical samples from Geldrop-Genoeshuis were dated to the second half of the 4th century-first half of the 5th century. Five contained no rye at all, but a sample taken from a granary yielded 218 seeds of rye (making up 10% of the total sample; Luijten 1990). 18 Late Roman macro-botanical samples were reported from Maastricht-Pandhof, six of which contained rye: four with only one or two seeds, but two samples containing 144 and 147 seeds of rye dated to the late 4th-early 5th and early 5th century respectively; Bakels and Dijkstra 2000, 64-71). None of the samples from Alphen-Kerkakkers could be dated closer than Late Roman-early medieval. Of the six samples dated to the 5th century, it was absent from three, while one yielded one seed (out of a total of three identified, so very low density) and one sample yielded six rye seeds (out of 35). The best indications for local cultivation come from a pit containing three rachis internodes and an estimated 500 seeds (Van Haaster 2005b, 88-89).

[155] Low counts were identified at the following sites: Breda West-Steenakkers (Wijster A house, numerous SFBs and RWG-style pottery) yielded at least 22 rye remains from four samples dated to the Roman period (out of a total of 10 Roman samples Koot and Berkvens 2004, appendix 4.2). Six Late Roman samples at Buggenum-Wijnaerden contained rye (out of 19 samples taken), only one yielded more than 10 seeds (with a total of 24 rye seeds found; Meurkens 2021). Higher counts of millet, barley and spelt were identified (Meurkens 2021, 172). the settlement at Leersum-Middelweggebied (with incomplete three-aisled houses, SFBs and RWG-style handmade pottery (see below; Tump 2014, 112-114), only yielded one rye seed (Tump 2014). At the villa at Voerendaal-Ten Hove, of the 55 analysed samples from the Late Roman-Early Medieval phase, only six contained rye seeds and one rye rachis internodes (Kooistra and Brinkkemper 2023, table 17.2). No rye was identified in the phase dated 2nd-3rd/4th century (Kooistra and Brinkkemper 2023, table 17.2). Rye pollen were identified in a sample from Kuringen-Rode Rokstraat (Hazen 2016, 74), but no remains were found in the macro-botanical samples from the site (Hazen 2016, table 5.11), meaning local cultivation or even consumption cannot be ascertained.

[156] Cuijk-De Nielt (Habermehl and Van Renswoude 2017), Helden-Schrames (De Winter 2010) and Valburg-Molenzicht (Van der Feijst and Veldman 2011).

[157] Such as at Alphen-Kerkakkers (De Koning 2005; Van Haaster 2005b); Breda West-Steenakker (Koot and Berkvens 2004); Goirle-Huzarenwei (Van Haaster 2005a); Holtum-Noord (Van Beurden 2009); Maastricht (Van Zeist 1968); Geldrop 't Zand (Lauwerier *et al.* 1999, table 3).

[158] Namely Maastricht-Pandhof and Holtum-Noord; Bakels and Dijkstra 2000, 25; Van Beurden 2009.

onwards, the most convincing evidence for established cultivation was found in the Late Roman period. Multi-period sites also gave indications that rye may have grown in popularity in the Late Roman period.[159] This increased presence of rye in Late Roman sites north of the frontier coincided with the spread of rye south of the frontier, where it was commonly encountered in insignificant amounts before the Late Roman period but where cultivation could only be identified with any degree of certainty from the Late Roman period onwards. A possible factor in the rise of rye could be that Late Roman rural communities were adapting to deteriorating environments for cereal production. The Late Roman landscape in the northwest saw a stark depletion of arable farmland as a result of intense surplus production in earlier periods.[160] It is also noteworthy that rye was positively absent in several large Late Roman settlement phases, and that many sites in Germania Magna in the Late Roman period yielded remains of other cereals that had been cultivated there throughout the Roman period (including *Hordeum vulgare* and *Panicum miliaceum*). This same diverse range of cereals was identified in Late Roman Germania Secunda. Rye was increasingly grown in the Late Roman period in the study area, but as part of a diet including various other cereals.

Furthermore, the Late Roman period saw the expansion of rural settlements into areas characterised by poor sandy soils, both in Germania Magna (central Lower Saxony and Drenthe) and Germania Secunda (Flanders and Noord-Brabant). Together, these developments may have led to an increasing need for a staple crop known for being able to grow on depleted or unfavourable soils.[161] Rye is known as a cereal for its ability to be grown in more challenging conditions compared to wheat, for example, including in cold areas and on poor soils,[162] while also being more drought resistant.[163]

Writing on Late Antique Gaul and Italy, Squatriti has argued against simplistic ethnic interpretations of rye consumption and cultivation, instead proposing a multi-causal understanding of rye in western Europe after AD 300, citing a range of possible underlying factors: *'[s]oil type, landholding arrangements, the design of sickles and ovens, demographic trends and settlement patterns, peasants' definition of economic security (regular returns, not big returns), Christianity, and possibly even barbarian invasions and the [Late Antique Little Ice Age]'*.[164] For the study area, the dispersal of settlements into lands with soils less suited to agriculture, combined with an increase in overall settlement numbers after the 3rd-century dip and the worsening environmental circumstances were likely major contributing factors in adopting rye on a greater scale than before, both in Germania Magna and Secunda.

Handmade pottery

A selection of relevant small finds are discussed in chapter 3, but much importance has also been attached in the migration narrative to Germanic-style pottery.[165] Handmade pottery in general is a difficult finds group. Germanic-style pottery may be identified as Germanic based on stylistic and typological comparisons or through fabric analysis. Handmade pottery is common in Late Iron Age and Early Roman sites in the province of Germania Inferior, although it would become significantly less important over the course of the Middle Roman period in rural settlement contexts.[166] Various studies have aimed to define Late Roman Germanic-style handmade pottery on Roman soil more precisely.[167] It is also increasingly recognised that handmade pottery was far from a uniform form group in Germania Magna.[168] Tracing Germanic pottery styles south and west of the frontiers is therefore a difficult undertaking.[169]

Identifying and describing (non-local) handmade pottery is also a highly specialised skill and rather than attempt to provide a complete overview of the various provenances of Germanic-style pottery in settlements in Germania Secunda, several key studies were summarized to show the complications of attaching uniform social labels such as 'Germanic' to this material. This will be illustrated largely through fabric analyses, which give the opportunity to identify non-local materials, but some form typology will also be addressed (most notably in cases where deviations from regional typologies or hybridity with provincial-Roman pottery

[159] Namely in Loxstedt-Littstücke, Peelo-De Es, Flögeln and Heeten-Hordelman (Behre 1998; Van Zeist and Palfenier-Vegter 1994ab; Behre and Kučan 1994; Van Haaster 2005c; Lauwerier *et al.* 1999).
[160] Groenman-Van Waateringe 1983.
[161] Behre 1992, 149.
[162] Mills 2006, 113.
[163] Mills 2006 131; cf. Steuer 2021, 412 on the link between soils and rye.
[164] Squatriti 2016, 167.
[165] Cf. Lenz 2005; Opsteyn 2003; Heeren 2017; Van Thienen 2016.
[166] Vos 2009, 88; cf. Van Enckevort 2012, 317; cf. Hendriks 2023, 628 on its disappearance and later reappearance in the Meuse valley.
[167] De Paepe and Van Impe 1991; Van Thienen *et al.* 2020; Opsteyn 2003; Verhoeven 2003.
[168] See Nösler 2013 for an overview of regional style groups, including the *Rhein-Weser-Germanische* (RWG) group, Frisian pottery and *Nordseeküstenahe* (NKN) pottery. Supra-regional typologies defined by Von Uslar (1938) and Plettke (1921) are increasingly used in conjunction with more regional or site-specific typologies, reflecting the scope and diversity of forms and styles (including but not limited to Taayke 1996/1997; Taayke *et al.* 2012; Van Es 1967; Bérenger 2000; Steidl and Walter 2000; Nösler 2017; Lau 2014).
[169] Often, only broad descriptions are given regarding the origin of the material (for example 'shows similarities to material from Free Germany'), which are hard to quantify and verify. A further hurdle in interpreting the place of Germanic-style handmade pottery in the Roman provinces is the lack of a uniform typology of local Late Roman handmade ware. Some studies have discussed typical Late Roman local fabrics (Van Thienen *et al.* 2020; Drescher 2012, 198; Van Kerckhove 2009; Van Enckevort 2011a, 57), but in Late Roman contexts, most of the attention tends to be on any sign of non-Roman identities.

styles were noted in specialist reports). Although the focus lay on Late Roman material, Germanic-style pottery from the provinces pre-dating the Late Roman period was also included when encountered, but this was not extensively surveyed. Finally, an attempt will also be made to quantify the importance of Germanic-style handmade pottery as part of the Late Roman ceramic 'diet' by looking at overall quantification from a selection of well-published settlements.

'Germanic' handmade pottery from Germania Secunda

The earliest instances of Germanic-style pottery were identified in several Early and Middle Roman settlement contexts.[170] Generally these appeared alongside provincial-Roman pottery. Most finds, however, dated quite broadly to the 4th and 5th centuries. The majority of Germanic-style handmade ware was described as related to the *rheinwesergermanische* (RWG) style group, with only a small number of sites yielding pottery in the *nordseeküstenahe* (NKN) or Frisian style. Most of the vessels of the RWG group appear to have been tempered with (burnt) organic remains, while the form spectrum corresponds closely to settlements in Germania Magna: funnel cups, cooking jars, flanged pots, wide bowls and situlae are all common. The majority of RWG-style pottery was found in 4th- and 5th-century contexts and contained (burnt) organic matter, although occasionally this was mixed with other inclusions, such as grog, sand, or sand, bone and rock.[171] One settlement, Naaldwijk, yielded handmade pottery in the Frisian style.[172] NKN-style pottery was noted at two sites: Holtum-Noord[173] and Gennep.[174]

At many sites, hybridity and adaptation of various Germanic styles were observed. Van Es noted that the handmade pottery from Wijk bij Duurstede made up a relatively small portion of the Late Roman assemblage[175] and that it largely fell within the Wijster and Von Uslar typologies. However, he also noted that some of the forms were not 'pure' RWG in style, but also showed influences of the pottery more commonly found along the northern coastal areas of Germany and the Netherlands (NKN) and the transitional zone between the RWG and NKN zones (Drenthe and Overijssel).[176] Hendriks describes a variety of regional characteristics present in the handmade pottery from Voerendaal-Ten Hove, including finger-dented RWG-type decoration and vessels showing stylistics elements of both RWG and NKN-style pottery.[177] The absence of organic tempering may also point to an origin from Drenthe.[178] The finds from Gennep also displayed a variety of characteristics: several Von Uslar forms were identified, but most vessels were plain and some of the decoration found could not be related to the Von Uslar typology but was instead more aligned with Saxon or Elbe-Germanische traditions.[179] Forms typical for northern Germany were absent and very little of the form spectrum at Gennep fitted in the styles common in the Roman period in Westfalia or the RWG tradition.[180] The material from Kuringen deviated from the RWG tradition in that very little of it was decorated.[181] It was deemed that most of the material had a local or regional origin.[182]

Although the Ede typology was used to identify the handmade pottery from Goirle-Huzarenwei and the form spectrum was said to potentially show signs of northern influences,[183] the report notes that not all handmade pottery could be identified that way.[184] For Krefeld-Gellep, Reichmann mentions that forms and fabrics show close connections to material from across the Rhine, although he also raises the possibility that it was made within the Empire.[185] RWG handmade pottery from the mid-5th century phase included various forms found within the Von Uslar typology, with Reichmann noting that although the material could have been imported from outside of the Empire, the Krefeld assemblages seems more traditional than the contemporary 5th-century handmade pottery from Duisburg.[186] The handmade pottery from Breda West-Steenakker included forms found in the Ede and Von Uslar typologies (Ede C1-C3, D2b/Von Uslar II).[187] The style was linked to the north-eastern Netherlands

[170] Breda West-Steenakkers: Taayke 2004; Cuijk-Heeswijkse Kampen (Roessingh and Vanneste 2009, 13; Ball and Heirbaut 2005, 20; Ball *et al.* 2001, 44, 115); Donk (Van Impe 1983, 80); Heeswijk Havenlaan (Ball and Heirbaut 2005, 119); Horst-Hoogveld (Habermehl and Van Renswoude 2017, 285; Verhoeven 2002, 21); Kontich-Alfsbergen (Verbeeck *et al.* 1986; Verbeeck and Lauwers 1987); Krefeld-Gellep: Mirschenz 2013, 133; Pirling and Siepen 2006, 187; Pirling 1997, Taf. 99.7; Reichmann 1999; Leersum-Middelweggebied (Drenth 2014, 111). Even earlier is pottery from the 1st century AD in Weeze-Vorselaer (Brüggler *et al.* 2017). De Paepe and Van Impe 1991, 171: Kontich jar made from A clay is proof of Germanic presence, but dates to the 3rd century, so presence of Germanic pottery should not automatically be linked to historical narratives of the 4th century. Radiocarbon date of house J in Donk also placed some of the activity there in the second half of the 3rd century. Van Thienen *et al.* 2020 further list a number of 2nd-3rd-century Germanic pottery outside of the study area: Bachte-Marie-Leerne, SintMartensLatem, Asper, Zele and Nazareth (Van Thienen *et al.* 2020, 144).

[171] See list in table 2.3.

[172] Van der Feijst 2015, 30. The appearance of Frisian pottery here is likely due to Naaldwijk's location in the far north-west of the province and its proximity to the frontier (local handmade wares similar to those found in Rijswijk-De Bult were also found; Reigersman-van Lidth de Jeude 2015, 50).

[173] Schotten 2009, 98.

[174] Habermehl and Van Renswoude 2017, 285; Schotten 2009, 101; contra Verhoeven 2003.

[175] Van Es 2021, 127.

[176] Van Es 2021, 138-139.

[177] Hendriks 2023, 639.

[178] Hendriks 2023, 641.

[179] Verhoeven 2003, 118.

[180] Verhoeven 2003, 118-119.

[181] Reigersman-Van Lidth de Jeude 2016, 49.

[182] Reigersman-Van Lidth de Jeude 2016, 50.

[183] Bink 2005, 56.

[184] Bink 2005, 56-57.

[185] Reichmann 1999, 132.

[186] Reichmann 1999, 141.

[187] Taayke 2004, 277-279.

(Overijssel and Gelderland) and the broader RWG style group.

Fabric analyses are often used to describe tempering materials which can sometimes place the pottery in a regional tradition, but the level of detail with which this is carried out (ranging from macroscopic descriptions to thin sections) means opportunities to compare material from different sites is limited.[188] In some cases, thin-section analysis has shown possible indications for manufacturing of Germanic-style pottery on Roman soil.[189] The largest and most comprehensive published fabric study into Late Roman handmade pottery of possible Germanic origin remains De Paepe and Van Impe.[190] De Paepe and Van Impe recognised five major fabric groups based on thin-section analysis of Germanic-style handmade pottery from a number of Late Roman settlements from within and without the Empire.[191] The spatial distribution of certain fabrics and styles allowed them to suggest several explanations for Germanic-style material across their study region.[192] Opsteyn mentions a small amount of handmade pottery from Wange-Damekot with volcanic tempering that was petrographically foreign to the area.[193] For some finds at Gennep and Leersum-Middelweggebied, possible production in the Eiffel region was suggested.[194]

The amounts of Germanic-style pottery found in Late Roman settlements could not always be quantified based on the published site reports. In some cases, provincial-Roman pottery made up the majority of all tableware found within a settlement; such as Baelen-Nereth (and Meldert-Zelemsebaan).[195] At other sites, Germanic-style handmade pottery made up a far more significant portion of the total assemblage, between 50 and 90%.[196]

Some correlation between Germanic-style pottery and other settlement features can be presented. Several sites yielded significant amounts of Germanic-style pottery but scored less strongly on other 'Germanic' markers. The pottery from Venlo was probably contemporary to several SFBs and a three-aisled house plan.[197] It was noted that the amount of NKN-style pottery found at Holtum varied strongly between different excavation campaigns,[198] while the house plans were largely one- and two-aisled. Donk yielded handmade pottery in Germanic style and non-local fabrics, but all houses were in the provincial-Roman tradition and the SFBs should probably be reinterpreted as deep stable litters (see above). A great deal of Frisian pottery was found at Naaldwijk-Hoogeland/Hoogwerf, but only one SFB was found at the site and there were no northern-style house plans.[199]

Other sites presented the reverse image. The settlements at Helden-Schrames and Goirle-Huzarenwei both yielded house plans that corresponded very closely to Germanic typologies,[200] SFBs and in the case of Goirle evidence for rye cultivation.[201] In both cases, however, the identification of the handmade pottery as Germanic was far from clear.[202] Geldrop-'t Zand yielded SFBs, a possible short house as well as significant amounts of

[188] Fabric analysis of Late Roman handmade pottery from Belgium has started to yield important information about provenance of raw materials (De Paepe and Van Impe 1991; Van Thienen *et al.* 2020; Van Thienen and Helfert 2022) and work in improving dating and typologies is currently being undertaken on handmade pottery from the northern Netherlands and Germany (Krol *et al.* 2020).

[189] A preliminary study of the Alamannic pottery from Groß-Gerau (outside of the study area) showed that the handmade material was made from the same clays as used for pottery produced in the Flavian and Trajanic periods (Van Thienen and Helfert 2022, 200). Calcite tempering was identified as a possible Germanic tradition, although material in continued local Roman traditions was also found. The possibility was raised that migrants had knowledge of local clay sources (Van Thienen and Helfert 2022, 200) and several petrochemical outliers were identified as possible signs of import, exchange or migration (Van Thienen and Helfert 2022, 200). Grog tempering was identified as a sign of possible local production of Germanic-style pottery in Breda West-Steenakkers (Dyselinck 2017, 83). A small number of fragments from Kuringen was petrographically analysed, which also resulted in the conclusion that the majority of the material was made locally (Van Thienen 2016, 52). Two samples yielded non-local materials, which was seen as indicative of trade networks (either of pottery or of raw materials).

[190] De Paepe and Van Impe 1991; for additional regional studies and site reports see Van Thienen 2016.

[191] De Paepe and Van Impe 1991, 155, table 1, see p. 167 on provenancing.

[192] De Paepe and Van Impe 1991, 167.

[193] Opsteyn 2003, 130.

[194] Thin sections of some of the Late Roman handmade pottery from Gennep showed volcanic material, meaning possible production in the Eifel region cannot be excluded (Verhoeven 2003, 120). A fragment of a bone-tempered Ede A3 jar with RWG-style decorations from Leersum-Middelweggebied was found to contain pyroxene, a volcanic mineral found in the Eifel region and in local Rhine sediments (Tump 2014, 112-114).

[195] Hanut *et al.* 2013, 150; Smeets and Van Steenhoudt 2012, 61, figure 7.7. Besides Baelen-Nereth and Meldert-Zelemsebaan, this was also found for Helden-Schrames (15 fragments of a single vessel; uncertain parallel Ede C3; De Winter 2010, 98, 182-184); Geldrop-'t Zand (not quantified, but most was local; Bazelmans 1990, 29; cf. Schotten 1991, note 4); Horst-Hoogveld (13% Germanic handmade pottery; Verhoeven 2002, 21); Voerendaal-Ten Hove (less than 20% of Late Roman material was handmade; Hendriks 2023, 638, table 26.4. figure 26.2); It was also noted that the handmade pottery from Wijk bij Duurstede-De Geer was a relatively small group within the Late Roman assemblage (Van Es 2021, 127); Krefeld-Gellep (5-10% of the 3rd-century phase RWG-style; 5th-century not quantified; Reichmann 1999, 130-132, Abb. 7.3-8).

[196] Gennep (59-76% of spectrum was handmade; Verhoeven 2003, Abb. 2); Kuringen-Rode Rokstraat (93% handmade pottery, most of which was identified as Germanic; Reigersman-van Lidth de Jeude 2016, 47-48); Naaldwijk (408 fragments, including some Ede or North-Holland style material; De Bruin 2008, 109, 116-117); Neer-Buggenum (almost 50%; Meurkens 2021, 80); Cuijk-De Nielt (66% of all Late Roman material handmade, some Germanic forms described; Habermehl and Van Renswoude 2017, 283); Leersum-Middelweggebied (four fragments wheel-turned, rest RWG-style material; Tump 2014); Goirle-Huzarenwei (84% handmade with potentially northern influences; Bink 2005, 44, 54-56).

[197] Schotten and Machiels 1994, 85-86.

[198] Schotten 2009, 94-95; Tichelman 2012, 84; in Van Enckevort *et al.* 2017, 113.

[199] Van der Feijst 2015.

[200] Bink 2005; De Winter 2010.

[201] Van Haaster 2005a.

[202] Bink 2005; De Winter 2010.

rye, but very little Germanic-style pottery was noted.[203] The handmade pottery from Kuringen-Rode Rokstraat was most likely locally made, although influenced by aspects of the RWG pottery style, despite the presence of two Germanic-style long houses.[204]

Discussion

As outlined above, the complexity of Germanic pottery outside of the Empire and the limited nature of many of the assemblages within the provinces are hindering factors. Ongoing research into fabrics and origins as well as chrono-typologies will provide the impetus for the next step in understanding this finds group. Based on the currently available publications of migration-related settlements in Germania Secunda, the main take-away is that this category is usually present in combination with Germanic-style architecture (but not always), may be present in either very small amounts with mostly wheel-turned pottery or in large amounts and that whenever fabric analysis is carried out, its Germanic origin is not always proven. The sources of clay and tempering as well as the typological form spectrum in some cases have provided indications for the possible local production of handmade pottery in a Germanic style.

Handmade pottery in Germanic fabrics or form styles entered the Roman West over a long period of time and in increasing amounts in the Late Roman period. In his concluding remarks on the handmade pottery from Voerendaal-Ten Hove, Hendriks provides a list of possible scenarios for how this material ended up south of the frontier: '*And the inhabitants could have made an (almost) complete switch to imported wheel-thrown wares within one generation. However, it is also possible that handmade vessels (e.g. containing foodstuff) were brought to Voerendaal little by little during the late fourth and early fifth century, some from neighbouring settlements and some from further afield. In this case, handmade pottery could simply have been additional to wheel-thrown vessels, for special purposes or occasions*'.[205]

The question remains how to label the people manufacturing and consuming this pottery. Are these first-generation migrants who brought vessels along from home, or did the introduction of Germanic-style pottery in the Roman provinces inspire a general taste for this type of material, causing its dispersal among provincial-Roman 'natives' as well (as far as that distinction can be made at all)? Some have suggested that the finding of Late Roman handmade pottery of Germanic typological form and style in local fabrics could be seen as copies of vessels brought in by earlier migration events. De Paepe and Van Impe have suggested trading or migration as possible factors for pottery in non-local fabrics, while they interpreted Germanic-style pottery in local fabrics as a sign that the Germanic migrants had stayed long enough within the Empire to know the qualities of the local soil for pottery production. The absence of their non-local fabric A at Liberchies, a site associated with Germanic *foederati*, was seen as a possible indication that these men had lived in Liberchies for some time.[206]

Based on a stylistic analysis of the Gennep finds, Verhoeven has suggested that stylistic similarities may not automatically mean direct migration: instead, the finds may also be reflective, according to him, of groups who had previously settled further south in the 3rd and 5th centuries.[207] Theuws and Hiddink also took a broader socio-cultural view, arguing that the material culture of the 4th and 5th centuries between Elbe and Seine became increasingly uniform, suggesting that manufacturers across this area were able to draw on a wide variety of examples and that the objects themselves could therefore not say much about the origins of its users or producers.[208] The varying amounts and assortment of styles found in these settlements do not seem to point towards any specific regional origin.

House architecture

Heeren's 2017 paper lists at least 13 sites with evidence for main buildings or longhouses,[209] to which some more recently excavated sites could be added.[210] The following section aims describe the range of building evidence from Late Roman settlements in Germania Secunda to provide a more detailed picture of architectural adoption and adaptation, as well as a longer chronological framework and the possibilities of cross-pollination between native provincial-Roman and Germanic architectural traditions.

House building traditions

The dichotomy between three-aisled longhouses in Germania Magna and two-aisled houses in Germania Inferior is broadly true for the Roman period, but there is more diversity in the archaeological record, especially when taking a broader chronological view. Three-aisled houses developed in the northern Netherlands and

[203] Bazelmans 1990, 25-29.
[204] Hazen 2016.
[205] Hendriks 2023, 641.
[206] De Paepe and Van Impe 1991, 170-171.
[207] Verhoeven 2003, 119.
[208] Theus and Hiddink 1996, 78.
[209] Heeren 2017, table 2; see also Kaspyrzk 2017; Roymans *et al.* 2020, table 1 for an updated list. Two houses from Tilburg-Stappengoor (Kooi 2015) listed in Heeren (2017) were excluded, based on the radiocarbon dates which place them in the very late 5th and 6th-7th century (Kooi 2015, 24-26; Van Enckevort *et al.* 2017, 107); one is also two-aisled (Van Enckevort *et al.* 2017figure 5.17).
[210] Such as Kuringen-Rode Rokstraat (Hazen 2016); Cuijk-De Nielt (Habermehl and Van Renswoude 2017); Wijk bij Duurstede-de Geer (Van Doesburg and Heeren 2021); Weeze-Knappheide (Brüggler 2021).

northern Germany from the Middle and Late Iron Age onwards, and regional typologies of three-aisled house plans have been formulated for Drenthe, Westphalia and Lower Saxony.[211]

The development of three-aisled houses in the northern Netherlands and northern Germany is well-established, starting in the Middle and Late Iron Age with the Hijken type.[212] The transition from the Late Iron Age to the Early Roman period saw the introduction of new types in Germania Magna, namely the three-aisled bipartite Fochteloo A and bi- or tripartite Fochteloo B houses.[213] In the Middle Roman period, the predominant house form became the Wijster A. This is a relatively short, bipartite house featuring two narrow entrances opposite each other on the transition between living quarters and stable part, with an extra entrance in the short stable end.[214] Very characteristic for this type is the presence of large pits at the entrances. The Wijster A type can be subdivided into various subtypes,[215] based on the alignment and number of wall posts. Wijster A houses generally date AD 100-250.[216]

In Lower Saxony, house types similar to those found in the northern Netherlands developed simultaneously (Flögeln 1a-d, 2 and 3).[217] Flögeln 1 houses are mostly found in contexts dating from the 1st to 3rd century.[218] Flögeln 1a was a bipartite plan similar to the Wijster Aia and is mostly found in 1st-century contexts. The tripartite 1b, which shared several characteristics with the Late Iron Age/Early Roman transitional type Noordbarge, dates 1st-3rd century.[219] The Flögeln 1c was a very long tripartite house that corresponds to the Late Roman Peelo A in Drenthe, but dates to the 2nd and 3rd centuries in Lower Saxony.[220] The 1d, finally, is a tripartite variant of the Wijster Aii dating from the 3rd-6th century.[221] Flögeln type 2 houses feature a centrally constructed stable part. They are very similar to the 1d type in terms of construction, but in this case the living areas are placed on either side of a central stable. Type 2 houses are also found in Rullstorf,[222] and parallels are widespread in Scandinavia.[223] This type deviates from most others in having the stable boxes in the central section of the house rather than in the side sections. This house type dates broadly to the 1st- 5th/6th century AD.[224] Finally, the Flögeln type 3 group consists of houses with regularly placed pairs of posts along the entire length of the house. This type is clearly divisible into two types: those where the rows of posts are placed closely together (3a) and those where the rows are spaced further apart (3b). Type 3 is equivalent to Wijster Aib,[225] and this Drenthe type also shows the same division in row spacing.[226] Whereas type 3a houses date to the 2nd and 3rd centuries AD, type 3b dates considerably later (5th-6th century),[227] despite its similarities to the Middle Roman Wijster AIb.

This process of standardisation continued in the Late Roman period, with the main house types Wijster B and C and the Peelo A and B. The Peelo A type is a tripartite version of the Wijster A. The first pair of central posts in the stable section (if preserved) is replaced by double wall posts and in the other side section, one extra pair of central posts is added.[228] A feature of the Peelo A that would become a staple characteristic of three-aisled houses is the three pairs of central posts in the central section. Only a handful of bipartite specimens are known and may be classified better as Wijster A houses.[229] The tripartite plans feature no less than five entrances: two opposing sets in the long sides of the house, and one in the short end in the stable section.[230] Its average measurements are 21-36 by 6-7 meters. Peelo A and Wijster B are often used interchangeably, as they are very similar and distinguishing them from incomplete plans is often impossible.

The main distinction between the two types is that the pair of posts added to the side section in the Peelo A type is replaced by two to four double wall posts in the Wijster B.[231] Both are characterised by the three pairs of central posts in the central section of the house. While the Peelo A house is tripartite, the Wijster B house is bipartite. The Wijster C type forms a slight deviation from the other types in the Late Roman period. It is bipartite and it differs from the Wijster B type in the number of inner posts in the middle section and therefore in its total number of entrances (three rather than five). The living quarters only feature one pair of inner posts, with the rest replaced by three-four pairs of double wall posts. This house type's average length is 18-22 meters, and its distribution is largely limited to the sandy soils of Drenthe.[232] Finally, the last and youngest house plan in the Drenthe typology is the Peelo B type, which dates to the 5th century. It is usually tripartite, with a central section that features three pairs of central posts. The number of inner post

211 Van Es 1967; Zimmermann 1992; Waterbolk 2009; Nüsse 2014.
212 Huijts 1992, 73-92; Waterbolk 2009, 55-63.
213 Waterbolk 2009, 72.
214 Waterbolk 2009, 73.
215 Van Es 1967.
216 Huijts 1992; Waterbolk 2009; Van der Velde 2014.
217 Zimmermann 1992, 98.
218 Zimmermann 1992, 98; Nüsse 2014, 74-82.
219 Waterbolk 2009, 72; Nüss 2014, 74.
220 Waterbolk 2009, 73.
221 Nüss 2014, 86.
222 Gebers 1985b.
223 Zimmermann 1992.
224 Nüsse 2014, 82.
225 Van Es 1967.
226 Zimmermann 1992, 102.
227 Nüss 2014, 93.
228 Waterbolk 2009, 73.
229 Waterbolk 2009, 73.
230 Waterbolk 2009, 73.
231 Waterbolk 2009, 73.
232 Waterbolk 2009, 73.

pairs in the other section varies, however.[233] There are three entrances (two in the long side, one in the short end of the stable section), although some only feature one entrance in the long side. As the stables are often relatively small in this type, the Peelo B appears somewhat smaller than its relations, with an average length and width of 13-24 and 5-6 meters respectively.[234] It has the same distribution as the Wijster ABC and Peelo A types.

Both the Wijster and Flögeln typologies also include types of short houses. Whereas some are simplified and shortened versions of long houses (Wijster type A; Flögeln longhouse types 1 and 3),[235] others are distinct types (Wijster type B).[236] However, a variety of differently constructed house types developed concurrently with these three-aisled plans, including one- and two-aisled houses. Between 100 BC and AD 100, the Noordbarge house type was also widespread throughout Germania Magna, a type characterised by its diversity: it could have a one-, two- or three-aisled inner construction.[237] The two-aisled Noordbarge houses show clearly related to the contemporary Oss-Ussen 5 house from south of the Rhine, while the one-aisled types closely resemble the Oss-Ussen 6.[238] Two-aisled house plans related to provincial-Roman types are also known from the central river area north of the Rhine,[239] as well as southwest of the IJssel,[240] Westfalia and southern Lower Saxony.[241] In northern Germany, especially the Westfalen-Lippe area, two-aisled houses of the Soest-Ardey type are common, which in some cases seem to be related to the Noordbarge type.[242] In this context, it is also important to note that the Didam and Wehl settlements north of the Rhine also yielded a number of provincial-Roman style house plans.[243] This emphasises the interactive nature of the (Late Roman) frontier: architectural styles apparently moved both ways in the Late Roman period.

Houses with sections of different constructions were also found in the far northern regions of Germania Magna and were first introduced there in the Middle and Late Iron Age (types Dalen/Colmschate and Diphoorn).[244] They continued to develop regionally (the Midlaren typology types A-E are all variations on this combination of two- and three-aisled longhouses, dating from the Late Iron Age to the Late Roman period).[245] A similarly constructed house was identified as the Vreden type by Nüsse[246] in northern Germany and the northern Netherlands. He sets this type apart from the Oss-Ussen 9 type (which has a similar inner construction) on the basis that Vreden plans do not feature continuous wall-supporting ditches.

South of the rivers, a similar variety of house plans developed. On the sandy and loess soils and in the river area, the two-aisled Oss-Ussen house 1-5 of the later Iron Age were replaced around the end of the first century by the Alphen-Ekeren house (equivalent to Oss-Ussen types 6-9). Three-aisled houses are also known from the Dutch sandy soils in the Roman period.[247] Regional variations developed: houses related to the Oss-Ussen 9 type (partially two- and three-aisled) are known from the river area: De Horden 3[248] and type Katwijk.[249] Simultaneously with developments further south, the house plans of the river area develop more towards one-aisled houses from AD 200 onwards, a practice that continued into the Late Roman period.[250] A number of three-aisled house plans dating to the Late Iron Age/ Early Roman period are also known from the central river area (Geldermalsen-Hondsgemet).[251] Composite houses with a one- and a two-aisled section can also be found in the river area (De Horden type 2).[252]

Three-aisled house plans are also known from the southwestern coastal and river area of the Netherlands. Here, we find three-aisled long houses with a roof that was supported by rows of inner posts, placed in pairs.[253] They date from the 1st to the 3rd century (Rijswijk typology).[254] Houses with a combination of a two- and three-aisled or one- and two-aisled section (such as the WNL type 6) are also found in the western river and coastal area[255] as well as further to the east.[256] The Kethel-Rijswijk house plan type, exclusively found in the southwestern coastal area, included a variety of one, two- and three-aisled constructions,[257] dating to the 1st-3rd century.[258]

Variations of the Alphen-Ekeren house can be found across north-western Europe, including the Netherlands, Belgium and France.[259] Alphen-Ekeren houses are also two-aisled, with three or more heavy

233 Waterbolk 2009, 84.
234 Waterbolk 2009, 84.
235 Zimmermann 1992, 127-132.
236 Van Es 1967, 73-74; Van Es and Taayke 2001, 161.
237 Waterbolk 2009, 72; see also Nüsse 2014, 58-61.
238 Waterbolk 2009, 72; see also Verlinde 1999 on the appearance of Oss-Ussen style houses in Overijssel.
239 Taayke *et al.* 2012, 70.
240 Van der Velde 2014, 103.
241 Hiddink 1999, 93, 150.
242 Nüsse 2014, 50.
243 Van Enckevort *et al.* 2017, 180.
244 Waterbolk 2009, 64.
245 Nicolay and Waterbolk 2008, 98, 103, 105-108.
246 2014, 65.
247 Van Enckevort and Hendriks 2014, 244, figure 4.
248 Van Renswoude and Boreel 2014, 282.
249 E.g., Van der Velde 2008, figure 4.5/4.6; Van der Velde 2008, 2011b; cf. Nüsse 1014, 65-66.
250 Van Renswoude and Boreel 2014, 287.
251 Van Renswoude and Boreel 2014, 282-283.
252 Van Renswoude and Boreel 2014, 286.
253 Vos and Lanzing 2000, 30.
254 Bloemers 1978.
255 Kodde 2014, 306.
256 Van Renswoude and Boreel 2014, figure 5b.E and 8.B.
257 Nüsse 2014, 54.
258 Nüsse 2014, 57-58.
259 Van Hoof 2007, 256-259; cf. Slofstra 1991, 144, figure 8.

inner posts with a lighter wall construction and a gable roof. Both long sides feature two opposing entrances and include one section used as a deep litter stable.[260] However, Van Enckevort and Hendriks also note that the Alphen-Ekeren type includes a much wider variety of house plans than earlier typologies allowed for.[261] Over time, Alphen-Ekeren houses became longer (up to 29 meters), which necessitated a change in roof construction and heavier 'holster'-shaped post holes.[262] Some individual specimens therefore appear to have been one-aisled as a result.[263]

Migration-related settlements

The 43 Late Roman timber-built longhouses from migration-related settlements (see appendix 1; figure 2.9) in Germania Secunda form a complicated and multifarious dataset. They fall into several categories: three-aisled bipartite plans, three-aisled, tripartite houses, houses with a two- and a three-aisled section, houses with other combinations of differently structured sections and houses that were three-aisled but too incomplete for further identification. Short houses are discussed separately. Identifying houses using typologies designed for other regions proved to be quite difficult, as houses often displayed characteristics of multiple types,[264] which is exacerbated when they are only partially excavated or preserved.[265] Several of these buildings are worth describing in more detail, as specific elements of them are particularly interesting in light of the migration discussion. Some correspond exceptionally closely to Germanic house typologies, while others deviate in very specific ways. Other house plans did not conform Germanic architectural traditions at all. Finally, there are also some plans that may belong in either category. All houses are listed with references in appendix 1.

At least 12 houses were found that showed relatively clear similarities to the Wijster, Peelo, Ede and Flögeln typologies. Two house plans were three-aisled and bipartite and could be linked to variations of the Wijster A house. Although this is a small category,[266] it is interesting to note that the house at Breda West-Steenakkers dates to the 3rd century.[267] This plan was relatively short, as fitting for longhouses of this period. It conforms very closely to a standard Wijster A house but has doubled posts along the entire length of the house, something also found in several Oss-Ussen houses.[268] The southern entrance also appears to include an awning of some sort, something also seen in houses from across the frontier.[269] This plan was dated to the same settlement phase as two other timber-built houses which were in the standard provincial-Roman style.[270] House 2 at Gennep-Stamelberg also corresponds closely to the standard Wijster A house, featuring clear stall boxes and a bipartite division.[271] The entrances are a little less clear in the house plan from Venlo-Blerick Heierhoeve,[272] but the house appears to have been bipartite. It also featured stall boxes, and uniquely for houses in migration-related settlements, clear wall ditches were identified.[273] The closest parallels in the tripartite category were found with the Peelo A/Wijster B types. Several houses featured six central posts in the middle section of the house.[274] Stall boxes were a rare phenomenon[275] and so was the replacement of central posts with double sets of wall posts, as found in many Drenthe house types.[276]

However, these tripartite houses are relatively short compared to contemporary Peelo A/Wijster B/Flögeln 1c houses in Germania Magna. There, these houses tend to measure between 21 and 36 metres,[277] with most falling between 28 and 32 metres.[278] Most of the complete houses Germania Secunda of this type were

[260] Van Enckevort and Hendriks 2014, 240.
[261] 2014, 245.
[262] Van Enckevort and Hendriks 2014, 139.
[263] Van Enckevort and Hendriks 2014, 241.
[264] A good example of this comes from a site located just outside of the Empire in the Central Dutch River area: Didam-Randweg. The excavators note that they identified a Late Roman house plan as a Wijster B house with elements from house types Wijster A, Fochteloo B and Midlaren (Van der Veken and Prangsma 2011, 80), types which tend to date more commonly to the Middle Roman period.
[265] Often the inner section of the house is less well-preserved, and it is impossible to know for certain how many central posts should be reconstructed. On the sandy soils of the south, the stall boxes are also often less well-preserved than in Germania Magna and as a result it is often impossible to definitively ascertain which part of the house was the stable or the living section. In incomplete plans, the replacement of central post by doubled wall posts, for example, can also be impossible to identify if parts of the wall or inner construction were disturbed or not excavated.
[266] Outside the study area, a 3rd-century Wijster A house was also excavated at Nazareth-'s Gravensdreef (Dyselinck 2017).
[267] The pottery from the features of the three-aisled house in Breda-West Steenakkers was dated to the late 1st and early 2nd century, while a charcoal sample from one of the postholes most likely dated to AD 120-260 (Koot and Berkvens 2004, 221, table 2.2 sample AA-52386).
[268] Cf. Van Enckevort and Hendriks 2014, figure 11a and 11b. The closest parallel for this in Germania Magna was found in Kablow near Berlin dated to the 2nd/3rd century (Brabandt 1993, Taf. 28.1), although the inner construction there is much more irregular.
[269] E.g., a house from Grasdorf-Moss (Brabandt 1993, Taf. 103.2) and Soest-Ardey (Reichmann 1982, 170, afb. 11 in Bink 2005).
[270] Berkvens and Taayke 2004a, 224-225.
[271] Heidinga and Offenberg 1992, 78.
[272] Van Enckevort and Hendriks 2014, figure 4.
[273] Cf. Wijster AIb/Flögeln type 3 houses; Nüsse 2014, Abb. 83.
[274] A key characteristic of the Wijster B/Peelo A and the later Peelo B type; Waterbolk 2009, 73, 84, iIdentified in Goirle-Huzenwei structures 1, 4 and 6 (Bink 2005), Helden-Schrames H97 (De Winter 2010); Meldert-Zelemsebaan H3 (Smeets and Steenhoudt 2012); Gennep house 1 (Theuws and Hiddink 1996).
[275] Goirle-Huzarenwei house 4 (Bink 2005); Venlo-Blerick Heierhoeve (Schotten and Machiels 1994); Gennep house 2 (Theuws and Hiddink 1997).
[276] Waterbolk 2009, 73. Possibly found in Alphen-Kerkakkers houses G3 and G4 (De Koning 2005); Kuringen-Rode Rokstraat house 5 (Hazen 2016). Also found in Helden-Schrames H97 and possibly H35 (De Winter 2010).
[277] Waterbolk 2008, 73.
[278] Nüsse 2014, figure 65.

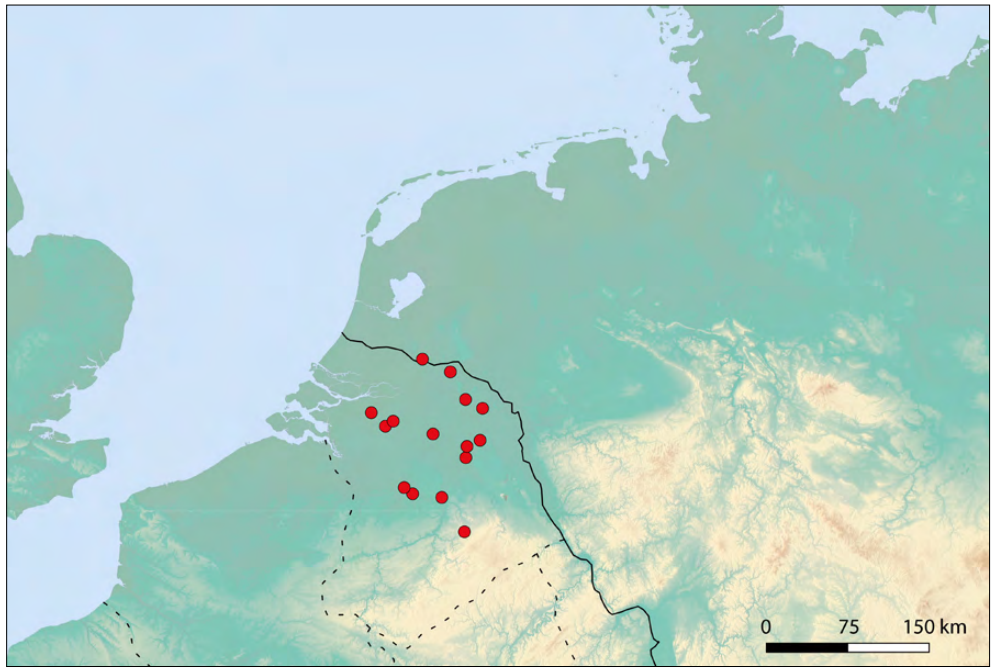


Figure 2.9. Map with all Late Roman Germanic-style three-aisled longhouses in Germania Secunda (data in appendix 1).

on the lower end of this range or were even shorter. The native Alphen-Ekeren houses tend to measure between 26 and 28 metres in length and six to eight to nine metres in width.[279]

A number of houses in Germany Secunda featured a combination of three- and one-aisled sections. Brüggler has noted for the two houses at Weeze-Knappheide with this structure that although they are incomplete and could not be identified to type, that particular house structure was common in Germania Magna from the 2nd/3rd to 5th century.[280] One house from Weeze-Knappheide features a dividing wall between the central section and the western side section.[281] The inner construction is largely incomplete but appears to be irregular,[282] with varying widths of the three aisles in different sections of the house.[283]

Of the Alphen-Kerkakkers houses, the excavators note they could not be placed in the main three-aisled or in the Alphen-Ekeren tradition, but showed signs of individual plans known from Drenthe, Westfalia and Lower Saxony as well as the river area,[284] emphasising the presence of short houses.[285] House 2 from Geldrop is incomplete and appears to be partially one-aisled, partially two-aisled, but little remains of the latter section, and it is possible that the entire house was one-aisled. Structurally, it may fit within the later Alphen-Ekeren tradition.[286] House 3 from Gennep-Stamelberg is a very simple structure, featuring just one pair of central posts, a possible entrance pit and no doubled wall posts,[287] giving it characteristics of both native and Germanic architectural traditions. House 10 in Goirle-Huzarenwei is also largely unique. Based on the number of reconstructed entrances, it can be divided into three sections, most or all of which seem to have been two-aisled. The most western section of the house may also have been one-aisled, although it does not seem to be directly related to the one-aisled Alphen-Ekeren tradition.[288]

At several Late Roman sites where Germanic migration was suggested, provincial-style Roman houses were found in the Late Roman phases. Cuijk-De Nielt yielded two houses in the regional provincial-Roman style.[289] Both houses dated to the first half of the 4th century, predating the SFBs found at the same site.[290]

[279] Van Enckevort and Hendriks 2014, 241.
[280] Cf. Nüsse (2014, 67-71), who lists at least 16 sites in Germania Magna with these types of houses and they are mostly found in Ostfriesland, Overijssel and eastern Westfalia (Nüsse 2014, 71, Abb. 60), although these houses vary widely in length, regularity, and wall construction.
[281] Also seen in Helden-Schrames H97 (De Winter 2010), Baelen-Nereth house D (Fock 2020) and possibly also Buggenum-Wijnaerden house 2 (Meurkens 2021).
[282] Brüggler 2021.
[283] As also seen in Meldert-Zelemsebaan H3 (Smeets and Steenhoudt 2012) and Goirle-Huzarenwei 4 and 6 (Bink 2005).
[284] De Koning 2005, 100.
[285] The Alphen-Kerkakker houses (De Koning 2005) are indeed among the shortest in the province and could possibly be classified as short houses. Houses G3 and G4 are both bipartite and feature some Germanic characteristics (entrance pits, doubled wall posts replacing central posts).
[286] Cf. Van Enckevort and Hendriks 2014, figures 2, 3, 8, 13; Wesselingh 2000, figure 11a.
[287] Heidinga and Offenberg 1992, 78.
[288] Bink 2005, 38.
[289] De Horden 3A/Oss-Ussen 9A and a two-aisled Oss-Ussen 7A house; Habermehl and Van Renswoude 2017, 124.
[290] Habermehl and Van Renswoude 2017, figure 6.11.

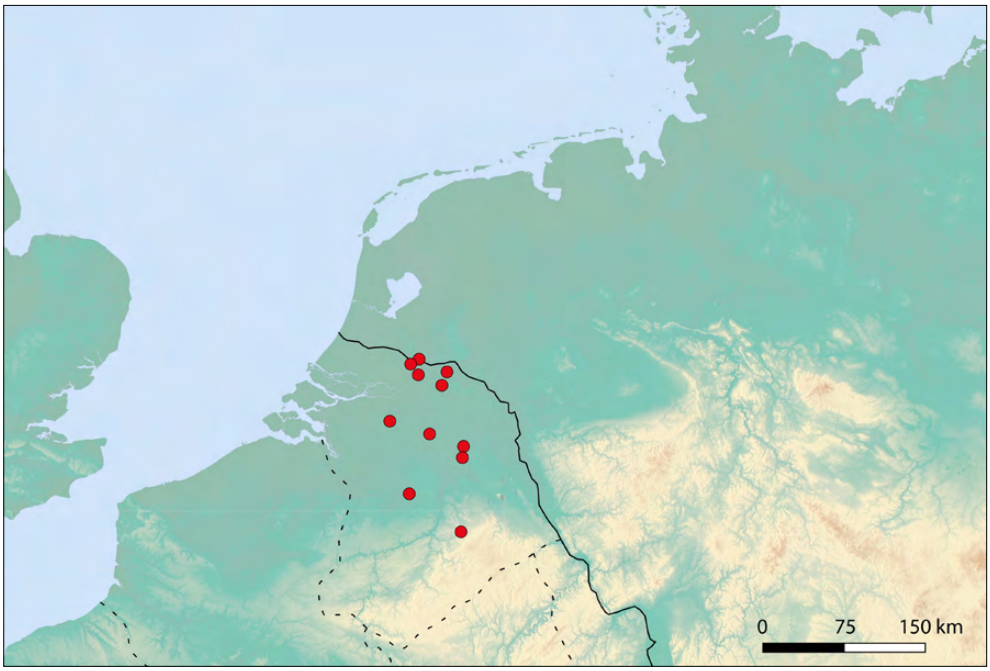


Figure 2.10. Distribution of Late Roman Germanic-style short houses in Germania Secunda (data in appendix 1).

Helden-Schrames also yielded a very incomplete two-aisled house plan[291] from the Late Roman period and contemporary with the two Peelo A/Wijster B houses and SFBs from the site. At Holtum, a cluster of house plans was excavated over the course of several excavation campaigns.[292] Most plans from the site appear to have been either one- or two-aisled.[293] A two-aisled house from Wijk bij Duurstede-De Geer[294] was dated to the Middle-Late Roman period. Several one-aisled houses are also known from Alphen-Kerkakkers (G1, G2), which date to the late 4th and 5th centuries, although they are difficult to interpret typologically.[295] Additional one-aisled house plans were identified in Aldenhoven[296] and Krefeld-Gellep.[297] One-aisled houses in the provincial-Roman style were also built in the Late Roman period on a number of villa sites, including Hambach 412[298] and Champion-Hamois.[299] The latter was constructed sometime between the late 3rd and early 4th centuries.[300]

Bipartite houses with a two-aisled and three-aisled section appear on both sides of the frontier.[301] Nüsse identified the house from Neerharen-Rekem as a Vreden type.[302] Also appropriate for the interpretation of the Neerharen-Rekem plan would be the Oss-Ussen type 9A, although it lacks the typical wall ditches. The heavy central posts in the two-aisled section of the house are also reminiscent of the heavy posts found in house 11 at Midlaren.[303] At least one house from Holtum-Noord also fits within this group.[304] The complex nature of the Wijk bij Duurstede-De Geer site mean its house plans are difficult to date, either based on location/orientation or by finds, although the report suggests the presence of some Germanic architectural elements.[305]

[291] H24; De Winter 2010, 111.
[292] Van der Ham and Wagner 2010; Helmich *et al.* 2011; Tichelman 2012.
[293] Van Enckevort *et al.* 2017, figure 5.20.
[294] 5; Van der Velde 2021, 498.
[295] De Koning 2005, figure 11. These are, like the other structures from Alphen, relatively short. House G1 possibly features five entrances, although no division is made between the rooms (De Koning 2005, figure 11), while G2 is bipartite.
[296] Lenz 2005, figure 18; after Lenz 1999, figure 14.
[297] Lenz 2005, figure 13; see Reichmann 1999, Abb. 5. The building from Aldenhoven, located on a villa site, is largely incomplete and appears to have not been longer than around 10 metres. The one-aisled structure from Krefeld, built between the ditches and the outer walls of the castellum dated to the mid-5th century (Reichmann 1999, Abb. 3; Lenz 2005, 396). Lenz notes a provincial-Roman influence on the house, citing the one-aisled structure, the lack of an integrated stable and the use of sills to support the posts (396-397). No Germanic-style handmade pottery was found at Aldenhoven (Lenz 2005, 402), although some was found at Krefeld-Gellep; see section 3.4). A two-aisled house in Helden-Schrames (H24) was dated to the Late Roman phase of the sites based on its orientation (De Winter 2010, 111; the limited finds dated broadly to the Roman period, with a slight emphasis on the Middle Roman period).
[298] Kaspyrzk 2017, figure 13; Kiessling 2008, 130-131, Taf. 75.
[299] Van Ossel 2006, figure 12.
[300] Van Ossel 2006, figure 12.
[301] In the south: Oss-Ussen 9A Wesselingh 2000, figure 11a; to the north the Vreden type and Midlaren group (Nüsse 2014, 65-66; Nicolay and Waterbolk 2008, 97-108).
[302] Nüsse2014, 65.
[303] Nicolay and Waterbolk 2008, figure 6.3.
[304] Van Enckevort *et al.* 2017, figure 5.20.
[305] House 21 from the settlement was three-aisled and was dated to the 3rd-4th century (Van der Velde 2021, 510). House 36 featured no central posts, which is explained by the report as indicative of the Peelo A/Wijster B variation where central posts are replaced by extra posts (Van der Velde 2021, 519-520; although these were not found, possibly due to later phases overlapping). Due to a lack of finds, the plan was dated to the Late Roman period based on the Peelo A parallel (Van der Velde 2021, 519-520).

Short houses are generally rare in settlement contexts in Germania Secunda (figure 2.10). Only 9 Late Roman settlements yielded short houses, with 16 possible plans identified overall (appendix 1). This may at least partially be a result of excavation methods and visibility: these smaller houses are more difficult to identify positively based on partial plans in small trial trenches. As they are also relatively simply built, a partial plan might not be recognised or confused with another secondary building like a granary or barn. This is supported by the fact that they have mostly been found on large-scale open plan excavations on sizable settlements with good evidence for phasing and chronology.

The contextual dating for many of the short houses is rather imprecise. The plan from Baelen-Nereth dated to the 4th century,[306] which is one of the earliest instances of a short house in the area. The majority broadly date to the Late Roman period, although at one site a date in the first half of the 5th century could be assigned based on associated finds.[307] The short houses show very limited variation from the established Germanic typologies, potentially because their simple nature allowed less room for innovation. Most short houses are one-aisled with a wall separating the house in two parts.[308] Some have rounded edges,[309] while others are square or rectangular.[310] A small number of sites yielded houses of the shortened Wijster A type.[311] The distribution of Late Roman sites with short houses largely clusters in the *limes* zone. It does not appear that this house style was adopted very widely in the Roman West, and it did not play a major role in the development of house plans in the region from the Late Roman to Early Medieval period.

The overview of the house plans from migration-related settlements reflects a wide diversity of construction types and states of preservation. Among the houses where links to Germanic architectural styles were clearer, a wide variety of types and regional origins were still identified. House plans with typological similarities to houses built in Drenthe, Lower Saxony, Westfalia and the river area were all found. Stall boxes, a key characteristic of Germanic longhouses, were very rarely found, despite the similar soil conditions. The replacement of central posts with doubled sets of wall posts was also not frequently found, although poor preservation of many of the house plans may be a limiting factor. The one characteristic feature of Germanic-style houses that was fairly common in these migration-related settlements was the three sets of central posts seen in the Peelo A/Wijster B houses of Drenthe.

It should also be emphasized that in several cases, it was difficult or impossible to unequivocally link a particular house plan to either Germanic or native-Roman architectural traditions. Houses with a combination of a two- and a three-aisled section are found in various regional traditions,[312] with some differences observed in the construction of the wall. Several one- or two-aisled houses were identified in Late Roman settlements, some of which could typologically be placed in the native Roman traditions. In other cases, however, this was not so certain and one- and two-aisled houses are known from Germania Magna in the Roman period.[313]

Differently built houses were frequently found within the same settlement (including Germanic- and Roman-style houses), although the lack of precise dating limits interpretation.[314] This opens up the question how rigid the regionally restricted the origins and traditions of these houses were. The decision to build a three- or one-aisled house could be informed by a myriad of factors, such as functionality, availability of construction materials, the wish to display the builder's regional origin or indeed the wish to fit in with neighbouring houses. The variety of house plans in these migrants' supposed area of origin further raises the question whether house plans are a good marker for migration. This question is further underscored by the appearance of SFBs alongside several Late Roman provincial-Roman houses.[315] Several houses with parallels to Germanic architecture could be dated earlier than the period of the late 4th and 5th centuries, most notably to the 3rd and first half of the 4th century.[316] This provides a similarly long chronology for Germanic-style longhouses in Germania Secunda as the introduction of SFBs and handmade pottery (see above).

306 Fock *et al.* 2015, 183.
307 Wijchen-Tienakker; Heirbaut and Van Enckevort 2011.
308 Wijster type Bii and variants; found at Helden-Schrames H10 (De Winter 2010) and Geldrop house 2 (Theuws and Hiddink 1996).
309 Kuringen-Rode Rokstraat (Hazen 2016); Wijchen-Tienakker (Van Enckevort 2011).
310 Tiel-Passewaaij (Heeren 2009).
311 Baelen-Nereth (Fock 2020), Valburg-Molenzicht (Van der Feijst and Veldman 2011) and Wijchen-Tienakker (Van Enckevort 2011).
312 Oss-Ussen 9C, Wesselingh 2000; Typ Vreden, Nüsse 2014, 50ff.; Midlaren, Nicolay and Waterbolk 2008.
313 Nüsse 2014, 32-33, 52.
314 E.g., Meldert-Zelemsebaan (Smeets and Steenhoudt 2012); Breda West-Steenakker (Hoegen *et al.* 2004, 379); Helden-Schrames (De Winter 2010); Alphen-Kerkakkers (De Koning 2005) and Wijk bij Duurstede (Van der Velde 2021).
315 Breda-West-Steenakker (Berkvens and Taayke 2004ab), Horst Hoogveld-Oost (Verhoeven 2002); Venlo-Blerick Heierhoeve (Schotten and Machiels 1994); Cuijk-De Nielt (Habermehl and Van Renswoude 2017), Helden-Schrames (De Winter 2010), Holtum-Noord (Van Enckevort *et al.* 2017) and possibly Alphen-Kerkakkers (De Koning 2005).
316 The Wijster A house from Breda West-Steenakkers dated to the 2nd-3rd century at the youngest (Koot and Berkvens 2004, 221) and at least one of the three-aisled houses from Baelen-Nereth (house A) which was too incomplete to identify to type was dated to the 4th century (Hanut *et al.* 2012, 244; Hanut *et al.* 2013, 151; Fock *et al.* 2015, 183). The Wijster Aii/Ede B house at Kuringen-Rode Rokstraat was also dated to the 4th century (Hazen 2016, 32-35, house 2).

Discussion

The aim of this chapter was to assess rural settlements associated with Germanic migration in Late Roman Germania Secunda. Out of the discussion of architecture, botanical samples and material culture, a varied and complicated image arose of a diverse settlement landscape. The overview presented above has shown that there was no 'signature' Germanic cultural package that can be readily or repeatedly identified in any rural settlement. Nor can any of the sites be reliably dated to a very short and specific period in history that would fit the historical narrative of the Frankish migrations.[317] Instead, the archaeological evidence is characteristically ambiguous. This means that any interpretation of this group of sites as whole needs to reflect their reflecting their homogeneity and chronological range.

Chronology

First of all, the available evidence for dating and chronology, indicated that a significant number of settlement features were introduced either before the Late Roman period or in the late 3rd-early 4th century,[318] as also already indicated by Flemish and French sites.[319] This includes a Germanic-style house plan,[320] but more numerous were the SFBs from the Early-Middle Roman period. A significant number of sites were also dated to the early-mid 4th century. Some 3rd-century Germanic-style pottery was also identified. This is a good indication that interaction across the frontier should not purely be seen as a short-term event of mass migration, but rather as a long-term process that spanned several generations.

In further support of that notion is the fact that several developments in the rural settlement landscape in Germania Secunda and Magna appear to have happened simultaneously. Rye and SFBs increased in popularity on both sides of the frontier from the late 3rd century onwards.[321] Although this does not exclude the role of migration in their introduction to the Roman provinces, it does indicate that other, non-cultural factors were also playing a role. In the case of rye, for instance, the multi-causal interpretation as argued by Squatriti includes a lot of factors that were likely at play in the Late Roman West.[322] As rural settlements in Germania Secunda were expanding into poorer soils, communities must have attempted to make a living in an increasingly marginal landscape. Additional factors besides migration probably played a role in the distribution of rye as a cereal throughout western Europe in the Late Roman period, including landholding arrangements, demographic trends and settlement patterns.[323]

The adoption of the SFB in provincial-Roman culture may also be related to its multi-functional nature as an ancillary building, which made it a highly adaptable feature for a rural settlement. This is supported by its frequent appearance in Early and Middle Roman settlements in Gaul.[324] Its increased popularity in the Late Roman period on both sides of the frontier could therefore be due to practical reasons, such as changing attitudes towards craft activities. This long chronology seems to reflect a long-term process rather than a relatively quick process of (re)settlement. Considering the range of settlements with 'Germanic' material dating to the 2nd and 3rd centuries and the overall low number of sites, the archaeological evidence seems more reflective of a slowly changing settlement landscape.

Variability and diversity

In addition to dating to a long time period, the archaeological data collected from the migration-related settlements in Germania Secunda also showed a great deal of variability and diversity in terms of finds and features. Each settlement presented a unique combination of structural evidence and finds, which suggests they should not all be interpreted as a single phenomenon. Publication biases play a major role of course but even in site reports of more recent date and complete excavations, not all 'Germanic' markers could be repeatedly and consistently identified.

Most of the settlements with SFBs or Germanic-style longhouses or pottery, for instance, did not yield strong evidence for the cultivation or consumption of rye.[325] On the sites where rye was found, other Germanic markers were sometimes absent.[326] Germanic-style handmade pottery was almost always found as part of a wider ceramic assemblage which included provincial-Roman wheel-turned wares. It was also sometimes found on sites with provincial-Roman architecture.[327] Longhouse

[317] Cf. Lenz 2005, table 2; Heeren 2017, 164.
[318] i.e., before Heeren's proposed date of the late 4th/early 5th century; Heeren 2015, 284; Heeren 2017, 164.
[319] De Paepe and Van Impe 1991; Van Thienen 2018, 9-10; Gonzalez *et al.* 2003.
[320] Wijster A house plan from Breda West-Steenakkers (Koot and Berkvens 2004, 221).
[321] Cf. Kossack *et al.* 1984, 220.
[322] Squatriti 2016.
[323] Squatriti 2016, 167.
[324] Durost 2011; Bayard and Lemaire 2014, 76; Kasprzyk 2017.
[325] The absence of rye in the botanical data from Helden-Schrames is notable for instance, given that the site did yield several SFBs and house plans that closely corresponded to Germanic typologies (De Winter 2010).
[326] Rye, Germanic-style handmade pottery and SFBs were found in abundance at Holtum-Noord, but no three-aisled house plans were found in any of the many excavation campaigns at the site (Van Enckevort *et al.* 2017, figure 5.20). Instead, the settlement yielded several houses plans more commonly found in provincial-Roman settlements.
[327] 'Native' house plans in the Alphen-Ekeren style were also found alongside Germanic-style pottery in Cuijk-De Nielt (Habermehl and

architecture was the main category discussed in this paper where changes towards a Germanic-style type settlement in the Late Roman period was most clearly identifiable. The continued appearance of provincial-style architecture therefore hints at the continued presence of communities building in that style. It also raises questions about how to interpret these buildings when accompanied by SFBs or Germanic-style handmade pottery.

Individual markers also displayed great variability and diversity. Each Germanic-style house plan was unique, with some showing more similarities to Germanic house typologies than others. The style, origin and amount of handmade pottery also varied between settlements, although the lack of standardized descriptors inhibits closer comparison. Stylistically, specialists have found that existing typologies do not always cover the range of material found.[328] Fabric analysis has also underscored a variety of sources of raw materials, including the possible local production of pottery in Germanic styles.[329] In addition, these settlements yielded relatively few Germanic-style dress accessories. This may be partially due to the soil conditions, as the majority of migration-related settlements are located on the sandy soils of Flanders and the southern Netherlands, in which metal finds tend not to preserve well. Wijster hairpins and tutulus brooches, which have been linked to Germanic women of elite status are rare in these settlements. The much more common simple two-piece Armbrust brooches are also not particularly common and are in fact frequently reported from Late Roman settlements without clear Germanic-style architecture (see chapter 3).

In short, no two settlements are alike in the combination of material culture, architecture and other cultural elements that were found there, and many settlement sites only yielded one or two 'Germanic' markers (table 2.3). There is also no clear spatial distribution of sites with more or fewer potentially 'Germanic' markers reported. Even taking into account the issues surrounding dating, there are no indications that settlements became more or less Germanic over time. Of all the Late Roman sites sampled, sunken huts and handmade pottery in a Germanic style were most often encountered. 15 sites yielded evidence for northern-style house plans and six sites yielded significant evidence for rye cultivation. Of course, in the case of older excavations, less information will be available on more specialist subjects such as archaeobotanical remains or pottery fabrics. However, even recently published site reports from modern development-led excavations such as those at Buggenum-Wijnaerden[330] and Kuringen-Rode Rokstraat[331] show that even under more ideal circumstances, not all potentially 'Germanic' elements are necessarily present within a settlement.

Continuity of the provincial-Roman rural settlement landscape

Many of the migration-related settlements discussed in this chapter also yielded finds and features commonly found in provincial-Roman, 'native' rural settlements. Several house plans were found in the provincial-Roman style, occasionally alongside Germanic-style pottery or SFBs. Wheel-turned pottery was found in almost all settlements, sometimes making up the bulk of the material with handmade Germanic-style pottery absent or present in only small amounts (such as in Baelen-Nereth).[332] Local handmade pottery was also frequently attested, as well as a number of case studies where pottery in a Germanic style were found to have been made in local fabrics. Cereals other than rye were still grown and consumed and, in some cases, only insignificant amounts of rye or no rye at all were reported. All these inconsistencies and variable settlement features need to be fully considered when discussing these settlements as a category.

It was established that despite significant setbacks, the provincial-Roman rural settlement landscape was not completely abandoned by its original inhabitants in the Late Roman period. Although many parts of Germania Secunda witnessed a significant drop in settlements in the late 3rd century, and settlement numbers remained low(er) afterwards, they were found to have remained relatively constant throughout the 4th and 5th centuries. Furthermore, the 4th century saw (partial) continuity of occupation in the villa landscapes of Wallonia and the German Rhineland,[333] and the militarised frontier of the Dutch and German river areas remained actively maintained throughout the Late Roman period. There is not a clear case to be made for a complete replacement of the rural population in Germania Secunda by Germanic migrants.

The continued provincial-Roman presence in Germania Secunda means that any migration by outside communities did not happen in a cultural vacuum but that new and old communities potentially lived alongside each other and interacted. Theuws and Hiddink raised the possibility that settlers from the

Van Renswoude 2017). The 1st-century settlement at Weeze-Vorselaer yielded an SFB alongside a two-aisled house as well as wheel-turned pottery and handmade ceramics that included native and Germanic elements (Brüggler *et al.* 2017). Similarly, at Bonn Vilich-Müldorf, a timber building with a one-aisled and a two-aisled section from the 1st-2nd century was found alongside an SFB (Gechter-Jones and Kempken 2007).

328 Bink 2005; Van Es 2021.

329 Hendriks 2023, 117; De Paepe and Van Impe 1991; Van Thienen 2016; Van Thienen *et al.* 2020; Van Thienen and Helfert 2022.

330 Meurkens 2021.

331 Hazen 2016.

332 Fock *et al.* 2015.

333 Dodd 2021.

regions south of the Boulogne-Cologne road played a role in the 4th-century colonization of the MDS region.[334] The distribution of migration-related settlements along the trajectories of Rhine and Meuse as well as the general region of Tongeren and the Cologne-Bavay road follow the general patterns of habitation, rather than a repopulation of the MDS-area, which still remained largely depopulated. In some cases, settlement phases linked to migration followed previous provincial-Roman activity,[335] while in other cases it appears the settlement was newly founded.[336]

The common presence of provincial-Roman wheel-turned imported pottery also indicates continued supra-regional trade ties between Germania Secunda and other areas of the Empire, which would have relied on local contacts between merchant and marketplaces. Germanic-style handmade pottery in local fabrics also challenges the narrative. It is sometimes interpreted as settlers reproducing familiar styles with local materials[337] but doing so would have relied on in-depth knowledge of the suitability of the local geology, both for raw clays and tempering materials. It is therefore not unimaginable that some of this material would be produced and/or consumed by people without a Germanic migration background. The difficulties in some cases to categories Germanic-style handmade pottery from Germania Secunda using typologies drawn up for Germania Magna[338] indicate that a certain amount of adaptation and further stylistic development occurred.

Long-term dynamics

The data presented in this chapter show a consistent and significant pattern of influence and cultural transfer from Germania Magna into the Roman provinces across the 3rd-5th centuries. However, differentiating assimilation across the river frontier from migration and colonisation is a different issue. The diverse nature of these settlements clearly indicates that these settlements represent more than simply newcomers moving into the area and continuing their cultural practices from home unchanged. The archaeological evidence dates too broadly to ascribe it to any short-term event and is too varied to reflect a single cultural or social origin. While the rising popularity of rye and SFBs in the study area were interpreted as more period-specific than culturally specific, handmade pottery and longhouse architecture were found to have clear stylistic links to Germania Magna. Pottery and house styles were adapted and transformed and were found alongside contemporary buildings and pottery in provincial-Roman styles. Migration-related settlements in Germania Secunda were not carbon-copies of rural settlements from Germania Magna, but displayed a certain level of hybridity, combining elements more commonly found within and without the Empire.

The accuracy of dating these settlements is insufficient to distinguish between different phases of settlement or to identify pioneers fore fronting larger migratory movements[339] or of founder communities.[340] These features could equally well be the result of a (second-generation) migrant community adapting to local life[341] or a community that had lived there for generations adopting new ways of life. The incomplete and ambiguous archaeological remains do not present us with a very clear interpretation either way, but these scenarios are not mutually exclusive and are expected results of mobility and settlement of newcomers. It is impossible to identify on the individual site level where its occupants may have lived previously, but the development of rural settlements in Germania Secunda certainly took inspiration from cultural norms from outside of the Empire, and it is highly unlikely that migration did not play a role in that.

Several migration-related settlements (Hasselt, Meldert, Neerharen-Rekem, Wange and Baelen-Nereth) cluster around the existing urban centre Tongeren, which was still inhabited at that time. This suggests that migratory movements were targeting areas that were still inhabited in order to achieve the best chance of survival[342] and forming clusters of potential cultural enclaves.[343] Secondly, the formation of a cluster of settlements with varying dates (Baelen-Nereth and Neerharen-Rekem have 4th-century phases, Wange, Hasselt and Meldert are most likely later), may be indicative of either chain migration[344] or of the expansion of settlements from a nucleus. It is more probable that the earlier settlements are more directly linked to migration processes, while later settlements

[334] Theuws and Hiddink 1996, 79.
[335] Wijchen-Tienakker (Heirbaut and Van Enckevort 2011); Breda West-Steenakkers (Berkvens and Taayke 2004ab); Cuijk-De Nielt (Habermehl and Van Renswoude 2017); Cuijk-Heeswijkse Kampen (Ball and Heirbaut 2005, 119); Horst-Hoogveld (Verhoeven 2002); Helden-Schrames (De Winter 2010); Sittard Geleen-Holtum Noord (Wagner and Van der Ham 2010; Tichelman 2012); Voerendaal-Ten Hove (Stoepker 1987; Stoepker 1988; Hiddink 2023); Baelen-Nereth (Hanut *et al.* 2012); Neerharen-Rekem (De Boe 1983ab; De Boe 1986); Wange-Damekot (Opsteyn 2003); Aldenhoven-Niedermerz (Lenz 2005); Naaldwijk-Hoogeland/Hoogwerf (Van der Feijst 2015); Tiel-Passewaaij Hogeweg (Heeren 2009); Valburg-Molenzicht (Van der Feijst and Veldman 2011).
[336] Alphen-Kerkakkers (De Koning 2005); Buggenum-Wijnaerden (Meurkens 2021); Gennep (Heeren 2017; Lenz 2005; Theuws and Hiddink 1996; Heidinga and Offenberg 1992); Goirle-Huzarenwei (Bink 2005); Leersum-Middelweggebied (Tump 2014); Weeze-Knappheide (Brüggler 2021).
[337] E.g. De Paepe and Van Impe 1991, 170.
[338] E.g., Van Es 2021; Bink 2005.
[339] Burmeister 2000, 544.
[340] Anthony 1997, 27.
[341] Cf. Härke 2004, 453; Halsall 2012, 32 on migrant assimilation.
[342] Cf. Burmeister 2000, 549.
[343] Burmeister 2000, 549.
[344] Cf. Burmeister 2000; Anthony 1997, 27.

may also have adopted certain traditions with Germanic origins, without (direct) links to those communities.

The archaeological evidence is probably best described as the outcome of long-term interaction between Germanic communities and the provincial-Roman native population, which resulted in cultural adaptation by both communities, which is reflected in the archaeology as a mixture of provincial-Roman and Germanic elements in settlements dated from the late 3rd to the mid-5th century. Spheres of interaction undoubtedly included migration of rural communities, but also very likely trade, career migration and developing and changing tastes and fashions. For the technology and decoration of some Late Roman dress accessories, Böhme coined the term *Mischzivilisation* and this term is well-suited to the rural settlement evidence as well.[345] The inconsistency of a lot of the archaeological evidence possibly reflects how this *Mischzivilisation* was an ongoing process in the Late Roman period.

In the Romanisation debate, globalisation has been explored as a framework for explaining cultural adaptation in the Roman provinces.[346] Pitts and Versluys define globalisation as '*processes by which localities and people become increasingly interconnected and interdependent*', commonly including increased connectivity.[347] Globalisation theory focuses on processes of homogenisation; however, it is recognised that increased heterogeneity may occur simultaneously.[348] The concept of glocalisation adds further discussion of this apparent paradox, highlighting how the '*homogenising elements of global culture [...] are differentially incorporated into local cultures, which are in turn altered in the process*'.[349]

This theoretical framework may be applied to the settlement evidence presented in this chapter, as well as many of the dress accessories presented in chapter 3. As Theuws and Hiddink already pointed out, material culture became more similar across the area between the Elbe and the Seine.[350] This chapter has outlined how the same homogenising processes also applied to architecture, diet and pottery, which became more widely shared geographically, transcending the Roman frontier. Within this globalising framework, however, settlements within the Empire did not become carbon copies of settlements outside of the Empire, they maintained certain elements of provincial-Roman settlement culture (certain types of house plans, wheel-turned pottery, cereals other than rye) and adopted Germanic-style features differentially. As pointed out above, practically all 'migration-related' settlements are unique in the type of 'Germanic' features they incorporated, the number and combination of these features and their combination with aspects of provincial-Roman timber-built settlements.

345 Böhme 1974.
346 Heeren 2014; Hingley 2005; Pitts and Versluys 2015b.
347 Pitts and Versluys 2015a, 11; Van Alten 2017, 2.
348 Pitts and Versluys 2015b, 14.
349 Pitts and Versluys 2015b, 14.
350 Theuws and Hiddink 1996, 78.

Site	Architecture		Other		Total	Reference
	Houses	SBFs	Rye	Germanic pottery		
Belgium						
Baelen-Nereth	X	X		X	3	Hanut *et al.* 2012; Hanut *et al.* 2013; Fock 2020; Fock *et al.* 2013.
Boutersem-Boskouterstraat		X			1	In 't Ven *et al.* 2005
Donk				X	1	Van Impe 1983; Van Ossel 1992, 296
Elewijt				X	1	Van Impe and De Buyser 1990
Erps/Kwerps-Lelieboomgaarden				X	1	Van Thienen 2016, Appendix 1
Kuringen-Rode Rokstraat	X	X		X	3	Hazen 2016
Meldert-Zelemsebaan	X	X	X	X	4	Smeets and Steenhoudt 2012
Neerharen-Rekem	X	X		X	3	De Boe 1983ab; De Boe 1986; Stroobants 2013
Rosmeer		X			1	Fath and Wesemael 2008
Wange-Damekot		X		X	2	Opsteyn 2003
Netherlands						
Alphen-Kerkakkers	X	X	X	X	4	De Koning 2005
Breda West-Steenakkers		X		X	2	Berkvens and Taayke 2004ab
Buggenum-Wijnaerden	X	X	X	X	4	Meurkens 2021
Cuijk-De Nielt		X		X	2	Habermehl and Van Renswoude 2017
Elst-Galgenplek				X	1	Bloemers and Thijssen 1990
Geldrop 't-Zand	X	X	X	X	4	Bazelmans 1990, 25-29; Heeren 2017
Gennep	X	X	X	X	4	Heidinga and Offenberg 1992; Lenz 2005, figure 8; Theuws and Hiddink 1996
Goirle-Huzarenwei	X	X	X	X	4	Bink 2005
Haps		X			1	Verwers 1998-1999
Helden-Schrames	X	X		X	3	De Winter 2010
Holtum-Noord		X	X	X	3	Van Enckevort *et al.* 2017
Leersum-Middelweggebied	X	X		X	3	Tump 2014
Maastricht		X	X		2	Bakels and Dijkman 2000; Van Zeist 1970
Naaldwijk		X		X	2	Van der Feijst 2015
Nijmegen		X		X	2	Bloemers and Thijssen 1990; Willems and Van Enckevort 2009
Someren Lierop-Steemertseweg		X			1	Verwers 1991ab.
Swalmen		X		X	2	Verwers 1998-1999, 266; Willems 1983; Wüstehube 1998, cat. 533
Tiel-Passewaaij	X			X	2	Heeren 2009
Valburg-Molenzicht	X			X	2	Van der Feijst and Veldman 2011
Voerendaal-Ten Hove		X	X	X	3	Stoepker 1987; Stoepker 1988; Hiddink 2023
Wijchen-Tienakker	X	X			2	Heirbaut and Van Enckevort 2011
Wijk bij Duurstede-De Geer	X			X	2	Heeren and Van Doesburg 2021
Germany						
Aldenhoven-Niedermerz		X			1	Lenz 2005
Froitzheim		X			1	Van Ossel 1992, 194
Haffen-Mehr		X			1	Kyritz 2014
Harff		X			1	Van Ossel 1992, 196-197, 222
Kaster-Hasselberg		X			1	Van Ossel 1992, 197
Krefeld-Gellep				X	1	Reichmann 1999
Neuss-Hochneukirch		X			1	Keller 1997
Rodenkirchen		X			1	Van Ossel 1992, 222
Weeze-Knappheide	X	X		X	3	Brüggler 2020; Brüggler 2021
Average					2	

Table 2.3. Late Roman settlements with references as mapped in figure 2.4 above. Includes sites with long or shorthouses, handmade pottery, SFBs and/or significant amounts of rye remains.

Chapter 3
Spatial distribution of civilian dress accessories

As outlined in the literature review, the appearance of female-gendered dress accessories in Late Roman furnished graves is often interpreted as a marker or signal of a non-Roman or Germanic identity.[1] Halsall has argued that a closer examination of the Germanic nature of the burial rite is needed,[2] and a more detailed understanding of the object typologies, decorative styles, chronology, and distribution is necessary to move the discussion forward.[3] In addition to this, it can be argued that including material from non-funerary contexts is vital in gaining a better understanding of how these items were worn and deposited. To this end, this chapter links with chapter 2, which deals in more detail with the settlement evidence. The aim of this chapter is to assess the archaeological basis behind the ethnic and other social interpretations of a selection of dress accessories most commonly found in the female 'jewellery grave' tradition. The second step is to trace dispersal of these styles into the Roman Empire through a 'contextually detailed analysis',[4] especially where site type profiles are concerned.[5]

For this chapter, only those dress accessories with Germanic connotations that are most commonly found in the study area were selected, with a particular focus on Germanic-style items commonly occurring within Germania Secunda.[6] Furthermore, the focus lies on objects that have reasonably good object typologies (meaning they can be reliably dated to the Late Roman period without a closed find context) to ensure that stray finds and settlement material can also be included. Even so, issues around dating abound. This is especially true for Germania Magna, where some pottery typologies have been partially based on the chronologies of metal finds.[7] This makes independent dating of material from this region difficult.

The finds will be presented chronologically, starting in the late 3rd and 4th centuries with the footless brooch with high catch-plate (Almgren Group VII Serie 3) and the Fécamp hairpin. For the transition between the 4th and 5th centuries, there is the Armbrust brooch family (Almgren Group VI Serie 2; both simple and elaborate types) and the tutulus brooch. Finally, dress accessories introduced in the early 5th century are presented, namely the supporting-arm brooch and the Wijster hairpin. In total, 2277 objects were inventoried for chapter 3 (table 3.1; appendices 3.1 and 3.2).[8] The chapter ends with a thematic discussion, focusing on depositional and chronological patterns, and their interpretation.

Object category	N
Footless brooch with high catchplate	490
Pins with spherical heads (Fécamp)	104
Simple two-piece Armbrust brooch	904
Elaborate two-piece Armbrust brooch	94
Tutulus brooch	183
Supporting-arm brooch	286
Pins with mushroom-shaped heads	182
Other hairpins (Vermand, Cortrat and unclassified)	34
Total	**2277**

Table 3.1. Count of objects discussed in chapter 3.

Late 3rd-4th century brooches and hairpins

In this period, the footless brooch with high catch-plate entered the study area. In Germania Magna, the 3rd century also saw the introduction of a large number of simple Armbrust brooches, but these are almost exclusively restricted to Eastern Europe and Scandinava and do not appear in the Roman provinces at this time.[9] In the later 4th century, the Fécamp hairpin also appears.

[1] Böhme 1974; Böhme 1985; Böhme 1996; Böhme 2003; Böhme 2009.
[2] Halsall 1992; Halsall 2000.
[3] Cf. Theuws 2009, 284.
[4] Reher and Fernandez-Götz 2015, 402.
[5] Swift 2010, 239; Eckardt 2005, 142-149.
[6] *Bügelknopffibeln* are generally rare in north-western Germany and within the Roman provinces mainly appear to have been found along the *Obergermanische* and *Raetische limes* (Bemmann 2008). As part of the research design, an initial survey of cast and composite saucer brooches was also made, but there the number of identifiable objects that could be added to already existing distribution maps was too low to include in the final project. The focus also lay on objects bridging the transition between the 4th and 5th centuries, so brooch and hairpin types introduced in the mid to late 5th century were not included.
[7] E.g., Plettke 1921 in Böhme 1974; Kroll *et al.* 2020, 412.
[8] Including a number of unpublished brooches from Heeren and Van der Feijst 2017; kindly made available by the authors but not included here in table 3.1 or appendix 3.
[9] The 3rd-century Armbrust brooches of Scandinavia and Eastern Europe were not extensively surveyed, but Schulze (1977) includes four individual brooches belonging to these types found in that part of Germania Magna that was included in my study area: simple two-piece Armbrust brooches with an elongated foot (Schulze type 7); Armbrust brooches with a bow with a triangular section and a sharply pointed foot (Schulze types 97-98) and Armbrust brooches with a flat bow and a long, slightly widened foot (Schulze type 154); all these date broadly to the 3rd and very early 4th century. AD 225-325. Further surveying also resulted in two Schulze type 33 brooches found in the limes are (Armbrust brooch with elongated foot of equal width to the bow).

The footless brooches with high catch-plate

The footless brooch with high catch-plate (*zweigliederige Armbrustspiralfibel mit hohem Nadelhalter*) is characterised predominantly by its elongated catch-plate and high bow. They are part of the broader family of brooches with high catch-plate.[10] A variety of subtypes and typo-chronologies exist[11] and the group enjoyed a long chronology (2nd-4th centuries). The bow of the footless brooch may be wire-shaped or flat (band-shaped) and is usually plain, although these brooches are sometimes decorated with diagonal grooves or ovolo around the eye or catch-plate. Its name is derived from the fact that the bow transitions directly into the catch-plate and various subtypes may be distinguished based on the form of the bow.[12] Many subtypes recognised in Germania Magna are highly regional and restricted to eastern Europe[13] and Scandinavia.[14] Several of the subtypes defined by Schulte and Przybyła do not date to the Late Roman period or only occur in the study area sparingly.[15] Of the footless brooches defined by Schulte, for example, the overwhelming majority of the A VII 3 Series from the study area that could be identified to a further subtype were A VII 3.5 types.[16] This type is defined by its arched bow, which typically has a square, polygonal or round cross-section.[17]

In recognition of the lack of typological diversity of footless brooches in the Low Countries, Heeren and Van der Feijst reduced the main types to two based on the shape of the bow: wire-shaped bows (HF 71a, cross-sections can be circular, oval or rhombic, equivalent to Schulte's VII 3.5a-c type) and flat, band-shaped bows (HF 71b; equivalent to Schulte's VII 3.5d type). These are also the only subtypes of footless brooches that are found in significant numbers south of the Lower Germanic frontier. The rest of this overview will

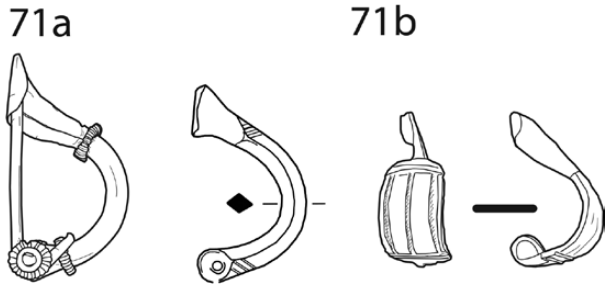


Figure 3.1. Wire-shaped (left) and flat-bowed (right) footless brooches with high-catch plate of Almgren VII, Serie 3, subtype 5/HF 71a (left) and HF 71b (right) (after Heeren and Van der Feijst 2017, figure 4.141).

therefore focus on the wire-shaped footless brooches of this type that date to the Late Roman period (Schulte's type 3.5bc; HF 71a; roughly comparable to Przybyła group IIIB; figure 3.1). This group can be divided further based on size and the transition between bow and catch-plate.[18] Almost two-thirds of all VII 3.5 brooches in the study area were of the VII 3.5c subtype (smaller variety with very rudimentary, slightly convex catch-plate).[19] Furthermore, the majority of footless brooches had wire-shaped bows (predominantly polygonal): only 12 out of a total of 480 Schulte VII 3.5 type footless brooches had flat bows.

Chronology

The footless brooch group enjoyed a long circulation period, especially in Germania Magna. Pryzyła's seriation[20] shows a broad circulation from the mid-2nd century to the Migration period and studies for central Germany equally showed distribution dates from the late 2nd-early 4th centuries.[21] Schulte argued for a main circulation period of the VII 3.5c type of at least AD 300-325 with a potential extension to AD 270-350.[22] A slightly longer circulation date including the mid-4th century would fit with the appearance of several footless brooches in 4th-century cemeteries with large numbers of Late Roman graves elsewhere in the study area[23] as well as a number of dendrochronological dates on wooden sarcophagi from the cemetery at Fallward in the early and mid-4th century.[24]

For the provincial-Roman finds, Böhme proposed that earlier forms within the Almgren VII group may already

Later, 4th- and 5th-century types developed from types were found more commonly in the study area and are discussed below.

[10] Almgren 1923, Gruppe VII.

[11] See most recently Schulte 2011, 12-36; Przybyła 2018 for overviews and discussion.

[12] Schulte 2011, 139-153, types A VII 1-6.

[13] Steuer 2021, Abb. 48.

[14] Schulte 2011, Beilage 4.

[15] Schulte 2011; Przybyła 2018.

[16] Only 14 footless brooches of Schulte's types 1-4 were identified in the study area, with the exception of one stray find from Maurik, these were found in Germania Magna.

[17] Schulte 2011, 148. The other subtypes of the VII 3 series are: VII 3.1: short bow with extended catch-plate; VII 3.2: evenly bent bow, bow-like or parabolic curve; VII 3.3: evenly bent bow, different cross-sections; VII 3.4: high bow-shaped bow, mostly narrow; VII 3.6: solid bow with square cross-section. Schulte also included some Einzelforme (2011, 152-153). A more recent typology was proposed by Przybyła (2018, 22-3), which used the type of bow and transition to the foot as a main distinguishing feature, subdividing further on the cross-section of the bow (Przybyła 2018, figure 3b). Przybyła (2018) focused mostly on Scandinavian finds, however, while Schulte notes that his A VII 3.5 is predominantly found in the *limes* zone, Westfriesland and the Elbe-Weser triangle (my key research area) and is rarer in Scandinavia (Schulte 2011, 148). Schulte (2011) is therefore followed here.

[18] Schulte 2011, 148.

[19] Schulte 2011, Abb.101.

[20] Pryzyła 2018, figure 121b.

[21] Seidel 2006, 37; Teegen 1999, 158; cf. Schulte 2011.

[22] Schulte 2011, Abb. 107.

[23] Westerwanna (Röhrer-Ertl 1971; Schulte 2001); Rebenstorf (Schulte 2001); Krempel (Schön 2017).

[24] Schulte 2011, table 4. A VII 3.5c brooch in Fallward grave 284 was dendrochronologically dated to around 300; Fallward grave 250 contained both a VII 3.5b and a VII 3.5c brooch and returned a dendrochronological date in the second quarter of the 4th century (Schulte 2011, table 4).

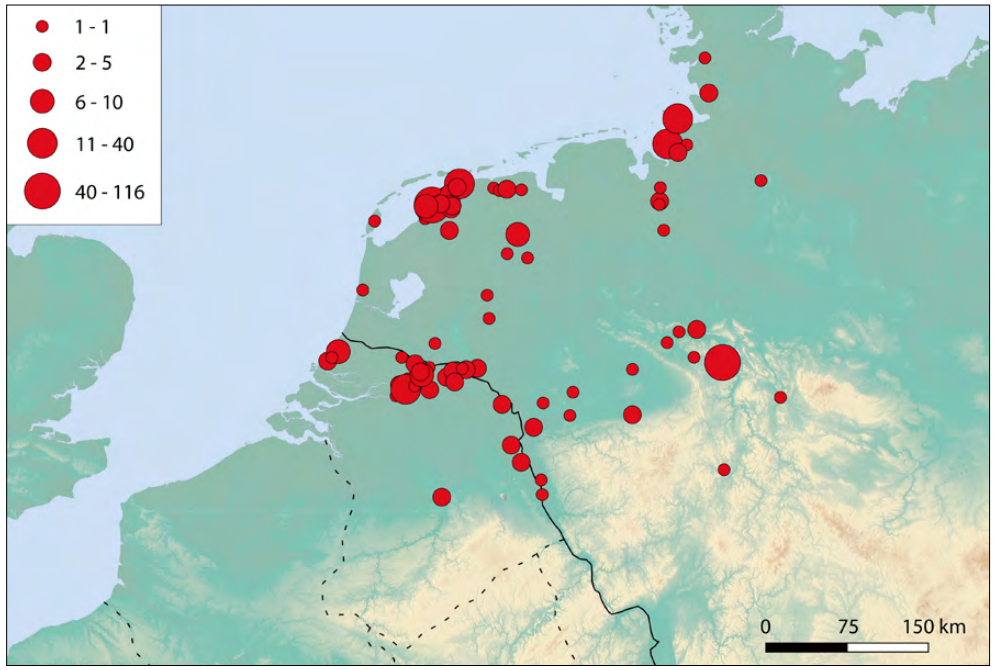


Figure 3.2. Distribution of VII 3.5/HF 71a type footless brooches with high catch-plate (top) and VII 3.5/HF 71b type footless brooches with high catch-plate (bottom).

have circulated in the Roman provinces in the late 2nd century.[25] Within the province of Germania Secunda, the available closed context dates for the VII 3.5 group firmly fall within the 4th century.[26] These footless brooches also appear in several settlement contexts without a 4th-century phase as the youngest brooch type, supporting their use in the late 3rd century.[27] As a whole, the evidence is strongest for the earlier forms of the footless brooch to have started circulating in Germania Magna in the 2nd century, while the Schulte VII 3.5 form was introduced in Germania Secunda in the late 3rd century and continued to be worn into the 4th century on both sides of the frontier.[28]

Distribution and contexts

In total, 490 Armbrust footless brooches with high catch-plate were collated for this study: 396 of which came from Germania Magna and 86 from Germania Secunda. The distribution map (figure 3.2) shows that the type is common in the northern Netherlands. For the German part of Germania Magna, regional studies have shown that the type is mostly found on either side of the lower Elbe and in central Germany.[29] The brooch is also common in Denmark and southern Sweden.[30] They are relatively rare along the German North Sea coast, although they were found at sites typically rich in Late Roman material.[31] Both Mirschenz and Schulte have highlighted the common occurrence of the VII 3.5 type in the Westfalen-Lippe area.[32] Flat-bowed types were almost exclusively found in Germania Magna.

Although this brooch type is relatively widely found in Germania Secunda, it never appears in large numbers within a single site and its distribution seems largely restricted to the immediate *limes* zone. A significant number was found in rural settlements and the majority of these were also situated in the river area. Footless brooches were more commonly found in native Roman settlements and rural and urban centres[33] than in settlements with potential Germanic markers.[34] They were also found in a number of military fortifications.[35]

[25] Böhme 1972, 35.
[26] Mid-4th century contexts are provided by graves 59 in Cologne-Jakobsstrasse (Schulte 2011, table 4); grave OO207 in Nijmegen (Steures 2013, 193-194) and Krefeld-Gellep grave 2674 (Pirling 1979, Taf. 55.20-21; the location of the grave within the cemetery dates this burial in the period after the mid-4th century; Pirling and Siepen 2006, 328). A late 3rd-early 4th-century date is also supposed based on context for two A VII 3.5b brooches from Neuss (Schulte 2011, 166).
[27] Heeren and Van der Feijst 2017, 188; cf. Erdrich 2003.
[28] For the Low Countries, Heeren and Van der Feijst propose different dates for the footless brooches with wire-shaped bows (AD 250-350) and those with band-shaped bows (AD 300-350; 2017, table 4.55). The band-shaped types are too rare to suggest a distinct chronology for.
[29] Teegen 1999, 158; Seidel 2006, 37.
[30] Riha 1979, 83; Przybyła 2018.
[31] Such as Bremen (Schulte 2011), Feddersen Wierde (Schuster 2006) and the cemetery at Westerwanna (Röhrer-Ertl 1971).
[32] Mirschenz 2013; Schulte 2011, Beilage 4.
[33] Rural settlements: Geldermalsen-Hondsgemet (Van Renswoude 2009); Wateringen-Julianahof (Eimerman 2009); Grubbenvorst-De Soom (De Winter and Weterings 2011); Huissen-Loostraat Zuid (Schurmans 2008). Urban settlements: Xanten (Mirschenz 2013); Voorburg-Hadriani (Hoss 2014); Nijmegen (Steures 2013; Zee 2010; Van den Broeke *et al.* 2011a; Oosterbaan 2011; Van Buchem 1941; Heeren and Van der Feijst 2017); Tiel-Medel (Heeren and Van der Feijst 2017).
[34] Neerharen-Rekem (De Boe 1986); Naaldwijk-HC (Van der Feijst 2015); Tiel-Passewaaij Hoge Weg (Heeren 2009, table 51); Wijk bij Duurstede-De Geer (Heeren and Botman 2021).
[35] Neuss (Simpson 2000); Nijmegen-Kelfkensbos (Heeren and Van der Feijst 2017).

It is finally noteworthy that on both sides of the frontier, it is generally rare to find footless brooches in funerary contexts. These numbers are partially skewed due to the many stray finds of footless brooches recorded in various works,[36] but only 4.65% were found in burials in Germania Secunda and 8.37% in burials in Germania Magna.[37]

Social connotations

As stated above, this particular type of brooch is common in Denmark, southern Sweden and the Elbe region, and also appears in large numbers in the Germanic provinces, especially the Rhineland[38] and the *Obergermanische-Raetische limes*.[39] Based on its appearance at Dutch sites lacking a 4th-century phase, it has been suggested that these brooches could have been worn by Germanic auxiliaries of the Gallic Empire in the latter half of the 3rd century.[40] This is supported by their occasional appearance in military contexts,[41] although this occurs more frequently on the *Obergermanische-Raetische limes* than on the Lower Germanic frontier.[42] Seemingly contradicting this is some of the burial evidence. Footless brooches are occasionally found in pairs,[43] a practice that is generally associated with female dress.[44] The limited available osteological data have also indicated the deposition of these brooches with women.[45] For some of the earlier VII 3.1-3.4 types, Schulte also presented several inhumation burials from Scandinavia where brooches with high catch-plates being worn in pairs on the shoulders, sometimes connected by a chain.[46]

The greater popularity of footless brooches in Germania Magna and its development from earlier types there together suggest that the form originated north of the frontiers. Its relatively long circulation date and contradictory evidence regarding gender make it difficult to connect this brooch type to a single social group. Its appearance in pairs in graves and its common occurrence in rural settlements places the footless brooch mostly in the civilian sphere of dress accessories, and predominant use by women on both sides of the frontier seems most likely. There is no direct correlation between this Germanic brooch type with other potential signs of migration (architecture, handmade pottery) of the 4th and 5th centuries in Germania Secunda.

Pins with spherical heads (Fécamp)

Fécamp pins are characterised by their round, flat or conical head that is often not much wider than the shaft itself (figure 3.3). Fécamp pins are widely found within and outside the Empire, in the Netherlands, Belgium, northern France and western and northern Germany.[47] The top half of the Fécamp pins is decorated with the typical Late Roman pattern of deep grooves or ribbing, alternated with two to seven zones of prismatic faceting, which is also found on Wijster hairpins (see below) and some tubular mounts on Late Roman military belts (see chapter 5).

Figure 3.3. Fécamp type hairpin.

Chronology

The Fécamp hairpins are the oldest type in Böhme's typology, who initially dated them to the late 4th and early 5th century, noting that they occasionally appeared in graves with brooches of that period,[48] but are generally older than the Wijster types. In Germania Magna, finds from settlements[49] and cemeteries[50] point to a predominantly late 4th-century circulation.

[36] Erdrich 2001; Schulte 2011; Heeren and Van der Feijst 2017.

[37] This may be a regional pattern, as Steuer cites no fewer than 914 graves from 124 cemeteries with footless brooches in Eastern Europe and the Roman provinces (2021, 485-486), although admittedly he appears to be speaking of the entire Almgren Group VII here, not just the Late Roman types.

[38] Böhme 1972, 34.

[39] Schulte 2011, Beilage 4.

[40] Heeren and Van der Feijst 2017, 188; cf. Erdrich 2003.

[41] Cf. Böhme 1972, 35.

[42] One was found in Nijmegen-Kelfkensbos (unpublished). Two others were found in Neuss (Lehner 1904; Schulte 2011).

[43] Krefeld-Gellep grave 2674, which also contained a beaded necklace; Pirling 1979, Taf. 55); Costedt grave 28 (Siegmund 1996); Grave OO207 in Nijmegen also contained a pair of wire-shaped footless brooches, one of which was used to keep three finger rings together, alongside four copper-alloy bracelets (Steures 2011, 698).

[44] E.g., Riha 1979, 42; Böhme 1972, 48; Mackreth 2011, 234. Although Böhme-Schönberger 2008, 144-145 has noted the presence of multiple brooches of men of Germanic origin as well.

[45] Notably grave 59 of a young girl in Cologne-Jakobsstraße; (Friedhoff 1991, 226, Taf. 68).

[46] Schulte 2011, 197.

[47] Heynowski 2017b, 50, type 1.6.3. For the Dutch river area, a subtype characterised by a head that is slightly wider than the shaft has been recognised (Fécamp-Alem type), which might have been a transitional type between the Fécamp and Wijster pins (Heeren and Botman 2021, 209). However, only a handful are known and these are all settlement contexts or stray finds, making it difficult to date the type precisely.

[48] Böhme 1974, 38. See also Werner 1962, 151 for this date; Böhme 2009, 40 mere states that they originated right of the Rhine in the 4th century before spreading to Gaul.

[49] Two Fécamp hairpins were found in a settlement deposit dating AD 330 and onwards (Hagers and Sier 1999). A settlement find from Bad Oeynhausen-Werste Bahnenbühne was also found in a building phase dated to the 4th century (Bérenger 2000, 206).

[50] Westerwanna grave 59 containing a Fécamp hairpin was deposited in a possibly 4th-century type urn (Böhme 1974, 255; Zimmer-Linnfeld 1960, Taf. 9); see also Liebenau grave L8/B2 (Cosack 1982).

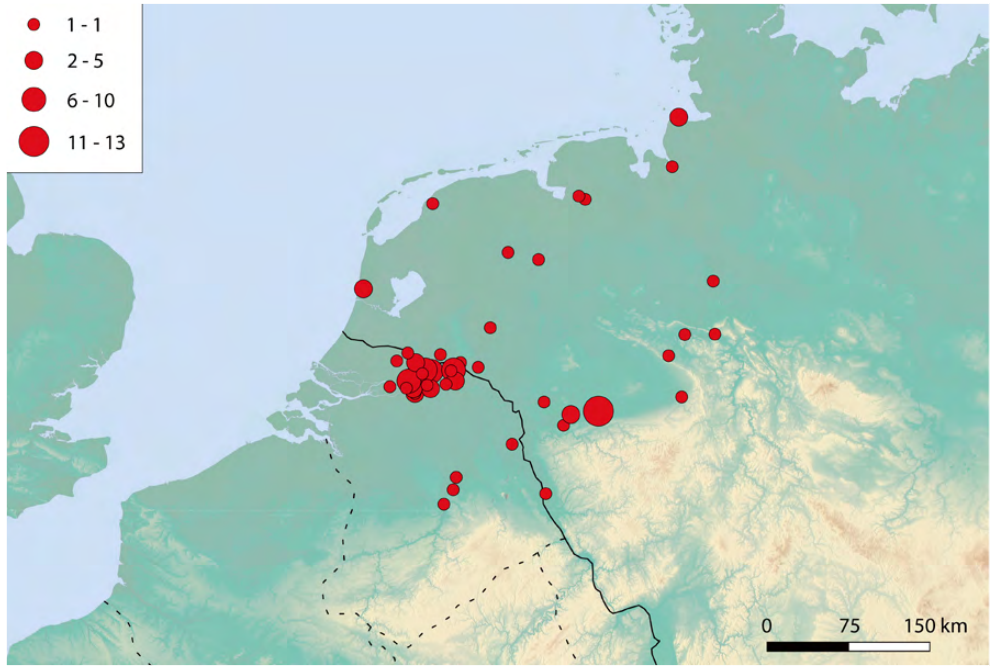


Figure 3.4. Distribution of Fécamp hairpins.

Settlement and funerary finds from Germania Secunda show a similar circulation predominantly in the late 4th century[51] and the early 5th century.[52] Although the number of context datable Fécamp hairpins is very small, its main circulation period in the study area appears to have been the second half of the 4th and early 5th century.

Distribution and contexts

65 Fécamp type hairpins were found in Germania Secunda, versus 39 in Germania Secunda. In Germania Magna, they are most often found in rural settlements.[53] The Fécamp hairpin occurs mostly in northern Germany, with only nine pins found in the Netherlands (figure 3.4). Although the Fécamp pin is relatively rare (compared to for instance the later Wijster pin), it was represented well in the large Late Roman cemeteries such as Wijster[54] and Westerwanna.[55] In Germania Secunda, the Fécamp pins were found a wide variety of contexts, including rural settlements, cemeteries, ritual deposits, villas and military sites, although its main distribution falls around the river area,[56] and they do not penetrate further south into Germania Secunda in significant numbers (especially when compared to the later Wijster type pins; see below). Whereas smaller hairpins are occasionally found together in groups of two or three in burials, Fécamp hairpins are usually single finds.[57]

Social connotations

These long, relatively thick hairpins are assumed to have been used to fasten headscarves or bonnets or the hair itself.[58] In inhumations, they are sometimes found on the right side of the head.[59] Compared to the Wijster pins, Fécamp pins are rare in Germania Secunda and find numbers are similar to the contemporary footless brooch with high catch-plate.

Fécamp pins tend to be associated with Germanic female dress customs.[60] Böhme's original distribution maps already showed that their main distribution was in the Dutch central river area,[61] and this pattern was further confirmed by the inclusion of more recent finds, especially from the Portable Antiquities of the Netherlands database. The fact that almost twice as many Fécamp pins are known from Germania Secunda compared to Magna challenges a purely Germanic connotation for this pin type.[62]

[51] Geldermalsen-Hondsgemet (found in a coin-dated ditch dated to the 4th century; Van Renswoude and Van Kerckhove 2009, 282-284); Krefeld-Gellep grave 4756 (Pirling and Siepen 2000, Taf. 21) is also dated to the late 4th century (with a pair of tutulus brooches, glass Gellep 801 beaker and glass jug type Gellep 809/Isings 120d).

[52] Nijmegen-Mariënburg 51/1963 (saucer brooch; Böhme 1974, 286; see also Steures 2013, 165).

[53] Notably Kamen-Westick (Könemann 2018) and Castrop-Rauxel (Böhme 1974, 228-9; Pape and Speckmann 2011).

[54] Van Es 1967.

[55] Böhme 1974, 255-257.

[56] This is the case for many if not all of the finds discussed in this chapter and is due to a number of factors: the generally better preservation in wet contexts and the increased registration of finds from private collectors.

[57] Böhme 1974, 37.

[58] Werner 1962, 151; Böhme 1974, 38; Verlaeckt and Proost 1996, 4 Cf. Rothe 2009, 73; Croom 2000, 137 on bonnets and other hair covers as part of the Gallic female dress ensemble.

[59] See Liebenau grave L8/B2 for female skeletal remains with a possible Fécamp hairpin (Cosack 1982; Rösing 1994, 216).

[60] Böhme 2009, 40; Werner 1962.

[61] Böhme 1974, Karte 9.

[62] Additionally, according to Verlaeckt and Proost (1996, 5), both the Fécamp and Wijster hairpin styles are based on 2nd- and 3rd-century

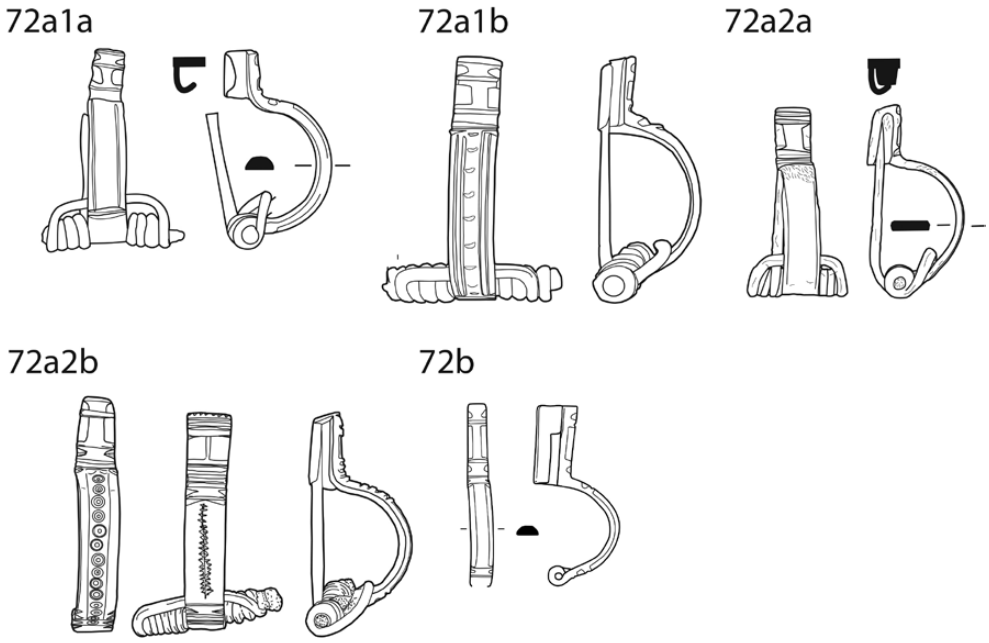


Figure 3.5. Main Armbrust types in the study area. From left to right. Top: HF 72a1a-a2b/Schulze type 35/36. Bottom: HF 72b/Schulze type 38 (after Heeren and Van der Feijst 2017, figure 4.143). Not to scale.

4th-5th century brooches

The 4th century, and especially the transition of the late 4th to the early 5th century saw a diversification of Germanic-style brooch types. In the late 3rd century, the first simple tutulus brooches were introduced, while more elaborate types developed over the course of the 4th and 5th centuries. At the same time, a diverse group of different Armbrust brooch types started circulating in the study area, becoming the main non-disc brooch type of the Late Roman period. Based on the variety of springs, axis mounts, bows, feet, bow cross-section, catch-plate and decoration, Schulze recognised a total of 255 subtypes of Armbrust brooches.[63] The way in which the various criteria are cross-referenced in Schulze's typology resulted in a great deal of overlap between various types as well as a number of *Einzelfälle* and it is often not possible to apply this typology to partial fragments. Many types and some specific characteristics also appear to be highly regional in nature and do not occur in the study area or date outside of the Late Roman period. In the study area, Armbrust brooch types dated to the 2nd and 3rd centuries are especially rare, on both sides of the frontier.[64] Tables 3.2 and 3.3 list those of Schulze's simple and elaborate Armbrust brooches that occur reasonably frequently within the chosen research area and timeframe, although it should be noted that not all of those were found in significant numbers.

The simple two-piece Armbrust brooch

The Armbrust brooch group (Almgren VI, 2) as originally defined by Almgren[65] included a wide range of types (including crossbow brooches and knee brooches/brooches with folded catch-plates) that are now more commonly classified as separate categories. The Late Roman Armbrust brooches that are found in the Roman Empire started their circulation in eastern Europe in the 3rd century.[66] Very little variation in bow shape, decoration or spring construction is found in the Low Countries specifically, informing Heeren and Van der Feijst's decision to reduce their Late Roman Armbrust brooch typology for this area to six main types: three simple (HF 72a, 72b and 72c) and three elaborate types (73a, 73b and 73c; discussed below), subdividing these in further subtypes based on easily identifiable construction aspects of the brooches, such as the shape and construction of the catch-plate and decorative schemes.[67] This approach has the major benefit of allowing partial brooch fragments to be more easily identified, although it leaves out several rarer types.

Schulze makes a distinction between axis mounts that are an integral part of the bow and those that are made by folding the end of the bow inward.[68] This distinction cannot always be made from illustrations, but whenever it could it appears that a folded axis mount was the more common method.[69] The vast majority were found

provincial-Roman types of hairpins (cf. Van Es 1967, 123), especially those of the frontier zone (on the Fécamp pin see Werner 1962, 152, notes 3 and 4).

[63] Schulze 1977. See later publications, including Schulze 1986b for additional types.

[64] Cf. Schulze 1977, Karte 1-6.

[65] Almgren 1923.

[66] Schulze 1977, Karte 1.

[67] Heeren and Van der Feijst 2017, 189-193, tables 4.56 and 4.57.

[68] Schulze 1977, Taf. 1.

[69] Only seven brooches were identified with a cast axis mount (Schulze types 8/10/13/18).

Schulze 1977	Catch-plate	Bow	Heeren and Van der Feijst 2017
With internal axis mount			
8	Open or closed	flat	
10	Cast	flat	
13	Cast	rhombic	
With folded axis mount			
29	Open or closed	flat	HF 72a1 (open) and HF 72a2 (closed)
30	Cast	flat	
35/36	Open or closed	flat	HF 72a1 (open) and HF 72a2 (closed)
38	Cast	flat	HF 72b
40	Open or closed	trapezoidal	
41	Cast	vertical	

Table 3.2. Concordance table of simple-two piece Armbrust brooches with short, rectangular feet identified in the research area (after Schulze 1977; Heeren and Van der Feijst 2017).

in Germania Magna,[70] but a small number were found in the river area.[71] Several subtypes can be recognised based on the cross-section of the bow and the shape of the catch-plate. The most common type of simple two-piece Armbrust brooch Germania Secunda has a hammered catch-plate (open or closed at the back; Schulze 35/36 is by far the largest group; see figure 3.5-3.6) which has the same width as the bow. Most of the bows tend to be flat and may be decorated with faceting or rows of grooves, dotted circles or other patterns. The feet are commonly decorated with faceting and notches on the side (see for example figure 3.5). Quite rare were brooches with hammered catch-plates with different types of bows and bow cross-sections (Schulze 29/33/40). These were only found in Germania Magna (figure 3.6). The main types are summarised in table 3.2.

After the Schulze 35/36 group, the most common simple brooches were those with cast closed catch-plates (Schulze 30/38/41; figure 3.5; figure 3.7). Again, these brooches are most commonly decorated on the foot only with faceting, horizontal grooves and perpendicular notches, which mays also feature on the bow and mount. Whereas the types 30 and 41 were most commonly found in Germania Magna, the Schulze 38 group was found relatively frequently on both sides of the frontier (see figure 3.7).

Chronology

This group of brooches is generally dated quite broadly to the 4th and 5th centuries across the study area.[72] Heeren and Van der Feijst have noted, however, that simple two-piece Armbrust brooches do not occur within Germania Secunda before the 5th century. The earliest circulation for those types common in the study area is the late 3rd-early 4th century, starting with the Schulze groups 29 and 35/36. The 29 group was only found in Germania Magna.[73] The 35/36 group was by far the most common subtype on both sides of the frontier. Schulze offered six 4th-century contexts in Germania Secunda of the Schulze 35/36 group.[74] In addition, four more funerary finds could be dated based on accompanying material.[75] Simple two-piece Armbrust brooches were also recorded in several settlements alongside footless brooches with high catch-plates,[76] which may hint at an early introduction in the study region in the late 3rd-4th century. Several Schulze 35/36 brooches from settlements where the end of occupation was dated in the 4th century are also worth mentioning in this context.[77] In conclusion, 4th-

[70] Schulze group 8: Holßel (Schulze 1977, Kat. 279). Schulze group 10: Westerwanna II (Schulze 1977, Kat. 480). Schulze 13: Liebenau grave 238 (Schulze 1977, Kat. 289); Bremen-Mahndorf (Schulze 1977, Kat 228). Schulze group 18: Bad Pyrmont (Schulze 1977, Kat. 305).

[71] Schulze group 8: Maren (Van Hemert 2010, cat. 191). Schulze group 10: Remagen (Schulze 1977, Kat. 548); Cologne (Schulze 1977, Kat. 519).

[72] Böhme 1974, 7-8; Böhme 2007; Heeren and Van der Feijst 2017, table 4.56.

[73] Sahlenburg grave 8, dated to the mid-4th century based on the inhumation burial rite (Schulze 1977, 28).

[74] Schulze 1977, 32. Two inhumation graves from Remagen which were dated by the ceramic contents to the first half of the 4th century or the mid-4th century (Schulze 1977, 32, note 151). Other funerary contexts from the German Lower Rhine include Rheindorf grave 35 (coin-dated to the first half of the 4th century) and Krefeld-Gellep grave 527 (stratigraphically dated to the second half of the 4th century; Schulze 1977, 32). A brooch was also found near the burgus at Asperden and was dated as such to the last third of the 4th century (Schulze 1977, 32, note 152). Grave 4 from Bornheim was dated to around AD 300 (Schulze 1977, 32).

[75] Graves 86 and 104.7 at Cologne- Luxemburgerstrasse contained Schulze 35/36 brooches accompanied by 4th-century ceramics (Von Boeselager 2012). The brooch in Krefeld-Gellep grave 5029 could be dated to the late 4th century based on coin material and two tutulus brooches (Pirling and Siepen 2006, 328).

[76] Soest-Ardey (Halpaap 1994; Fundchronik Westfalen-Lippe 9A); Kamen-Westick (Könemann 2018) and Castrop-Rauxel (Böhme 1974, 228-229; Isenberg 2007 10, 250-254).

[77] The rural timber-built settlement of Geldermalsen-Hondsgemet yielded eight partial simple two-piece Armbrust brooches, including two Schulze 35/36 brooches. Based on the rest of the small finds (including an early Armbrust brooch with cast foot Schulze type 41, two footless brooches with high catch-plate and an early tutulus brooch; Van Renswoude 2009), a date around the mid-4th century is probable (the end of habitation activity on

century dates for the Schulze 35/36 group are known from Germania Secunda, although the majority of finds are stray or settlement finds. On balance, however, just as many contexts from the 4th century could be found as from the 5th century, suggesting that the type enjoyed a long circulation period within the province. For Germania Magna, the chronology of simple two-piece Armbrust brooches is similarly long. Although Schulze dates the 35/36 to the last third of the 4th century at the latest, several funerary contexts may be listed in which these brooches were deposited with 5th-century material, like supporting arm brooches,[78] developed tutulus brooches,[79] saucer brooches,[80] and Wijster hairpins.[81] A seriation study of the cemeteries at Dörverden and Liebenau further identified simple Armbrust brooches from the late 4th century to the second quarter of the 5th century.[82] Other Armbrust brooches with hammered foot (Schulze types 8 and 40) were also dated to the 4th and early 5th century,[83] although none were found in Germania Secunda.

The same chronology can be defined for the Armbrust brooches with cast feet. The two most common types (Schulze 10 and 38; the distinction cannot always be made) started to circulate in the study area in the 4th century. Several 4th-century contexts are known from Germania Secunda for this brooch type,[84] which continued to circulate into the 5th century. This long chronology is mirrored in Germania Magna.[85] Types 13, 30 and 41 were only found in Germania Magna, but are dated to the (late) 4th and early 5th century.[86]

This short overview of the main simple Armbrust types seems to suggest that these brooches were largely contemporary in Germania Magna and Secunda as both regions yielded several closed contexts that could be dated to the 4th and 5th centuries. It could be argued that after its introduction in the late 3rd century, the simple two-piece Armbrust brooch became a popular brooch on both sides of the frontier simultaneously, while also disappearing around the same time in the mid to late 5th century. One major difference between Germania Magna and Secunda, however, is the lack of diversity of types in the latter, where almost all identifiable simple Armbrust brooches were of the Schulze 35/36 group. Although this was also the predominant type outside of the Empire in the 4th and 5th centuries, more variety was found there in terms of bow cross-sections and foot types which were largely absent from the provinces.

Distribution and contexts

On both sides of the frontier in the study area, the simple two-piece Armbrust brooch was the most common brooch type in the Late Roman period. 902 individual specimens were collected in the dataset, 427 of which came from Germania Magna. The finds from the PAN database constitute a third of all simple Armbrust brooches in Germania Secunda. As noted above, some of Schulze's subtypes circulated only in Germania Magna. Although some of those are cases of unique finds, some broader regional patterns could be discerned. Brooches with closed, cast feet are significantly more common in Germania Magna than the provinces for instance (figure 3.7). The Armbrust brooches with a hammered open or closed foot of equal width as the bow (Schulze 35/36) are by far the most common subtype on both sides of the frontier, making up over two-thirds of simple Armbrust brooches in Germania Magna and 90% of all simple Armbrust brooches in Germania Secunda. The ubiquity in the Roman provinces may be taken as a sign for production in the Lower Rhine area.[87]

Contrary to supporting-arm and tutulus brooches, this group of simple two-piece Armbrust brooches most often found in non-funerary contexts, in both Germania Magna and Germania Secunda (see tables 3.6 and 3.7). Its main distribution area ranges from the coastal area of northern Germany to the central Netherlands and south-west Germany. They are rare in Wallonia outside of the *Höhensiedlungen* and associated cemeteries. They

the site is dated by the excavators around the mid-4th century (Van Renswoude 2009, 284; 5th-century pottery was also absent; Van Kerckhove 2009, 183-186). The end of the settlement of Utrecht-Hogeweide 12 is dated to the 3rd century based on the pottery (Nokkerts *et al.* 2009), but two simple two-piece Armbrust brooches were found in a layer of flood sediment that could post-date that (there were no other later finds). The final occupation of Neerharen-Rekem has similarly been placed in the late 4th century (De Boe 1983ab; De Boe 1986).

[78] Holßel (Böhme 1974, 236), Ketzenberg (Böhme 1974, 237), Sahlenburg 586/1930 (Böhme 1974, 248) and 21 (Böhme 1974, 250); Hemmoor-Warstade grave 72 (Böhme 1974, 235); Liebenau P10/A2 (Häßler 1990, Taf. 44).

[79] Holßel grave 10 (Schön 2017, Taf. 11); Sahlenburg grave 1 (Böhme 1974, 249).

[80] Altenwalde grave 7 (Böhme 1974, 219); Bad Lippspringe grave 1 (Böhme 1974, 221); Sahlenburg 28 (Böhme 1974, 250), Bremen-Mahndorf grave 28b (Brieske 2001, table 2); Westerwanna 1372 (Böhme 1974, 260); Westerwanna 1848 (Böhme 1974, 262); Issendorf grave 3127 (Weber 2000, 22).

[81] Bad Lippspringe grave 1 (Böhme 1974, 221), Dortmund-Asseln grave 25 (Könemann 2015).

[82] Siegman 2004, 141. As this study focused on the Saxon period, no information about the early and mid-4th century was presented and no specific subtypes were discussed.

[83] Schulze 1977, 18-19, 36.

[84] In Germania Secunda, found in cremation at Remagen (Schulze 1977, Kat. 548; likely dated to the 4th century). Krefeld-Gellep grave 1325 (contained a 4th-century Pirling 108 jug; although Böhme 2007, note 3 dates this grave to the early 5th century); Cologne-Braunsfeld (coin-dated to the second half of the 4th century; Schulze 1977, 35).

[85] Mückenberger 2013, 117. Westerwanna grave 2266 (type 10 brooch) may be dated to the 4th century based on the urn (Schulze 1977, 20, Kat. 480). Liebenau grave L12/B9 (with two supporting-arm brooches type Mahndorf; Häßler 1985, Taf. 33) was dendrochronologically dated to the first half of the 5th century (Feindt and Fischer 1994, 60); in Sahlenburg, Schulze 38 brooches were found in 'younger' urns (graves 54 and 3; Schulze 1977, 35). Schulze 38/HF 72b brooches were also found in burials alongside developed tutulus brooches in Holßel grave 10 and Langen grave 9 (Schön 2017, Taf. 11 and 20).

[86] Schulze 1977, 21, 29.

[87] Cf. Schulze 1977, 171 who suggested their ubiquity in the Rhine-Weser area may indicate a production centre there.

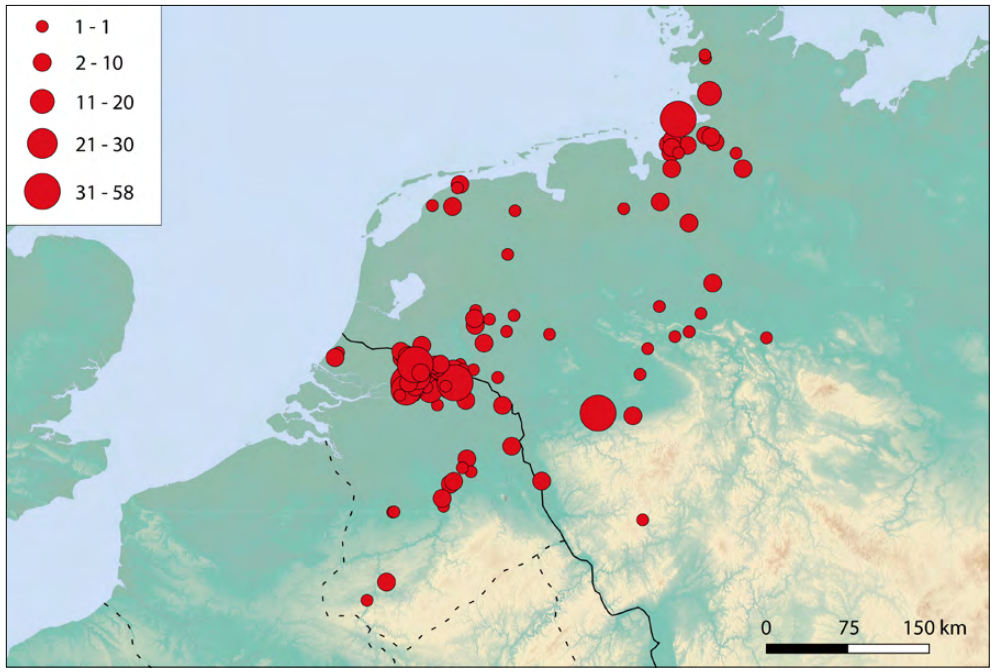


Figure 3.6. Distribution of simple two-piece Armbrust brooches with open or closed hammered foot of the same width as the bow (Schulze types 8, 29, 35/36 and 40; HF 72a).

were furthermore found in several 'migration-related settlements',[88] although these are far outnumbered by the number of brooches recovered from urban centres, villas and native Roman rural settlements. In large-scale open-plan excavations they constitute one of the largest small finds groups and it is not uncommon to find dozens of simple Armbrust brooches in Late Roman settlement contexts.[89]

Noteworthy, finally, is this group's relatively common appearance in military contexts. Simple Armbrust brooches with a hammered open or closed foot of equal width as the bow were found in military fortifications along the Lower Rhine[90] and cemeteries associated with *Höhensiedlungen* further inland,[91] suggesting that were widely worn by a variety of people in a variety of contexts. From the distribution and dating evidence, a purely Germanic or female interpretation is not immediately obvious. What stands out instead is the widespread and enduring popularity of the Armbrust tradition across a wide area over a prolonged period of time.

Social connotations and production

Some have linked this group of brooches to the presence of Germanic settlers and specifically to Germanic women.[92] Others have been cautious in using ethnic interpretations due to the brooch's prominence within the provinces.[93] Its ubiquity in the frontier zone especially allows for the possibility to suggest a production origin around that area.[94] The larger numbers from within the Roman provinces are potentially influenced by denser population there compared to Germania Magna, but it is telling that it is frequently found in provincial-Roman rural settlements with no apparent markers of Germanic identities.[95]

As for the gender connotation of the brooch, it has been noted that it often appears in pairs or sets in funerary depositions,[96] which tends to be associated with female dress practices.[97] Several graves from Germania Secunda[98] and Magna[99] have yielded pairs of matching simple Armbrust brooches, occasionally also with other

[88] Baelen-Nereth (Hanut *et al.* 2012; Fock *et al.* 2013); Cuijk-De Beijerd en 't Riet (Heirbaut 2005); Gennep-Stamelberg (Heidinga and Offenberg 1992); Grubbenvorst-De Soom (De Winter and Weterings 2011); Holtum-Noord (Wagner and Van der Ham 2010; Tichelman 2012); Neerharen-Rekem (De Boe 1983a, 70); Odijk-Singel West/Schoudermantel (Verhelst and Schurmans 2007); Tiel-Passewaaij (Heeren 2009, table 51).

[89] Geldermalsen (Verhelst 2002; Verhelst 2003; Van Renswoude 2009); Tiel-Passewaaij-Hoge Weg (Heeren 2009, table 51); Wijk bij Duurstede-De Geer (Heeren and Botman 2021).

[90] Cologne-Deutz (Carroll-Spilleck 1993) Nijmegen-Josephhof (Zee 2010); Nijmegen-Kelfkensbos (unpublished); Wijchen-Tienakker (Heirbaut and Van Enckevort 2011) and Froitzheim (Van Ossel 1992).

[91] Montaigle (Böhme 2007); Furfooz (Böhme 1974); cf. Schulze 1977, 178 on their appearance in *foederati* graves in northern France.

[92] Notably Böhme 2007; Böhme 2009.

[93] Heeren and Van der Feijst 2017, 191; Heeren 2023, 192.

[94] Schulze (1977, 20) argues this point for the relatively rare type 10; cf. more generally Heeren 2023, 192.

[95] Such as Arnhem-Schuytgraaf (Van Enckevort *et al.* 2017), Houten-Loerik (Vos and Lanzing 2001), Utrecht-Hogeweide/LR54 (Nokkerts *et al.* 2009) and Odijk-Singel West/Schoudermantel (Verhelst and Schurmans 2007).

[96] Böhme 1974, 7.

[97] Although Von Richthoven (2000, 20ff.) has noted burials of men with multiple brooches in Germania Magna and the Iron Age; see also Böhme-Schönberger 2008, 144-145.

[98] Krefeld-Gellep 527 (Pirling 1966, Taf. 45); Nijmegen-Nieuwstraat 16 (Böhme 1974); Zoelen-Scharenburg 3 (Veldman 2011); Rhenen-Dondersberg 825 (Wagner and Ypey 2011).

[99] Wageningen-Geertjesweg 67 (Van Es 1964); Gudendorf 1324 (Böhme 1974, Taf. 19.8-8).

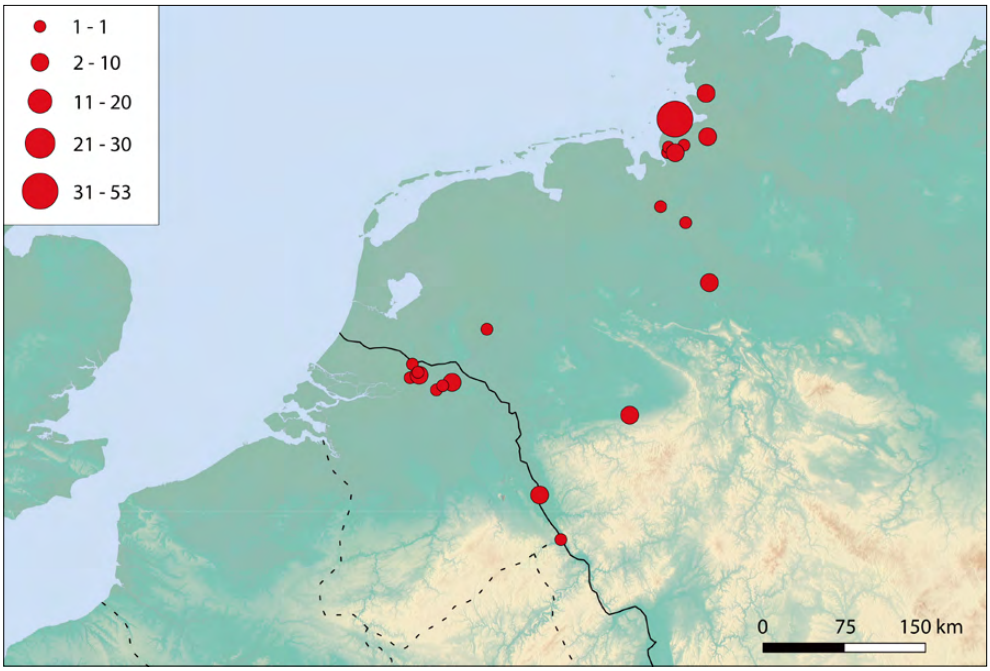


Figure 3.7. Distribution of simple two-piece Armbrust brooches with closed, cast foot of the same width as the bow (Schulze 10, 13, 30, 38 and 41; HF 72b).

brooch types,[100] suggesting it was part of the female costume. However, as pointed out above, it is also widely found in military settlements as well and its ubiquity is reminiscent of more gender-neutral brooches from earlier periods such as the wire brooch.[101] The small number of osteologically sexed graves from the study region also indicates that the brooch was deposited in burials of both men and women, for both the hammered (Schulze 35/36) group[102] and the cast (Schulze 10/38) group.[103]

Schulze identified a range of decorative schemes on Armbrust brooches, but the data from the study area were very limited.[104] Of the 780 brooches for which images were available or that were seen in person, 203 were plain (or survived in such a state that decoration could not be ascertained). The most common decoration on the other brooches was a pattern of alternating horizontal grooves, faceted surfaces and small perpendicular notches in the side of the brooch, most often found on the foot, sometimes on the bow or axis mount (figure 3.5 above). The bow was most often left plain, although some brooches showed rows of dots, dotted circles, swirls, etched lines or even diagonal grooves more typically found on supporting-arm brooches (see below). The pattern of faceting, notches and horizontal grooves are quite typical for Late Roman material and are also often found on military belt fittings[105] as well as some contemporary crossbow brooches and supporting-arm brooches. Dotted circles also appear on many Late Roman belt elements (especially buckles and strap ends; see chapter 4) as well as a range of other copper-alloy dress accessories and other personal items (such as bone combs,[106] keys, fire strikers and tweezers).

This embeds the simple two-piece Armbrust brooch within the wider decorative styles and tastes of the Late Roman West. Böhme already spoke of a *Mischzivilisation* when discussing the hybridity of the Wijster hairpins (see below) and the combination of Germanic and Roman elements of the simple Armbrust brooch points to something similar. The overrepresentation of frontier finds of the simple Armbrust brooch is also very similar to the distribution of the *limes*-centric Wijster hairpin.[107] Rather than a brooch directly representing a German ethnic identity it seems that instead they were part of a style or fashion that included elements from both Germanic and Roman visual languages that was expressed in a variety of objects.

The chronology of the simple Armbrust brooch places it just at the end of the footless brooch circulation

[100] Krefeld-Gellep grave 968: two matching iron simple Armbrust brooches with a saucer brooch and a mid to late 5th-century bow brooch with semi-circular headplate (Pirling 1966, 78); Langen 32 (with two matching saucer brooches; Böhme 1974, Taf. 25.12-14); Sahlenburg grave 21 (simple Armbrust brooch with three supporting arm brooches (none matching; Böhme 1974, Taf. 38); Helle 20 (simple Armbrust brooch with supporting arm brooch; Böhme 1974, 234).

[101] Heeren and Van der Feijst 2017, 126.

[102] Male: Issendorf grave 1917 (Weber 2004, Taf. 72); grave 3888 (Häßler 2001, Taf. 59). Child: Issendorf 1063 (Weber 2004, Taf. 33); grave 3836 (Häßler 2001, Taf. 48). Female: Issendorf grave 1017 (Weber 2004, Taf. 31).

[103] Male: Liebenau grave L9/A3 (Cosack 1982, Taf. 19). Liebenau grave L7/B3 contained several individuals, including a man (Cosack 1982, Taf. 16).

[104] Schulze 1977.

[105] Especially 'longer' objects such as rectangular suspension mounts, belt strip-like belt stiffeners and belt slides (see chapter 4).

[106] Thomas 1960.

[107] Böhme 1974, 35-36, Karte 9.

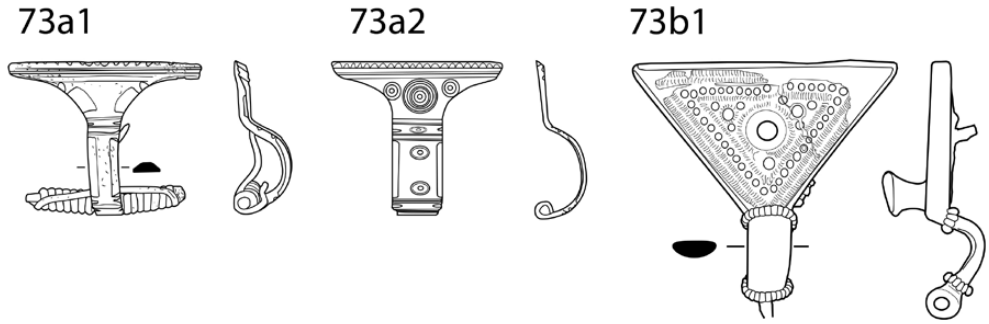


Figure 3.8. Main elaborate Armbrust brooches in the study area. Top: left: HF 73a1/ Böhme type C; centre: HF 73a2/Böhme type B; right: HF 73b1/Böhme type Vert-la-Gravelle (after Heeren and Van der Feijst 2017, 4.145).

period and therefore at right at the moment when the development of Germanic-style material culture into the Roman provinces intensifies. The sheer number of brooches found in the *limes* zone and their relative uniformity in form (wrought foot of equal width to the bow, band-shaped bow) and decoration (plain or lightly etched bow, foot with faceting, notches and horizontal grooves) heavily imply a production of simple two-piece Armbrust brooches within the immediate *limes* region, in tandem with Böhme's same suggestion for the 5th-century Wijster hairpin.[108] Simple two-piece Armbrust brooches appear to have been inspired by the late 3rd-century specimens more common in Germania Magna and indeed inspire later types in the 5th and 6th century that are again more commonly found north of the frontier, but the 4th-5th-century specimens seem to have been the predominant provincial and *limes*-based dress accessory. The data from Germania Secunda suggests that simple two-piece Armbrust brooches were not exclusively linked to Germanic or female identities,[109] but that they represent a style 'of the frontier'.[110]

The two-piece Armbrust brooch with elaborate foot

Alongside the simple two-piece Armbrust brooch, related types with more elaborate feet developed. Again, only a handful of the numerous types defined by Schulze[111] were found within the study area and even fewer appeared in Germania Secunda in any significant numbers (figure 3.8). Böhme originally distinguished four types of *Armbrustfibel mit Trapezfuss*: type A (slightly widened foot), B (trapezoidal foot),[112] C (very wide trapezoidal foot) and type Vert-la-Gravelle (triangular foot).[113] The distinction in foot width between types A and B and types B and C respectively can be difficult to pin down for fragmented pieces, and these three types are grouped together in Schulze's type 137,[114] with type A also fitting into her group

Böhme 1974	Schulze 1977	Heeren and Van der Feijst 2017
A	137; 156-157	
B	137	73a1-2
C	137	73a1
Vert-la-Gravelle	129; 131; 134	73b1

Table 3.3. Concordance table of Armbrust brooches with elaborate feet (after Böhme 1974, figure 1; Schulze 1977; Heeren and Van der Feijst 2017, 191-193).

156.[115] Heeren and Van der Feijst distinguish between the wide and very wide trapezoidal foot, but have no equivalent for Böhme's type A.[116] The triangular foot of the Vert-la-Gravelle type was split into at least three groups by Schulze based on the spring construction, bow cross-section and catch-plate construction and is broadly comparable to Heeren and Van der Feijst's type HF 73b2.[117] Later studies also recognised additional, but much rarer types with elaborate feet, but these are extremely rare in the studied section of Germania Magna and absent from Germania Secunda so will not be further discussed.[118]

Chronology

The Armbrust brooches with trapezoidal foot types A and B were originally dated by Böhme from the mid-4th century onwards,[119] while his type C was dated in the second half of the 4th century[120] (see concordance table 3.3).[121] In later publications, the dating for Böhme's type B and C shifted to the late 4th and first third of the 5th

[108] Böhme 1974, 38.
[109] Contra e.g. Böhme 2009.
[110] Cf. Miller 1996.
[111] Schulze 1977.
[112] Closely related to the supporting arm brooches with trapezoidal foot (Böhme's *Stützarmfibel mit Trapezförmigen Fuss*; 1974, 10-14).
[113] Böhme 1974, 8-10.
[114] Schulze 1977, 81-82.
[115] Schulze 1977, 90-91.
[116] Heeren and Van der Feijst 2017, 191.
[117] Although they describe the triangular foot as a 'box' (Heeren and Van der Feijst 2017, 192), which is not always the case and not described by Böhme in his type definition (1974, figure 1).
[118] These are broadly the Armbrust brooches with pointed catch-plates (Schulze types 85, 108, 113), diamond-shaped feet (Schulze types 164-165, 167; HF 73c) and with a circular 'box' (variation of Böhme's Vert-la-Gravelle type; HF 73b2). With the exception of one brooch from Bonn-Nordstraße (Gottschalk 2015, Taf. 10), none of these were found in Germania Secunda and no more than one or two were found for each group in Germania Magna. Therefore, these brooches will not be further discussed.
[119] Böhme 1974, 10.
[120] Böhme 1974, 10; similar dating was proposed by Schulze 1977.
[121] Schulze types 137/156/157 were originally dated first half to late 4th century (Schulze 1977, 82, 90-91).

century.[122] Few closely dated contexts are available for Armbrust brooches with trapezoidal feet within the study area. Contexts for Böhme's group A and B, on both sides of the frontier, have been dated to the 4th century, based on associated grave goods.[123] Datable closed contexts for Böhme type A are lacking, but Schulze notes that they appear frequently alongside her group 35/36 and places them within the same dating range.[124] Her seriation of brooches and urns in burials in Germania Magna also showed that her 137 group was consistently found in the same type of urns as her group 35/36 simple two-piece Armbrust brooch.[125] This suggests the elaborate Armbrust brooches with trapezoidal feet can be dated broadly to the 4th and 5th centuries (see above). A continued date of this group in the 5th century is also suggested by how closely their trapezoidal feet resemble those of the supporting-arm brooch with trapezoidal foot (see below).[126] Most of the evidence for the Böhme type C brooch also points towards a 5th-century circulation date,[127] although outside of the study area dates in the second half of the 4th century are cited.[128] Similarly, the mid-4th century date of the Vert-la-Gravelle type can be extended to the early 5th century as well.[129]

Distribution and contexts

Despite the low numbers of elaborate Armbrust brooches found, it has a rather wide distribution (see figure 3.9), comparable to that of the related simple two-piece Armbrust brooch. There is of course a cluster in the central Dutch river area due to the PAN dataset and scatters of finds were found in the southeast of the province and north of the frontier. Generally, however, the elaborate Armbrust forms appear slightly more common in Germania Magna (57) than Germania Secunda (39). Armbrust brooches with trapezoidal feet that are only slightly wider than the bow (Böhme type A; Schulze types, 156-157) were only recorded in Germania Magna. The majority of elaborate Armbrust brooches in Germania Magna were found in grave contexts, with a substantial number also from a small number of finds-rich settlements.[130] In Germania Secunda, most finds from excavated contexts were found in rural settlements as well. A number of 'migration-related settlements' yielded elaborate Armbrust brooches[131] and a small number were found in military contexts, both in fortifications[132] and associated cemeteries.[133]

Social connotations

It is difficult to see the interpretation of the simple and elaborate Armbrust brooches as separate. Being the rarer type, the distribution of the elaborate Armbrust brooch overlaps completely with the far more widespread simple type, but there are differences in terms of find context. It is found in far fewer archaeological contexts and was less common in military, urban or villa sites (see tables 3.6 and 3.7). Compared to the wide distribution of the simple Armbrust brooch across the region and across site types, the elaborate form reads much less like a common brooch type and more as a socially distinct type that was worn by a more selective social group (whether that was based on gender, status or regionality).

It also shows a wider range of decorative patterns, elaborating on the standard faceting with notches that is so characteristic for simple Armbrust brooches. Possible decoration may also include *Pressblech*, which Böhme interpreted as a sign of provincial-Roman production.[134] Based on their distribution, Böhme originally suggested a Saxon origin for his types A and B, while type B was mostly found left of the frontier and the Vert-la-Gravelle type was completely absent in Lower Saxony and Westfalia,[135] which may have indicated an origin of the Vert-la-Gravelle type in central or southern Germany.

The updated maps presented in figure 3.9 show that the Vert-la-Gravelle type is extremely rare in the study area, while the Armbrust brooches with trapezoidal feet were found widely across the study area and overlap significantly in distribution with the simple two-piece Armbrust brooches (despite being considerably rarer). It has

[122] Böhme 1987, Abb. 38.

[123] Germania Magna: based on the urns Gudendorf grave 1334 and Westerwanna grave 507 both with Böhme type A brooches were dated to the second half of the 4th century and late 4th century respectively (Schulze 1977, 90-91). Type B was found in grave 21 in Sahlenburg dated to the mid-4th century (Schulze 1977, 82).

[124] Schulze 1977, 90.

[125] Schulze 1977, 82.

[126] Böhme 1974, 14.

[127] Hemmoor-Warstade grave 60: type C/Schulze 137 with 5th-century supporting-arm brooch (Böhme 1974, 235). Liebenau grave P10/A2 type B or C/Schulze 137 dated to the 5th century based on a Mahndorf (HF 78b2) supporting-arm brooch. Found with developed tutulus brooch in Issendorf grave 3475 (Weber 2004, 21).

[128] Brieske 2001, 26.

[129] Schulze 1977, 79-80; Heeren and Van der Feijst 2017, 192-193. While one was found in a 4th-century burial in Westerwanna (grave 1807 alongside a Sommer 1Cf2 buckle and Sommer Dc strap end second half 4th century; Böhme 1974, 262, Taf. 53.14-15; Schulze 1977, Kat. 441), other contexts may be dated to the 5th century, such as Cologne-Hofergasse 11/13 (with a mid-4th century Gellep 516/Isings 32 glass beaker and a glass Gellep 537/Trier 14 bowl; Böhme 1974, 177, Taf. 75); outside of the study area in Vert-la-Gravelle grave 26 with a set of elaborate tutulus brooches type Oudenburg; Böhme 1974, Taf. 145.1-4.

[130] Notably Kamen-Westick (Könemann 2018); Wijnaldum (Besteman *et al.* 1999), Didam-Kollenburg (Koster *et al.* 2001), Castrop-Rauxel (Böhme 1974, 228-229) and Castricum-Oosterbuurt (Hagers and Siers 1999).

[131] Tiel (Heeren 2009), Neerharen-Rekem (Böhme 1974, 193) and Gennep-Stamelberg (Heidinga and Offenberg 1992); see chapter 3 for a more detailed discussion).

[132] Wijchen-Tienakker (Heirbaut and Van Enckevort 2011); Krefeld-Gellep (Reichmann 1987) Two were found in the Nijmegen fortification (Josephhof and Kelfkensbos; Zee 2010).

[133] Krefeld-Gellep (Reichmann 1987).

[134] Böhme 1974, 10; Böhme 2007, 8.

[135] Böhme 1974, 10.

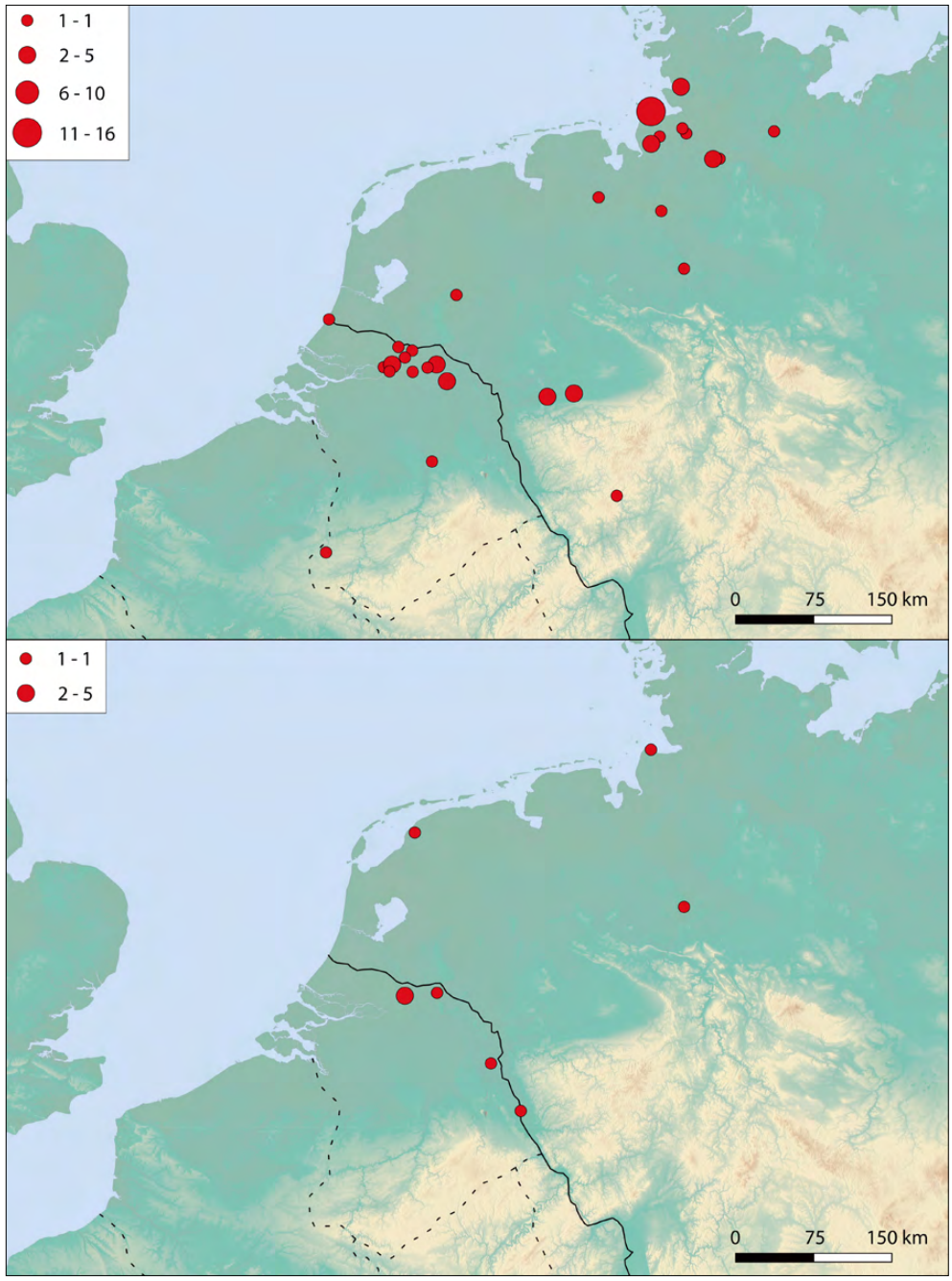


Figure 3.9. Distribution of the elaborate type of Armbrust brooch. Top: Schulze type 137, 156-157/Böhme types A-C; Bottom: Böhme Vert-la-Gravelle/Schulze 129, 131, 134.

also been suggested that this group of brooches was worn exclusively by women.[136] There is plenty of evidence that the simple form was part of a multiple-brooch style dress, both in Germania Magna[137] and Secunda.[138] The one exception comes from Westerwanna grave 194, which yielded a belt plate with suspension mount and an elaborate Armbrust brooch, perhaps highlighting the high status of the

[136] Heeren and Van der Feijst 2017, 191.

[137] See Westerwanna 1013 (with another, indeterminate Armbrust brooch and two tutulus brooches; Böhme 1974, 259); 1372 (elaborate Armbrust brooch and a heavily corroded iron Armbrust brooch; Böhme 1974, 260); Sahlenburg 21 (matching set of elaborate Armbrust brooches with a simple Armbrust brooch; Böhme 1974, 250); Ketzenberg 10 (two simple two-piece Armbrust brooches with a *Bügelknopf* brooch; Böhme 1974, 237); Helle 20 (simple Armbrust brooch and an elaborate type with trapezoidal foot; Böhme 1974, 234); Hemmoor-Warstade grave 60 (elaborate Armbrust brooch with trapezoidal foot, HF 78a supporting-arm brooch and a crossbow brooch; Böhme 1974, 235); Hemmoor-Warstade grave 72 (elaborate Armbrust brooch with trapezoidal foot with a HF 78a supporting-arm brooch and a simple two-piece Armbrust brooch; Böhme 1974, 235); Altenwalde grave 40 (matching set of elaborate Armbrust brooches; Böhme 1974, 218).

[138] Grave 200 in Nijmegen-Hugo de Grootstraat yielded a non-matching set of elaborate Armbrust brooches with trapezoidal foot (one silver, one copper alloy) and potentially also a matching set of simple two-piece Armbrust brooches (the finds documentation is not clear on this).

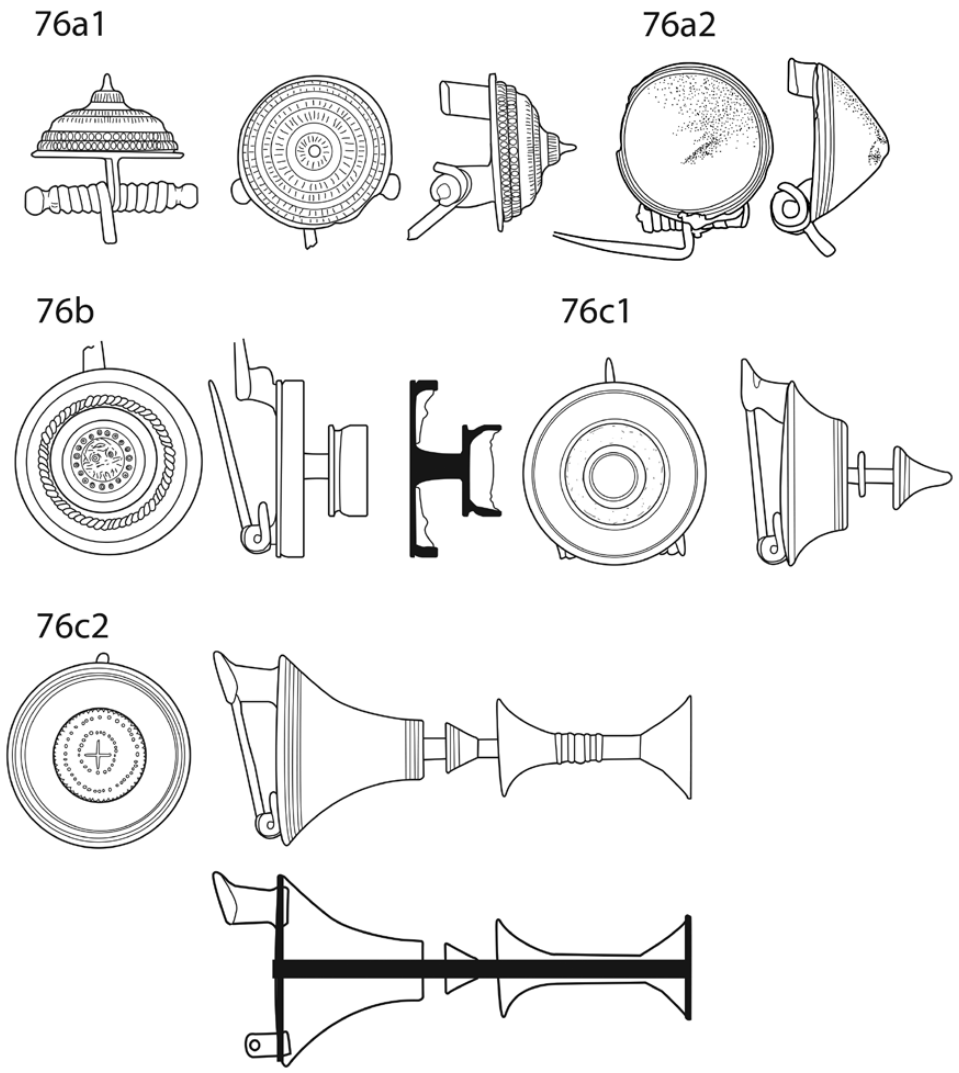


Figure 3.10. Main tutulus brooch types in the study area (after Heeren and Van der Feijst 2017, figure 4.151).

deceased by incorporating coveted military insignia in the burial rite.[139]

The tutulus brooch

Tutulus brooches are frequently found at the edges or just beyond the study area, in northern Germany and in northern France.[140] Their rarity is in no doubt largely due to their composite construction method, which makes them fragile in archaeological contexts. Tutulus brooches consist of a copper-alloy plate, on which one or more hollow cones of sheet metal (copper-alloy or silver) are mounted by means of an iron rod. Pin and catch-plate (also often in iron) are attached separately to the back of the plate. Often only the iron rod or the base plate survives (the latter may easily be confused with a disc or saucer brooch). The delicate sheet metal that is key to identifying and dating the different types described by Böhme[141] does not tend to survive well outside of well-preserved burial contexts.

Böhme originally defined numerous types showing a development from simple to elaborate cone constructions (see figure 3.10).[142] The earliest type Dienstedt is technically a box brooch and is a precursor to the proper tutulus brooches, which developed in the Elbe-Weser area in the 4th century.[143] In later works, Böhme collated several types together and dropped others (see table 3.4 for a concordance table). The earliest forms (early Nijmegen and Ortbrook) are characterised by a simple cone. Slightly more evolved types have taller cones, namely the Cortrat A type (spiked end) and the late Nijmegen form (rounded terminal; later renamed to the Vert-la-Gravelle type).[144] Later, even more developed types consisted of multiple stacked cones and could include discs and beads. Cortrat B (later renamed Marteville) and Oudenburg

[139] No osteological data from burials with elaborate Armbrust brooches was found.
[140] Böhme 1974, Karte 6.
[141] Böhme 1974, 21-24.
[142] Böhme 1974, Abb. 6.
[143] Böhme 2003, 255; cf. Böhme 1974, 19-24; Böhme 1996, 94, Abb. 68.
[144] Böhme 2003, figure 4.

Table 3.4. Typology of the tutulus brooch (after Böhme 1974, 29-24; Böhme 2003, 256 and Heeren and Van der Feijst 2017, 198, table 4.59).

Böhme 1974	Böhme 2003	HF	Description
Dienstedt		76a1	Pressblech
Dienstedt		76a2	simple cone
		76b	second disc
Cortrat A			
Nijmegen late	Vert-la-Gravelle		cone with domed head
Cortrat B	Marteville		cone with disc
Ortbrook; early Nijmegen	Ortbrook-Nijmegen	76c1	cone with spiked head
Oudenburg	Cortrat-Oudenburg	76c2	double cone with terminal disc
Issendorf			double cone with spatula terminal
Babilonie			Einzeltyp

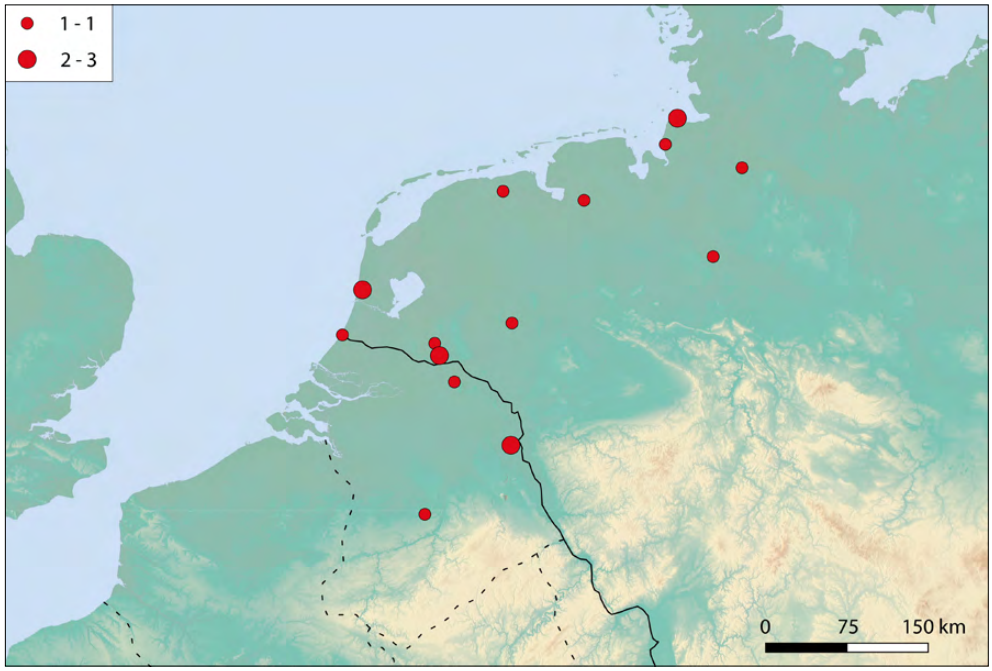


Figure 3.11. Distribution of early tutulus brooch types Ortbrook-Nijmegen.

types are characterised by a flat terminal disc, while type Issendorf ends in a spatula-shaped terminal. Heeren and Van der Feijst added a transitional type between these simple and elaborate tutulus brooches, the Raalte-Heeten type (HF 76b).[145]

Chronology

Böhme dated the Dienstedt type in Germania Magna to the second half of the 3rd century.[146] The earliest proper tutulus brooch is said to have developed in the Elbe-Weser region from around AD 300 onwards,[147] based on dendrochronological evidence from several burial contexts.[148] Based on associated finds, this early type also circulated in Germania Secunda in the 4th century.[149] Heeren and Van der Feijst date the circulation of their transitional Raalte-Heeten type to the 4th century,[150] bridging the gap between the simpler and more elaborate forms. Over the course of the 4th and 5th centuries, the more elabore tutulus forms developed (Cortrat-Oudenburg; Issendorf; HF 76c2). Their main circulation period appears to have been the 5th century in Germania Magna,[151] although

[145] Heeren and Van der Feijst 2017, 197.
[146] Böhme 1974, 21.
[147] Böhme 2009, 39, Abb. 3.
[148] Böhme 2003, 255. Germania Magna: Leer (dendrochronologically dated to after AD 282-296; Böhme 2003, 255; cf. Bärenfänger 1999b) and Fallward grab 284 (with a on VII 3.5 brooch and dendrochronologically dated to around AD 300; Böhme 2003, 255; cf. Schön 1999, 154, Abb. 18).
[149] Germania Secunda: Nijmegen-Grutberg/B620 (burial coin-dated to after AD 318; Böhme 2003, 255; Steures 2013, 129; finds date the context in the second half of the 4th century; Heeren and Van der Feijst 2017, 197); Krefeld-Gellep grave 4756 (with a 4th-century Fécamp hairpin and a glass jug type Gellep 809 dated second half 4th-early 5th century; Pirling and Siepen 2006, 257) and Krefeld-Gellep grave 5029 (coin-dated to after AD 335; Böhme 2009, 39; Pirling and Siepen 2006, 485).
[150] Heeren and Van der Feijst 2017, table 4.59.
[151] Based on associations with 5th-century brooches such as Liebenau grave II/230 (spossible saucer brooch; Böhme 1974, 241), Liebenau grave II/290 (composite saucer brooch; böhme 1974, 240-241), Liebenau N10/B1 (with supporting-arm brooch (Häßler 1990), Sahlenburg grave 1 (with supporting-arm brooch (Böhme 1974, 249,

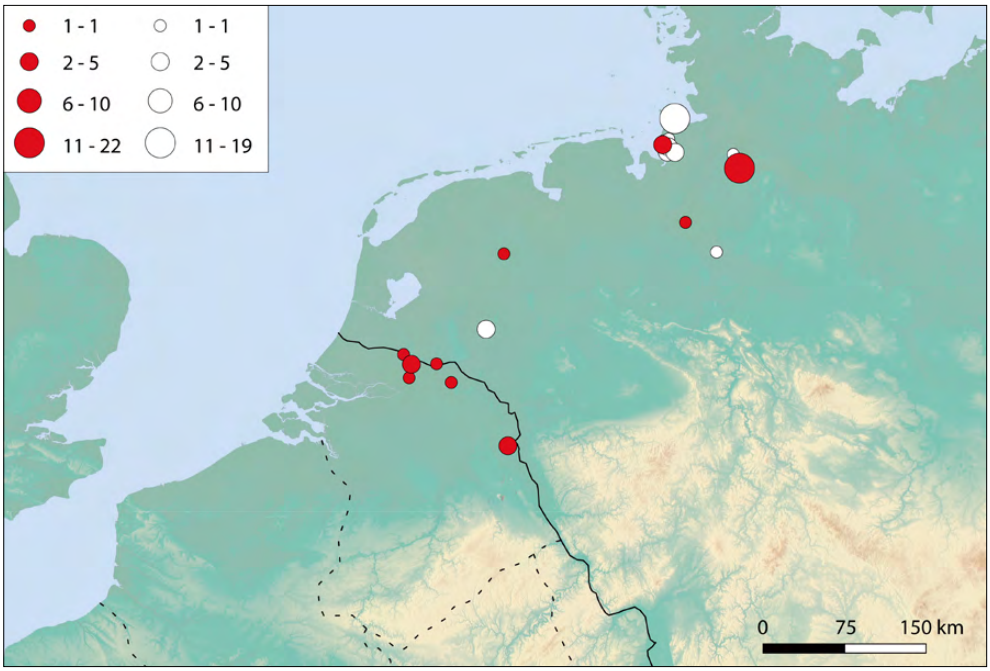


Figure 3.12. Distribution of developed tutulus brooches type Oudenburg-Cortrat (red) and unidentifiable developed tutulus brooches (white).

several contexts suggest an earlier development from the late 4th century onwards.[152] A 5th-century date was also found for Germania Secunda, although fewer closely datable contexts were found there.[153]

Distribution and contexts

More than five times as many tutulus brooches were found in Germania Magna compared to Germania Secunda (155 compared to 28, respectively). Unlike the Armbrust brooches, this type was not found in significant numbers in eastern Germania Magna, instead clustering clearly around the northern German coastal area with very few finds from Westphalia and the Lippe area. Even at large complexes characterised by huge numbers of small finds like Kamen-Westick, tutulus brooches were absent.[154] Within Germania Secunda, the vast majority of tutulus brooches were found in the river area (figure 3.11-3.13), with only a handful of specimens found further to the south. Tutulus brooches were only found in a very narrow selection of contexts, with no finds from military or villa complexes. Most of the settlement finds of tutulus brooches from Germania Secunda did not occur on sites with other potential markers of Germanic identity.[155]

In general, the earlier types are rarer found mostly in Germania Magna, suggesting the form may have originated in the north before also becoming popular in the south. Relatively many elaborate tutulus brooches were identified, especially in the northern parts of the study area. There is some division between the Germania Magna and Secunda, however. The elaborate brooches that could be identified to type show that different styles of cones and tips were used on either side of the frontier. Type Issendorf, for example, was only found in Germania Magna (figure 3.13), with especially many numbers known from Westerwanna.[156] Other types, like Nijmegen and Oudenburg were found on both sides (figure 3.12).

Social connotations

The female-gendered connotations of the tutulus brooch stem mostly from its association with other brooches and hairpins in graves. Both the early and later types are also commonly found in pairs. Pairs of elaborate tutulus brooches were found in numerous graves in Germania Magna.[157] The evidence for Germania

Taf. 36.4), Wehden grave 778 (supporting-arm brooch; Böhme 1974, 252, Taf. 41), Westerwanna grave 2005 (with saucer brooch; Böhme 1974, 263), Westerwanna Cuxhaven U83 (with supporting-arm brooch; Böhme 1974, 263-264) and Issendorf grave B (saucer brooch and a *gleicharmige Kerbschnitt* brooch; Böhme 1974, 236-7).

[152] Weber 2000, 24; Brieske 2001, 19; cf. Böhme 1987, Abb. 38 on dating to the late 4th and early 5th century.

[153] Nijmegen grave OO362, where a Marteville type was found with a supporting arm brooch (Steures 2013, 720). Krefeld-Gellep grave 1389 containing a matching pair of Cortrat-Oudenburg brooches is dated to the first half of the 5th century (Pirling and Siepen 2006, 328).

[154] Könemann 2018.

[155] With the one exception Tiel-Passewaaij (Heeren 2009, table 51), where two short houses were found and some Germanic-style handmade pottery (see chapter 2).

[156] Böhme 1974, 349.

[157] Including Wehden grave 778 (Böhme 1974, 252), Sahlenburg grave 1 (Böhme 1974, 249; Brieske 2001); Sahlenburg grave SN-Kg 1 (Brieske 2001); Liebenau grave II/230 (Böhme 1974, 241; Brieske 2001), Issendorf grave B (Böhme 1974, 236-7, Taf. 23.4); Issendorf grave 3533 (Häßler 1994); and Gudendorf-Köstersweg grave 1332 (Böhme 1974, 232); Langen grave 19 (Böhme 1974, 238); Langen grave 32 (Böhme

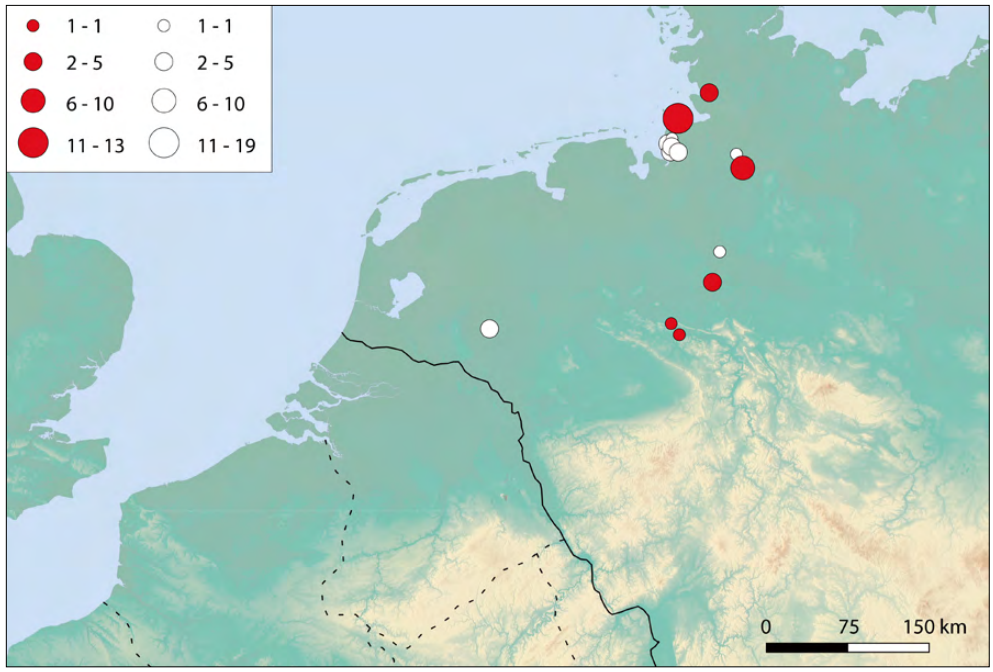


Figure 3.13. Distribution of developed tutulus brooches type Issendorf-Babilonie (red) and unidentifiable developed tutulus brooches (white).

Secunda is a little scarcer.[158] Skeletal evidence is more mixed, with tutulus brooches also found in burials of men.[159]

As for regional origin, for the earliest Ortbrook-Nijmegen type, it is generally assumed that production took place in Germania Magna[160] as they derive from the 'box brooch' type Dienstedt and are commonly found in central Germany.[161] Little is known about the new Raalte-Heeten type, but its restricted regional distribution and similarity in form to the Ortbrook type may also point towards production in the north.[162] Halsall argued that the earlier tutulus brooch types show clearer developmental links to provincial-Roman disc brooches than to Germanic predecessorsand suggested that tutulus brooches developed in the Gaul in the mid-late 4th century first before being adopted in the north.[163] The construction of the catch-plate of tutulus and disc brooches, is quite different,[164] however, but are similar for tutulus and box brooches.[165] Halsall also criticised the fusion of the Ortbrook and Nijmegen types, suggesting that this was done to remove the Gallic origin of the Nijmegen type and placing the development of the earliest tutulus brooches firmly in the Elbe region.[166]

However, it seems possible that merging the two types was done in recognition of the rarity of the Ortbrook type,[167] reclassifying it as a subtype of the much more common early Nijmegen type (which is found in relatively large numbers in Germania Magna; contra Halsall's suggestion that it was a Gallic type).[168] There is no clear spatial distribution of these brooches that may hint at a regional origin.[169] Based on the probable development of the tutulus brooch from Germanic box brooches from the later 3rd century,[170] the regional origin of the earliest tutulus brooches may therefore tentatively be placed in the Elbe-Weser and frontier region.

The later developed types show more regionalised distributions. Halsall has pointed out in several

1974, 239); Lagen grave 61 (Böhme 1974, 239); Westerwanna grave 286 (Böhme 1974, 256); Westerwanna grave 454 (Böhme 1974, 256); Westerwanna grave 1011 (Böhme 1974, 258); Westerwanna grave 1013 (Böhme 1974, 259); Westerwanna grave 1190 (Böhme 1974, 260); Westerwanna grave 1319 (Böhme 1974, 260); Westerwanna grave 1213 (Böhme 1974, 260); Westerwanna grave 1782 (Böhme 1974, 261); Westerwanna grave Cuxhaven U83 (Böhme 1974, 264).

158 A matching pair of Ortbrook-Nijmegen brooches was found in Krefeld-Gellep grave 4756 with a hairpin (Pirling and Siepen 2000, Taf. 21).

159 Female: Liebenau grave N10/B1 (Brieske 2001; Rosing 1994, 240); Issendorf grave 130 (Jansen 1972; Caselitz 2005, 217); Issendorf grave 555 contained a possible male (Weber 2004; Caselitz 2005, 223). See also Weber 2000, 24.

160 Heeren and Van der Feijst 2017, 198.

161 Böhme 1974, 21.

162 Heeren and Van der Feijst 2017, 197-198.

163 Halsall 2009, 115.

164 Whereas tutulus brooches are closed using a two-piece spring (also found on Armbrust and saucer brooches), provincial-Roman disc brooches feature a hinge (Heeren and Van der Feijst 2017, 149, 196).

165 Heynowski 2013, figure 3.26.4.

166 Halsall 2009, 116.

167 Only two were recognised, both in Germania Magna: one from Ortbrook (Böhme 1974, 244, Taf. 31.10) and one from Westerwanna grave 454 (Böhme 1974, 256, Taf. 47.10).

168 Halsall 2009, 148. This type was found six times in Germania Magna: Castricum-Oosterbuurt (two specimens; Hagers and Sier 1999, figure 61a-b), Fallward (Böhme 2007, list 4), Feerwerd (Miedema 1983, 156-157, figure 109), Leer (Böhme 2007, list 4; Bärenfänger 1999a, Abb. 104) and Westerwanna grave 310 (Böhme 1974, 256, Taf. 47.2).

169 Four sites from Germania Secunda yielded a total of six early Nijmegen brooches; for Germania Magna this was seven brooches from six sites.

170 Böhme 1974, 19; Heeren and Van der Feijst 2017, 196.

publications that the Issendorf and Babilonie types show a distribution almost exclusively north and east of the Rhine, while the Cortrat and Oudenburg types are found on both sides of the frontier.[171] This is confirmed as well by the distribution maps presented above (figure 3.11-3.13). Halsall has suggested, following from his arguments discussed above, that the Issendorf type (only found outside the Empire) was a local Germanic derivation of the earlier provincial-Roman Nijmegen types.[172] There are suggestions, based on the decorative techniques applied to some developed tutulus brooches, that they were manufactured within the Empire (see for a similar discussion on supporting-arm brooches below).[173] The simplest explanation from an archaeological standpoint would be to describe the tutulus brooch as a widely distributed, yet rare family of brooches, some subtypes of which had a more regionalised circulation.

As the earliest types developed around the frontier zone and north of it, it is not unthinkable that further developments of the brooch type followed regional preferences, with some brooches being more widely popular (Oudenburg-Cortrat, found across the study region) and others being more regionally restricted styles (Issendorf-Babilonie; only in Germania Magna). The distribution and chronological developments of the tutulus brooch group are quite complicated but do not appear to clearly show exports towards Germania Magna.[174] The late 4th and early 5th century saw an increased fluidity in the movement of material culture across the frontier combined with an increasing number of brooch types (such as saucer and supporting-arm brooches)[175] and the described regionality of the developed tutulus brooches seems to fit well within this broader pattern of innovation. The cross-frontier movement of the tutulus brooches style or direct link to migration as suggested by others[176] is not immediately clear from the data from Germania Secunda. Much like the simple two-piece Armbrust brooches, the tutulus brooches of the Late Roman period seem to be a frontier-specific phenomenon that combined a wide supra-regional popularity with localised variation.

5th century brooches and hairpins

The 5th century saw the introduction of several new brooch types in the study area on both sides of the frontier, including the supporting-arm brooch.[177] At the same time, many of the Armbrust brooch types discussed above continued to circulate in both Germania Magna and the Roman provinces. Only in the second half of the 5th century do we see new Armbrust types being developed in this region, which largely seem to originate in southern Germany west of the Rhine and south of the Danube.[178] In the 5th century, a far greater range of Germanic-style hairpins also developed, categorised according to the shape of the head (mushroom-shaped, polyhedric and other). Most of these types are exclusive to the 5th century. Of these, the Wijster, Muids and Tongeren hairpins are the most numerous and will be discussed in more detail below. Other related types are much rarer, however, and were not included in full here because not enough new information could be found.[179]

The supporting-arm brooch

The supporting arm brooch is a composite brooch where the axis is contained by supporting arms or lugs connected to the bow. The bow and arm supports are typically cast as one piece.[180] Four main types of supporting-arm brooches may be recognised, with additional subtypes based on decoration and regionality (see table 3.5 for the main characteristics; figures 3.14-3.15).[181] Although the various typologies for supporting-arm brooches are largely interchangeable, Heeren and Van der Feijst numbers (HF) will be used for brevity (table 3.5).[182]

[171] Halsall 1992, figure 17.2; Halsall 2000, 171-172; Halsall 2009, figure 22, 115-116.
[172] Halsall 2009, 115.
[173] Cf. the niello decoration on the Oudenburg-type tutulus brooch from Fécamp, which was interpreted by Werner (1962, 153) as a possible sign that Roman workshops were producing brooches on the instructions of 'barbarians'.
[174] As suggested by Halsall 2009, 116.
[175] also see Schulze 1977 and Schulze-Dörrlamm 1986b on the introduction of new Armbrust types in the 5th century.
[176] Halsall 1992; Böhme 2003; Böhme. 2008.
[177] Other 'new' brooches introduced in this period include the cast and composite saucer brooches and the equal-arm brooch.
[178] Types Rathewitz, West Stow and Sližany; Schulze-Dörrlamm 1986b. They are generally rare too and may be listed here: Glauberg (Schulze-Dörrlamm 1986b); Mahndorf (Schulze-Dörrlamm 1986b); Krefeld-Gellep grave 530 (matching pair; Pirling 1966, 46); Leeuwarden-Oldehoofsterkerkhof (Dijkstra and Nicolay 2008); Bonn-Nordstrasse 48 grave 7 (Gottschalk 2015).
[179] Briefly, these include the Vermand and Cortrat types. The Cortrat type is characterised by a polyhedron-shaped head and apart from one specimen (Feddersen Wierde; Böhme 1974, 355) were only found in Germania Secunda (Böhme 1974, 355; Heynowski 2017b, 125, type 6.9.1; Riha 1990, 109). The close typological relation between the Germanic Cortrat pin and Riha's provincial-Roman-style 12.21.2 hairpin may indicate some level of hybridity in the pin's style. The Vermand type is a very slim hairpin characterised by its pierced head and lunula-shaped pendant. Without these two elements present, the pin is impossible to distinguish from any other Germanic-style long hairpins, potentially impacting its visibility (only two were identified in the study area). Hair needles with pendants are known from the Roman period across Europe (Riha 1990, 101). A variety of types with differently shaped pendants are recorded from Augst (Riha 1990, Typ 7, Taf. 41, 1383-1385) dating to the 2nd and 3rd centuries. The style and form of the pendants is based on pre-Roman jewellery styles (Riha 1990, 101). Like The Cortrat hairpin, the Vermand pin is rarely found in Germania Magna and appears to draw stylistically on Middle Roman hair pin styles from the provinces. Again, this implies some form of hybrid expression with Germanic hair and dress styles merging with provincial-Roman forms of needles and pins.
[180] Heeren and Van der Feijst 2017, 201.
[181] Böhme 1974, 10-14, 51-52; Heeren and Van der Feijst 2017, 201-203; Brieske 2010, 103.
[182] After Heeren and Van der Feijst 2017.

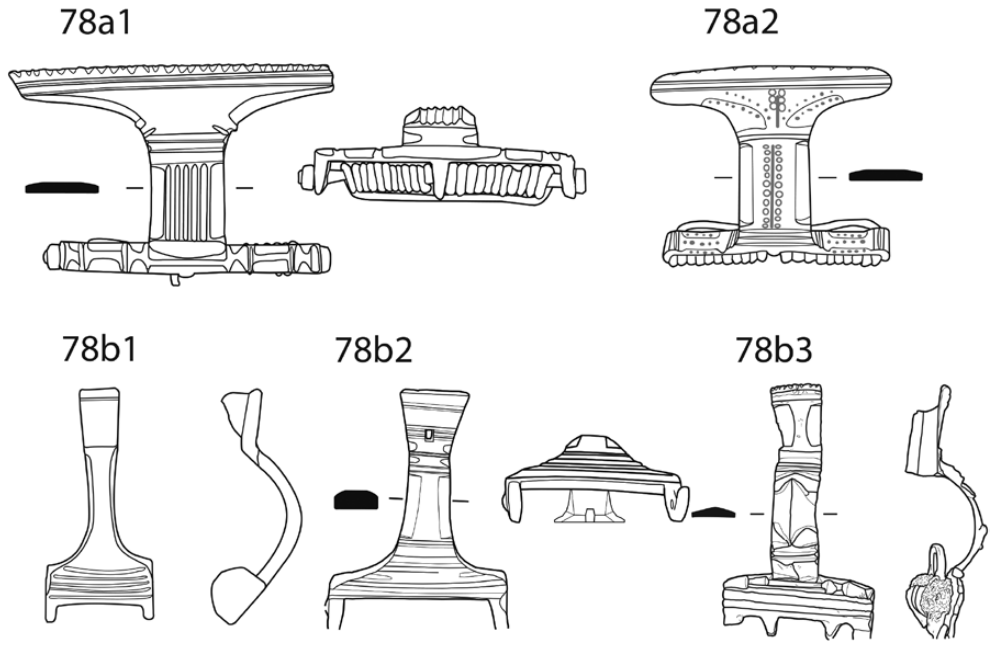


Figure 3.14. Variations of the supporting arm brooch. From left to right, Top: HF 78a1/Böhme Niedersächsischen Typ A/B and HF 78a2/ Böhme Gallischer Typ A/B. Bottom: HF 78b1/ Böhme Typ Perlberg, HF 78b2/Böhme Typ Mahndorf, HF 78b3/ Wijnaldum type (after Heeren and Van der Feijst 2017, figure 4.155).

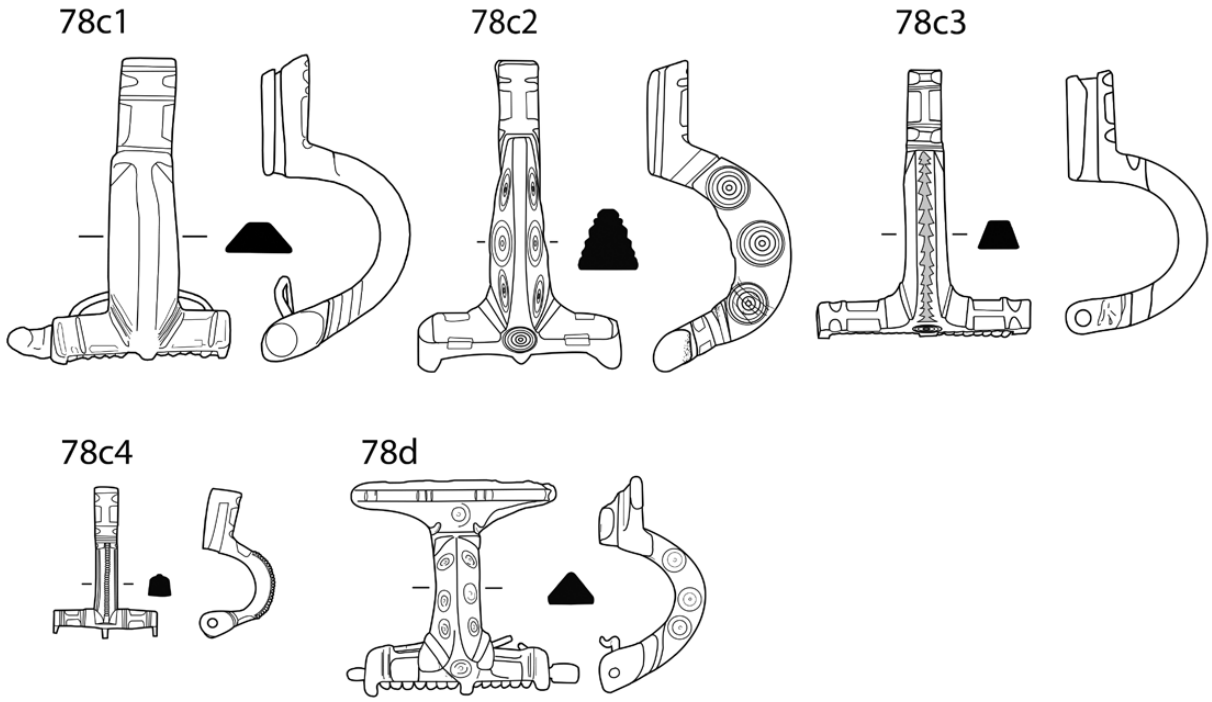


Figure 3.15. Variations of the supporting arm brooch. From left to right, Top: HF 78c1-3/Böhme Stützarmfibel mit stabformigem Bügel. Bottom: HF 78c/Böhme Stützarmfibel mit stabformigem Bügel and HF 78d/Brieske 2010 type (after Heeren and Van der Feijst 2017, figure 4.155).

Chronology

Böhme originally dated the development of the supporting-arm brooches with trapezoidal feet from the mid-4th century onwards,[183] with the Saxon subtypes dating early and the Gallic subtypes dating later (last third of the 4th century-period around AD 400). Based on the similarity between the supporting-arm brooches with *bändförmigem Fuss, ohne Achsenträger* (HF 78b) supporting-arm brooches with trapezoidal feet, Böhme suggested they began circulating in the last third of the 4th century, continuing into the early 5th century.[184] He dated the supporting-arm brooches with solid bows (HF 78c) to the first half of the 5th century based on

[183] Böhme 1974, 12-13; Böhme 2009, 40.

[184] Böhme 1974, 13-14.

Description	Böhme 1974, 10-14, 51-52	Type HF
supporting arm brooch		78
trapezoidal foot, 3 axis supports, flat bow cross-section	Stützarmfibel mit Trapezförmigen Fuss	78a
groove decoration	Niedersäschischen Typ A/B	78a1
niello inlay	Gallischer Typ A/B	78a2
slightly broadened foot, 2 axis supports	Stützarmfibel mit gleichbreitem, bändförmigem Fuss, ohne Achsenträger	78b
narrow supporting arm	Typ Perlberg	78b1
broad supporting arm	Typ Mahndorf	78b2
cheeks underneath pseudo-supporting arm (Wijnaldum)		78b3
narrow foot, 3 axis supports, high bow cross-section	Stützarmfibel mit stabformigem Bügel	78c
simple execution, groove decoration		78c1
dot and circle on bow		78c2
niello inlay		78c3
small, in gold		78c4
slightly broadened foot, bow band, 3 axis supports	Stützarmfibel mit stabformigem Bügel	78d

Table 3.5. Typology of supporting arm brooches (after Heeren and Van der Feijst 2017, 201-203 and Böhme 1974, 10-14, 51-52).

associated grave goods,[185] noting that although they were similar in construction and decoration to the supporting-arm brooches with trapezoidal feet, there was no reason to date them to the same period.[186] Brieske follows Böhme's chronology closely in the dating of her type (the HF 78d; *stabförmigen Bügel* with trapezoidal foot) to the late 4th and early 5th century.[187]

The supporting-arm brooches with trapezoidal foot are now more commonly dated in Germania Magna to the late 4th and early 5th century.[188] Closed contexts in Germania Secunda are scarce, with only one grave (Nijmegen OO362) with a HF 78a brooch coin-dated after AD 348[189] and there is little to suggest widespread use before the late 4th century. Dates for the supporting-arm brooches with band-shaped feet (types Mahndorf and Perlberg) have similarly shifted towards a later period in recent works.[190] Chronological works on the Issendorf and Liebenau cemeteries have showed that they circulated predominantly in the first half of the 5th century to mid-5th century,[191] a date that is also found in several settlements in Germania Magna.[192]

The supporting-arm brooches with *stabförmigen Bügel* are still mainly dated in the first half of the 5th century in Germania Magna.[193] Heeren and Van der Feijst noted the common occurrence with this brooch type in burial contexts alongside *einfache Gürteln*, leading them to shift its date even further to AD 430-470.[194] Dating of ceramic and glass vessels of burials containing the HF 78c in Germania Secunda supports a broad date of first half of the 5th century to mid-5th century.[195] There is little evidence that supporting-arm brooches were widely worn in the provinces before the start of the 5th century.

Distribution and contexts

Large numbers of supporting-arm brooches were recorded in both Germania Magna (185) and Germania Secunda (101). In Germania Magna, the supporting arm brooches are predominantly found in cemeteries, with few finds from rural settlements,[196] although stray finds from the dwelling mounds in the northern Netherlands and Germany are likely to also have come from settlement contexts. Supporting-arm brooches are less common than simple two-piece Armbrust brooches in Westfalia and the Lippe area and mainly cluster around the frontier zone and the North Sea coast (figures 3.17-3.20).[197]

Supporting-arm brooches in Germania Secunda were recorded in equal numbers in funerary and settlement

[185] Böhme 1974, 52.
[186] Böhme 1974, 52.
[187] Brieske 2010, 103.
[188] Mückenberger 2013, 120; Brieske 2001, 31. Based on e.g., Liebenau grave P10/A1 with a 5th-century belt set; Häßler 1990; Brieske 2001, 31.
[189] Steures 2013, 220-221.
[190] E.g., Böhme 1999, 69; Böhme 1986, 530.
[191] Brieske 2001, 31; Weber 2000, 22. E.g., Liebenau grave 3527; Brieske 2001, 31.
[192] Mückenberger 2013, 121; Aufderhaar 2016, 49.
[193] Mückenberger 2013, 120; Heynowski 2013, 95; cf. Häßler 1994; 2002.
[194] Heeren and Van der Feijst 2017, 203.
[195] Rhenen-Dondersberg grave 842 (late rim development of an Alzei 27 coarse-tempered jar; Wagner and Ypey 2012, 615-621); Rhenen-Dondersberg grave 846 (with a Gellep 331 vessel dated first half 5th century; Wagner and Ypey 2012, 626-630).
[196] The most notable settlement complexes are Elsfleth-Hogenkamp (four supporting-arm brooches; Mückenberger 2013); Feddersen-Wierde (two; Schuster 2006); Kamen-Westick (six; Könemann 2018; Brieske 2010; Elchfeld 2014); Mahlstedt (three; Elchfeld 2014); Sievern (two; Aufderhaar 2016); Wijnaldum-terp Tjistma (two; Zijlstra 1991; Besteman *et al.* 1999).
[197] Cf. Böhme 1998, 441; Böhme 2003, 156.

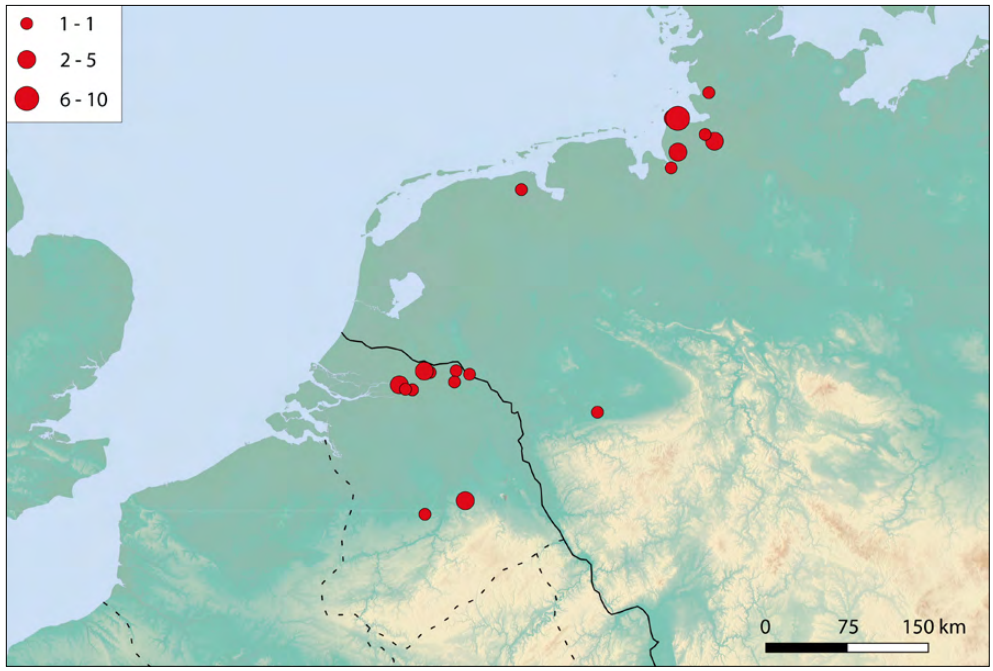


Figure 3.16. Distribution of the supporting-arm brooch A, Niedersächsischen subtype; HF 78a1.

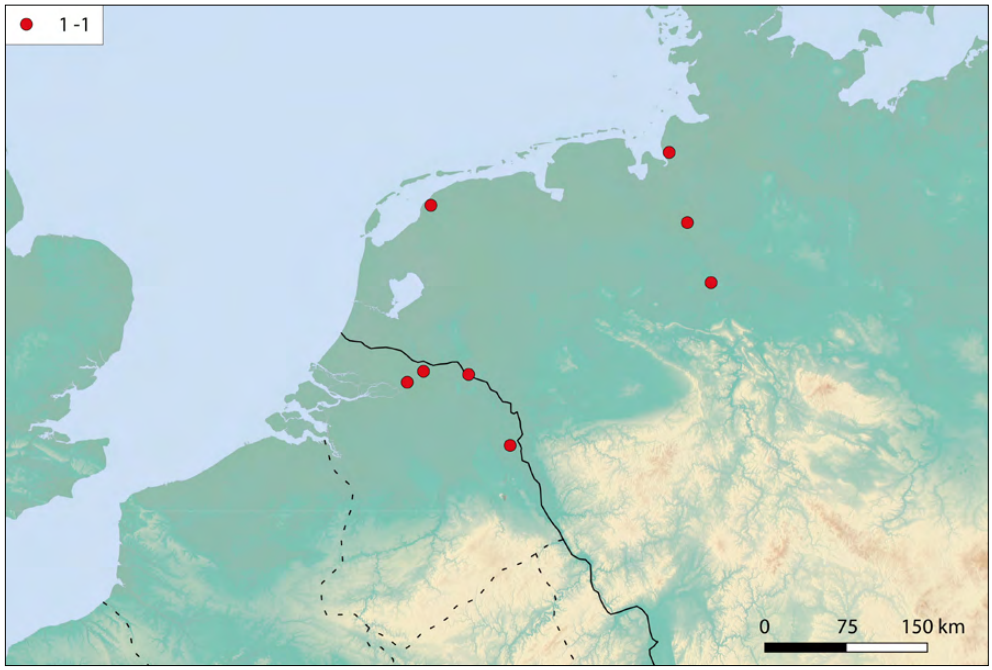


Figure 3.17. Distribution of the supporting-arm brooch A, Gallic subtype; HF 78a2.

contexts, in contrast to almost all other brooch types discussed in this chapter. Seventeen rural settlements (including three villa sites) yielded supporting-arm brooches, three of which may be classified as 'migration-related' settlements (see chapter 2) based on the occurrence of long houses, pottery and sunken huts.[198] Although Böhme suggested a military association for the 78c type (see for more on this below), this type was surprisingly rare in military fortifications or their associated cemeteries.[199] Most of the funerary finds were associated with urban centres.[200] Deposition in

[198] Weeze-Knappheide (Brüggler 2020), Holtum-Noord (Wagner and Van der Ham 2010; Tichelman 2012) and Gennep-Stamelberg (Heidinga and Offenberg 1992; Theuws 2008, Abb. 5; Theuws and Hiddink 1996, figure 61, 62). Of the funerary finds, two were found in cemeteries associated with 'migrant settlements': Valburg-Molenzicht (Van der Feijst and Veldman 2011) and Tiel-Passewaaij (Heeren 2009, table 51; Aarts and Heeren 2011, 171-2).

[199] One was found in the burgus of Wijchen-Tienakker, although it is unclear from the exact find context whether the brooch was found in a context contemporary to the fortification (Heirbaut and Van Enckevort 2011). There are three brooches from Nijmegen, with two antiquarian finds without context and one from an isolated grave in the Hugo de Grootstraat (unpublished). Finally, there are three dredge finds from the Meuse and Waal rivers from areas where Late Roman fortifications are suspected (two from Rossum-Alem and one from Maren-Kessel). One stray HF 78c2 was recorded from the grounds of the fortification at Ortho (Böhme 1974, 294).

[200] Tongeren (Böhme 1974, 301); Nijmegen-OO (Steures 2013).

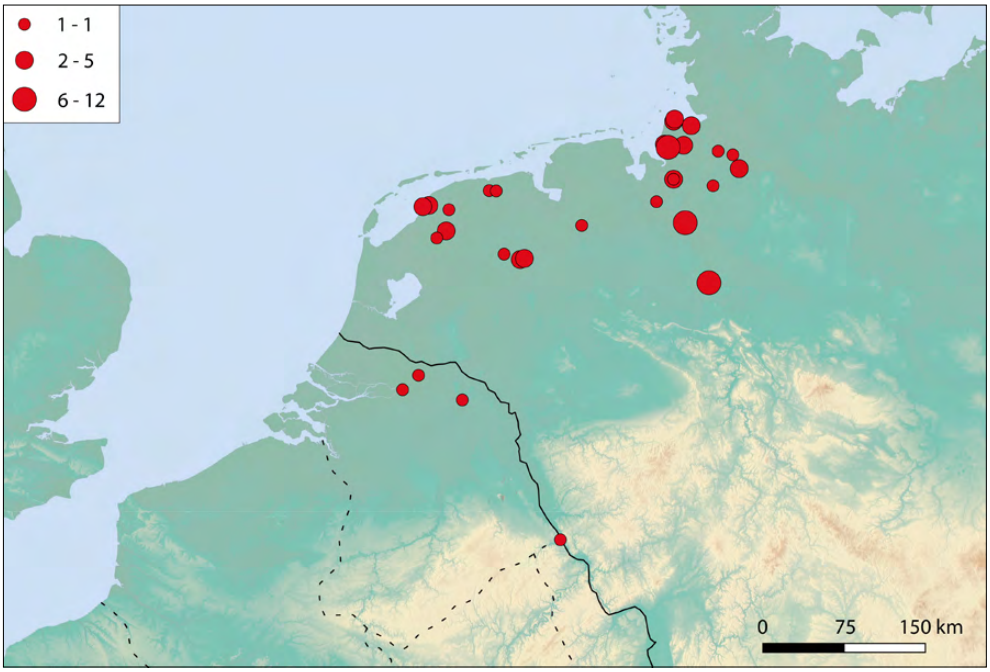


Figure 3.18. Distribution of the supporting-arm brooch B; HF 78b.

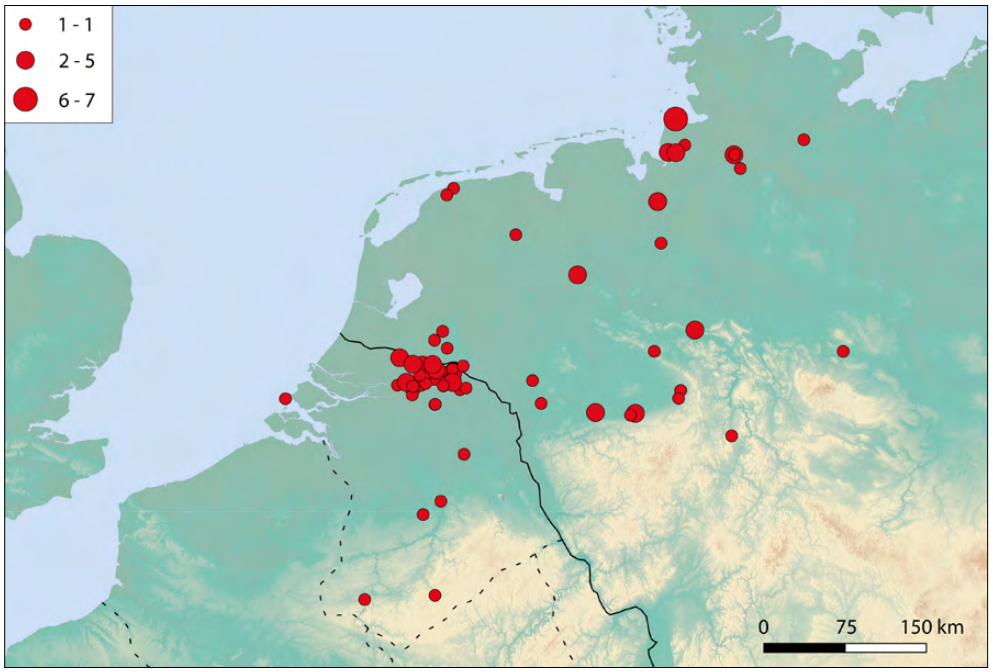


Figure 3.19 Distribution of the supporting-arm brooch C; HF 78c.

graves is a deliberate act, while settlement and stray finds might also represent refuse or lost items. The frequent appearance of the supporting arm brooch in cemeteries in both Germania Magna and Secunda and its general absence from rural settlements suggests that it was potentially more of a high-status brooch than the more common simple two-piece Armbrust brooch. No significant differences in distribution were identified between the four different supporting-arm brooch types (figures 3.16-3.20).

Social connotations

Swift has pointed out that supporting-arm brooches are found widely along the Rhine and Danube frontiers and has suggested that these form a long-term frontier development.[201] Such a narrative closely mirrors the developments of Wijster hairpins and simple two-piece Armbrust brooches (Schulze 35/36) within the Lower Rhine frontier zone and would fit with the provincial-style decoration occasionally found on them.[202] The division in male and female subtypes is largely based on the fact that subtypes HF 78abd are often found in pairs,[203] while the HF 78c is occasionally found in weapon graves, at least west of the Weser.[204] The correlation

[201] Swift 2006, 100; cf. Whittaker 1994, 216.
[202] Böhme 1974, 52.
[203] Heeren and Van der Feijst 2017, 203; see also Böhme 1974, 10-14.
[204] Böhme 1974, 51.

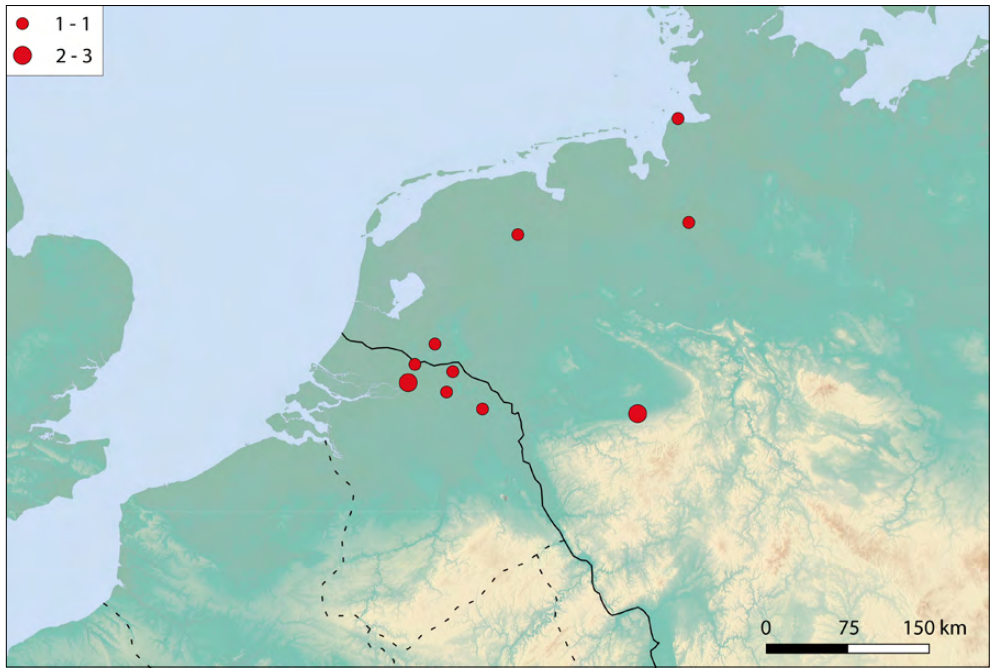


Figure 3.20. Distribution of the supporting-arm brooch D; HF 78d.

between female dress and the HF 78a and 78b types is particularly strong for Germania Magna, where several graves with (matching) sets were found.[205] Several burials from Liebenau confirm the female gendering of the 78a and 78b through skeletal remains.[206] The evidence from Germania Secunda is a little scarcer, but some graves contained HF 78a brooches with other brooches as part of a potential female dress tradition.[207]

The HF 78abd brooches are most often found in graves and relatively often in quite rich graves with several more brooches and other dress accessories. Böhme suggested a workshop origin in northern France for some of the Gallic supporting-arm brooches (HF 78a2),[208] but these were quite rare in the study area: the *Niedersächsischen* type (HF 78a1) circulated more widely within Germania Secunda (figure 3.16). The 'Gallic' subtypes also appear on both sides of the frontier but are generally rarer (figure 3.17). A parallel may be drawn here with the supposedly Germanic tutulus brooch type Issendorf (see above): the distribution of the Gallic types is not clearly restricted to the Empire.

Böhme concluded that type HF 78c could be mostly associated with male dress.[209] They are indeed often found alongside military belt fittings on both sides of the frontier,[210] although there are some

[205] Bremen-Mahndorf grave SN-Kg 23: HF 78b2 with two unclassified saucer brooches (Brieske 2001); Bremen-Mahndorf grave 123,38: unclassified supporting-arm with unclassified saucer brooch (Brieske 2001); Bremen-Mahndorf grave WO-Kg 3527 with a matching set of two 78b1 brooches (Brieske 2001); Flögeln-Vossbarg grave 53: 78c with a plate of saucer or tutulus brooch (Schön 1988a); Flögeln-Vossbarg grave 75: 78a with a plate of a saucer or tutulus brooch (Schön 1988a); Hemmoor-Warstade grave 60: 78a with crossbow brooch and elaborate two-piece Armbrust brooch (Böhme 1974, 235); Hemmoor-Warstade grave 62: 78, Bügelknopf brooch and unclassified buckle (Böhme 1974, 235); Issendorf grave 3527 with a matching set of HF 78b1 supporting-arm brooches (Häßler 1994); Issendorf grave 3546 with a matching set of HF 78b2 supporting-arm brooches (Häßler 1994); Liebenau grave L12/B9 with matching set of HF 78b2 supporting-arm brooches (Häßler 1985); Otterndorf unknown grave with matching set of HF 78 supporting-arm brooches (Schön 1988b); Wehden grave 778: HF 78a with matching set of elaborate tutulus brooches (Böhme 1974, 252); Westerhamm B: HF 78a, matching set of tutulus brooches (Böhme 1974, 254); Zweelo grave 86.25: matching set of HF 78a (Böhme 1974). Westerwanna: grave 110 with a matching set of HF 78a1 brooches (Böhme 1974, 255; Zimmer-Linnfeld 1960, Taf. 14); grave 1990 contained a 78a and a possible saucer brooch (Böhme 1974, 262). Sahlenburg 21 (78a with a simple and elaborate two-piece Armbrust brooch; Böhme 1974, 250), 586/1930 (with a simple two-piece Armbrust brooch; Böhme 1974, 248), 1 (with a simple two-piece Armbrust brooch and remains of a tutulus brooch; Böhme 1974, 249) and 18 (with matching pair of HF 77a2 brooches; Böhme 1974, 249).

[206] Liebenau grave J11/A2 (Häßler 1985, Taf. 76); L12/B9 (Häßler 1985, Taf. 33); N12/A2 Häßler 1990, Taf. 90; Rösing 1994, 241); N12/B4 (Häßler 1990, Taf. 93; Rösing 1994, 241); P10/A2 (Häßler 1990, Taf. 44; Rösing 1994, 236).

[207] Mainly Nijmegen grave OO362: HF 78a2 with an unclassified iron Armbrust brooch and an elaborate tutulus brooch (Steurer 2013); outside the study area we may point to Oudenburg grave 88: HF 78a with an elaborate Armbrust brooch and a matching pair of elaborate tutulus brooches type Oudenburg (Mertens and Van Impe 1971, 113-6).

[208] Böhme 1974, 12.

[209] Böhme 1974, 10. Although he notes some regionality: west of the river Weser, these brooches were predominantly found in burials of individuals identified as men (presumably based on other gendered finds), while east of the river it also occurred in female-gendered graves. The burial of a man (grave 1672) in Issendorf contained a Mahndorf type supporting-arm brooch.

[210] In Germania Magna: Gudendorf-Am Finkenberge grave A (with Sommer 3f buckle and Sommer B strap end; Böhme 1974, 233); Langen grave 59 (with Sommer 1D buckle; Böhme 1974, 239); Westerwanna grave 1091 (with a Sommer 1Ab buckle; Zimmer-Linnfeld 1960, Taf. 134) and one isolated grave in Wiepenkathen with a belt plate (Böhme 1974, 265). In Germania Secunda, an often-cited example from the study area is grave 842 in Rhenen-Dondersberg (Wagner and Ypey 2012, 617), where a HF 78c brooch was found suspended from a military belt (type *Einfache Gürtel*) two additional graves besides Rhenen 842 were found, namely Rhenen 846 (with Sommer 1E buckle, three tubular mounts, Sommer Bc, three triangular suspension mounts and a belt slide; Wagner and Ypey 2011).

Figure 3.21 Wijster type hairpin.

exceptions.[211] There is also incidental evidence for HF 78c brooches being buried alongside women.[212] As more HF 78c brooches were found south of the frontier than north of it, Heeren has suggested this supporting-arm subtype was potentially created within Germania Secunda.[213] The scarcity of HF 78c brooches in military contexts, both in fortifications and associated cemeteries is also curious.[214] Even in Krefeld-Gellep, where the cemetery yielded plenty of evidence for 5th-century (military) activity in belt sets and other finds, no HF 78c brooches were found. The 78a and 78b forms, however, were identified at a number of Late Roman military complexes.[215] The overall spatial distribution of the HF 78c looks remarkably similar to that of the other subtypes.

The elite status of the HF 78c supporting-arm brooch is also expressed by their disproportional deposition in graves compared to contemporary brooches. The overlap between local government, military positions and elite status that existed in the Late Roman West in the 5th century,[216] likely meant that the supporting-arm brooch could deliver a variety of social cues. A more fitting interpretation would be as a high-status brooch that was also worn by military personnel, but not exclusively in the way 4th-century crossbow brooches may have been (see chapter 4). The grave evidence linking the HF 78c to other military accoutrements is also stronger in Germania Magna, potentially signalling that the brooch was seen differently in different parts of the research area. There appears no clear chronological development in the supporting-arm brooches and their distribution to suggest they were dispersed from Germania Magna to the south. The different forms of supporting-arm brooch all seem to have developed simultaneously on both sides of the frontier.

Pins with mushroom-shaped heads (Wijster/Muids and Tongeren)

Of the three types of mushroom-headed hairpins, only the Wijster pin was found in any significant numbers. It is characterised by a mushroom-shaped head and elaborate decoration similar to the pattern found on the Fécamp pin (ribbing and bands of prismatic faceting; figure 3.21). Wijster pins also occasionally feature grooves on the top of the head, which Böhme identified specifically as a regional style for the Meuse and Lower Rhine area.[217] Muids hairpins are identical to Wijster pins in shape, but feature much more elaborate decorative styles with ribbing, grooves and geometric *Kerbschnitt*. The Tongeren pins feature the same ribbing along the shaft, but also feature conical knobs along the upper shaft,[218] a feature also found on some hairpins from the Lower Rhine in earlier periods.[219] In total, five Muids pins and 14 Tongeren pins were identified compared to 163 Wijster pins, so the focus of this section will be on the latter.

Chronology

Although originally dated to the first half of the 5th century (slightly later than the Fécamp type),[220] later publications suggest that Wijster hairpins were in use from the last quarter of the 4th century to second third of the 5th (AD 390-470).[221] From the available dated contexts in the study area, there is no indication that the Wijster pins appear earlier in Germania Magna than on Roman soil. In Germania Magna, they are consistently found alongside 5th-century brooch types[222] or material that may date to both the 4th and 5th centuries.[223] Closed contexts within Germania Secunda have yielded

[211] Such as grave 211 in Wijster, where one HF 78c brooch was found alongside a Wijster hairpin (Böhme 1974, Taf. 72.1-2).
[212] Issendorf grave 3831 (Häßler 2001, Taf. 47).
[213] Heeren 2017, 171.
[214] The one exception to this is a HF 78c2 supporting-arm brooch from the fortification grounds at Ortho, although it is a stray find (Böhme 1974, 294, Taf. 93.14.).
[215] Haus Bürgel (Elchfeld 2014); Remagen-Auxiliarkastell (Friedrich 2010); Virton-Chateau Renauld (Cahen-Delhaye and Massart 2021).
[216] Van Thienen 2017, 101.
[217] Böhme 1974, 35. Although a fair number of Wijster pins appear to have had plain heads, mushroom-shaped heads decorated with three or four grooves meeting in the centre of the head were the most popular form in the study area, with most of these appearing in the river area.
[218] Cf. Heynowski 2017b, type 6.8.3. Similar in fact, to Middle Roman hair needles documented in northern Germany as part of a group of hairpins with plastic elements (Jung 2012).
[219] Jung 2012.
[220] Böhme 1974, 39.
[221] Böhme 1987, 772, *Abb*. 40; see also Werner 1990 in Könemann 2015, 211 based on the close stylistic similarities with the Fécamp pin.
[222] Bad Lippspringe grave 1 (pair of composite saucer brooches type Lippspringe and a simple two-piece Armbrust brooch with hammered open foot; Böhme 1974, 221); Wijster 211 (supporting arm brooch HF 78a1; Böhme 1974, 274).
[223] Grave 25 in Dortmund-Asseln contained a Wijster pin with two simple two-piece Armbrust brooches and grave 10 with an imported Chenet 342/Gellep 273 footbowl (Könemann 2015, 222. Wijster grave 211 combined a Wijster pin with a 5th-century supporting-arm brooch *mit stabformigem Bügel* (HF 78c1; Böhme 1974, Taf. 72.1-5). Kaarst grave 14 (Siegmund 1998b). In the rural settlement Castricum-Oosterbuurt, a Wijster pin with a Fécamp pin and several silver tutulus brooches were found in association with contexts dating from 330 onwards. The excavators note however that they were found mostly in recently disturbed parts of the site or in the top soil, leading to the suggestion that these finds may have been brought to the site in the early medieval period for reworking (Hagers and Sier 1999, 31).

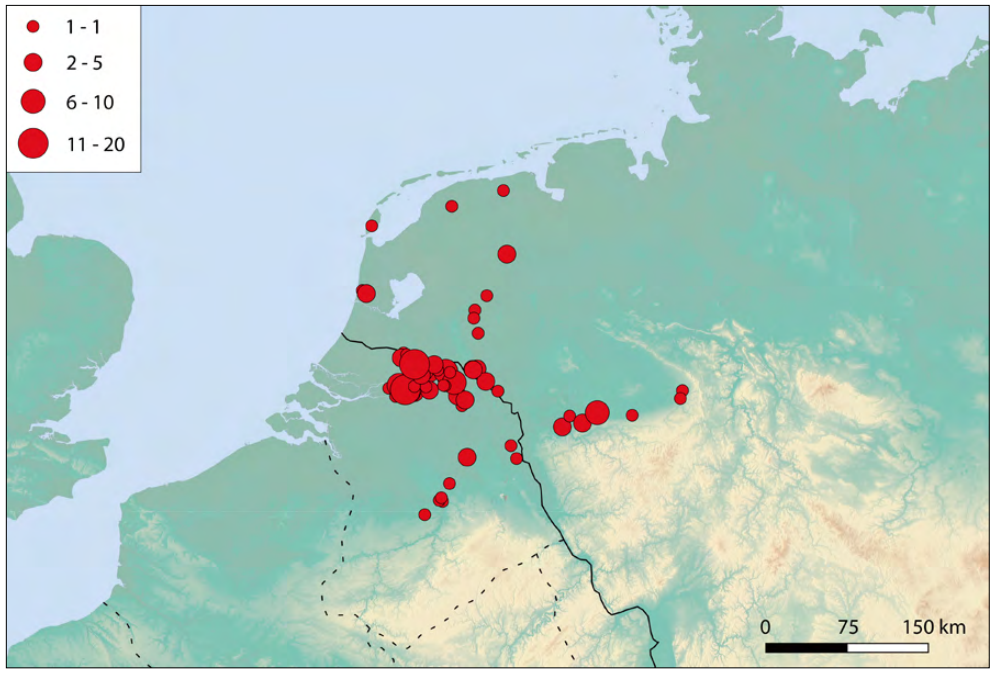


Figure 3.22. Distribution of Muids and Wijster type hairpins.

similar results[224] and the Wijster hairpin seems to have circulated well into the 5th century on both sides of the frontier.[225]

Distribution and contexts

Wijster pins are found widely across western Germany, Belgium, the Netherlands and northern France, but concentrate in large numbers around the *limes*. In total, 133 Wijster hairpins were found in Germania Secunda, the vast majority from the Dutch central river area (figure 3.22). Almost half are stray finds recorded in the PAN database, but Böhme already noted the large number of Wijster pins from the river area.[226] Combined with the variety of decorative schemes found there, he suggested that they may have been produced there.[227]

In Germania Magna, 30 Wijster pins have been found, mostly in settlement contexts. By far the most come from Kamen-Westick.[228] The lack of Wijster pins from the Dutch and German coastal area is noteworthy, as the cemeteries and dwelling mount settlements there yielded large numbers of contemporary Late Roman brooches. This suggests that the Wijster hairpin may not have been a standard part of the dress traditions throughout Germania Magna but might have been a more regional phenomenon. Besides Kamen-Westick, they are common between the Rhine and Meuse, east of the Rhine and between the Ruhr and Lippe.[229] Within Germania Secunda, stray finds from the river area also dominate, although some were found on settlement sites[230] or in cemeteries.[231] The Wijster hairpin is also much more common than the older Fécamp type, possibly suggesting that this type of dress accessory or the fashion it represents increased in popularity after the 4th century. A direct link to Germanic migration-related settlements can in some cases be made,[232] but they are equally common in provincial-Roman contexts.[233]

Social connotations and production

The distribution of Wijster hairpins supports Böhme's notion that this hairpin type was worn and produced locally in the river area and Westfalen,[234] although

[224] 5th-century grave contexts: Rhenen-Dondersberg 825 (matching pair of HF 72 brooches; Wagner and Ypey 2011); Nijmegen B465 contained a 5th-century Vermand hairpin, a composite saucer brooch HF 77a1, as well as numerous samian and glass ware vessels dating IV-Va, among specifically a Late Roman terra nigra footbowl dated 390-470 and a Pirling 236 glass bow dated 390-470; Steures 2013, 651; Böhme 1974, 85); Krefeld-Gellep grave 2420 with a composite saucer brooch (Pirling 1979, Taf. 16). In settlements, Wijster pins tend to appear alongside material that could not be dated closer than 4th and 5th (Ewijk-Keizershoeve, Nijmegen-Lentseschoolstraat).

[225] Cf. Nieveler and Siegmund (1999, 9) Rheinland Phase 2. Wijster hairpins are also occasionally found in early medieval funerary contexts (Wijchen-Centrum graves 5, 34 and 156; all dated to the 6th or early 7th century; Heeren and Hazenberg 2011, 70), but these are likely heirlooms.

[226] Böhme 1974, 38.

[227] Böhme 1974, 38.

[228] Seven pins (Könemann 2018; Böhme 1974) while most settlements sites have yielded one or two Wijster pins. It could be said, however, that the metal assemblage from Kamen-Westick is a-typical, given the large amount of imported (scrap) metal found there (Könemann 2018).

[229] Könemann 2015, 211.

[230] Asselt (Böhme 1974, 284), Neerharen-Rekem (De Boe 1986).

[231] Borgharen-Daalderstraat (Van de Graaf and Loonen 2013); Tongeren (Vanvinckenroye 1984; Vanvinckenroye 1995ab).

[232] Wijster hairpins were found in Cuijk-De Nielt (Habermehl and Van Renswoude 2017), Neerharen-Rekem (De Boe 1986), Gennep-Stamelberg (Heidinga and Offenberg 1992) and the cemetery in Rhenen-Dondersberg (Wagner and Ypey 2011).

[233] Ewijk-Keizershoeve (Blom *et al.* 2012; Van der Feijst and Kemmers 2013) and the various unpublished excavations around Nijmegen.

[234] Böhme 1974, 38. Countering the notion of limes-based production, a possible casting mould Wijster style hairpins dating to the Late

the style of dress it represents had its origins north of the frontier. As the 5th-century Wijster pin is closely typologically related to the mainly 4th-century Fécamp type in form, function and decorative scheme, this might represent an increasing popularity of a 'Germanic' style dress fashion in the Roman provinces rather than a direct causal link between the appearance of these hairpins and Germanic migration.[235]

The Fécamp and Wijster pins appear to show the same social processes of adoption, imitation and adaptation as the footless brooch with high catch-plate and the subsequent simple and elaborate two-piece Armbrust brooches. A 4th-century object style from Germania Magna, in this case the Fécamp pin, was introduced in small numbers in the Roman provinces over the course of the 4th century. In the late 4th and early 5th century, the form, style and in the case of the hairpin function of this foreign material culture became increasingly popular in Germania Secunda, resulting in an increase in form and style variety (the Wijster, Cortrat and Vermand types).

Discussion

In this chapter, a chronological overview is presented of how and when Germanic style dress accessories appeared in the study region. Often, the occurrence of these objects has been linked to north-south migration of Germanic communities into the Empire, specifically in the last quarter of the 3rd century[236] and the turn of the 5th century.[237]

Decorative schemes

The decorative schemes found on the civilian, and typically female-gendered, dress accessories discussed above are embedded in the wider visual language of Late Roman material culture. The three most common forms of decoration (see Plate 1 for a selection of decorated brooches) are faceted edges with horizontal grooves and perpendicular notches,[238] dotted or concentric circles[239] and prismatic zones interspersed with ribbing,[240] which can all be commonly found in other spheres of material culture.[241] This shared visual language also includes provincial-Roman patterns, including niello, found on a range of brooches (supporting-arm, tutulus and elaborate Armbrust.[242] This shared technological and decorative repertoire suggests a certain level of *Mischkultur* that transcended the frontier.[243] The main aim of this chapter was to analyse whether a direct personal link between Germanic style dress accessories and ethnic/regional identities could be adequately shown and whether migration on its own is the best narrative to explain the archaeological record. The main developments in style and decoration will be recapped, as well as depositional patterns of different object types and evidence for adoption, adaptation and copying of material culture styles over time.

Depositional patterns

Before comparing the distribution patterns of the find categories discussed above, some critical evaluation of how to interpret distribution maps needs to be done. Robbins outlined a list of biases that occur in collecting material, including identification bias by metal detectorists, site targeting bias and the effects on preservation of the physical landscape.[244] In addition, we may also suggest different types of heritage legislation, as the study area spans several different national and regional jurisdictions for how archaeological material is excavated, stored and published.

Only objects were included that could be typologically identified with relative certainty even when incomplete (see discussion in chapter 3), alleviating some of the identification bias as outlined by Beck and Jones.[245] Combined with the focus on dress accessories, which tend to receive more attention by metal detectorists and finds specialists writing site reports alike, this also assures at least a broadly comparable recovery or collection bias for all objects covered in this thesis.[246]

These biases need to be taken into consideration when comparing the distribution of different types of objects and when comparing the occurrence of specific objects in different parts of the study area. To achieve

Roman period was reported from Bathmen (Groenewoudt and Lubberding 1996), but closer inspection showed that this mould lacks the characteristic prismatic zones with ribbing of the Wijster hairpin.

[235] Association with female burials is attested by Nijmegen grave B465 (Steures 2013, 110-115) and Dortmund-Asseln grave 25 (Könemann 2015, 249-250); grave 10 from that cemetery yielded a Wijster pin from a male-identified burial, however.

[236] Erdrich 2003.

[237] Heeren and Van der Feijst 2017, table 7.4.

[238] This scheme permeated throughout Late Roman material culture. Not only was it the most common decorative scheme for the simple and elaborate Armbrust brooches, it was also found on a number of supporting-arm brooches, *Bügelknopf* brooches and tweezers. It was also a common appearance on military belt fittings, including buckles, belt stiffeners, belt slides, terminal fittings, suspension mounts and belt plates (see chapter 4).

[239] Which occur frequently on elaborate Armbrust brooches with trapezoidal foot and supporting-arm brooches with trapezoidal foot. These patterns are also common on a variety of belt fittings and bone objects (combs, needle tubes).

[240] Slightly rarer are the ribbing and prismatic zones that are so typical for Wijster, Tongeren and Fécamp hairpins. This combination was also observed on a number of tubular mounts and is a common occurrence on oracle sticks.

[241] Although animal styles, so common on military belt buckles, are absent.

[242] This was seen by him as indicative of provincial-Roman production or at least stylistic influence (Böhme 1974, 52).

[243] Cf. Theuws and Hiddink 1996; Böhme 1996, 93.

[244] Robbins 2012.

[245] Beck and Jones 1989, 244.

[246] Cf. Bevan 2012, 494.

	Armbrust brooch	Other brooch types				
	footless	simple	elaborate	supporting-arm	tutulus	Total
Germania Magna						
cemetery	8,33	61,83	71,67	63,78	82,58	586
context unknown	1,01	1,17	1,67		0,65	11
hoard	29,55	0,47				119
settlement	12,88	31,15	21,67	13,51	12,26	241
stray find	48,23	5,39	5	22,7	4,52	266
Total	396	427	60	185	155	1223
Germania Secunda						
cemetery	4,35	11,32	14,71	9,9	53,57	88
context unknown		9,22	8,82	1,98		48
military fortification	4,35	4,4	11,76	6,93		36
ritual deposition				1,98		2
settlement	38,04	27,04	38,24	18,81	39,29	207
stray find	50	47,17	26,47	58,42	7,14	342
villa	3,26	0,84		1,98		9
Total	92	477	34	101	28	732
Grand total	488	904	94	286	183	1955

Table 3.6. Find contexts of brooches in Germania Magna and Germania Secunda (expressed as percentages per type group).

as comprehensive a view as possible, a combination of PAN data and finds from excavation reports were used.[247] Finds from all types of contexts were also surveyed (including surface, settlement, burial, ritual deposition), meaning a range of ways in which material culture may have ended up in the ground (loss, deliberate deposition, refuse) are included in the dataset.

Different types of national or regional legislation around archaeological heritage mostly impacted the distribution of finds from private collections, as these are not always systematically registered and published in the same way in all subregions of the study area. Landscape and preservation are also important contributing factors, with the wet, clay soils of the river area and North Sea coast being well-known for their excellent preservation of metal finds and the acidic sandy soils elsewhere infamous for often poor preservation of metal finds.[248] This also feeds into site-targeting bias, as areas known for their rich and well-preserved surface finds tend to be favoured by metal detectorists.[249] In the specific case of PAN for the Netherlands, a large amount of material used for this dissertation comes from the eastern river area. This area has good soil conditions for the preservation of metals and is currently in agricultural use, increasing the number of surface finds.[250]

But this overrepresentation of the river area already existed on distributions maps drawn up before the PAN scheme began.[251] Conversely, only 142 belt fittings or buckles of Late Roman military belts (and 43 crossbow brooches) were found in the PAN database, compared to 538 civilian-associated brooches and hairpins. This shows that stray finds do not always simply reflect patterns already known from excavated data, but form a uniquely composed dataset that can make a significant contribution to understanding how distribution of finds relate to modern and past practices.

Some differences in depositional practices were observed between Germania Secunda and Germania Magna (table 3.6-3.7; colour-coded for intensity on a green-red scale. A discussion of find contexts needs two caveats. First is the overrepresentation of stray finds in the Dutch river area due to the large number of stray finds reported there as part of the PAN initiative. Secondly, the number of differentiated site types in Germania Secunda is higher than in Germania Magna (no villas, urban centres or military fortifications).

The overrepresentation of tutulus brooches in funerary contexts is likely a taphonomical pattern rather than deliberate practice: the composite and delicate construction of this brooch means its best chances of survival are in burial contexts and in settlement contexts or as stray finds they are likely to be confused with saucer brooches. The same does not apply the supporting-arm brooches, which are

[247] Cf. Vos *et al.* 2018, 14.
[248] Heeren and Van der Feijst 2017, 367-368; the use of sods to improve soil conditions in the Middle Ages also impacts finds density; Heeren and Van der Feijst 2017, 366.
[249] Cf. Robbins 2012.
[250] Heeren and Van der Feijst 2017, 366.
[251] Such as Böhme 1974, Karte 9 of Wijster hairpins.

Site types	unclassified	Cortrat	Fécamp	Muids	Tongeren	Vermand	Wijster	Total
Germania Magna								
cemetery	5,88		15,38				13,33	11
context unknown			7,69				6,67	5
settlement	88,24	50	74,36				70	66
stray find	5,88	50	2,56				10	6
Total	17	2	39				30	88
Germania Secunda								
cemetery	16,67	28,57	6,15		35,71	50	6,67	22
context unknown		28,57	6,15				1,5	8
military fortification			3,08				0,75	3
ritual deposition			3,08				0	2
settlement	16,67	14,29	12,31	20			30,83	52
city							3,01	4
stray find	50	28,57	67,69	80	50	50	54,89	134
villa	16,67	0	1,54		14,29		2,26	7
Total	6	7	65	5	14	2	133	232
Grand total	23	9	104	5	14	2	163	320

Table 3.7. Find contexts of hairpins in Germania Magna and Germania Secunda (expressed as percentages per type group).

also overrepresented in cemeteries, although only in Germania Magna. In Germania Secunda, the stray finds from the river area, which we might tentatively interpret as rural settlement finds dominate.[252]

If we interpret stray finds as rural finds, then more than half of all Armbrust brooches in Germania Magna and more than two-thirds of all Armbrust brooches in Germania Secunda were found in rural settlement complexes. As such, they present very different site type profiles compared to the tutulus and supporting-arm brooches, suggesting different values were attached to them (with Armbrust brooches more likely to be found in household refuse or as accidental losses versus the deliberate deposition in burials of tutulus and supporting-arm brooches). The same pattern is true for the hairpins (table 3.7). Both the earlier Fécamp and later Wijster hairpins were predominantly found in settlement contexts (or as stray finds) on both sides of the frontier. It is possible, however, that a small number of sites is skewing these data somewhat: whereas Germanic-style hairpins were typically deposited without any other hairpins in a single grave,[253] several settlements in Germania Magna yielded large numbers of hairpins (often ten or more).[254] It was more common in Germania Secunda to find small numbers of Germanic-style hairpins per site, but there the number of settlements was higher.

An association was made between the potential high status of or restricted access to an object type and the likelihood to find it in a funerary context (see above). The high status of the supporting-arm brooch in Germania Magna is underscored by the relative frequency with which they are found in graves accompanied by military insignia (belt fittings).[255] The same was found for a number of other high-status dress accessories, namely hairpins[256] and tutulus brooches.[257] In Germania Secunda, it was found only once with a Wijster hairpin, although in that case the military buckle pre-dates the female-gendered items by at least half a century, potentially suggesting it was an heirloom.[258] In almost all cases, these high-status civilian dress accessories were found with one or two non-functional, decorative belt elements, like strap ends, belt stiffeners or suspension mounts, a *pars pro toto* approach that will be discussed in more detail in chapter 4. The dichotomy in grave goods between objects with a military connotation and those that are associated with women is much more pronounced in Germania Secunda, while in Germania

[252] Cf. Nicolay 2007, 76.
[253] Böhme 1974, 37.
[254] Castrop-Rauxel (Pape and Speckmann 2011; Böhme 1974, 228-9); Wijk bij Duurstede-De Geer (Heeren and Botman 2021, 209-210); Feddersen Wierde (Schuster 2006, Taf. 15); Kamen-Westick (Könemann 2018; Böhme 1974, 264).
[255] Bremen-Mahndorf grave 119: a 78a2 supporting-arm brooch with a Sommer Bc strap end (Böhme 1974; Sommer 1984). Langen A: square suspension mount with HF 78a brooch (Böhme 1974, 238). Liebenau P10/A1: HF 78b1 with 2 round suspension mounts, buckle 3f and strip fitting as well as two saucer brooches (Häßler 1990). Liebenau: P10/A2: HF 78b1 with 2 belt loops and HF 78a (Häßler 1990). Westerwanna 1575: HF 78a1 with belt plate (Böhme 1974, 261). Zweelo grave 86: HF 78a with rectangular suspension mount (Böhme 1974). Liebenau: L12/B9: matching set of HF 78b2 with suspension mount (Brieske 2001).
[256] Westerwanna 498: Fécamp pin with tubular mount (Böhme 1974, 257). Westerwanna 733: unclassified hairpin with tubular mount (Böhme 1974, 258).
[257] Langen 19: tutulus brooches with tubular mount with plate (Böhme 1974, 238).
[258] Nijmegen-Nieuwstraat grave 46: Wijster hairpin, Sommer 1Aa buckle, two simple two-piece Armbrust brooches (Böhme 1974, 285).

Magna these labels appear to have been more fluid in the Late Roman period.

Chronological overview

The first appearance of Germanic-style dress accessories on Roman soil was traced back to the late 3rd century, although in some sense this is an arbitrary and artificial line to draw. Germanic brooches like the one-piece Germanic wire or knee brooch and the two-piece Germanic knee brooch[259] appear in small numbers in the Roman provinces continually from the 1st-3rd centuries. In that context, the appearance of tutulus and Armbrust brooches in Germania Secunda is part of a continuous ebb and flow of peoples and material culture moving across the frontier, in both directions.[260] Relatively low levels of material culture in Germanic styles seem to be entering the Roman provinces over the course of the 4th century (increasing in intensity in the second half of the 4th century), simultaneously with similar developments in the rural settlement landscape (see chapter 2).

In the late 3rd and 4th century, the appearance of footless brooches with high catch-plate and of Fécamp hairpins is a relatively rare phenomenon, and both objects tend to be found more commonly outside of the Empire than within. In the case of the footless brooches, these also date earlier in Germania Magna than in Germania Secunda. The footless brooches also displayed more variation in style in Germania Magna. Combined with their relative rarity in the provinces this makes it more likely that these brooches (and hairpins) were imports or brought into the Empire by migration. In this early period, not many finds make their way south and the distribution of finds is very wide, suggestive of a slow trickle of finds finding their way into the Empire. The scarcity of objects and the relatively common use of silver and gilding suggests that these were expensive, high-status imports.

Over the course of the 4th century, the way Germanic-style dress accessories are treated in Germania Secunda changed. Variations of the tutulus brooch developed in in this period that were both recognisably part of the same brooch style, but regionally restricted to either Germania Magna or Secunda, showing a certain level of regionalisation. At the same time, dress accessories became more uniform across the study area in the Late Roman period.[261] The simple-two piece Armbrust brooch, for example, originated in Eastern Europe and Scandinavia, but became common on both sides of the frontier in the study area in the 4th and 5th centuries. The sheer number of finds of these brooches from the immediate frontier zone indicates that these were widely worn by the local provincial-Roman population and potentially also produced there. Some regional preferences exist (cast vs. hammered feet for instance), but generally the Schulze 35/36 types with faceting decoration on the feet and occasionally bow dominate the find spectrum in the entire research area, with no particular bias for any subtype in any subregion. With the Germanic origin of the Armbrust brooch tradition and the provincial-Roman stylings of the decoration, the simple two-piece Armbrust brooch is really a hybrid form of material culture.

In the very late 4th and 5th centuries, this simultaneous pattern of a 'pan-Germano-Roman' visual style and increased regionality continues. The large number of Wijster hairpins recorded in the Lower Rhine area and the diversity of decorative styles identified there again suggest local production[262] or at least that the pin was a well-recognised element in the (female) dress tradition. Despite its relative ubiquity in the river area compared to other hairpin types, the Wijster hairpin may still be classified as a relatively rare object category, certainly when compared to contemporary brooches. The introduction of another relatively rare object category in this period, the supporting-arm brooch, follows many of the same processes. In decoration it fits in well with other types of Late Roman material culture. Although supporting-arm brooches were found in significant numbers on both sides of the frontier, some subtypes were more common in Germania Magna and some more in the provinces, in much the same way as the 5th-century tutulus brooches.

Above, the point about the commonness of the simple two-piece Armbrust brooch was repeatedly made to contrast with the more high-status Wijster hairpins and supporting-arm brooches. The Armbrust brooches, although they continued to circulate in the 5th century, were really part of a brooch tradition rooted in earlier periods, while the rarer and more elaborate Wijster hairpins and supporting-arm brooches were 5th-century introductions. The introduction of more restricted, high-status dress accessories in the Lower Rhine frontier zone signifies societal changes and the potential emergence of an elite dress sense.

Böhme suggested that brooches and hairpins in the Late Roman period showed a clear chronological distinction of older forms in Germania Magna and younger forms in Gaul.[263] This is supported by the material covered in this chapter, to a certain extent. No clear chronological differences were found between the two areas for the Fécamp and Wijster hairpins, which appear to have broadly originated in the frontier

[259] Heeren and Van der Feijst 2017, figure 4.87 and 4.121.
[260] Cf. Galestin 2010.
[261] Cf. Theuws and Hiddink 1996.
[262] Böhme 1974, 38. figure 13.
[263] Böhme 2009, 439-440.

area. Similarly, the development of supporting-arm brooches does not appear to have started in Germania Magna, but rather around the frontier zones.[264] Footless brooches with high catch-plates, simple and elaborate Armbrust brooches and tutulus brooches do fit in this narrative, however. Typologically related members of the footless and Armbrust brooch families circulated in Germania Magna well before the start of the Late Roman period, although it should be added that the area of Germania Magna that was studied already showed a more limited range of brooch types than areas further north and east. The earliest tutulus brooch forms likely developed from the Germanic box brooches,[265] but again related styles began to develop south of the frontier soon after. The widespread distribution of simple two-piece Armbrust brooches in Germania Secunda and the frontier zone also suggests that this brooch style developed there.

Adoption, adaption and acculturation

Germanic-style brooches had always managed to make their way into the Empire (one-piece Germanic wire or knee brooch; the two-piece Germanic knee brooch), but often in small numbers. The Late Roman evidence presented above indicates that a shift happened in the way these object styles were dispersed. The early introductions of small numbers of footless brooches with high catch-plate and Fécamp hairpins were followed by an influx of Germanic-style Armbrust brooches and Wijster hairpins on both sides of the frontier, forming a largely cohesive, occasionally regionally specific Germano-Roman material culture in the 4th and 5th centuries that appeared to have its focal point in the frontier zone rather than on the edges of the study area. Rather than a unidirectional movement of ideas or goods, these brooches and hairpins draw a picture of complex cross-border interactions. This applies specifically to the simple two-piece Armbrust brooches and tutulus brooches discussed in this chapter, countering previous work that linked these brooches predominantly to Germanic and female identities.

The linguistic concept of creolisation has been successfully applied to the archaeology of the Roman Empire.[266] It fits well with the observation of several brooch types that share stylistic and technological roots and characteristics with both Roman and Germanic material culture. It has been noted that several of the objects discussed in this chapter featured decorative styles rooted in provincial-Roman origins, such as the decorations on some of the elaborate Armbrust brooches[267] and the niello inlay on supporting-arm and tutulus brooches.[268] Böhme already interpreted much of this process not just as the import of Germanic-style material through trade or migration, but as the creation of a new style or *Mischzivilisation* which incorporated both Germanic and Roman aspects of material culture.

With this in mind, a purely ethnic interpretation of all of these objects is difficult to maintain. By sharing characteristics of both provincial-Roman and Germanic styles, many of the object categories discussed in this chapter may be better classified as 'culturally hybrid artefacts'[269] or expressions of 'cultural bricolage'.[270] This is especially true for those artefacts appearing in the second half of the 4th and the first half of the 5th century, as earlier object types seem to have been less hybrid in style and more closely derived from or aligned to Germanic artefact styles. These subtle differences in social and cultural connotations also inform the comparative chemical analysis of Late Roman copper-alloy dress accessories presented in chapters 6 and 7. The analysis of typologically similar objects from Germania Secunda and Magna may highlight subtle differences in metal use in different areas and for different object types.

This process of cultural hybridity fits with modern notions of cultural change in the Roman Empire, specifically the debate surrounding Romanisation, creolisation and globalisation and glocalisation. Millet reframed the Romanisation paradigm as a two-way acculturation process highlighting the role of local groups or even individuals.[271] Crucially in this comparison, is the understanding that by adopting aspects of Roman culture in the immediate post-conquest era, local frontier communities did not become ethnically Roman in the process[272] and nor did the inhabitants of Germania Secunda 'become Germanic'. Some objects described in this chapter are quite regionalised, such as Wijster hairpins and simple two-piece Armbrust brooches with were found in large numbers in the immediate frontier zone but much less so further to the south. At the same time, tutulus brooches were quite rare, while they are more common in northern France.[273] This places the province of Germania Secunda in a globalising space where large areas of the Roman West and its bordering lands started sharing similar material culture styles, while also maintaining regional differences.

Both the concepts of globalisation and glocalisation as discussed in chapter 2 seem to fit the material evidence in this chapter well. The increased similarities in style of

[264] Cf. Swift 2006, 100; Whittaker 1994, 216.
[265] Böhme 1974, 19; Heeren and Van der Feijst 2017, 197; contra Halsall 2009.
[266] Webster 2001.
[267] Böhme 1974, 10; Böhme 2007, 8.
[268] Werner 1962, 153; Böhme 1974, 52.
[269] Burke 2009, 13-14.
[270] Terrenato 1998.
[271] Millet 1990; cf. Carr 2003.
[272] Cf. Woolf 1998 on 'becoming Roman'.
[273] Böhme 1974, Karte 6.

and taste in dress accessories across the study area from the 4th century onwards, especially in the Armbrust brooch family, hints at an increased connectivity and connectedness between the Roman Empire and its neighbours.[274] Whereas the earlier footless brooches with high catch-plate may have been specifically worn by particular social groups,[275] the later simple two-piece Armbrust brooches are so numerous across so many different contexts and so stylistically uniform that is seems unlikely that they were worn to express or formulate a particular personal or group identity.

Rather, they seem to represent a much wider shared taste in brooch style, with members of the Armbrust brooch family being worn widely across northern Europe. The specific subtypes found within the study area form a regional subgroup within this wider geographic framework, which is regionally unique but shows ties with other regions. Similarly, tutulus brooches and supporting-arm brooches are found widely between northern Germany and northern France, but specific types occur only in specific areas, reflective of a regional or local adaptation of a much more widely shared material culture style, which fits well within Pitt and Versluys' definition as '*homogenising elements of global culture [...] are differentially incorporated into local cultures, which are in turn altered in the process*'.[276]

The dispersion of such Germanic-style hybrid and glocalised dress accessories in the Late Roman West therefore cannot be taken purely as a dispersal of people from Germania Magna. The increased mobility of people in the Late Roman period[277] certainly played a key role in spreading artefact styles across the Lower Rhine frontier and its bordering regions and the northern origin of these object styles is not doubted. However, the inclusion of provincial-Roman decorative schemes and the increased uniformity of material on both sides of the frontier suggests that the Lower Rhine frontier was also facilitating a unification of material culture in Germania Magna and the border province of Germania Secunda (cf. chapter 2 on the settlement evidence).

[274] Cf. isotopic evidence discussed in chapter 1 also suggesting cross-border mobility increased in the Late Roman period (Kootker and Heeren 2022; Kootker *et al.* 2022).
[275] See Erdrich 2003.
[276] Pitts and Versluys 2015b, 14.
[277] Kootker *et al.* 2022.

Chapter 4
Spatial and chronological distribution of male/military dress accessories

The main aim of this chapter is to provide a similar study of Late Roman military dress accessories in Germania Secunda and Magna as was presented on civilian and Germanic dress accessories in chapter 3. By focusing on stylistic developments, distribution, and revised dating, this may inform us on the transition in frontier defences between the 4th and 5th centuries, the organisation of *foederati* and the various social connotations and understandings attached to the Late Roman military-associated belt (including their potential adoption by the civilian population). These data are furthermore useful in informing the comparative variables used in the chapters on pXRF. The focus here will be on military belt fittings, but a brief section is also devoted to crossbow brooches.

The second half of the 20th century saw the publication of several large and extensive regional and typological studies of Late Roman military belts.[1] Many more finds have been published since then, especially from sites in the *limes* region. Several important cemetery sites[2] on both sides of the frontier published after these main works give us the opportunity to look more closely at the circulation dates of this material for the province of Germania Secunda specifically and the areas of Germania Magna directly bordering it.[3] The influx of finds from rural settlements in the last 20 years as a result of development-led archaeology also provides an opportunity to move away from funerary evidence and talk in more broader terms about the distribution of these finds.

The potential regionality of Late Roman military dress accessories was already highlighted in Sommer's work and later re-emphasised by Swift.[4] Böhme proposed the existence of provincial styles of *Kerbschnitt*-decorated belts, with particular decorative schemes and construction styles being restricted to either the Rhine or Danube provinces,[5] a thesis further developed in later works.[6] This chapter focuses on the military belt accoutrement found within the administrative unit of Germania Secunda only, so the diversity in styles and typology may be analysed in more detail, including the large number of belt fittings that were not decorated with *Kerbschnitt*. Most typo-chronologies for belts provide dating schemes based on material from across the Empire, which given the degree of regionality may be refined more precisely for Germania Secunda.

Furthermore, both Böhme and Sommer relied heavily for their relative and absolute chronologies on graves dated either by coin finds or by crossbow brooches.[7] Coins from closed contexts can at best offer a *terminus post quem* for deposition.[8] Dating evidence from glass and ceramic tableware can also be added, and, in this chapter, these finds will be included in the discussions on chronology as much as possible. These types of clear regional and chronological distinctions are an important tool in ensuring as many well-defined variables as possible are available by which the pXRF data (chapters 6 and 7) can be divided and contrasted.

The distribution of dated military dress accessories can be used as a proxy for studying the development of the Late Roman Rhine frontier over time. This period saw great political changes affecting the region, with general Stilicho withdrawing troops in AD 402 to fight in the civil war.[9] The standing army is assumed to have been replaced in the following years by Germanic *foederati*,[10] but the impact of these historical developments on how the frontier and its garrisons were maintained as well as the size and organisation of these new border forces have long remained underdeveloped. The literature review already highlighted recent work on gold coinage and rural settlements (for the latter, also see chapter 3) which attempted to locate the *foederati* archaeologically and understand their position within the Late Roman social and cultural landscape.

The focus of this chapter is on the military belt sets, but the Late Roman crossbow brooch will also be briefly discussed. The potential of crossbow brooches for studying changes in frontier organisation have already been explored elsewhere.[11] Combining these brooches with the belt pieces may provide us with a

[1] Keller 1971; Böhme 1974; Sommer 1984; Madyda-Legutko 1987.
[2] See note 2 in chapter 1.
[3] Although the majority of the finds in Böhme (1974) are also from this area, he also includes a lot of material from France. Keller (1971) mainly focuses on southern Bavaria, with Madyda-Legutko (1987) studying the Upper Raetian *limes* and Sommer (1984) bringing together finds from Britain to Eastern Europe.
[4] Swift 2000a, 199-204.
[5] Böhme 1974, 93-97.
[6] Böhme 2021.
[7] Böhme 1974; Sommer 1984.
[8] Lockyear 2012; Boehmer 2020.
[9] Kulikowski 2000, 326; Roymans 2017, 66; Schwarcz 1995, 295; Claudianus, *De Bello Gothico* 429-432.
[10] Roymans 2017; Heeren 2017; Southern and Dixon 2009.
[11] See Swift 2000ab; Böhme 2023.

Object	N
crossbow brooches	381
buckle (with backplate)	562
strap end	256
belt stiffener	219
belt plate	170
suspension mount	455
tubular mount	234
belt fitting, misc.	90
Total	2367

Table 4.1. Count of object categories discussed in chapter 4.

more complete image of the Lower Rhine frontier in both the 4th and 5th centuries. Table 4.1 summarises all items discussed in this chapter. The distribution and finds contexts of crossbow brooches will be discussed first, followed by a discussion of the Late Roman belt. This discussion consists of a typological overview and discussion of the various dating evidence, followed by assessments of spatial distribution, depositional practices in burial contexts, decoration and social connotations, broadly following the same structure as in chapter 3.

Crossbow brooches

From the late 3rd century onwards, the military brooch of choice was the crossbow brooch across the Roman West, coinciding with the wearing of the heavy half-moon cloak or *chlamys*.[12] Extensive historiographies of crossbow brooch studies and typologies can be found in previous works,[13] so the following literature review will be kept brief. The crossbow brooch is a cast brooch with a tubular hinge and is derived from the hinged brooch with equal arms.[14] A large number of regional studies and site reports have been published,[15] detailing the overall development of the brooch as well as distinguishing regional styles and developments.[16] A concordance table of the main crossbow brooch typologies with circulation dates for the study area is presented below in table 4.2 (figure 4.1). In her extensive supra-regional study encompassing both Britain and the continent, Swift made further divisions based on detailed decorative and stylistic characteristics.[17] An important contribution of her work is the recognition that the development of crossbow brooch types was not always linear,[18] and that several different chrono-typological paths developed alongside each other (such as her 3/4, 5i and 6i types).[19] Despite this, a certain linearity of dating is still maintained, although date ranges of various types overlap.[20]

Swift 2000a	Heeren and Van der Feijst 2017	Date Heeren and Van der Feijst 2017	N found
1	68a	AD 270-300	40
2	68b	AD 300-360	25
2i	68b1	AD 300-360	17
2ii	68b2	AD 300-360	9
2iii	68b3	AD 300-360	18
3_4	68c1-5	AD 340-400	190
5	68d	AD 390-450	5
5i	68d1	AD 390-450	5
5ii	68d2	AD 390-450	2
6	68e	AD 390-500	2
6i	68e1	AD 400-500	3
6ii	68e2	AD 390-450	3
unclassified	68	AD 270-500	62
Total			381

Table 4.2. Typology and dating of crossbow brooches in the study area (after Swift 2000a; Heeren and Van der Feijst 2017).

Chronology

The circulation dates for crossbow brooch subtypes in the Lower Rhine area were amended most recently by Heeren and Van der Feijst (reproduced below in table 4.2),[21] closely following dates proposed by Keller and Pröttel and extending the dating of the later 5 and 6 types into the mid- and late 5th century respectively.[22] All major typologies allow for a certain amount of overlap in dating between typological groups, mainly between groups 2 and 3/4 and groups 3/4, 5 and 6. As Swift's types are better known internationally, her terminology will be used throughout, but the dates proposed specifically for the Lower Rhine by Heeren and Van der Feijst will be followed,[23] given that significant dating arguments presented by Pröttel[24] and Keller[25] are based on contexts from far outside the study area.

Distribution and contexts

Crossbow brooches are generally rare in Germania Magna (55 were found; compared to 326 in Germania

[12] Wild 1968, 192.
[13] Most notably Swift 2000a and Van Thienen 2017.
[14] Heeren and Van der Feijst 2017, 180.
[15] A non-exhaustive chronological list includes Van Buchem 1941; Van Buchem 1966; Keller 1971, 26-54; A. Böhme 1972; Jobst 1975; Riha 1979, 169-177, type 6.5; Feugère 1985, 423-426, type 31; Haalebos 1986, 69, type 16; Pröttel 1988; Swift 2000a, chapter 2; Hull T191-192 in Bayley and Butcher 2004; Heeren and Van der Feijst 2017, 178-182, type 68.
[16] See especially Swift 2000a, chapter 2.
[17] Swift 2000.
[18] Swift 2000a, 27, figure 11.
[19] Swift 2000a, figure 11; Van Thienen 2021.
[20] Swift 2000a, table A; Heeren and Van der Feijst 2017, table 4.52.
[21] Heeren and Van der Feijst 2017, table 4.52.
[22] Keller 1971; Pröttel 1988.
[23] Heeren and Van der Feijst 2017, table 4.52.
[24] Pröttel 1988.
[25] Keller 1971.

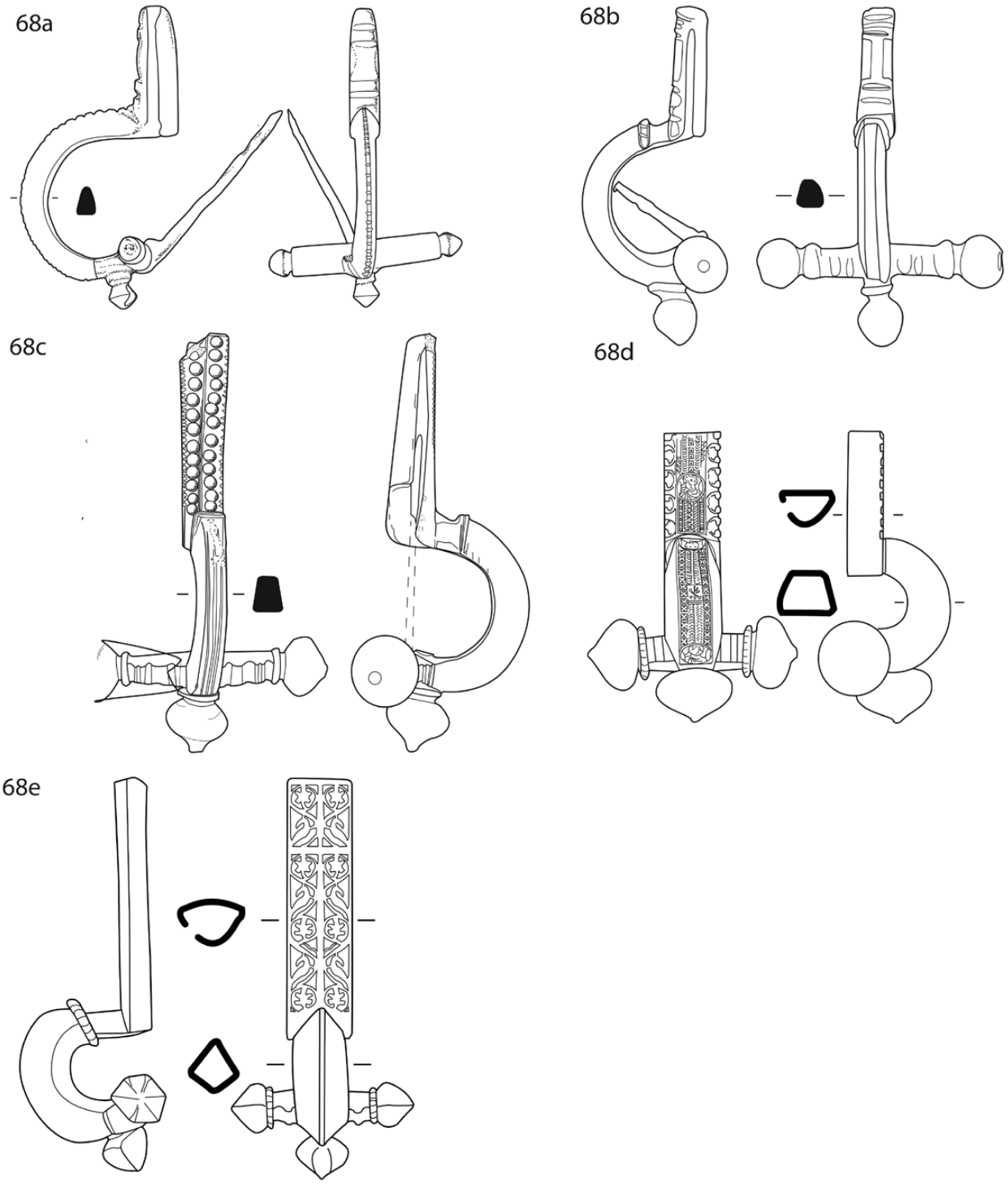


Figure 4.1. Main crossbow brooch types (after Heeren and Van der Feijst 2017, Plate 65-67).
For concordance with Swift types, see table 4.2.

Secunda), but they occasionally appear in rural settlement and burial contexts along the North Sea coast. Crossbow brooches were relatively often found in Germania Magna in non-funerary contexts: more than a third of all crossbow brooches came from settlement contexts, with stray finds the second most common context. The distribution of crossbow brooches in Germania Secunda is above all linked to the *limes* and military infrastructure in the hinterland. They appeared most frequently in military fortifications or associated cemeteries[26] and it is common to find large numbers of

[26] Altkalkar-Burgniatium (Boelicke 1994); Bonn (Sommer 1984; Gottschalk 2015); Cologne-Deutz (Swift 2000; Carroll 1998; Friedhoff 1991; Von Boeselager 2012; Päffgen 1992); Heerlen (Heeren and Van der Feijst 2017; Haalebos 1986); Jülich (Hertel *et al.* 2006; Pöppelmann 2010; Gottschalk 2015); Krefeld-Gellep (Pirling 1966; Pirling 1974; Pirling 1979; Pirling 1989; Pirling 1997; Pirling and Siepen 2000; Pirling and Siepen 2003); Cuijk (Van Hemert 2010); Maastricht (Haalebos 1986); Neuss (Lehner 1904); Nijmegen (Steures 2013; Van Buchem

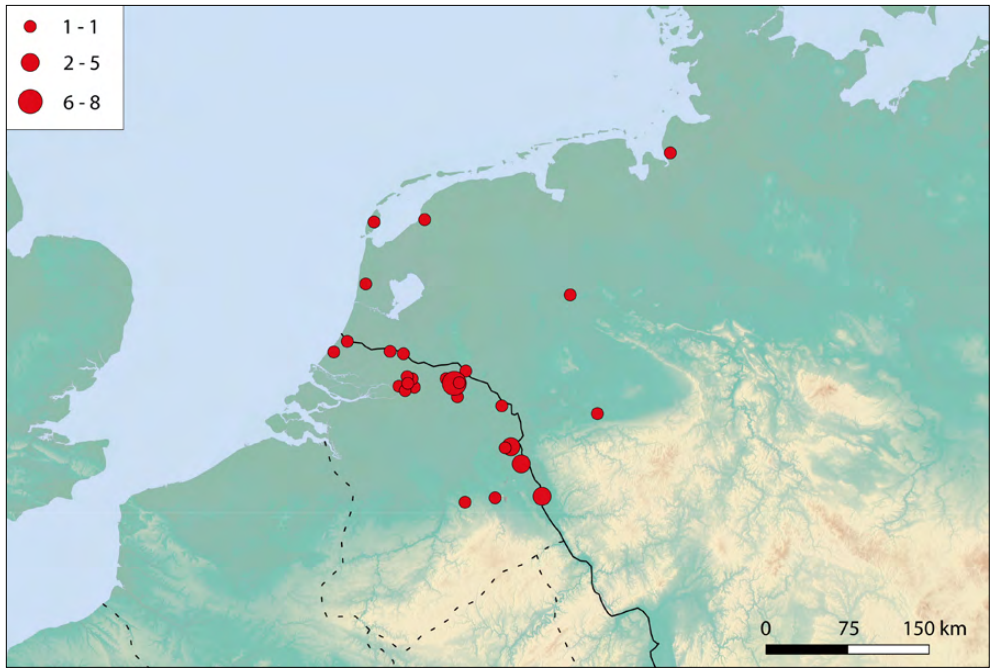


Figure 4.2.
Distribution map of crossbow brooches Swift type 1.

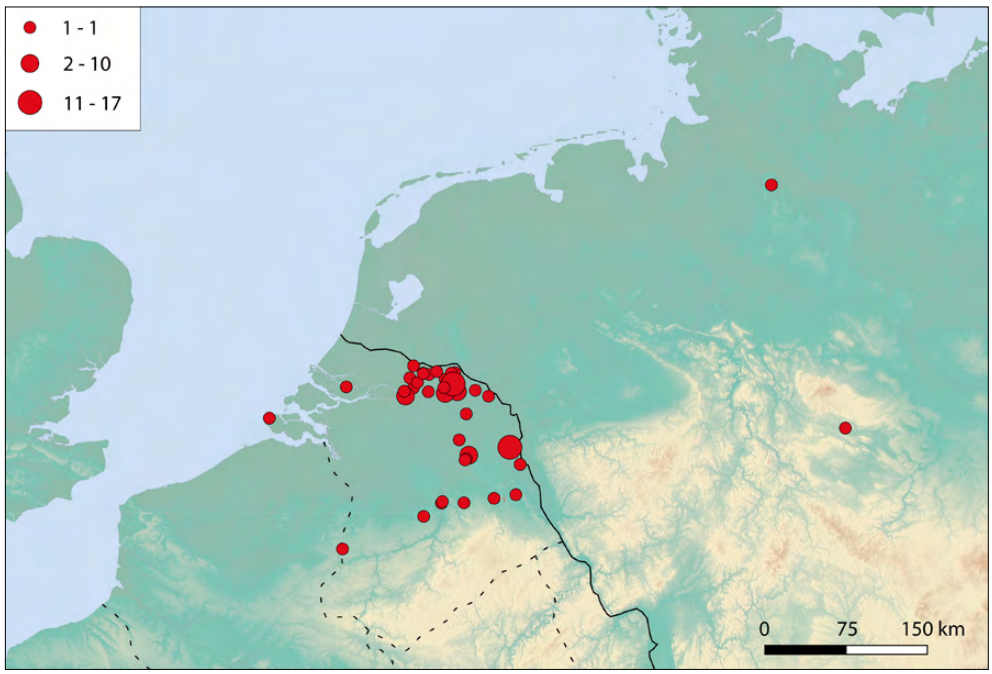


Figure 4.3.
Distribution map of crossbow brooches Swift type 2.

crossbow brooches within one site complex. Crossbow brooches were significantly rarer in the *Höhensiedlungen* further inland,[27] although reasonably common in urban centres this far south.[28] Only earlier brooch types such as the Swift 2iii and 3/4 were found in these southern sites. Swift 5 and 6 type crossbow brooches were only found in the immediate *limes* area.

Below, distribution maps of different types of crossbow brooches are presented. The earliest brooches (Swift type 1; figure 4.2) are rare and closely follow the Rhine frontier, including the Dutch western river area. Only a small number of these early crossbow brooches were found in Germania Magna. Their distribution in Germania Secunda overlaps significantly with that of contemporary rural settlements.

In the first half of the 4th century (see figure 4.3), the distribution of crossbow brooches (Swift type 2) shifts towards the east of the Lower Rhine area, closely

1941; ibid. 1966; Zee 2010); Remagen (Friedrich 2010; Reuleaux 1885); Xanten (Boelicke 2002).

[27] Furfooz (Böhme 1974); Liberchies (Mertens and Brulet 1974); Virton (Massart 2021).

[28] Tongeren (Vanvinckenroye 1984; Vanvinckenroye 1995a).

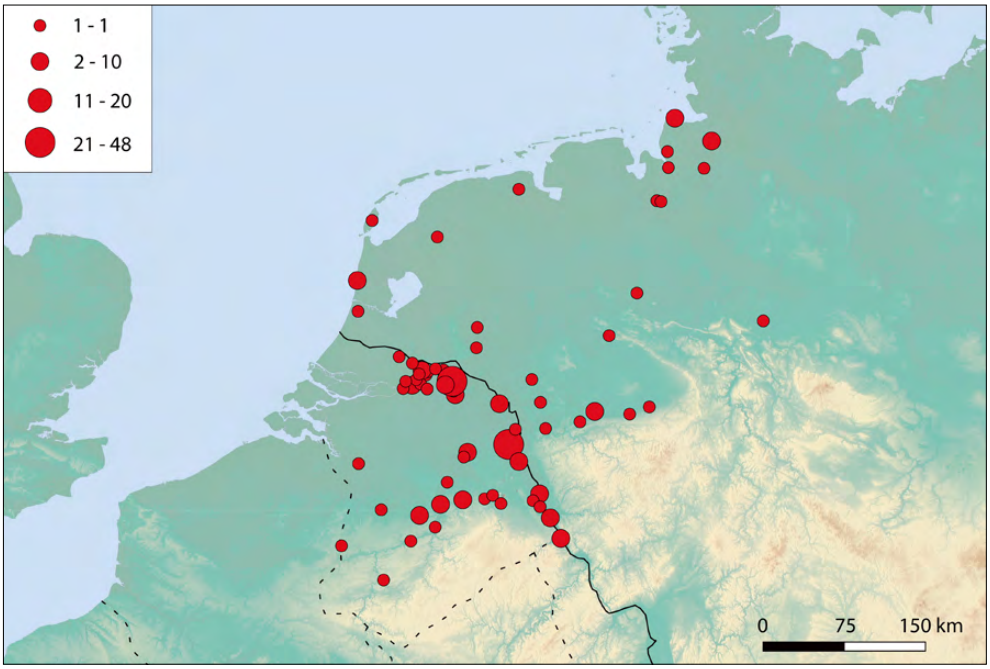


Figure 4.4. Distribution map of crossbow brooches Swift type 3/4.

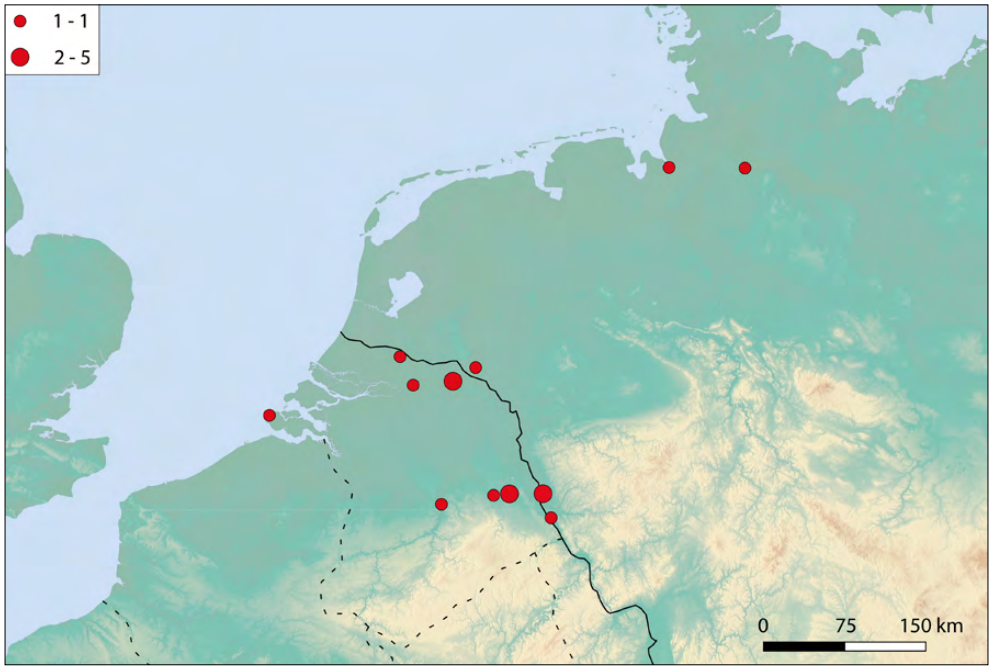


Figure 4.5. Distribution map of crossbow brooches Swift type 5 and 6.

mirroring the drop in settlement numbers in the western river area. Again, very few crossbow brooches in this period were found outside the Roman Empire. The bulk of the crossbow brooches was found in military fortifications and associated cemeteries. Apart from some stray finds from the river area, some finds came from rural settlements in the immediate limes zone.

More than half of all crossbow brooches found in the study area are of type Swift 3/4, and date to the second half of the 4th century (figure 4.4). The military association of this subtype is especially strong. Whereas earlier crossbow brooch types were mainly represented at large, well-excavated complexes, this later type also appeared more frequently in smaller fortifications further inland. Stray finds from areas where military sites are suspected in this period include Maurik, Kessel-Lith and Rossum-Alem. This corresponds well with Van Thienen and Lycke's suggestion that the crossbow brooch becomes more closely associated with the military during the second half of the 4th century.[29] Not only is the *limes* zone clearly visible in this period, the road from Cologne to Bavay also seems to be represented by a cluster of crossbow brooches found in

[29] Van Thienen and Lycke 2017, 2017, 52-55.

eastern Flanders and Wallonia. This reflects a defensive system that increasingly included fortifications further away from the Rhine frontier (Meuse fortifications and *Höhensiedlungen*), as already posited by Swift.[30]

There is also a closer connection to urban centres, with Swift type 3/4 crossbow brooches a frequent occurrence in the urban contexts at Xanten, Tongeren, Nijmegen and Cologne. As this group was the most common type of crossbow brooch found, an increase in rural finds can also be seen in this period, on both sides of the frontier. The increasingly military association of the Swift type 3/4 group (figure 4.4)[31] may indicate that finds from Free Germany may be interpreted as related to veterans.[32]

Although the total number of crossbow brooches found that date to the 5th century is much lower than those dating to the 4th century, their distribution and find contexts are interesting to compare (Swift type 5 and 6). The distribution map shown below (figure 4.5) shows a very dispersive figure, with low numbers of brooches found at only a handful of major site complexes. The vast majority of these are military sites.[33] Swift interprets the latest crossbow brooch types as a marker of high status.[34] Increased distribution in urban or rural centres of civilian occupation might be expected therefore, but this was not found. Instead, of the 13 5th-century crossbow brooches found, only three did not come from Late Roman military or urban-military sites.

Social connotations

As discussed above, the military nature of the crossbow brooch is most readily illustrated by its spatial distribution: in the 4th century, it is found in significant numbers almost exclusively along the western Roman frontier,[35] whilst being quite rare in Germania Magna. This pattern was also clearly visible in Germania Secunda. In both the 4th- and 5th-century, crossbow brooches in this province show a pronounced correlation to military infrastructure. Finds from the *limes* zone were also overrepresented in the civilian brooches discussed in chapter 3, however, these included a large number of stray finds. Crossbow brooches are still a relatively rare occurrence outside of excavated military sites: at the time of writing 43 are recorded from the Dutch river area in the PAN database, compared to 183 simple two-piece Armbrust brooches.

For the earlier crossbow brooch types (Swift 1-3/4), the distribution and find contexts confirm their status as the military brooch of this period. Late (Swift 5-6) crossbow brooches were found relatively less often in the area to the right of the Rhine. This supports the notion that these types were worn by people of high status and members of the civilian bureaucracy, who were less likely to travel to Germania Magna and deposit their brooches in funerary contexts. Böhme has suggested that the role of the crossbow brooch among Germanic soldiers was taken over by the supporting-arm brooch, although its distribution is not significantly distinct from the female-associated supporting-arm brooches (see chapter 3). The correlation of Swift 5-6 brooches with belts in graves is also less strong than for the Swift 3/4. Heeren and Van der Feijst have suggested that later subtypes of the crossbow brooch were also worn by members of the civilian elite.[36] Heeren linked the appearance of scrapped silver, Germanic pottery and a Swift 3/4 crossbow brooch from Tiel-Passewaaij to possible membership of the *foederati* of the inhabitants.[37] However, the precise interpretation of these settlements and the regional identities of their inhabitants is far from straightforward (see chapter 2).

The Late Roman military belt

Late Roman military belts could consist of a buckle with belt plate, belt loops and stiffeners, decorative fittings and a strap end.[38] Early studies often focused on reconstructing complete belt sets, mainly from funerary sets.[39] For the majority of the 4th century, wide and highly elaborate belt sets were in fashion.[40] These include belts where the buckle was mounted into a larger plate, a style that can be divided into two main types: those with five decorative plates[41] and those with three decorative plates.[42] Both types could also include additional fittings, suspension mounts and a strap end. Simpler belts came into fashion in the 5th century (*einfache Gürtel*),[43] which consisted of a buckle, two terminal fittings with *Astragalröhre* and several other items such as suspension mounts. A transitional type between these two traditions, the Vieuxville type was also recognised, which featured three terminal fittings and *Kerbschnitt* decoration. In Böhme's original typology, both A and B were dated to AD 350-400. The Vieuxville set was dated AD 380-420 and the *einfache*

[30] Swift 2000a, 81.
[31] Van Thienen and Lycke 2017, 52-55.
[32] Cf. Böhme 2012.
[33] Including Nijmegen-Josephhof (Zee 2010); Cologne-Deutz (Carroll 1998); Krefeld-Gellep (Pirling 1966; Pirling 1989; Pirling and Siepen 2000; ibid. 2003) and Bonn-Jakobstraße (Sommer 1984).
[34] Swift 2000a, 88.
[35] Feugère 1985, 425; Swift 2000a, 73-78; Collins 2010, 64-65; Heeren and Van der Feijst 2017, 182, 397.
[36] Heeren and Van der Feijst 2017, 182; cf. Van Thienen and Lycke 2017, 52, 60 on the later crossbow brooches as elite objects.
[37] Heeren 2017, 164. Other finds of crossbow brooches from 'migration-related settlements' include several 4th-century types in Wijk bij Duurstede (Heeren and Botman 2022).
[38] See for reconstructions Böhme 1974, *Abb*. 54-55; Bishop and Coulston 2006, figure 141.
[39] Bullinger 1969; Ypey 1969; Böhme 1974; Sommer 1984.
[40] Hoss 2012, 40; Bishop and Coulston 2006, 218-224; type A in Ypey 1969.
[41] Type A in Böhme 1974, 55, Abb. 15; Ypey 1969, Abb. 1-2.
[42] Type B in Böhme 1974, Abb. 15.
[43] Böhme 1974, 64.

Gürtel were dated AD 400-450.[44] Böhme's recent re-appraisal of his original typology further refined this terminology,[45] including also a number of belts of the 'classical' type, which included a number of buckle and strap end types that were relatively simple in execution.[46] The elaborate *Kerbschnitt* sets of his original type A and B were further defined into specific constellations of decorative plates.[47] This scheme also included the later *einfache Gürtel*, renamed the Jülich-Samson type. Both Sommer[48] and Böhme[49] also defined of individual belt components, including belt stiffeners, hinges, suspension mounts and belt plates.[50]

Many archaeological finds, even those from funerary contexts, are impossible to fit into a particular belt style. It is relatively rare for burials to contain a complete set and even then, the configuration of belt fittings found may not fit into established types.[51] Most often, burials only contained parts of a belt, usually the buckle with one or two fittings. This could potentially mean that not all belts were worn in elaborate fashions (perhaps reflecting military rank or status) or that only parts of the belt were deposited in burial situations. In some cases, the belts were not deposited as worn, for example in contexts where multiple buckles were found or where belts were deposited near the feet or next to the body.[52] Stray finds, settlement material and incomplete finds are also difficult to place using only complete sets for reference.

Whereas Sommer's 1984 dating scheme has not been adapted upon much in later works, Böhme continued to develop his original 1974 thesis by including more closed-context grave finds.[53] In these later works, he also addressed the reliance on coin-dated graves for his earliest phases.[54] This resulted in increasingly later and more narrow dating suggestions[55] and in his latest work, Böhme dated his types to the late 4th and the 5th century.[56] While Böhme's original dates from 1974 were already later than Sommer's (starting in AD 350, while Sommer's earliest dates start around AD 310), this reappraisal widens the gap even further. It also leaves the occurrence of many of types of belts alongside 4th-century crossbow brooches without an explanation. In the sections below, closed-context dates using coin dates, associated crossbow brooches and pottery and glass finds will be used to finetune the chronologies of Late Roman military belt fittings for Germania Secunda. Dating in Germania Magna will also be discussed whenever datable material was found.

Böhme's original typology[57] focused largely on discussion highly decorated and elaborate buckles and strap ends, while Sommer[58] included a much larger number of simpler types (some of which are included in Böhme 2021 as '*klassische Schnallen*'). The approach to typology by both authors is quite distinct. Böhme's work put style and decoration first; for example, his group of 'simple dolphin-headed buckles' includes buckles with a variety of types of back-plate, construction methods and different numbers and positions of the dolphins.[59] Sommer, instead, used construction as the first classification criterion and subdivided further based on back-plate shape, frame shape and then decoration.[60] Keeping with the example of the dolphin-headed buckles, Böhme's corresponding group[61] includes at least three types found in Sommer, namely the 2Ac, 1Cd and 1Ac, which in Sommer's work all date quite differently. For the strap ends, similarly different approaches were taken by both scholars. Due to his methodical approach to the form and construction of these objects, Sommer's typology proved to be the more practical of the two in identifying partial finds.

Buckles

A buckle consists of the frame, tongue and bar, with a backplate often attached separately. Sommer's typology for buckles follows the technical construction of both elements closely in his definition of three main buckle types. The first type (*Sorte* 1; Plate 2.1) consists of a closed buckle (bar and frame are cast as one continuous, closed piece) with a plate made of sheet metal that is folded around the bar. The plate has a small opening where the tongue is folded around the bar. The second type of buckle (*Sorte* 2) has only a partial bar with thickened terminals that slot into openings in the plate. These are fixed together with an axis driven through the plate, effectively making it a three-part hinge. The tongue is mounted from the axis. *Sorte* 3 (Plate 2.2), finally, describes buckles that are cast completely in one piece together with the backplate. These types feature a small opening in the plate through which the tongue is fitted.

[44] Böhme 1974, 89.
[45] Böhme 2021, 5-132.
[46] These include, among others, buckle types found in Sommer (1984) as types Sommer 1Aa/Ab, 1Cab/1Cb, 3e, and heart-shaped (Sommer A) and amphora-shaped Sommer Ba/Bb) strap ends.
[47] Böhme 2021, Abb. 20.
[48] Sommer 1984.
[49] Böhme 1974; Böhme 2021.
[50] For neighbouring regions, see the overview presented in Heynowksi 2017a.
[51] Böhme 2021, 96 lists some 'irregular' *Mischgarnituren*.
[52] Cf. Gottschalk 2008; Böhme 2021; Vrielynck 2010.
[53] Böhme 1987; Böhme 2021.
[54] Using coins minted under Valentinian I to Magnus Maximus and Arcadius to Jovinus for defining *Stufen* AD 350-400 and AD 380-420 respectively; Böhme 2021, 139.
[55] Böhme 1987.
[56] Böhme 2021, 145-162.
[57] Böhme 1974.
[58] Sommer 1984.
[59] Böhme 2021, Abb. 11.
[60] Sommer 1984.
[61] Böhme 2021, Abb. 11.1-4.

Within these groups, Sommer makes further divisions based first on the shape of the plate (*Form*) and secondly on buckle shape and decoration (*Typ*). Finally, each of these subgroups is sometimes further split up into decorative styles or form differences (*Varianten*; again, these are numbered). In rare cases, these variations can make a chronological difference.[62] Suggested dates for Germania Secunda are presented in table 4.3 below based on closed contexts, mainly burials, containing belt fittings and datable objects such as brooches, glass and pottery vessels and coins. The broader pattern that was achieved with this method was the confirmation of many of Sommer's original dates,[63] although some circulations dates could be extended or narrowed down.

The most common buckle forms in the 4th century were the Sommer 1A (bag-shaped backplate and D-shaped frame), buckles with a square backplate and animal-decorated frame (Sommer 1Cf) and the Sommer 3e (fixed backplate). The Sommer 1A buckle consistently appeared in Germania Secunda with material dating either to the first or the second half of the 4th century,[64] suggesting a long circulation date of AD 300-400. The same goes for groups 1Ab[65] and 1Ac.[66] Less common were the buckles with tongue-shaped plates (Sommer 1B), buckles with a large backplate (Sommer 1E) and buckles with a three-part hinge (Sommer types 2A and 2B). The Sommer 1Bb buckle appears to have circulated mostly in the second half of the 4th century with some possible extension into the early 5th century.[67] Only one 1Ba buckle was found in a closed context, which dates to the first half of the 4th century,[68] consistent with Sommer's original date of AD 310-350[69] and making the 1Bb later than the 1Ba. Sommer 1Ca buckles could sometimes be contextually dated to either the first or second half of the 4th century and in some cases to the 5th century.[70] Except two cases where the context was dated to the first half of the 4th century, all Sommer 1Cb buckles could be dated to the second half of the 4th century.[71] Similarly, two burials of Sommer 1Cd dated to the first half of the 4th century, with all other contexts suggesting a later date in the second half of the 4th century.[72] Sommer 1D buckles were found in contexts dating to the first half of the 5th century.[73]

[62] Most notably in the 1Cf type (buckle with animal-headed terminals and square backplate), where the width and height of the backplate in relation to the buckle, as well as the decoration on the plate, can be used to distinguish between 4th- and 5th-century types (Sommer 1984, 25-30).

[63] Sommer 1984.

[64] Bonn-Nordstrasse 48 grave 2: 1Aa with Swift 3/4D, coarse-tempered Pirling 120-122 jar and coins terminus post quem 383 (Gottschalk 2015, Taf. 10). Grave 1041 in Krefeld-Gellep (Pirling 1966, 84) also contained a Swift 3/4B crossbow brooch (340-400) and Qualitätsware beaker Pirling 99 (IVc-IVd), grave 2911 (Pirling 1989, Taf. 3) contained a Swift 3/4B crossbow brooch and a conical glass beaker type Gellep 185/Isings 106b. In Krefeld grave 5527 (Pirling and Siepen 2003, Taf. 5), finally, a 1Aa buckle was found together with a Late Roman terra nigra footbowl Pirling 273 (IVB) and a Sommer A strap end (original date 310-350, although it will be argued below that this type should be dated to the second half of the 4th century). See also Eschweiler-Lohn grave 26 1Aa with Gellep 186 (IVB; Gottschalk 2015, Taf. 63); Hambacher Forst grave 68 with glass dated IVB (Brüggler 2009, Taf. 112) and Cologne-Jakobsstrasse grave 107 (Friedhoff 1991, Taf. 77): 1Aa with Swift 3/4, and colour-coated beaker dated IVA. Some graves broadly date to the 4th century and could not be dated more precisely, namely Krefeld graves 2915 (smooth-tempered two-handled flagon type Alzei 22/Pirling 84al IIId-IVc; Pirling 1989, Taf. 6), 332 (conical glass beaker type Gellep 185/Isings 106b; IIId-IV; Pirling 1966, Taf. 26), 3010 (Gellep 196 glass gobelet; IIId-IV; Pirling 1989, Taf. 14), 4586 (Sommer B strap end and HF Swift 2iii crossbow brooch; 340-400; Pirling and Siepen 2000, Taf. 5) and 6112 (Swift 3/4B crossbow brooch and Gellep 196 glass vessel; IIId-IV; Pirling and Siepen 2003, Taf. 94).

[65] Krefeld-Gellep grave 1398 contained a Sommer Ba strap end (AD 310-350) and a Gellep 196 glass vessel (IIId-IV; Pirling 1974, Taf. 25). Grave 2787 included a Sommer A strap end (AD 310-350) and a coarse-tempered Pirling 103 jug (IVb-IVd; Pirling 1979, Taf. 75). Along similar lines, a Sommer A and a Sommer Ba strap end were found in grave 2991 with a coarse-tempered Pirling 107/Alzei 30 jug (IVb-IVd; Pirling 1989, Taf. 12). Grave 5892 contained both Sommer A strap end and a Swift 3/4B crossbow brooch (Pirling and Siepen 2003, Taf. 52). Grave 3229 finally, contained a number of coarse-tempered vessels dating to the 4th century (Pirling 115 and Gellep 84), as well as a Sommer A strap end and glass vessels Gellep 178 and 180 (IIIb-Va) and Gellep 213/Isings 128 (second half 4th century; Pirling 1989, Taf. 51).

[66] Once with generic 4th-century pottery (3011: Pirling 102; Pirling 1989, Taf. 14). In grave 5781 it was accompanied by a coarse-tempered jug Pirling 109, a Sommer Cb strap end and a Swift 3/4A crossbow brooch (Pirling and Siepen 2003, Taf. 38). The 1Ac1 buckle in grave 3093 was found with a Swift 3/4B crossbow brooch (Pirling 1989, Taf. 28).

[67] Krefeld grave 5590 with a Sommer Da strap end, Swift 5ii crossbow brooch and late 4th-early 5th-century pottery (Pirling and Siepen 2003, Taf. 17). Grave 1124 in Krefeld yielded a Swift 3/4A crossbow brooch and a glass vessel Gellep 186 dated to the second half of the 4th century (Pirling 1966, Taf. 93).

[68] Krefeld-Gellep grave 905 (Pirling 1966, Taf. 76), it is unclear whether this type should also be dated in the second half of the 4th century. Most of the finds in this grave appear consistent with an earlier date in the first half of the 4th century: glass beaker Gellep 178-180 (IIIB-Va), terra sigillata bottle Pirling 18 (IV), two marbled ware two-handled flagons Pirling 72 (IVa-IVc) and a Qualitätsware beaker Pirling 59 (IV).

[69] Sommer 1984, 74-79.

[70] First half 4th century: Krefeld-Gellep grave 3511 (a variety of pottery, including a glazed Pirling 6 bottle; Pirling 1989, Taf. 85); second half 4th century: Krefeld-Gellep graves 1106; 3025; 4743; 5909 (Pirling 1966; ibid. 1989; Pirling and Siepen 2000; ibid. 2003); 5th century: Vieuxville 1938 (alongside 5th-century belt set; Böhme 1974, 305, Taf. 110.14); Vireux-Molhain graves 8 (Lémant 1985, 9, figure 12; based on the rouletted samian bowl Chenet 320; Bayard 1985, 74) and 11 (Lémant 1985, figure 18 with Sommer 3f buckle and Bc2 strap end).

[71] Krefeld-Gellep grave 3521 was dated in the first half of the 4th century based on the colour-coated Pirling 69 beaker and marbled Pirling 72 flagon (Pirling 1989, Taf. 90); Nijmegen grave B132 also fits that date based on the burial stratigraphy and terra nigra beaker (Steures 2013, 179.

[72] Tongeren-Zuidwest grave 9 was dated first half 4th century based on the colour-coated Pirling 69 beaker, samian ware and coarse-tempered pottery (Vanvinckenroye 1984, Pl. 29); similarly, Krefeld-Gellep grave 3238 (with matching Sommer Ba strap ends; Pirling 1989, Taf. 43). Dates in the second half of the 4th century were found for Cologne-Luxemburgerstrasse grave 114 (Von Boeselager 2012, Taf. 158; with Sommer Bb strap end and coarse-tempered Pirling 107-109 jar; glass vessels Gellep 713/Isings 99 and Gellep 221), Krefeld-Gellep grave 4596 (Pirling and Siepen 2006, 483), Tongeren-ZW grave 18 (Vanvinckenroye 1995b; coarse-tempered Gellep 103) and 94 (Vanvinckenroye 1984, Plate 59; post quem from follis minted under Constantine II AD 337-341; also supported by coarse-tempered pottery).

[73] Krefeld-Gellep grave 5590 (Pirling and Siepen 2003, Taf. 17); Tongeren-Zuidwest grave 158 (Vanvinckenroye 1984, Pl. 90; coarse-tempered pottery and glassware; also *post quem* from a siliqua minted under Honorius).

Sommer 1984 type	Sommer 1984 date	Proposed date	N
1A	310-350	300-400	5
1Aa		300-400	31
1Ab		300-400	12
1Ac		300-400	13
1Ba	310-350	300-350	1
1Bb		350-400/450	3
1C	310-450	300-500	8
1Ca	364/7-450	350-450	22
1Cb	364/7-407	300-400	25
1Cc			1
1Cd	364/7-407	300/350-400	8
1Ce	364/7-407	350-400	4
1Cf		350-450	30
1Cf1-4ab	364/70-407	350-400	66
1Cf4c-5	400-450	400-450	26
1D		400-450	4
1E	364/7-407	350-400/450	6
1Ea	364/7-407	350-400/450	3
1Eb	364/7-407	350-400/450	4
1Ec	364/7-407	350-400/450	1
1Ee	364/7-407	350-400/450	1
1Ef	364/7-407	350-400/450	1
2A	310-350	300-350	2
2Aa		300-350	1
2Ac	310-350	300-350	2
2B			6
2Bb	310-350	300-350	1
2Bc	310-350	300-350	4
2Bd	310-350	300-350	2
2Bf		300-350	3
2C	364/7-407	350-400	2
3a	400-450	400-450	2
3b	400-450	400-450	4
3c	450-500	450-500	4
3e	310-350	300-400	12
3f	400-450/500	400-450/500	62
3g		400-450/500	1
3h		400-450/500	1
Unclassified		300-500	167
Total			562

Table 4.3. Main circulation dates for belt buckles in Germania Secunda (typology after Sommer 1984) and total numbers found across the study area.

The elaborately decorated buckles with a large backplate (Sommer 1E) were dated by Sommer to the second half of the 4th century and by Böhme to the period AD 350-420 in 1974 and then later to AD 370-430.[74] Based on pottery and coin dates, the majority from Germania Secunda appear to date in the second half of the 4th century, with some contexts in the early 5th century.[75]

Although rare in Germania Secunda, buckle types 2Aa and 2Bc appear mostly in 4th-century contexts, predominantly in the first half.[76] The Sommer 3e is the only buckle with a fixed backplate that dates exclusively to the 4th century, with most contexts placing it in the middle of the 4th century (extending Sommer's original date in the first half of the 4th century to the entire 4th century).[77] No direct indications were found for a continuation of this type into the 5th century. The 5th-century buckles were dominated by the buckles with square plates and animal-headed terminals (Sommer 1Cf4-5) and those with a fixed backplate and animal-headed terminals (Sommer 3f). Although in some cases the accompanying finds did leave the possibility of an earlier, late 4th-century date open, the majority of contexts with Sommer 1Cf4-5 and Sommer 3f buckles dated firmly in the 5th century.[78]

Strap ends

Sommer differentiated between four main forms of strap ends (*Formen*): hearts-shaped, amphora-shaped, round and square strap ends, which are further sub-divided into smaller groups based on minute differences

[74] Böhme 2021, 145-146.

[75] Eschweiler-Lohn grave 5 (Gottschalk 2015) contains a Gellep 180 or 797 glass bowl, which date predominantly to the 4th century, a date that in the case of the Gellep 180 extends into the early 5th century (Pirling and Siepen 2006, 240, 243, Furfooz grave 6 with a 4th-century coarse-tempered jug Alzei 30/Pirling 108 (Böhme 1974, Taf. 89.6-16); Tongeren set (Böhme 1974, 301, Taf. 106.1) with a Sommer Bb1 strap end; Vireux-Molhain grave 22 with rouletted Chenet 320 bowl from the late 4th century (Bayard 1985, 74). For circulation in the early 5th century: Rhenen grave 846, containing a glass bowl Gellep 331 and a HF 78c supporting-arm brooch (Wagner and Ypey 2012; grave 188 in Vieuxville contained two glass vessels; the bowl fits in the 4th-century Gellep 222 type, while the beaker forms part of a 5th-century development of a 4th-century tradition (Gellep 185; Alénus-Lecerf 1986).

[76] Hürth-Hermülheim grave 5 (Gottschalk 1999; Gottschalk 2007, 272, figure 20.6); Krefeld grave 2909 with a marbled flagon Pirling 72 (Pirling 1989, Taf. 3); Tongeren-Zuidwest grave 48 (Vanvinckenroye 1995b, 167); Treigne grave 137 (Bullinger 1969, Taf. XXX; Sommer 1984, Taf. 42; Dasnoy 1966, figure 19).

[77] Krefeld-Gellep graves 2864, 3089, 3381 all place it in the mid to late 4th-century (Pirling 1979, Taf. 81; Pirling 1989, Taf. 63). Circulation in the first half of the 4th century also attested by Cologne-Jakobsstrasse grave 74, 3e with Sommer Bb and Gellep 207 glass vessel (Friedhoff 1991).

[78] Sommer 1Cf4-5: Tongrinne with Sommer Bc and IV-Va pottery (Böhme 1974, 303); Rhenen 833 (Wagner and Ypey 2012); Krefeld 4735 with rouletted Chenet 320 (IVd-Va; Pirling and Siepen 2000, Taf. 18). Sommer 3f: Haillot 11: 4th and very early 5th (Böhme 1974, 290, Taf. 91.1); Jülich grave 74: Sommer Bc2 and glass beaker type Gellep (Pöppelmann 2010, 88, Taf. 26-28); Jülich grave 92: Frankish pottery (Pöppelmann 2010, Taf. 35); Jülich grave 140: Gellep beaker (Pöppelmann 2010, 88, Taf. 47); Jülich grave 141: glass beaker (Pöppelmann 2010, Taf. 48); Bonn-Kastell: Sommer 3f and Sommer Bc2 strap end (Naber 1984); Krefeld grave 43: Chenet 304/Pirling 40 plate and Gellep 229 glass vessel (late 4th and 5th centuries; Böhme 1974); Krefeld 808: with Late Roman terra nigra Pirling 252/274 foot vessel (Pirling 1966, Taf. 69); Rhenen 842: with supporting-arm brooch HF 78c1, coarse-temepered Alzei 27L jar, and Gellep 180 glass vessel (Wagner and Ypey 2011).

in execution (*Typen*; see table 4.4 below).[79] Within these smaller groups, different decorative styles can be recognised (*Varianten*). Decoration also factors into some *Typ* categorisations (e.g., C and D type strap ends), although in most cases this did impact the dating of the types. The heart-shaped strap ends (Sommer A; Plate 3.1) are often plain but can occasionally be found with dot-and-circle or *Tremolierstich* decoration. Sommer defined 5 subtypes based on the type of mount, which in most cases did not survive. Sommer A is the earliest strap end type and was originally dated by Sommer in the first half of the 4th century[80] and by Böhme in the second half of the 4th century.[81] In Germania Secunda, it was found in contexts dating to both these periods,[82] suggestive of a long circulation period encompassing the entire 4th century.

Sommer's B type, the amphora-shaped strap end, correspond to Böhme's *Lanzettförmige* strap ends, although the latter mainly subdivides them on decoration.[83] Sommer uses the shape of the amphora 'handles' as their defining feature, which can then be further divided based on the mount type (Ba), decoration (Bb) or both (Bc). Further subtypes are based on the shape of the mount and decorative schemes, although these can get incredibly specific and difficult to identify for fragmented specimens.

The Ba type was subdivided into six different subtypes, the first five of which were dated AD 310-350.[84] With the exception of Tongeren-Zuidwest grave 29, all closed contexts with Ba strap ends could be dated to the first half of the 4th century.[85] The different types of decorative scheme as recognised by Sommer for the Bb and Bc types are chronologically distinct. The chronological differences between the Bc1 and Bc2 strap ends are also significant. With the Bb types, the main circulation of the type appears to have been in the second half of the 4th century,[86] despite some subtypes originally dated by Sommer to the first half of the 4th century (Bb1 and Bb2).

The Bc subtype was the most common amphora-shaped strap end in the region. Sommer's *Varianten* based on decoration and mound shape make a distinction between more rounded, drop-shaped strap ends with elaborate *Kerbschnitt* dating (Bc1; Plate 3.2) and more angular, plainer strap ends (Bc2; Plate 3.3). The Bc1 strap end[87] was mostly found in 4th-century contexts, but also occasionally in contexts dated to the early 5th century.[88] The evidence for the Bc2 shows a main circulation period in the first half of the 5th century.[89]

[79] There are other types of strap ends that tend not to be very common. Böhme describes so-called *Längliche Riemenzungen* which are pointed strips, often decorated with dotted circles or faceting. These are rarely found in Late Roman contexts and may date from the late 4th to the mid-11th century (Heynowski 2017a, 162-170). This group will not be discussed here further.

[80] Sommer 1984, 74-79.

[81] Böhme 1974, Abb. 51/52.

[82] First half of the 4th century: Krefeld-Gellep graves 2991 (coarse-tempered Pirling 107/Alzei 30 jar; Pirling 1989, Taf. 12.2-7) and 2768 (Gellep 191 glass vessel; Pirling 1979, Taf. 71.12-14); dates in the second half of the 4th century come from Cologne-Jakobsstraße grave 204 (cemetery phase 8; Friedhoff 1991, 271, Taf. 90); and Krefeld-Gellep graves 2942 (Swift 3/4B crossbow brooch; Pirling 1989, Taf. 8); 2996 (with Swift 3/4 crossbow brooch; Pirling 1989, Taf. 8); 4743 (Pirling 1989, Taf. 8), 5892 (with Swift 3/4 crossbow brooch; Pirling and Siepen 2003, Taf. 5.5-6), 5527 (Pirling 273; Pirling and Siepen 2003, Taf. 5), 5580 (Pirling and Siepen 2006, 489), 2787 (Pirling 99 coarse-tempered jar; Pirling 1979, Taf. 75); 3381 (glass vessel Gellep 186 and a number of Gellep 541 glass vessels; Pirling 1989, Taf. 63). General dates in the 4th century are provided by Krefeld-Gellep graves 2835 (Pirling 12 glazed pottery; Pirling 1979, Taf. 80.5-6), 2922 (Sommer 1Ab buckle; Pirling 1989, Taf. 7) and 3229 (Gellep 213/Isings 128 glass vessel; coarse-tempered Pirling 115 and Gellep 84; Pirling 1989, Taf. 51).

[83] *Lanzettförmige Riemenzungen mit Kerbschnittverzierung* and *Lanzettförmige Riemenzungen mit Punzverzierung* respectively (types n-p; Böhme 1974, 73-75).

[84] Sommer 1984, 50.

[85] Tongeren-Zuidwest grave 29 was dated to the second half of the 4th century (Vanvinckenroye 1984, 33). Contexts in the first half of the 4th century include Krefeld-Gellep graves 2872 (with Swift 3/4 crossbow brooch; Pirling 1979, Taf. 83), 2991 (with Sommer 1Ab buckle and Sommer A strap end; coarse-tempered Pirling 107/Alzei 30 vessel; Pirling 1989, Taf. 12) and 3238 (Pirling and Siepen 2006, 473).

[86] Cologne-Jakobstraße grave 74 (with Sommer 3e buckle, Gellep 59-62 colour-coated beaker and Gellep 222/Isings 116 glass bottle; cemetery phase 6; Friedhoff 1991, 229, Taf. 8); Cologne-Luxemburgerstraße grave 114 (coarse-tempered Gellep 109 jar; Von Boeselaeger, 496, Taf. 158); Hambach 132 grave 58 (Brüggler 2009, Taf. 106); Krefeld-Gellep graves 1398 (Sommer 1Ab buckle; Gellep 196 glass vessel; Pirling 1974, Taf. 25), 2832 (Swift 3/4B crossbow brooch; Pirling 1979, Taf. 79), 3093 (Swift 3/4B crossbow brooch; Pirling 1989, Taf. 28), 3666 (Sommer 1Cb1 buckle; Pirling 1989, Taf. 114) and 4657 (Swift 3/4 crossbow brooch; Pirling and Siepen 2000, Taf. 11).

[87] See Böhme 1974, 73-74.

[88] Earliest occurrence in the first half of the 4th century as part of a set in grave 137 in Treigne (with Sommer 2C buckle; Bullinger 1969, Taf. XXX; Sommer 1984, Taf. 42; Dasnoy 1966, figure 19); dates in the second half of the 4th century are provided by Furfooz grave 3 (Gellep 540/Isings 97a glass vessel AD 300-350, as well as a Swift 3/4 brooch and 4th-century buckle; Böhme 1974, 289, Taf. 88); Krefeld-Gellep grave 1330 (Sommer 1Ce1 buckle; Pirling 1974, Taf. 22). As for later dates: Rhenen-Dondersberg grave 839 contained a 5th-century belt set; however, the Bc1 strap end does not match the rest of the set and is likely an inclusion of an heirloom in a later burial. The Sommer Bc1 strap end from Samson grave 10 does date later, based on the inclusion of a Sommer 3f buckle (Böhme 1974, 299, Taf. 98.17). Its appearance in belts sets in Nettersheim-Ob der Kaul (Nieveler 1992; Nieveler 2003; Gottschalk 2015, Taf. 137), Nismes grave 3 (Cattelain *et al.* 2020, Plate IV; Cattelain *et al.* 2016, 263), Rhenen-Dondersberg htave 846 (Böhme 1974, 272, Taf. 68.6; Wagner and Ypey 2011) and Eschweiler-Lohn grave 5 (Gottschalk 2015, Taf. 36) could not be dated more closely than second half 4th-early 5th century.

[89] 5th-century dates are provided by Vireux-Molhain grave 11 (alongside Sommer 3f buckle; Lémant 1985, 13, figure 18); grave 12 from Jamiolle (tubular mount and Sommer 1Cf5 buckle (Böhme 1974, 292, Taf. 93.3); Nijmegen grave Broerstraat (Sommer 3f buckle with a complete Jülich-Samson belt set; Böhme 1974, 285, Taf. 84.14); Rhenen-Dondersberg grave 842 (Sommer 3f buckle; HF 78c1 brooch; 5th-century Alzei 27 coarse-tempered jar (Wagner and Ypey 2011, 616-717); Rhenen-Dondersberg grave 833 with Sommer 1Cf4 buckle as part of a Jülich-Samson set and 5th century bone comb (Wagner and Ypey 2011, 600); as part of a Jülich-Samson set in Rhenen-Dondersberg grave 835 (Wagner and Ypey 2011, 606) and Nijmegen B61 (Steures 2013, 57.). Tongeren-ZO grave 11b was coin-dated after AD 388-402 (Vanvinckenroye 1995b). Also 5th-century are Krefeld graves 929 (with Sommer 3f buckle; Pirling 1966, Taf. 74), 1100 (with Sommer 3f buckle; Pirling 1966, Taf. 91), 1113 (Pirling 1966, Taf. 91), 1382 (with Sommer 1Cf5 buckle; Pirling 1974, Taf. 25) and 4627 (Pirling and Siepen 2000, Taf. 7), as well as Jülich grave 74 (with a Sommer 3f buckle; Pöppelmann 2010, Taf. 26-28). Set 45.4 fom Hürth-Hermülheim forms a later Jülich-Samson set with 5th-century glass

Sommer 1984 type	Sommer 1984 date	Revised date	N
A	310-350	300/350-400	26
B		300-450	11
Ba	310-350	300-350/400	13
Bb	364/7-407	350-400	20
Bc		300-450	6
Bc1	310-350	350-400/450	28
Bc2	400-450	400-450	85
C		300-400/450	3
Ca		350-400	1
Cb	310-350	300-400	1
Cc	364/7-407	350-400	4
Cd	400-450	400-450	6
D		350-450	20
Da	364/7-407	350-400/450	11
Db	364/7-407	350-400	2
Dc	400-450	400-450	5
Unclassified			13
Total			256

Table 4.4. Main circulation dates for strap ends in Germania Secunda (typology after Sommer 1984) and total number of objects found across the study area.

Some Sommer B strap ends could not be identified to a specific subtype. In two out the three cases, they were accompanied by crossbow brooches dating AD 340-400,[90] and the third was found with a Swift 5ii crossbow brooch dated AD 390-450.[91] Together with the context-dates for the identifiable subtypes of the Sommer B strap end, this seems to suggest that although earlier circulation was possible, the entire B group mostly circulated from the mid-4th century onwards.

Disc- or saucer-shaped strap ends (Plate 3.4) or Sommer C types consist of a flat piece of metal from which the strap end and mount are both stamped. Contrary to the name, these may also be square (Ca) or U-shaped (Cd). Types Cb and Cc are characterised by the finishing of the rim: ovolo on the Cb type and decorative tubing on the Cc. Only subtypes Cb, Cc and Cd were found in the study area in significant numbers. Types Cb and, following Sommer the Cc, can be dated to the second half of the 4th century from closed contexts,[92] type Cd to the first half of the 5th century.[93]

Sommer type D (Plate 3.5) is a simple square or rectangular strap end made of a folded piece of sheet metal. The fold may be sculpted into a ribbed tube, similar in style to the tubular mounts found on belt plates (see below). Subdivisions can be made on the style and elaborateness of the decoration (Da, Dc) or the size of the strap end (Db), criteria that can be difficult to apply to partial specimens. Types Da and Db were originally given a date of AD 350-400 by Sommer, with the Dc dating AD 400-450.[94] This type is quite rare in the study area and the number of closely dated contexts is therefore small. Generally, the dates proposed by Sommer are supported, although there appears some overlap in dating between the two groups with the Db continuing into the early 5th century.[95] The Dc subtype was found only in 5th-century contexts.[96]

Assorted belt fittings

A number of different functional and decorative fittings are associated with the Late Roman military belt: plates, stiffeners, loops, suspension mounts and tubular mounts. The plates, stiffeners and suspension mounts may be divided into form groups, but in general all these objects were found to be part of both 4th- and 5th-century belts. Belt plates can be divided by their overall shape, as their decoration is too varied to group them by style. Differently shaped plates belonging to the same set often feature matching decorative schemes.[97] Although square or rectangular plates were the most common, triangular, rhombic and even (semi-)circular plates were also found.

Belt stiffeners are long, narrow strips of copper alloy with staples on either end to fix the stiffener to the leather. They are often plain but may be decorated with groove patterns or even *Kerbschnitt*. There are three main forms: simple rectangular strips, strips with trapezoidal terminals and propellor-shaped stiffeners. The strips with trapezoidal terminals are quite rare in Germania Secunda. Belt stiffeners shaped like propellors were also found in contexts dated to both the 4th and 5th centuries, starting in the early 4th century.[98] They may be found on belt sets of various types, such as the Sommer Serie 1 Variant 3 and Sommer Serie 2 Form b.[99] The simpler, strip-like stiffeners, however, appear to

(Gottschalk 2008, 145). Hochemmerich grave 2 (Siegmund 1998b, Taf. 80.2/1) appears to date much later based on the Frankish pottery; the strap end is likely an older find.

[90] Krefeld-Gellep graves 2872 (Pirling 1979, Taf. 83) and 4586 (Pirling and Siepen 2000, Taf. 5).

[91] Krefeld-Gellep grave 1222 (Pirling 1966, Taf. 98).

[92] Sommer Cb: Krefeld-Gellep grave 5781 (with Sommer 1Ac buckle and Swift 3/4A crossbow brooch; Pirling and Siepen 2003, Taf. 38).

[93] Sommer Cd: Vieuxville 1938 (with Sommer 1Cf5 buckle; Böhme 1974, 305, Taf. 110.2).

[94] Sommer 1984, 55.

[95] Sommer Da: dates in the second half of the 4th century provided by Hambach 132 grave 148 (Gaitzsch *et al.* 2000, 204), Krefeld-Gellep graves 4655 (Pirling and Siepen 2000, Taf. 10) and 5538 (Pirling and Siepen 2003, Taf. 5); general 4th-century dates are found in Jülich-Römerstrasse 29 grave 15 (Gottschalk 2015, Taf. 114; Perse 1998, Abb. 5) and Nijmegen grave OO366 (Steures 2013, 221, 721). Sommer Db: 4th-centuery date from Krefeld-Gellep grave 5589 (Pirling and Siepen 2003, Taf. 17) and a 5th-century date from Krefeld-Gellep grave 5590 (as part of a Jülich-Samson belt set with a Swift 5ii crossbow brooch; Pirling and Siepen 2003, Taf. 17).

[96] Krefeld-Gellep grave 43 (with a Sommer 3f buckle; Pirling 1966, Taf. 10).

[97] Böhme 1974, 55; Ypey 1969; Bullinger 1969.

[98] E.g., grave 5 in Hürth-Hülheim (Gottschalk 1999) and grave 2991 in Krefeld-Gellep (Pirling 1989, Taf. 12).

[99] Sommer 1984, 5-8.

have become more common only in the second half of the 4th century, continuing into the first half of the 5th century,[100] and again featured on various types of sets, including the Sommer Serie 1 Variant 3.

Tubular mounts are slim, ribbed tubes fitted on to the end of decorative plate via a small slit in the side (Plate 2.3) or cast with a plate in one piece, which was used as a terminal fitting. They can also be found attached on some types of strap end (see above Sommer type D), but these are much shorter and smaller in diameter. Tubular mounts are often found without the plate attached and are hard to date or attribute to a particular belt style. Tubular mounts with rectangular plates are associated with the later, *einfache Gürtel*[101] and are included in Böhme's 2021 Stufen A and B (ranging from the late 4th to the mid-5th century).[102] The elaborate *Kerbschnitt* belt sets also feature tubular mount constructions, however (Sommer Serie 2, Varianten 1-3). In some cases, these are cast as part of the plate but in others they are mounted on to the plates.[103]

Belt loops are relatively rare in the Late Roman period and are formed much like belt stiffeners. They are typically folded in a flat U shape to allow the belt to slip. They were found in a variety of forms: plain, with trapezoidal terminals and with faceting or *Kerbschnitt* decoration. They appear to date mostly in the second half of the 4th century and the first half of the 5th century.[104]

Finally, there are the suspension mounts, the most common find of belt component after the buckle and strap end. Suspension mounts are fittings hanging from the bottom of the belt with a ring attached, from which small tools such as knifes or tweezers could be suspended.[105] They may appear in a wide variety of forms, such as round, square/rectangular, rhombic or triangular (Plate 2.4). The most common form in our study area seems to be the round form, which may be decorated with concentric grooves on the front surface, or small *Kerbschnitt* like grooves along the rim to achieve a rosette effect.

Although Nicolay dates all types of suspension mounts to the 4th century specifically,[106] others have associated them with the *einfache Gürtel* and Vieuxville/Jülich-Samson type belt sets of the 5th century.[107] In fact, rosette-shaped suspension mounts were found as parts of both 4th- and 5th-century type belts (although some early 4th-century contexts were found, the majority were dated from the mid-4th century onwards).[108] This long chronology applies to all types of suspension mount and for suspension mounts in Germania Magna.[109]

Distribution and deposition

A map of all Late Roman military belt elements is presented below in figure 4.6. Most areas are well represented, including the frontier zone, the villa landscapes of Belgium and Germany and the German North Sea coast. Areas with fewer or no finds are the sandy soils of the southern Netherlands and Flanders, the northwestern Netherlands and the northern part of North Rhine-Westfalia. These same areas also yielded fewer indications for habitation in the chapters on brooches and settlements, suggesting that the distribution of military belt fittings closely mirrors the distribution of general activity in the study area (see also discussion of distributions in chapter 3).

Previous authors have already noted a certain regionality of belt types within the Late Roman West, for example between the *limes* regions of the Rhine and Danube,[110] with some types more common in

[100] Treignes grave 137 (possible Chenet 304 plate; Bullinger 1969, Taf. XXX); Hambach grave 58 (with Sommer Bb strap end; Brüggler 2009, Taf. 106); Rhenen-Dondersberg grave 829 (Late Roman terra nigra footvessel; Böhme 1974, 269, Taf. 62); Krefeld-Gellep grave 1100 (with Sommer 3f buckle; Böhme 1974, 281, Taf. 79); Nijmegen-Broerstraat grave 159 (with Sommer 3f buckle; Böhme 1974, 285, Taf. 84); Bonn-Kastell (with Sommer 3f buckle and Sommer Bc2 strap end; Naber 1984); Gennep-Touwslagersgroes grave 55 (with Sommer 3f buckle; Theuws 2008).

[101] Böhme 2021, 151.

[102] Böhme 2021, figures 74 and 75. Dating evidence in the 5th century is provided by Bonn- Grab an der Kastellmauer (Sommer 1984, Taf. 75); Bonn-Kastell (Naber 1984); Ewijk-Keizershoeve (Blom *et al.* 2012); Hürth-Hermülheim grave 45.4 (Gottschalk 2008); Jülich graves 72, 74 and 144 (Pöppelmann 2010); Krefeld-Gellep grave 1100 (Böhme 1974, 281, Taf. 79.23); Rhenen-Dondersberg graves 833, 835 and 842 (Böhme 1974, 270, Taf. 63, Taf. 64 and Taf. 66); Tongeren-ZW grave 158 (Vanvinckenroye 1984). In some cases, tubular mounts were found as part of belt sets that could be context-dated to the 4th century: Krefeld-Gellep grave 5048 (Pirling and Siepen 2000, Taf. 45), which contained a Swift 3/4 crossbow brooch and a Sommer 1Cf3 buckle as well as a tubular mount, which may be dated on context in the 4th century; Furfooz grave 3; containing a Sommer Bc1 strap end, Swift 3/4 brooch and 4th-century pottery (Böhme 1974, 289, Taf. 88.7; Dasnoy 1969; Brulet 2008b, figure 386); also, Krefeld grave 1330; containing a Sommer 1Ce2 buckle and Sommer Bc1a strap end; dated second half 4th century (Pirling 1974, Taf. 22); and Hambach Stelle 189 (Gaitzsch *et al.* 2000, 208).

[103] E.g., Sommer 1984, Taf. 10.2 from Bad Kreuznach.

[104] Rhenen-Dondersberg grave 829 and 846 (Böhme 1974, 269, Taf. 62.7; Böhme 1974, 272, Taf. 68.4); Krefeld-Gellep grave 5048 (Pirling and Siepen 2000, Taf. 45); Tongeren-ZW grave 118 (Vanvinckenroye 1995b).

[105] Nicolay 2007, 36.

[106] Nicolay 2007, 36ff.

[107] Böhme 2021, 151, Abb. 75.

[108] 4th-century: Krefeld-Gellep graves 720, 1107a (Pirling 1966, Taf. 63, 92), 1331 (Pirling 1974, Taf. 22) and 3001 (Pirling 1989, Taf. 13); Wijchen-Centrum 32 (Heeren and Hazenberg 2011); Rhenen-Dondersberg 829, 835 (Wagner and Ypey 2011); Spontin B (Böhme 1974). 5th-century: Kalkar-Monterberg 17a (Böhme 1974, 276); Krefeld-Gellep 929, 1100 (Pirling 1966, Taf. 74, 91); Rhenen-Dondersberg 833, 842 (Wagner and Ypey 2011); Vieuxville 1938 (Böhme 1974, 305).

[109] Among others: Sahlenburg graves 29 and 32 (Böhme 1974, 250, Taf. 39.9; Böhme 1974, 250-1, Taf. 40.9); Wijster grave 116 (Böhme 1974, 274, Taf. 71.6); Westerwanna graves 212 and 693 (Böhme 1974, 256, Taf. 46.19-20; Böhme 1974, 258, Taf. 49.3-4, 7); Issendorf grave 3521 (Häßler 1994); Liebenau grave M8/A2 (Cosack 1982).

[110] Sommer 1984, Karte 1-7; Böhme 1974, 90-91; Swift 2000a, 185-186, 188-189.

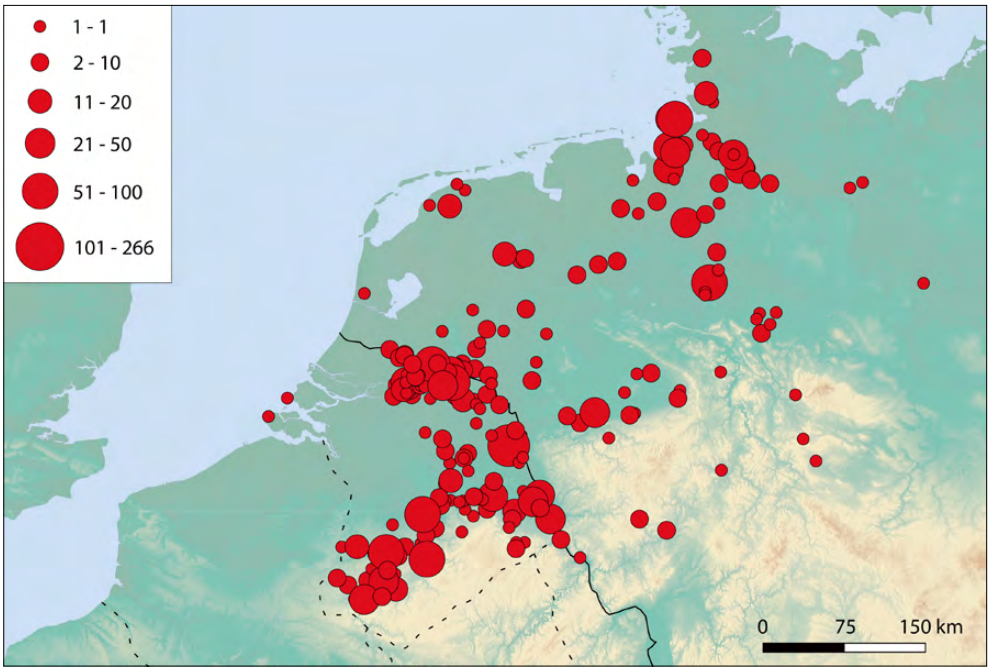


Figure 4.6. Distribution of all belt buckles, strap ends and fittings found in the study area (4th and 5th centuries).

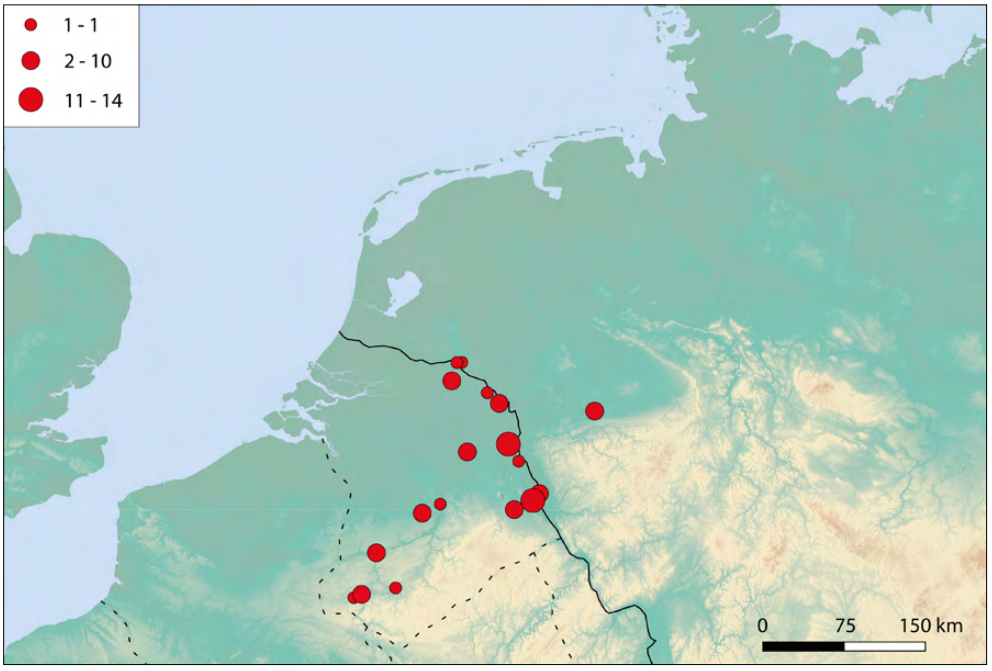


Figure 4.7. Distribution map of propellor-shaped belt stiffeners.

either region.[111] Not all types of buckles and strap ends in Sommer's typology were found in the study area, as many are regional types found predominantly in other areas of the Empire. In Germania Secunda, there appears to be a strong overall preference for *Sorte* 1 type buckles in the 4th century over *Sorte* 2 types. Sommer also proposed that the 1Cf buckle was a type specific to Northern Gaul[112] and this preference is strongly represented in Germania Secunda and Magna: 1Cf buckles make up 32% of all buckles in the study area in the 4th century. In the 5th century, Sommer *Sorte* 3 buckles with a fixed backplate are the most common form in the study area, especially those with animal-headed terminals (Sommer 3f).

Similarly, characteristic for the region are propellor-shaped belt stiffeners and tubular mounts with rectangular plates,[113] both of which were frequently found alongside both 4th- and 5th-century buckles and strap ends (the latter mostly from the second half of

[111] E.g., Vieuxville type buckles, which are common in the Gallo-Belgic regions, but are not found along the Danube; Böhme 1974, 90-91, Karte 12.

[112] Sommer 1984.

[113] Cf. Sommer 1984, Karte 2 and 7 respectively.

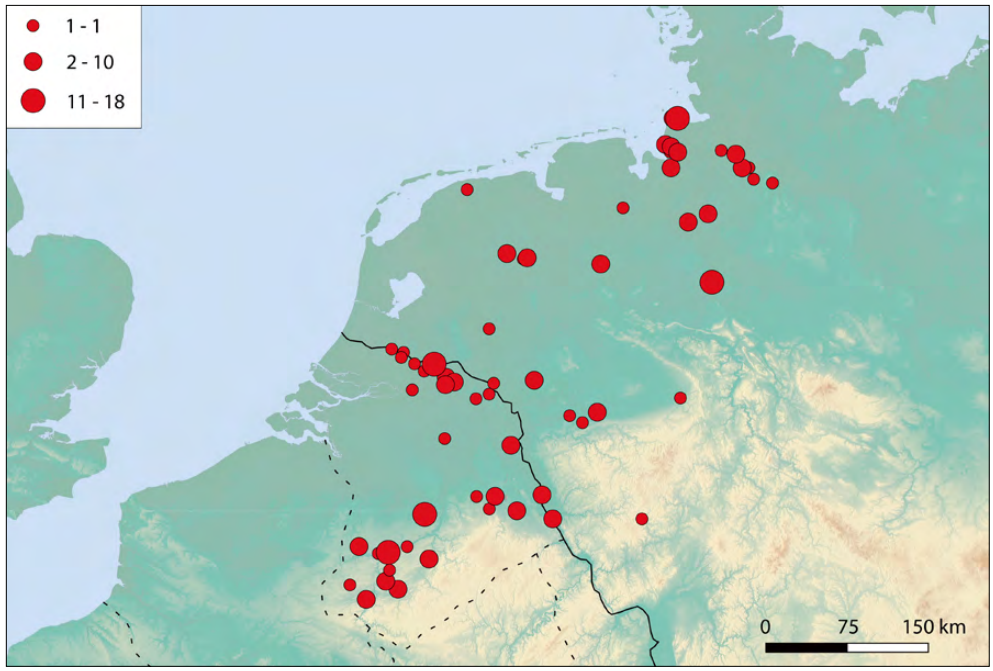


Figure 4.8. Distribution of tubular mounts.

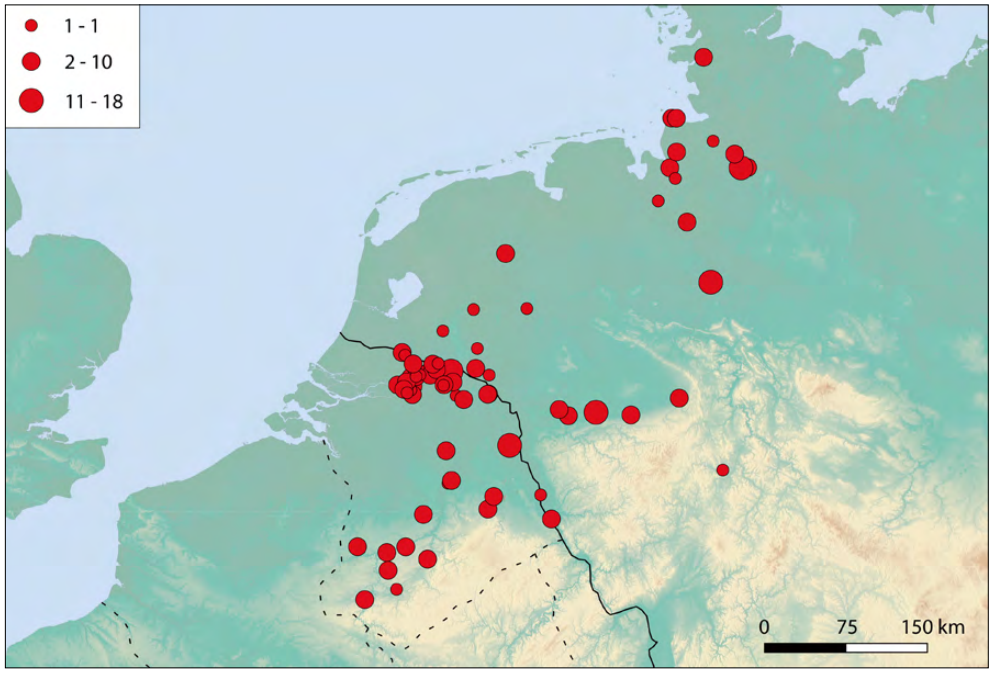


Figure 4.9. Distribution of round suspension mounts.

the 4th century onwards). Apart from Kamen-Westick, no propellor-shaped fittings were found in Germania Magna (figure 4.7). Tubular mounts on the other hand were one of the most common fittings found outside of the Empire and indeed everywhere else (figure 4.8). Round and rectangular suspension mounts similarly were found across the study area (figures 4.9-10), while triangular suspension mounts were predominantly found in Germania Secunda (figure 4.11) and rhombic mounts in Germania Magna (figure 4.11). As for strap ends, the majority in the study area were amphora-shaped, across the 4th and 5th centuries and in both Germania Secunda and Magna. Sommer type D strap ends (folded square) were the rarest form (14.84% of all strap ends) found and were predominantly found in Germania Secunda.

Site types and distribution by period

The combined datasets of crossbow brooches and military belt fittings may be mapped together in broad chronological blocks. Of course, not all dates for all types completely overlap, but generally speaking, crossbow brooches of Swift type 2 may be mapped on top of belt fittings dated to the first half of the 4th century (similar for the Swift 3/4 group and belt fittings of the

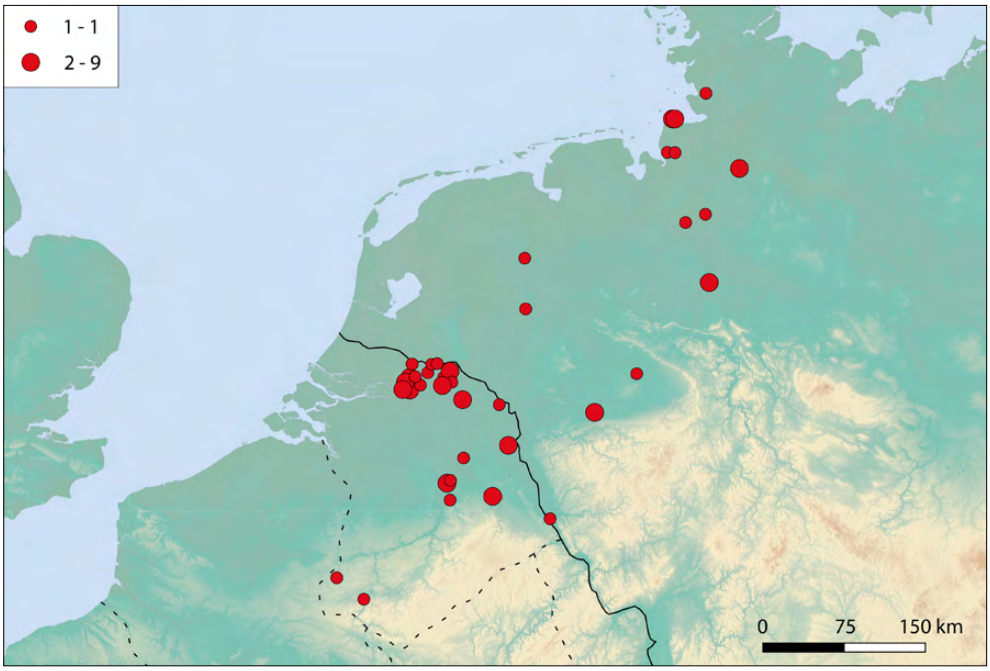


Figure 4.10. Distribution of rectangular suspension mounts.

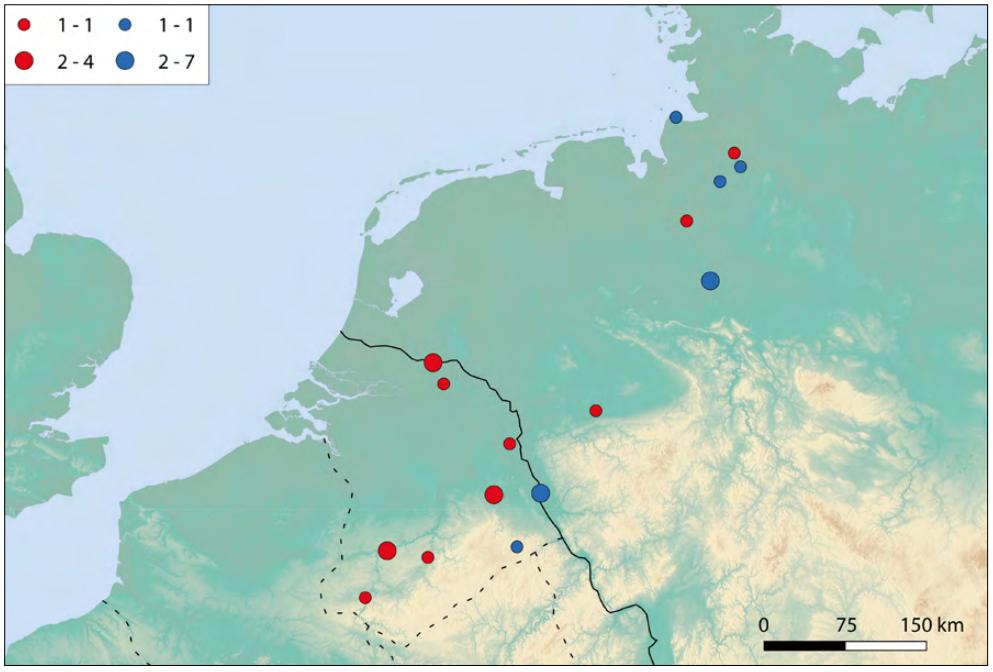


Figure 4.11. Distribution of rhombic (red) and triangular suspension mounts (blue).

second half of the 4th century). The 4th-century belt fittings show a very similar distribution to the Swift 3/4 crossbow brooches (figure 4.12), with clear clusters around the *limes* and road system. The vast majority were found in (military) cemeteries, with hardly any finds of buckles in rural settlements or villa complexes (where 4th-century crossbow brooches occasionally occur). Of the eight buckles from rural settlements, five come from settlements where other finds and variables have been linked to Germanic migrants (chapter 3).[114] All datable belt parts from these sites are dated to the second half of the 4th century. A small number of strap ends and fittings was found in provincial-Roman rural settlements in Germania Secunda (42 in total). These predominantly date to the second half of the 4th and the first half of the 5th century.

Deposition in most urban centres was also limited to the 4th century. In Xanten, all datable belt fittings found dated to the 4th century. Cologne yielded mostly 4th-

[114] Namely Baelen-Nereth (Hanut *et al.* 2012, figure 4.3; cf. Hanut *et al.* 2013, 153); Cuijk-De Nielt (Habermehl and Van Renswoude 2017, figure 10.29); Neerharen-Rekem (De Boe 1986; Van Ossel 1992, 300) and Holtum-Noord (Wagner and Ham 2011).

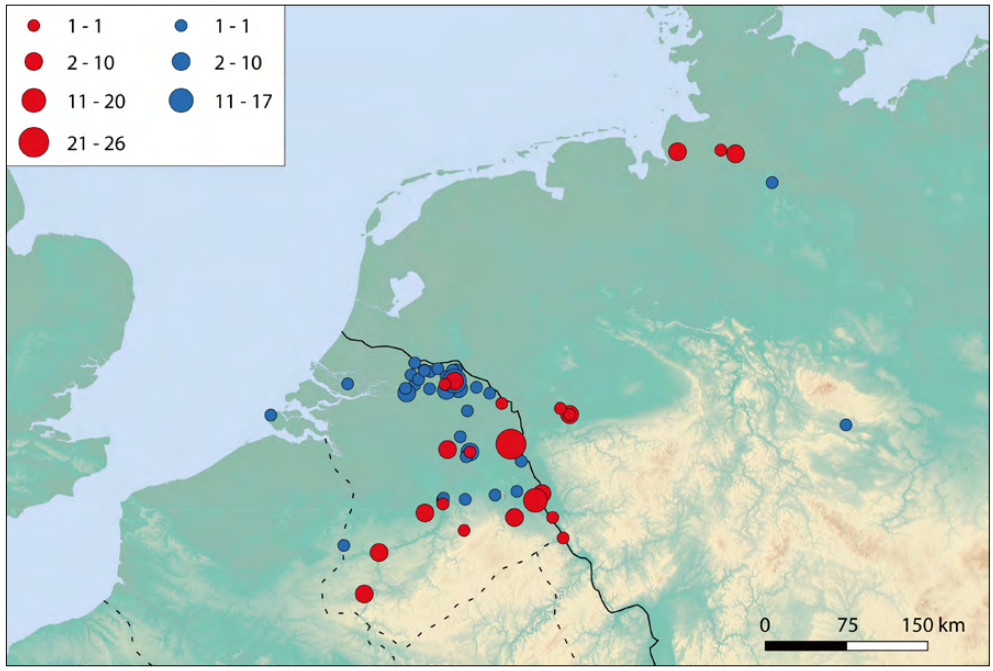


Figure 4.12. Distribution of belt fittings (red) and crossbow brooches (blue) dated to the first half of the 4th century.

century material with a small number of 5th-century finds; in Nijmegen the numbers for each period were about equal and Tongeren yielded more 5th-century than 4th-century material. Significant continuity was also found in cemeteries associated with or near military fortifications.[115] Other military complexes with 4th-century material such as Andernach, Remagen and Furfooz did not yield any 5th-century material. It is notable that the evidence for continuity between the 4th and 5th centuries is equally good for the immediate frontier zone and the *Höhensiedlungen* in the hinterland. More detailed chronological developments in the distribution of belt fittings may be linked to the distribution of crossbow brooches.

This period presents a curious difference in distribution between crossbow brooches and belt fittings. The latter are generally quite rare in the study area and are completely absent from the central Dutch river area, while crossbow brooches were very numerous there. There is some activity in the hinterland, but no belt fittings were found in the *Höhensiedlungen* of the Ardenne region: all early 4th-century belt fittings south of the frontiers were found in urban or rural contexts. Finds from the *limes* infrastructure are the most common and most of the larger German Lower Rhine forts are represented.

Dutch Rhine or Meuse fortifications yielded few to no finds from the first half of the 4th century; while in some cases this may be due to excavation or publication bias, it may also represent a very true lack of activity at certain sites. There is some material from southern urban/military sites (Tongeren and Maastricht), but no finds from Nijmegen for example could be reliable dated to the first half of the 4th century. As seen above, the continuity of military activity in the eastern Dutch river area is much more evident from the crossbow brooches in this period (Swift 2), which were found in a number of rural settlements and military fortifications in the *limes* zone. I believe the general rarity of belt fittings in the Lower Rhine in the first half of the 4th century is due in some part to typology rather than a genuine absence of material. The empty regions of the central Dutch river area are filled with a lot of material that could not be dated more closely than 4th-5th century and could therefore conceivably include material from the first half of the 4th century. Military activity in many Lower Rhine forts in that area is established for the first half of the 4th century through other means.[116]

Stray finds or finds from rural settlements in the *limes* hinterland were extremely rare. One buckle (a Sommer 2B) was found in the 'migration-related settlement' of Baelen-Nereth. Rural cemeteries yielded additional material.[117] The number of belt fittings found in Germania Magna in this period is negligible, totalling 11 pieces. There are several notable points about this small dataset. First of all is the fact that all four buckles are of the Sommer *Sorte* 2 type (generally rare in the research area; see above). Most of these finds are also

[115] Including in Bonn (Sommer 1984; Müssemeier 2011; Naber 1984; Gottschalk 2015); Jülich (Pöppelmann 2001; Gottschalk 2015; Krueger 1975); Krefeld-Gellep (Pirling 1966; ibid. 1974; ibid. 1979; ibid. 1989; Pirling and Siepen 2000; ibid. 2003), Nijmegen (Steures 2013; Böhme 1974); Ben-Ahin, Eprave and Samson (Böhme 1974).

[116] Including coins and pottery; Van der Meulen 2017; Brüggler 2018.

[117] Hürth-Hermülheim (Gottschalk 1999; ibid. 2007; ibid. 2008); Wijchen-Centrum (Heeren and Hazenberg 2011).

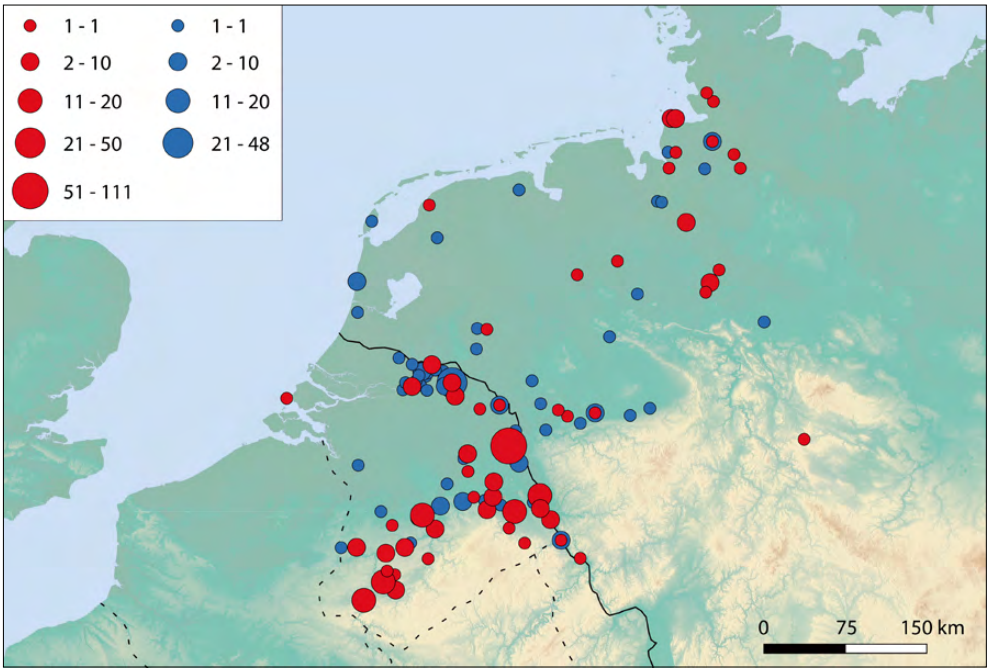


Figure 4.13. Distribution of belt fittings (red) and crossbow brooches (blue) dated to the second half of the 4th century.

from settlements.[118] This closely mirrors the pattern seen in this period in the crossbow brooches (Swift 1 and 2), which are similarly rare in Germania Magna and also mostly found in settlements.[119]

The difference in distribution between the first and second half of the 4th century is quite stark (figure 4.13). Several areas that were previously empty are filled in, and there is now a complete overlap in distribution between crossbow brooches and belt fittings. In the Dutch river area, which in the previous period did not yield a great number of belt fittings, a significant number of belt fittings are found dating to the second half of the 4th century, although the majority of these were registered stray finds. Excavated material is known from Nijmegen (both from the inner structures of the fort and its associated cemeteries), as well as several German Lower Rhine forts (Bonn, Cologne, Krefeld-Gellep, Jülich) and several sites located along the Meuse and further in-land (Cuijk, Tongeren). The *Höhensiedlungen* of the Ardenne region in Germany and Wallonia also yielded significant numbers of belt fittings in this period (Eprave, Furfooz, Samson, Spontin), although crossbow brooches are rarer here (Furfooz, Liberchies).

This intensification in belt fittings closely mirrors the contemporary crossbow brooches: more than half of all crossbow brooches found in Germania Secunda are Swift 3/4 types. The dispersion of belt fittings into the southern fortifications along the Cologne-Bavay route can be seen as indicative of a deepening or widening of frontier defense systems.[120] Again, finds from rural settlements in the hinterland of the *limes* were extremely rare. One Sommer 1Cf2 buckle from Cuijk-De Nielt was registered, again a potential 'migration-related settlement' based on a number of sunken huts.[121] Cemeteries fill in the gap, especially in the German Rhineland[122] and Wallonia.[123] The cemetery at Rhenen-Donderberg yielded the largest number of finds from any rural site in this period.

Significantly more datable material was also found in this period in Germania Magna, potentially signifying intensification of movement between the Roman provinces and Free Germany by veterans. Several of the large cremation cemeteries in Lower Saxony areas were represented,[124] in addition to settlements further to the south in Overijssel and Westphalia.[125] All buckles from Germania Magna are Sommer *Sorte* 1 types (mostly 1Cf, some 1C and 1E), closely mirroring the most common types in Germania Secunda. Similarly, the majority of strap ends were amphora-shaped (Sommer Bc1), with a smaller number of Sommer C types.

[118] Recklinghausen-Erin (Erdrich 2002, Taf. 47); Castrop-Rauxel (Böhme 1974; Pape and Speckmann 2011; Pape and Speckmann 2010; Neujahrsgruß 2008); and Oldendorf (Schlüter 1985; Erdrich 2002, 458).
[119] Bielen (Seidel 2006, 39, Abb.15) and Kamen-Westick (Könemann 2018) and Texel (PAN-00051835).
[120] Cf. Swift 2000a, 219.
[121] Habermehl and Van Renswoude 2017.
[122] Eschweiler-Lohn (Gottschalk 2015), Katzem-im Jäger (Sommer 1984; Siegmund 1998b; Gottschalk 2015); Nettersheim (Nieveler 2003; Gottschalk 2015).
[123] Tongrinne (Böhme 1974), Treignes (Bullinger 1969).
[124] See Böhme 1974 for Bremen-Mahndorf; Hemmoor-Warstade; Westerwanna and (Böhme 1974).
[125] Castrop-Rauxel (Pape and Speckmann 2010; Pape and Spekmann 2011; Böhme 1974; Neujahrsgruss 2008); Deventer (Hermsen 2007), Recklinghausen-Erin (Erdrich 2002), Kamen-Westick (Könemann 2018) and Klusenstein (Böhme 1974, 238).

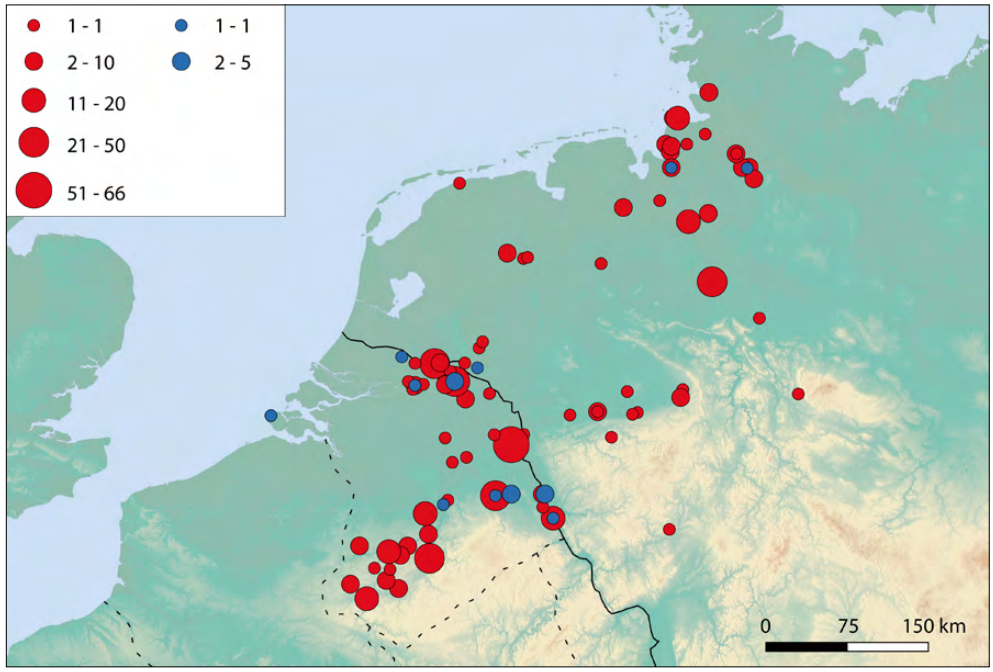


Figure 4.14. Distribution of belt fittings (red) and crossbow brooches (blue) dated to the 5th century.

The overall distribution of belt fittings in the 5th century does not differ significantly from the second half of the 4th century in Germania Secunda. There is good continuity in many of the *Höhensiedlungen* in Wallonia and the number of sites with military belt fittings here increased in the 5th century,[126] further deepening the frontiers. In the immediate river area, several sites associated with the larger military fortifications still yielded material in the 5th century,[127] although the overall amount of material dated to the 5th century is lower than in the 4th century.

The Rhine frontier showed remarkable continuity in appearance of military-associated belts and brooches in the first half of the 5th century (figure 4.14). Rural settlements and cemeteries are still well-represented, including Rhenen-Dondersberg and a number of other rural cemeteries.[128] No clear increase in material from rural or settlement contexts could be identified. The general distribution of belt fittings in the 5th century still closely follows the military frontiers, along the Rhine and Meuse and Cologne-Bavay route. There are no clear indications that belt fittings were disseminated amongst a wider selection of the rural or civilian population in the 5th century or were brought into the rural hinterland in increased numbers by *foederati* living there. The correlation between belt fittings and 'migration-related settlements' is also not particularly strong: in the 5th century four pieces are known from four sites.[129]

The amount of material found in Germania Magna did increase, however, compared to the later 4th century, in contrast to the relative absence of crossbow brooches there in the same period. This increase is best observed in the cemeteries of Lower Saxony, where both the number of sites with 5th-century material increased and the amount of material found per site. Settlements in Westphalia that yielded plenty of 4th-century material such as were still represented,[130] although only small numbers of finds were identified in each settlement. New settlement material was found in Lower Saxony[131] and Westphalia,[132] but again not in great numbers (one to two datable finds per settlement). This increased exchange of material culture between the Roman Empire and the settlements of the Germanic north could potentially signify an increase in military service by Germanic *foederati* in the 5th century (figures 4.15-16).

[126] Ben-Ahin (Böhme 1974, 287); Eprave (Böhme 1974, 288); Furfooz (Böhme 1974, 289-290); Hamme (Böhme 1974, 291); Samson (Böhme 1974, 298-299); Tongrinne (Böhme 1974, 303); Vieuxville (Alénus-Lecerf 1981; ibid. 1982; ibid. 1984; ibid. 1985; ibid. 1986; Böhme 1974); Virton (Massart 2021).

[127] Bonn (Sommer 1984; Müssemeier 2011; Naber 1984; Gottschalk 2015); Jülich) Pöppelmann 2010; Gottschalk 2015); Kalkar-Monterberg (Böhme 1974, 276; Sommer 1984); Krefeld-Gellep (Pirling 1966; ibid. 1974; ibid. 1979; ibid. 1989; Pirling and Siepen 2000; ibid. 2003); Nijmegen (Steures 2013; Böhme 1974).

[128] Ewijk-Keizershoeve (Blom *et al.* 2012); Gennep-Touwslagersgroes (Theuws 2008); Hürth-Hermülheim (Gottschalk 1999; Gottschalk 2008).

[129] Buggenum Wijnaerden (Meurkens 2021); Wijchen-Tienakker (Heirbaut and Van Enckevort 2011, figure 12.1) and Wijk bij Duurstede-Trekweg (Nicolay 2007).

[130] Castrop-Rauxel (Pape and Speckmann 2010; ibid. 2011; Neujahrsgruss 2008); Recklinghausen-Erin (Erdrich 2002 Taf. 47) and Kamen-Westick (Könemann 2018).

[131] Sievern (Aufderhaar 2016); Elsfleth-Hogenkamp (Mückenberger 2013).

[132] Paderborn-Balhorn (Neujahrsgruß 1981; Eggenstein 2000) and Soest-Erwitte (Erdrich 2002, 273).

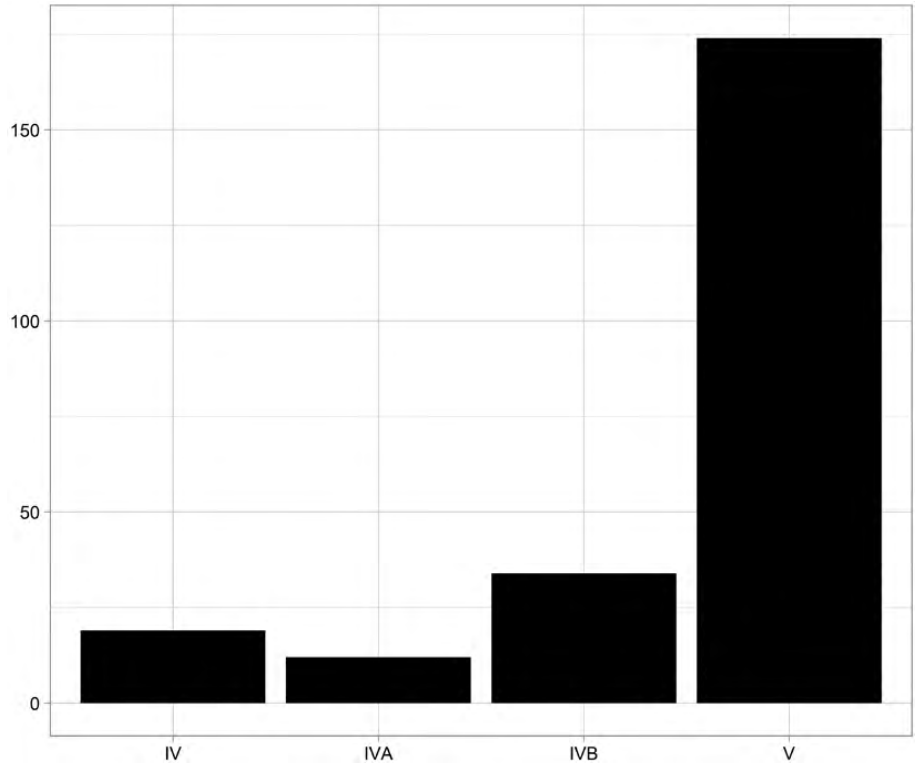


Figure 4.15. Bar plot of dated Late Roman belt fittings and crossbow brooches in Germania Secunda.

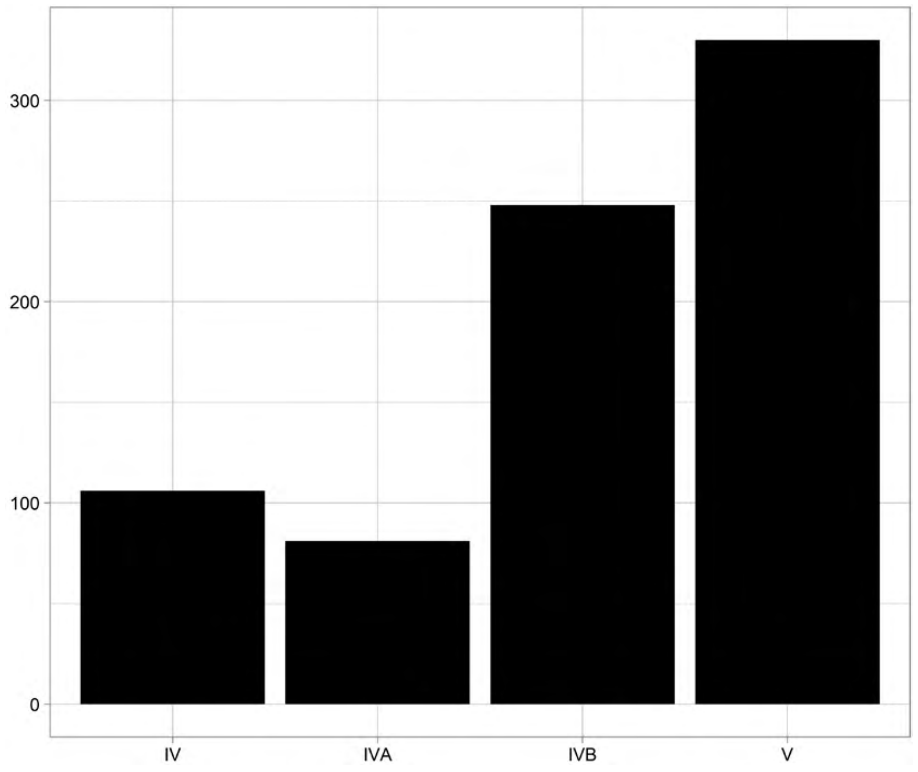


Figure 4.16. Bar plot of dated Late Roman belt fittings and crossbow brooches in Germania Magna.

Depositional practices: 'belt graves'

As artefact traps of deliberately deposited material, cemeteries and graves are the largest source of belt fittings in the dataset. Settlement and stray finds (which potentially also include accidental losses) only made up 28% of the dataset. Rural settlements and villas in the frontier zone were also more likely to yield belt fittings compared to sites further from the frontier. To describe the grave contents for each grave containing belts or parts of belts would be beyond the scope of this chapter, but a brief characterisation of the 'belt grave' ritual may be presented. In general, graves with belts do not differ greatly in terms of burial customs from

those without belts and fit into their regional burial rites. In both Germania Magna and Germania Secunda, both the inhumation and cremation burial rite were practiced, and both may be encountered within the same cemetery[133] although inhumations were generally the norm in Germania Secunda and cremations in Germania Magna. No biases in belt deposition were found towards any particular rite in either region.

In Germania Secunda, if other grave gifts are present, buckles were clearly clear part of the provincial-Roman furnished inhumation grave tradition.[134] Only in a handful of cases do excavation reports mention buckles in graves in Germania Secunda with 'Frankish' or 'Germanic' pottery, such as grave 4586 in Krefeld-Gellep.[135] Graves from the 5th century tend to feature fewer additional grave goods, a pattern that is generally visible in Late Roman graves,[136] although even then datable finds including wheel-turned pottery, glassware and coins were found alongside belts. No major differences in associated grave goods were found between belt graves in military, urban or rural cemeteries. In Germania Magna, cremations are deposited in local urns and inhumations are accompanied with the same range of grave goods as 'non-belt graves'.

Association with crossbow brooches

Given the military connotations of both object categories, it might be assumed that a strong correlation would be found between belts and crossbow brooches in graves in Germania Secunda. Böhme noted the poor correlation between *Kerbschnitt*-decorated belt sets and crossbow brooches, suggesting that *Kerbschnitt* belts may have been worn by soldiers with a migration background who did not wear a crossbow brooch or associated *sagum*.[137] The data from my study area, however, show a close correlation between crossbow brooch of the Swift 3/4 group with what Böhme classified as 'classic buckles' (*klassische Form*),[138] in these cases the Sommer types 1Aa and 1Ab and 1Ca-ca, as well as a selection of strap end types and ancillary accessories such as tubular and suspension mounts.[139] Graves with belt fittings and Swift type 2 crossbow brooches were only found in Krefeld[140] and only a small number of Swift 5 brooches were deposited in belt graves.[141] This particular brooch/belt grave phenomenon is almost exclusively found in the immediate frontier zone and within that area predominantly in cemeteries closely associated with military or urban centres (Krefeld-Gellep, Jülich, Nijmegen). Finds from rural cemeteries from further south are notably rare. No crossbow brooch/belt combinations were found in graves in Germania Magna, although crossbow brooches were generally rare.

Association with supporting-arm brooches

In the 5th century, only three belt graves were found in Germania Secunda that included a supporting-arm brooch, although in each case these were of the *mit stabförmigen Bügel* military type.[142] Two came from the cemetery at Rhenen.[143] Three further graves with both 78c supporting-arm brooches and belts were found in Germania Magna,[144] although in this region three more graves with female-gendered supporting-arm brooches and belt parts were also identified.[145] A small number of belt graves in the study area also contained weapons, which with the exception of three graves[146] all

133 Eg., Tongeren (Vanvinckenroye 1984; ibid. 1995ab); Krefeld-Gellep (Pirling and Siepen 2006); Liebenau (Häßler 1990).

134 Which included wheel-turned pottery, glass and metal tableware, animal bones and small finds (including iron spoons, knives, scissors, coins and glass beads).

135 Pirling and Siepen 2000, Taf. 5.9.

136 Böhme 2021, 169.

137 Böhme 2021, 168-169.

138 Böhme 2021, Abb. 1.

139 Bonn-Nordstraße grave 48 (Swift 3/4C with Sommer 1Ab buckle; Gottschalk 2015); Cologne-Jakobstraße grave 107 (Swift 3/4 with Sommer 1A; Friedhoff 1991); Furfooz grave 3 (Swift 3/4B, Sommer 1Cf3 and Sommer Bc1; Böhme 1974); Jülich grave 15 (Swift 3/4B, Sommer 1Cb; Pöppelmann 2010); Krefeld-Gellep graves; 1041 (Swift 3/4B, Sommer 1Aa; Pirling 1966, Taf. 84); 1124 (Swift 3/4B, Sommer 1Bb; Pirling 1966, Taf. 93); 2872 (Swift 3/4B, Sommer Cd; Pirling 1979, Taf. 83); 2911 (Swift 3/4B; Sommer 1Aa; Pirling 1989, Taf. 3); 2996 (Swift 3/4B, Sommer 1Aa, Sommer A; Pirling 1989, Taf. 12); 3025 (Swift 3/4D, Sommer 1Ca; Pirling 1989, Taf. 15); 3027 (Swift 3/4B, Sommer 1Cb; Pirling 1989, Taf. 27); 3028 (Swift 3/4B, Sommer *Sorte* 1; Pirling 1989, Taf. 27); 3093 (Swift 3/4B, Sommer 1Ac1, Sommer Bb; Pirling 1989, Taf. 28); 4657 (Swift 3/4, Sommer Bb; Pirling and Siepen 2000, Taf. 11); 5048 (Swift 3/4, rectangular belt plate; Pirling and Siepen 2000); 5541 (Swift 3/4B, Sommer 1Aa; Pirling and Siepen 2003, Taf. 6); 5781 (Swift 3/4A, Sommer 1Ac1, Sommer Cb, nine propellor fittings; Pirling and Siepen 2003, Taf. 38); 6610 (Swift 3/4B, Sommer *Sorte* 1, 3 suspension mounts; Pirling and Siepen 2003, Taf. 90); 6112 (Swift 3/4B, Sommer 1Aa; Pirling and Siepen 2003, Taf. 94); Nijmegen B167 (Swift 3/4C, Sommer 1Cb1; Steures 2013, 71; 638); OO271 (Swift 3/4A, Sommer 1Cb1; Steures 2013, 204, 706); OO283 (Swift 3/4B, Sommer 1Aa; Steures 2013, 206, 709); Wesseling grave 1 (Swift 3/4B, Sommer 1Ab; Gottschalk 2015).

140 Krefeld-Gellep graves 720 (Swift 2i; suspension mount; Pirling 1966, Taf. Taf. 63); 3511 (Swift 2iii; Sommer 1Ca buckle; Pirling 1989, Taf. 85); 3521 (Swift 2iii, Sommer 1Cb1 buckle; Pirling 1989, Taf. 90); Krefeld-Gellep grave 4586 (Swift 2, Sommer B strap end; Pirling and Siepen 2000, Taf. 5).

141 Bonn-Jakobsstraße (Swift 5 with Sommer 1A buckle and Sommer Ba strap end; Sommer 184, Taf. 27); Krefeld-Gellep grave 1222 (Swift 5ii; square plate; Sommer B strap end; Pirling 1966, Taf. 98); Krefeld-Gellep grave 5590 (Swift 5ii, Sommer 1D and 1Bb buckle, two suspension mounts, two tubular mounts, Sommer Dd strap; Pirling and Siepen 2003, Taf. 17).

142 Rhenen grave 842 HF 78c1 with Sommer 3f buckle and Sommer Bc strap end; Wagner and Ypey 2012); Rhenen grave 846: HF 78c1 with tubular mounts, Sommer 1E buckle, suspension mounts, Sommer Bc strap end (Wagner and Ypey 2012).

143 Wagner and Ypey 2011.

144 Gudendorff-Am Finkenberge grave A (HF 78c, Sommer 3f buckle, Sommer B strap end; Böhme 1974); Langen grave 59 (HF 78c1, Sommer 1D buckle; Böhme 1974); Westerwanna grave 1091 (HF 78c with Sommer 1Ab buckle; Böhme 1974); Wiepenkathen (HF 78c2 with rectangular belt plate; Böhme 1974).

145 Langen grave A (HF 78a with suspension mount; Böhme 1974); Liebenau grave P10/A1 (HF 78b1 with Sommer 3f buckle, belt fitting and plate and suspension mounts; Häßler 1990, Taf. 43); Westerwanna grave 1011 (HF 78a with tubular mount; Böhme 1974).

146 Eprave grave 239 (lance), Rhenen grave 841 (javelin) and Vieuxville (spatha, lance, axe); Böhme 2021, 171.

concerned axes, which could be reclassified as tools.[147] Although rare, the practice was found in contexts dating from the second half of the 4th century to the first half of the 5th century[148] and in some cases involves burials of children. Although more common in France,[149] it was occasionally found in Germania Secunda as well[150] and two further children's graves with a belt/weapon combination occured in Germania Magna.[151] The fact that this type of burial was found in both areas and was equally rare on both sides of the frontier seems to suggest it was a more elite, restricted practice of burial, possibly connected to military families.

Pars pro toto deposition

A major issue when dealing with funerary evidence is distinguishing whether a burial constituted the dressed body or whether the dress accessories found as grave goods represented any other particular burial practices. In some instances, rolled-up belts were found in graves deposited near the feet or besides the body, suggesting that those were not worn on the body but deposited purposefully and with care.[152] Böhme viewed this as an indication of the status and value of these objects.[153]

An even clearer indication of additional meaning belt graves were imbued with is the occurrence of partial belts. Of the entire belt set, only the buckle would technically be necessary to make something a functioning belt (set). In that light, it is interesting to note the deposition of *pars pro toto* belts in some parts of the study area: the deposition of all types of belt fittings in graves, but without the buckle. These 'buckle-less belt graves' were mostly found in Germania Magna, where two-thirds (66.18%) of all graves containing belt parts did not contain a buckle. This was only the case in 17% of the belt graves in Germania Secunda. No correlation was found in either region between the absence of a buckle and either the cremation or inhumation rite (apart from the general regional preferences). As the main functional element of the belt this is rather curious, especially in the light of some burials in northern Germany where very elaborate belt sets are deposited consisting of many matching fittings and stiffeners but without a buckle.[154] The often incomplete deposition of sets was already noted by Böhme for the Jülich-Samson sets,[155] but this was also the case for earlier material.

This raises the question where the buckles did end up if not in graves and why they were kept separate. They are not particularly common in settlements in Germania Magna either.[156] Kamen-Westick, renowned for the large number of Roman metal finds found there yielded 44 Late Roman belt parts, three of them buckles. There is thus not a great deal of evidence for suggesting buckles were kept out of the burial rite for their metallurgical value. Hoss has posited that wearing the military belt as a veteran was of greater benefit to display one's identity than receiving the military diploma.[157] It could be that the visual meanings of wearing the military belt did not hold the same importance outside of the Roman Empire (where the visual and material language of the frontier may not have been recognised to the same degree) and that belts in graves in Germania Magna therefore do not represent 'belts as worn' the way belt burials in Germania Secunda were seemingly designed.[158]

Decoration on belts

A lot of emphasis has often been placed on *Kerbschnitt* decoration in previous studies into Late Roman military belts.[159] It is, despite this, one of the rarest forms of decoration on Late Roman belts and is mostly associated with a select number of strap end types (Sommer Bc; D) and buckles (Sommer 1E). The majority of belt buckles, strap ends, and other fittings were decorated with other patterns and schemes and in terms of percentages some differences were noted between Germania Magna and Secunda (table 4.5). A higher percentage of buckles, strap ends and suspensions found in Germania Magna were decorated than in Germania Secunda. This could indicate that people were more selective in which items to bring with them when leaving the Empire or that those that were able to do so enjoyed a higher social status.

In his 1974 work, Böhme already highlighted the difficulty in defining precise belt groups based on decoration, as each piece appeared to have been unique.[160] His 2021 study broadly defined simple pieces (*'klassischer' Form*), *Kerbschnitt*-decorated pieces and belts decorated with dots (*punzverzierte Garnituren*), although there still appears to have been some overlap in decorative features between these groups. Some buckles and strap ends classified as *punzverziert* also feature *Kerbschnitt*-like triangular motives,[161] while

147 Cf. Theuws 2009.
148 4th century: Eprave 239; Rhenen 846; Vieuxville (Böhme 2021, 171). 5th century: Jülich 143 (Böhme 2021, 171).
149 Böhme 2021, note 771-772.
150 Krefeld-Gellep, grave 2749 (Pirling 1979, Taf. 67); Rhenen grave 841 (Wagner and Ypey 2012); Samson graves 1-3 (Böhme 1974); Bonn-Jakobstraße (Sommer 1984, Taf. 27).
151 Sahlenburg 3; Bremen-Mahndorf 19b; Böhme 2021, 171.
152 Krefeld-Gellep grave 4755 (Pirling and Siepen 2000, Taf. 20); Furfooz grave 6 (Böhme 1974, 289, Taf. 89); Eschweiler-Lohn grave 5 (Gottschalk 2015); Vieuxville grave 188 (Alénus-Lecerf 1986).
153 Böhme 2021, 167.
154 Liebenau grave L12/B5 for instance, containing a strap end and ten matching belt stiffeners (Häßler 1985, Taf. 28-29). This grave is also extraordinary as the remains were sexed as female (Häßler 1985), for more on this see below).
155 Böhme 2021, 99.
156 Including stray finds, 38 compared to 92 from funerary contexts.
157 Hoss 2012, 31.
158 See also Halsall 2009, 128; Gottschalk 2008 on placement in graves.
159 Bullinger 1969; Böhme 1974; Ypey 1969.
160 Böhme 1974, 54.
161 E.g. Böhme 2021, Abb. 67.A and C.

	Germania Magna	Germania Secunda
buckle	62.59% (76.06%)	59.03% (68.70%)
strap end	86,08%	72,55%
suspension mount	89,02%	85,77%
belt stiffener	64,71%	84,38%
tubular mount	94,57%	96,91%

Table 4.5. Percentage of belt parts with decoration in Germania Magna and Secunda (numbers in brackets include animal-headed terminals).

concentric circles and dotted circles appear on pieces in each group. In some cases, Sommer's typology included decoration (both the type of decoration and its location on the buckle) as a defining characteristic, often to distinguish variants of particular buckle types (e.g., the 1Ca and 1Cb buckles). For the vast majority of types, however, he simply listed all various schemes of decoration identified instead. A similar approach is taken here, noting the most commonly occurring schemes per object type.

The precise definition of *Kerbschnitt* differs between authors. Some reserve the term only for the elaborate deep-carved motifs known from some high-status finds, which may include geometric patterns or more figurative displays including animals and leaves. The term is also commonly used for any sort of decorative filing of objects, such as the faceting found on Armbrust brooches (see chapter 3). The true *Kerbschnitt* decoration included figurative scenes and geometric schemes, consisting of rows of interlocking polygons. However, some buckles featured more superficial and irregular punched triangles (varying in shape, size and alignment/position). It is possible that this style of decoration mimicked the 'real' *Kerbschnitt* but was carved into the belt after casting. A comparison of the objects (mostly buckles) with real and imitation geometric *Kerbschnitt* shows that the base shapes and types of the buckles are identical. These are also identical to buckles and other objects decorated with patterns carved into the metal after casting (dots, semi-circles, grooves, dotted circles and concentric circles). This opens up the possibility that base material (objects that were finished but not yet decorated) was shipped out and then decorated to individual taste.

This would account for a number of pieces that show uneven decoration: rows of dotted circles or triangles that are not aligned perfectly (for example the belt plates from Übach-Palenberg).[162] The personal touch of the Tongeren strap end[163] is also obvious. It shows a man on one side and a man on horseback on the other side clearly scratched into the surface of the strap end after casting, in a rather coarse manner, suggesting individual handicraft rather than professional work. The depiction is also presented upside-down, so more aimed towards the wearer, clearly showing the personal nature of these objects. Other objects show constellations of, for example, concentric circles that are imperfectly aligned.[164]

Buckles

42% of all belt buckles recorded did not feature any decoration at all, neither on the backplate nor on the buckle itself. It was more common for the backplates to feature decoration than the frames.[165] Because each piece was unique in the amount of surface decoration and type and combination of patterns, it was not attempted to identify decorative style groups; instead, the most common patterns per typological group are listed below in order of commonness (table 4.6). The same prevalence of certain schemes per buckle type were found in Germania Secunda and Germania Magna. Buckles do not appear to have become less elaborately decorated over time and all non-*Kerbschnitt* decoration was found throughout the 4th and 5th centuries.

Strap ends

Almost two-thirds of all strap ends were decorated in some form. Some decorative aspects are baked into the typological divisions, such as presence of *Kerbschnitt* on Sommer Bc1 and Db strap ends. Split out per typological group, the following decorative schemes were most commonly noted (table 4.7).[166]

Concentric and dotted circles featured on almost all types, *usually* on the centre of the strap end plate or along the edges. *Kerbschnitt* was mostly found on 4th-century types. No major differences in decorative preference were noted between Germania Magna and Secunda. Slightly less common were the presence of horizontal grooves and faceting, found for example on a lancet-shaped strap end from Krefeld-Gellep grave 43. Other unique finds include a strap end from Tongeren depicting a man on a horse (see figure 4.23 above).[167] A handful of strap ends, mostly of the Sommer B variety displayed incised triangles for decoration, often placed in a concentric pattern or following the outline of the

[162] Böhme 1974, Taf. 82.8-9.
[163] Böhme 1974, Taf. 106.5 and 5a.
[164] See for examples Böhme 1974, Taf. 16.16, Taf. 33.7, Taf. 63.4-5 and Taf. 64.6-8).
[165] The buckle tongues were usually left plain. Böhme notes that pins in the shape of animal heads are regional to the Rhine provinces (1974, 97), but these are relatively rare and occur more frequently on the Upper Rhine. The most common decoration for tongues found were horizontal grooves interspersed with faceted surfaces filed into the tongue. Parallels for this type of decoration were also found in other belt fittings, but notably also in a number of common contemporary brooch types (see chapter 3).
[166] No counts are given per decorative scheme, as in some cases multiple different patterns occurred on the same object.
[167] Böhme 1974, Taf. 106.5.

Type	Frame	Plate
Sommer 1A	plain	plain
Sommer 1Aa	plain, dotted circles	concentric circles, plain
Sommer 1Ab	plain	concentric and dotted circles
Sommer 1Ac	plain	plain, concentric and dotted circles
Sommer 1B	plain	plain
Sommer 1Ca	plain	plain
Sommer 1Ca1	plain, dots	plain, notches in edge
Sommer 1Ca3	plain, semi-circles	dotted circles
Sommer 1Ca4	faceting	plain
Sommer 1Ca5	dots	plain
Sommer 1Cb	plain	plain, grooves
Sommer 1Cb1	plain, dots	plain
Sommer 1Cb2	plain	plain
Sommer 1Cb3	grooves	plain
Sommer 1Cb4	plain, grooves	plain
Sommer 1Cb5	plain	plain
Sommer 1Cd	plain, dotted circles	plain
Sommer 1Cd2	plain	plain, dots
Sommer 1Cd3	plain	plain
Sommer 1Cd5	dots	plain
Sommer 1Cd6	dotted circles	grooves
Sommer 1Ce	plain	grooves
Sommer 1Ce2	dotted circles	grooves
Sommer 1Cf	plain, semi-circles, triangles, dots	grooves, semi-circles, triangles, dots
Sommer 1Cf1	semi-circles, dots, triangles	semi-circles, dots, dotted circles
Sommer 1Cf2	semi-circles and dotted circles, dots	plain, grooves, geometric Kerbschnitt
Sommer 1Cf3	plain, semi-circles, grooves	plain, dots, geometric Kerbschnitt
Sommer 1Cf4	faceting, dots, triangles	faceting, figurative Kerbschnitt, grooves, triangles, concentric circles
Sommer 1Cf5	triangles, dotted circles, dots, geometric Kerbschnitt	triangles, geometric Kerbschnitt, dotted circles, dots
Sommer 1D	plain	plain
Sommer 1E	plain	figurative and geometric Kerbschnitt
Sommer 2A	plain, dots	dots
Sommer 2B	plain, dotted circles	plain, dotted circles
Sommer 2C	plain, dotted circles	plain, dotted circles
Sommer 2D	circles	notches on rim
Sommer 3b	plain	notches on rim, dotted circles
Sommer 3c	ribbing	grooves, concentric circles
Sommer 3e	plain	plain
Sommer 3f	dots	dots, grooves
Sommer 3h	dotted circles	no data

Table 4.6. The most common decorative schemes on frames and plates of buckle types (typology after Sommer 1984).

strap end (see for the same pattern on buckles above). In almost all cases, these decorations matched those of the buckle and backplate they were found with.

Much like the buckles, the strap ends clearly show significant continuity of decorative patterns throughout the 4th and 5th centuries. Although *Kerbschnitt* became significantly less common in the 5th century, staple decorative schemes such as dotted circles, rows of dots, punched triangles and concentric or dotted circles appear on both 4th- and 5th-century strap ends of various types. No single scheme could be identified that only or predominantly occurred in either period.

Suspension mounts

The decoration schemes found on the suspension mounts were fairly standardised and follow a clear

Type	Decoration
Sommer A	concentric circles, dotted circles, plain
Sommer B	concentric circles, dotted circles, faceting, plain
Sommer Ba	dotted circles, plain
Sommer Bb	concentric circles, dotted circles, plain
Sommer Bc	concentric circles, dotted circles, faceting, plain
Sommer Bc1	figurative and geometric Kerbschnitt
Sommer Bc2	concentric circles, dotted circles, faceting, plain
Sommer C	faceting, rosette, plain
Sommer Ca	rosette, plain
Sommer Cb	dotted circles
Sommer Cd	concentric circles, plain
Sommer D	plain
Sommer Da	concentric circles, dotted circles, scoring
Sommer Db	geometric Kerbschnitt
Sommer Dc	faceting

Table 4.7. The most common decorative schemes on strap end types (typology after Sommer 1984).

pattern related to the type of mount. The round suspension mounts were almost always decorated with a flower-shaped outline (rosette mounts). The second most common decoration was a cluster of concentric circles. No clear differences in decoration were found between the different sub-regions or between periods. Triangular suspension mounts were extremely rare and were only found as part of two belt sets from graves[168] where they featured elaborate figurative *Kerbschnitt* to match the other fittings and plates. Square, rectangular and rhombic suspension mounts were relatively rare (especially the rhombic type), but all followed the same decorative scheme: parallel horizontal grooves running the width of the mount, with perpendicular notches and faceting in the edges of the mount.

Belt stiffeners

Faceting with horizontal grooves and notches was also the most common decoration pattern on strip-like belt stiffeners, in all regions and periods. Occasionally, a line of dots or small dotted circles running along the length of the strip was added or concentric circles, both of which are also frequently found on simple Armbrust and supporting-arm brooches (see chapter 3). Propellor-shaped belt stiffeners were almost always plain, sometimes featuring a concentric set of circles in the centre or a rib running along the length.

[168] Rhenen-Dondersberg 846 (Böhme 1974, 272, Taf. 69; Wagner and Ypey 2011); Samson 10 (Böhme 1974, 299, Dasnoy 1968).

Decorative plates

Decorative plates, tended to follow the decorative style of the main buckle and backplate they were found with when part of a grave set. Most were plain, while some featured geometric *Kerbschnitt*, ovolo along the rims, hatched lines running along the rim creating a central frame and dotted circles. While geometric *Kerbschnitt* and patterns of dotted circles or semi-circles were the most common schemes in the 4th century, the majority of 5th-century belt plates were plain. This was the case in both Germania Magna and Secunda.

Tubular mounts

The decoration of tubular mounts was fairly uniform. The tubes all featured horizontal ribbing (figure 4.10). Böhme assumes this effect to have been achieved by use of a lathe for those that were not cast.[169] In a few rare cases, prismatic zones were added, to create an effect that is similar to the contemporary Wijster and Fécamp hairpins. This effect was found on seven tubular mounts, five of which came from Germania Magna. The plates were mostly left plain, with some featuring a range of decorative schemes such as concentric circles, semi-circles, triangles, dotted circles, hatched lines, figurative and geometric *Kerbschnitt*. No preferences for specific schemes were found in any of the sub-regions of the study area. 5th-century tubular mounts seem to have featured simpler decoration: fewer plates had *Kerbschnitt* and the most common schemes were arrangements of dotted circles and hatched lines.

Discussion

Many of the non-*Kerbschnitt* decorative schemes briefly described above overlap with those commonly found in civilian-associated dress accessories (faceting, dotted circles concentric circles, dots; see chapter 3). Geometric and figurative *Kerbschnitt* does appear to have been restricted to military belts,[170] raising the question of how to interpret belt fittings that were more simply decorated or left plain. Swift suggested that those buckles with the widest and most universal distribution could be argued to have stronger associations with the military.[171] Taking that argument further, common non-*Kerbschnitt* belt items like the buckles with animal-headed terminals and amphora-shaped strap ends are still likely to have been worn predominantly by military

[169] Böhme 1974, 92.

[170] These show some similarity to 5th-century and early medieval saucer brooches (Böhme 1974, 24-30), although arguably those date later than the majority of figurative *Kerbschnitt* belts and could be later adoptions of this style by non-military communities.

[171] Swift 2000a, 201.

personnel as their distribution is closely focused around the immediate frontier zone in both Germania Secunda.

Both *Kerbschnitt* and non-*Kerbschnitt* belt fittings show good evidence for military connotations in their distribution and deposition, at least within Germania Secunda. Most, although not all *Kerbschnitt*-decorated objects were dated to the (second half of the) 4th century,[172] when the *einfache Garnitur* became the predominant belt form in the 5th century. The deep geometric and figurative *Kerbschnitt* on many of these objects would have been cast (see also the mould from Emmerich-Praest),[173] while most other decorative schemes found could be added later. However, it needs to be emphasised that the majority of belt fittings was not decorated with *Kerbschnitt* in either period. Of all recorded belt elements, 9.57% were decorated at least partially with elaborate geometric or figurative *Kerbschnitt*. It makes intuitive sense to explain this relative rarity in terms of status and rank within the military community itself, with officers being able or allowed to wear more elaborate and more elaborately decorated belts. The popularity of non-*Kerbschnitt* decoration shows that those wearing plainer belts were keen to have some other form of decoration. It is possible that these schemes were added to fittings later.

This opens up the possibility that the casting or forging of belt fittings and their decoration may have happened at different times and therefore in different places. Lacking any hard evidence for workshops or tools, this remains speculative, but it could be possible that belt parts were produced relatively plainly (potentially even half-finished) and distributed as such to the army. Previous studies have suggested the wide variety and individuality of belts and their decorations may be indicative of small-scale workshops, but separating the various stages of the *chaîne opératoire* in this manner allows different manufacturing activities to be organised either locally or centrally. This point will be further explored in chapter 7 on the object dimensions and metallurgy, data related to the casting of the objects.

Notably, a number of decorative stylings were also common in other forms of material culture. The link between the faceting with horizontal grooves found on buckle tongues, backplates, suspension mounts, belt stiffeners and strap ends with Armbrust and supporting arm brooches has already been made above. Dotted circles are also commonly found on Armbrust and supporting arm brooches and on other types of Late Roman material culture, such as bone and antler combs,[174] needle holders, fire strikers and bone chest fittings. The combination of ribbing with prismatic zones that is so distinct for Late Roman hairpins was also occasionally found on tubular mounts, although admittedly this was quite rare.

Social connotations

In the discussion above, the military nature of the Late Roman belt has been largely supported by its distribution. However, some scholars have questioned the military nature of belts on other grounds or suggested other social or gendered labels.

Adoption by civilian administrators

Sommer, for instance, claimed that by the Late Roman period, the military belt had lost its military exclusivity and was widely adopted by the civilian population, including women.[175] The significant overlap in decorative stylings with contemporary civilian dress accessories could be seen as in support of this non-military use, but as stated above, could also simply mean that these types of imagery were widespread and popular and not restricted to any particular social group. Furthermore, the association between Late Roman belts and fortified sites or cemeteries belonging to military complexes is quite strong, while they are rare in rarer in urban or rural contexts. Furthermore, finds associated more with women specifically or the civilian population more generally (chapter 3) hardly ever appear together in single contexts with military-associated finds.[176] The correlation between military belts and crossbow brooches in graves in the frontier zone is also notable, especially in the second half of the 4th century.

Swift recognised that not all Late Roman belts were necessarily restricted to the military but suggested that those types with the most universal distribution would have been the likeliest to have been military in nature.[177] This line of reasoning was already followed above to account for the most common belt fittings in the study area, namely the buckles with animal-headed terminals and amphora-shaped strap ends. The same may also be posited for propellor-shaped belt stiffeners. Other types of buckles and strap ends were very rare in Germania Secunda, namely buckles of Sommer *Sorte* 2

[172] Of all datable objects with *Kerbschnitt* (geometric or figurative), 83% was dated to the second half of the 4th century, 15% to the first half of the 5th century. Alternatively, 21% of all belt elements dated to the 4th century contained Kerbschnitt, compared to 5% of all 5th-century belt elements.

[173] Sommer 1984, 102.

[174] Thomas 1960; Böhme 1974, 122-125.

[175] Swift 1984, 102ff.

[176] Only two graves in Germania Secunda contained a combination of military belt fittings and a simple two-piece Armbrust brooch, one of which also included a Wijster hairpin; Nijmegen-Nieuwstraat grave 46 (Böhme 1974, 285, Taf. 85); Nijmegen grave B143 (Steures 2013). Four instances of this combination were found in Germania Magna, in one of these with a tutulus brooch. Bremen-Mahndorf grave 208 (Böhme 1974); Dortmund-Asseln grave 2 (Könemann 2015); Gudendorf-Köstersweg grave 1332 (with tutulus brooch; Böhme 1974) and Langen grave 9 (Böhme 1974).

[177] Swift 2000a, 201.

(with three-part hinge) and round or square strap ends (Sommer types C and D).

The issue that arises is that the majority of these less common types were still found within military or urban-military complexes, namely 62.50% of Sommer *Sorte* 2 buckles and 55.56% of Sommer type C and D strap ends (not including stray finds). The only difference between the frontier zone and the hinterland in Germania Secunda is the number of belt accoutrements found in each subregion: the same variety of types is represented in each area. The same is true with the surveyed area of Germania Magna: the belt buckles and fittings found there do not deviate substantially from those in Germania Secunda but are simply an extension of the same spectrum with the same relative numbers of finds of each category. This does not seem indicative of widespread use of military-style belt buckles by non-military personnel.

The distribution of military belt fittings in urban-military complexes such as Nijmegen, Tongeren and Xanten does give some support to the idea that they could also be worn by governmental officials. It could be questioned how much distinction there really was in the Late Roman frontier area between army personnel and government officials, given the militarisation of the Roman state since the reign of Diocletian.[178] Bureaucratic and military identities in the frontier zone both derived their powerful status from the military might of the Roman state and distinguishing between the two might be a moot point, especially in the Late Roman frontier provinces.

Possible wear by women

As for Sommer's assertion that military-style belts were also worn by women, there is little clear archaeological data available. Böhme already noted a small number of graves in Germania Magna that he assigned to women containing belt buckles and/or other fittings.[179] Only a small number of these could be identified to type as the majority were very small and fragmented copper-alloy or iron buckles, with only a handful of military-style buckles, strap ends, tubular mounts and suspension mounts. His identification of female graves also seems to have been largely based on the presence of multiple brooches, not osteological data.

Osteological data of human remains are available for a number of cemeteries on either side of the frontier. Generally, sexed graves in Germania Secunda containing belt fittings were those of men, usually between the ages of 18 and 45.[180] In Germania Magna, however, a small but not insignificant number of burials that contained belt parts were osteologically sexed as women (with varying degrees of certainty). Some of these, like Liebenau L12/B5 were very elaborate, containing multiple matching belt stiffeners.[181] Others contained a single buckle or a few suspension mounts,[182] although no particular preference for specific belt parts could be identified. The majority of these graves were dated to the 5th century, however, potentially indicating a shift in belt connotations in that period.[183]

If we include gendered graves (male/female identification based on the other grave goods), the dataset of female belt graves increases somewhat, but not significantly. An interesting case is the cremation burial in Altenbülstedt.[184] Based on the elaborate set of 5th-century brooches, it was assigned a female label, but it also contained a 4th-century Sommer 3e buckle. In this case, the deposition of the buckle could perhaps be interpreted as a family heirloom. These female belt graves might also indicate that the military identity of the man could sometimes be transferred to members of his family. Alternatively, these restricted Roman objects could have important meanings in Germania Magna outside of the military realm, for instance indicating high status or contacts with the Empire because of their rarity.

Germanic identities

Some have linked Late Roman burials with belts as belonging to Germanic *foederati*.[185] In addition, it has been posed that the deposition of a precious metal coin as *obol* (*siliquae* or *solidi*) was favoured predominantly by those of Germanic origin.[186] However, Böhme himself has noted that this practice is rarely found in belt graves.[187] For Germania Secunda at least, this particular rite was found at least four times, two of which concerned graves containing elaborate belt sets and other grave goods,[188] suggesting the practice may also be related to an elite status.[189]

[178] Kulikowski 2000; Van Thienen 2021.
[179] Böhme 1974, 46-47.
[180] Tongeren graves 29 and 94 (Vanvinckenroye 1984, 33, 61); Cologne-Jakobsstraße graves 74 and 204 (Friedhoff 1991); Someren-Waterdael III grave 976 (Hiddink and De Boer 2011, table 9.2); Nismes (Cattelain *et al.* 2016); Nismes Tombe 3 (Cattelain *et al.* 2020); Hürth-Hermülheim grave 5 and 15 (Gottschalk 1999; ibid. 2007; ibid. 2008); Gennep-Touwslagersgroes (Theuws 2008); Someren-Waterdael (Hiddink and De Boer 2011, figure 9.2).
[181] Häßler 1985.
[182] Liebenau graves M12/B3 (Häßler 1985, Taf. 10), L12/B2 (Häßler 1985, Taf. 24), K12/B6 (Häßler 1985, Taf. 55), P10/A2 (Häßler 1990, Taf. 44). Also, Issendorf grave 3540 (Häßler 1994).
[183] Cf. Brather-Walter 2021 on the militarisation of early medieval burials in Germania Magna.
[184] Böhme 1974, Böhme 1974, 218, Taf. 1.3.
[185] Böhme 2021, 144; Böhme 1996; Böhme 1999.
[186] Böhme 2021, 144; Gottschalk 2008, 153.
[187] Böhme 2021, 142.
[188] Rhenen grave 842 (Wagner and Ypey 2011); Vieuxville unnumbered grave (Böhme 1974, 305).
[189] Other graves are: Spontin grave F with a partial buckle (Böhme 1974, 300, Taf. 103) and Hürth-Hülheim grave 38.3 with a buckle (Gottschalk 2008).

A Germanic label has also been proposed for iron buckles.[190] Although these occur slightly more frequently in Germania Magna than in the Roman provinces, they are extremely rare compared to the copper-alloy buckles and in some cases, both are found together.[191] They were also found in graves, such Nijmegen B140 and B654 that did not contain anything other than provincial-Roman import and trade items, such as glass vessels, melon beads and scissors.[192] It is possible that these iron buckles may not have been as strictly military-associated as their copper-alloy counterparts. Problematic conservation plays a role, but iron buckles tend to be very simple in form and generally lack animal-headed terminals or other characteristics of the Late Roman military belt.

Above, the preference for handmade urns in Germania Magna and the provincial-Roman furnished grave tradition alongside wheel-turned pottery, glass and small finds in Germania Secunda was already raised. Böhme has argued that this shift from using handmade pottery to provincial-Roman imports in burials was a sign of integration.[193] Other signs of assimilation into the provincial-Roman rural culture that he noted were the transition from cremation burials to inhumations, using coins as obols and the adoption of the *tunica* by women over their original Germanic *peplos*.[194]

This is one possible perspective, but it seems a stretch to insist on a Germanic interpretation of people who were buried with accoutrements of the Roman army, in a Roman burial rite (inhumation with *obol*), with Roman pottery and Roman brooches (see also literature cited in chapter 1). The deposition of personal dress accessories is something that was common on both sides of the frontier and the deposition of weapons and military accessories is known from the Roman provinces in the Early and Middle Roman period as well.[195] It seems more fitting to interpret these graves as a Late Roman adaptation of earlier practices than put undue emphasis on their 'foreign-ness'. At least in Germania Secunda, the military nature of the burial seems to transcend any indications for non-Roman identities.

[190] Sommer 1984, 101.
[191] For example, Rhenen-Dondersberg grave 818 yielded an iron Sommer 1Cb1 buckle alongside a complete copper-alloy belt set (Sommer 1Ea buckle with five plates), an axe, and a lance (Wagner and Ypey 2012). In Krefeld-Gellep grave 10 one was found along with two copper-alloy buckles and grave 5538 of the same site yielded an iron buckle with a copper-alloy Da strap end (Pirling 1966, Taf. 9; Pirling and Siepen 2003, Taf. 5). Nijmegen grave B180 combined an iron buckle with a copper-alloy propellor-shaped belt stiffener and B167 contained a crossbow brooch (Steures 2013).
[192] Steures 2013.
[193] Böhme 2009, 56.
[194] Böhme 2009, figure 14.
[195] Van Doorselaer 1963/1964; Theuws 2009.

Discussion

The first aim of this chapter was the make an inventory of all recognisable Late Roman belt fittings in the study area (buckles, strap ends, plates, suspension and tubular mounts and belt stiffeners) to characterise the types of belts worn in Germania Secunda, how they dated, how they were decorated and where and how they were deposited. Patterns related to possible production organisation also emerged.

Typology and regional preferences

While differently constructed buckles were favoured in different periods (*Sorte* 1 in the 4th century, *Sorte* 3 in the 5th century), most other aspects remained the same in both centuries. Buckles with animal-headed terminals, amphora-shaped strap ends and rosette-shaped suspension mounts were the most popular items throughout the Late Roman period. Chronological continuity of predominant decorative schemes such as triangular hatching, faceting with horizontal grooves, dotted circles and concentric circles was also identified. Furthermore, no major differences were found in object style or typology between Germania Magna and Germania Secunda: the former appears to have simply been an extension of the spectrum found in the latter. The recurring pattern in each section of this chapter was one of consistency and continuity.

Spatial distribution and the frontier

The second aim of this chapter was to map these military-associated dress accessories in both Germania Secunda and Magna as a proxy for understanding how the Late Roman frontier functioned and was operated. Although the extensive works by Böhme[196] and Sommer[197] were invaluable in this, a large amount of excavation data from the last 30 years (particularly from settlements) and finds from the PAN database could be incorporated to provide updated distribution maps, roughly doubling the number of recorded belt fittings compared to the publication status in 1984.

The distribution of crossbow brooches in the Lower Rhine area (figures 4.2-5) showed that from the mid-4th century onwards, the frontier became increasingly militarised and the number military-associated dress accessories increased sharply. This period also saw an increase in military activity further in-land, with a cluster of crossbow brooches visibly representing the fortified road from Cologne to Bavay.[198] The belt fittings display a very similar narrative, and saw a sharp increase in numbers from the mid-4th century onwards. The majority of belt fittings in Germania

[196] Böhme 1974.
[197] Sommer 1984.
[198] Cf. Brulet 2017, figure 2.

Secunda date to the second half of the 4th century; in Germania Magna the majority dates to the first half of the 5th century. The relative decline in military belt fittings in Germania Secunda coincides at the turn of the 5th century with this relative increase in Germania Magna, indicating a changing dynamic in power in the region. Previous studies have interpreted the presence of Roman material culture in Germania Magna, specifically crossbow brooches, belts and weaponry, as indicative of Germanic veterans returning home after serving in the Roman army.[199] The increase in finds in Germania Magna certainly seems to indicate that Germanic soldiers were increasingly wearing military-associated belt insignia. The distribution of these same finds in Germania Secunda is still heavily focused around the frontier zone and the fortifications of the hinterland, making it likely that these objects were still closely related to military identities. The increase in military belts outside of the Empire from the turn of the 5th century onwards fits closely with when the *foederati* are said to have entered the study region based on the coin evidence.[200]

A significant difference between these two regions was found, however, in the manner in which belt fittings were deposited in funerary contexts. While in Germania Secunda, the buckle was the most frequently included part of the belt in the burial rite, in Germania Magna a preference was found for the deposition of all fittings except for the belt buckle. They were also occasionally found in female graves in this area. This hints at important differences in how military belts were perceived in both regions. The burial rite in Germania Secunda suggests a mostly personal importance of the belt for the deceased, most likely through their professional life as a member of the army. The *pars pro toto* depositions in Germania Magna open up the possibility that these objects still held great value (through their association with the Roman Empire and indeed the army), but that these meanings could also be transposed on to members of the community who had not directly served in the Roman army (family members of veterans, for example).

Decoration and production

The popularity of decorative schemes also found on contemporary civilian dress accessories and widely used tools and objects (combs, fire strikers and needle tubes) reflects that these schemes were simply popular and widely present in the material culture spectrum: with the exception of the really high-end *Kerbschnitt*, the decoration of military dress accessories did not take place in a cultural or social vacuum. I do not believe that that makes the belt fittings less closely associated with the Roman army or that only *Kerbschnitt*-decorated belts were state-issued. Rather, it shows how military dress accessories were stylistically part of Roman material culture in the provinces.

Many of the non-*Kerbschnitt* decoration schemes could be applied to these objects after casting and finishing and therefore may have happened at a later date in a different place (as also indicated by the various half-finished objects from the frontier zone). This opens up the possibility that soldiers were relatively free to determine how much or which type of decoration they wanted to have on their belt and would explain why popular, widespread decorative schemes occurred on both military and non-military items: Late Roman soldiers were not living in a cultural vacuum after all. The speculation that decoration/finishing was organised more locally while casting may have been organised more centrally will be investigated more in the chapters on metallurgy (6 and 7).

[199] Böhme 2012; ibid. 2021.
[200] Roymans 2017; see also Roymans and Heeren 2022; Heeren 2017; Roymans *et al.* 2020.

Chapter 5
Methodology for pXRF

Chapter 5 is the first of three chapters discussing pXRF and standardisation of dimensions analysis of a selection of copper-alloy dress accessories. This chapter begins with a literature review of previous studies using pXRF and its applicability to archaeological research questions. Following from this, this chapter gives a summary and review of the measuring protocol used by comparing it to other recent pXRF studies. The rest of the chapter aims to provide a more general characterisation of Late Roman copper alloys and their corrosion processes, as well as a brief overview of sampling choices and data presentation methods. While the bulk of the chapter focuses on pXRF, the final section includes a discussion of variation statistics. Chapters 6 and 7 then present the results of these analyses.

Literature review

There are a range of methods available to analyse the composition of metal alloys, and it is key to choose the appropriate method to fit the research questions. At the start of the project, the most important aim was that the eventual dataset would be sufficiently large to study broader trends in alloy composition to answer questions about social and cultural organisation.[1] A non-destructive technique was therefore preferable, as it would ensure more museum curators and private collectors would be willing to grant access to their finds.[2] Given the scope of the project, a speedy analysis which could be carried out on site and requiring minimal sample preparation would also be a prerequisite.[3] Portable X-ray fluorescence spectrometry or pXRF fulfilled all these criteria and was therefore an ideal candidate from a practical perspective.[4] It can also be easily transported to the storage location of the finds, and an experienced user may take a large number of measurements per day.[5]

The analytical limitations inherent to these advantages, however, mean that particular care needs to be taken in ensuring that the research questions posed in this dissertation can be answered using this method. The recent technological advances in XRF technology have made this technique available to non-specialist users, and its application in archaeology has therefore not always been without criticism, particularly concerning the performance of pXRF and hand-held XRF (HHXRF) in comparison to more traditional lab-based methods with regards to analytical accuracy, precision, and reproducibility.[6] These criticisms are briefly discussed below.[7]

Many of the commercially available pXRF systems have a superior detection resolution compared to lab-based instruments from around 5-10 years ago.[8] They are capable of detecting a wide range of elements with a reasonably low detection limit.[9] pXRF equipment tends to be more sensitive to heavier elements due to their higher excitation energy.[10] However, all elements in ancient copper alloys (copper, tin, zinc and lead) have relatively high atomic numbers,[11] and can therefore be quantified accurately using pXRF outside of optimal (i.e., lab) conditions. It is also, like atomic absorption spectroscopy (AAS), a mass analysis method, meaning that it can successfully quantify the main components of an object, but is generally thought of as less effective for detecting smaller trace elements or impurities.[12]

Another important variable is the measured surface area, which needs to be large enough (most studies cite a minimum of 1-3 mm) to obtain data of sufficient quality.[13] The main analytical limitation is imposed by the non-destructive nature of the method: by not taking samples or deep-cleaning objects,[14] the analysis is limited to the surface of an object.[15] Using pXRF on

[1] See for successful examples of big-data approaches Bayley and Butcher 2004; Roxburgh *et al.* 2016; ibid. 2017; Roxburgh 2019; Van Thienen and Lycke 2017.
[2] Liritzis and Zacharias 2011, 112; Orfanou and Rehren 2014, 387.
[3] Gigante *et al.* 2003, 293; Shackley 2011b, 8.
[4] Shackley 2011b, 8-9.
[5] Gigante *et al.* 2003, 296; Gigante *et al.* 2005a, 58.
[6] Frahm and Doonan 2013, 1425; Shackley 2010; Speakman and Shackley 2013; Lutz and Pernicka 1996; also see Arai 2004.
[7] Given the space limitations of this thesis, the technology behind XRF is not discussed here. Excellent overviews of how XRF works can be found in most general textbooks on archaeological chemistry (e.g. Hall 2017; Pollard *et al.* 2007; Pollard and Heron 2008; Potts 2008; Shackley 2011a); see also for a literature review Roxburgh 2019.
[8] Roxburgh *et al.* 2018, 56; Speakman and Shackley 2013, 1436.
[9] Orfanou and Rehren 2014, 391; Gil *et al.* 1989, table 3.
[10] Orfanou and Rehren 2014, 396; Hall 1960, 32.
[11] Martinón-Torres *et al.* 2012, 544-545; Pillay 2001, 595.
[12] Orfanou and Rehren 2014, 396.
[13] Orfanou and Rehren 2014, 396. The size of the measured object in question also matters, as previous studies have found that samples smaller than 10 mm in overall dimension and thinner than 2 mm lead to a significant decrease in accuracy of most XRF applications (Shackley 2011b, 9-10; cf. Lundblad *et al.* 2008). Although very small fragments of objects are usually not identifiable, the thinness of most copper-alloy sheet used in the Roman period may be a factor of unreliability. Properly positioning awkwardly shaped or thin objects like hairpins and brooches was also a challenge.
[14] Which may in some cases may also be considered a destructive practice, as intergranulate corrosion can sometimes also be found between the corrosion layer proper and the original surface (Orfanou and Rehren 2014, 390; cf. Scott 1985, 50-51), necessitating the removal of at least 0.8-10mm (Ponting and Segal 1998, 111; Nicholas and Manti 2014, 2).
[15] Around 0.1 mm; Roxburgh *et al.* 2017, 245.

metal finds in most cases means that measurements are taken of a corroded surface or patina, which usually differ in composition of the original bulk of the material, limiting possibilities for, for example, provenancing.[16] Corrosion processes on Roman copper alloys are discussed below. Further challenges may be presented by inherent heterogeneity of the bulk material of the object itself,[17] uneven surfaces,[18] soil contamination, original decoration and surface treatment such as gilding or tinning.[19]

XRF is often successfully employed for qualitative or semi-quantitative analyses,[20] applied to research questions that search for broader trends in alloy use, rather than ascertain absolute weight percentages.[21] pXRF is therefore recommended by most as a survey method, which can be followed up, if need be, with more in-depth technologies.[22] Recent evidence-based research papers have shown the possibilities pXRF has to offer to archaeological research questions, and are very elaborate in their discussion of best practices.[23] The speed and portability of pXRF are crucial in making larger survey studies possible and previous studies have shown that it is best used to gather datasets that include some element of comparison.[24]

Set-up and review

The equipment used for all sessions was a Niton Xl3t GOLDD XRF scanner equipped with a large area silicon drift detector, owned by the Dutch National Heritage Agency (RCE)[25] using the factory-calibrated settings for metals and alloys ('electronic metals' setting).[26] The same set-up was used for all sessions. The scanner was mounted into a lead-lined chamber for improved precision and safety. Before each session, the machine was left turned on for a few minutes to warm up. Subsequently, a systems check was performed, and several readings were taken on a standard brass bullet casing to monitor instrument drift. The readings of the bullet casing are discussed below.

The scanner itself was regularly calibrated for the duration of the project and the CHARM reference set was regularly analysed by the RCE radiation department to ensure that the results were both internally consistent and replicable.[27] The Niton Xl3t GOLDD XRF scanner can analyse an area of 8 mm²,[28] which is sufficiently larger than the generally accepted minimum of 1-3 mm².[29] The scanner uses the '.8.4c_900_Library.alloy' reference library for the identification of elements and alloys.

What is unique in this instance is that the specifications of the scanner that was used have been tested and published. In a recent paper, Roxburgh *et al*. tested the factory electronic metals settings using the CHARM reference set in a closed test bench, showing that the relative standard deviation remained within a few percentage points.[30] They also concluded that the machine-reported analytical error for the targeted elements stabilised under 0.2% around 35 seconds (testing the main range spectrum of Cu-Ba and Au-Pb at 50 Kv and the low range spectrum of Al-Cu at 10 Kv).[31] This gave me a well-argued background to formulate my own analytical protocol.

With Roxburgh *et al*.'s 2018 findings in mind, each analysis performed for 40 seconds in a closed chamber: 30 seconds on the main range filter using a tube voltage of 50 kV (targeting the Cu-Ba and Au-Pb spectra) and 10 seconds on the low range filter at 20 Kv (targeting Al-Cu) in the hope of more consistently detecting lighter elements such as Co (cobalt) and Ni (nickel). The data were extracted from the machine using the NitonConnect Data software which is included with the equipment. This software package also performed the initial peak interpretation with 2σ values. The raw data were extracted in a .csv format, which was subsequently saved for further data processing in Microsoft Excel spreadsheets.

The chosen settings resulted in a wide range of elements being targeted: Cu (copper), Sn (tin), Zn (zinc), Pb (lead), As (arsenic), Sb (antimony), Hg (mercury), Ag (silver), Au (gold), Ni (nickel), Fe (iron), Al (aluminium), Bi (bismuth), Ba (barium), Cd (cadmium), Co (cobalt), Cr (chromium), In (indium), Mn (manganese), Mo (molybdenum), Nb (niobium), Pd (palladium), Pt (platinum), Se (selenium), Ti (titanium), V (vanadium), W (tungsten) and Zr (zirconium).

[16] Nørgaard 2017, 112.
[17] Gigante *et al*. 2003, 294.
[18] Liritzis and Zacharias 2011, 123; Frahm and Doonan 2013, 1426.
[19] Hall 1961; Martinón-Torres *et al*. 2012, 545.
[20] Hall 1960, 34; Gigante *et al*. 2005b; Shackley 2011b, 36-37; Pollard and Heron 2006, 49.
[21] Martinón-Torres *et al*. 2012, 545.
[22] Pollard and Heron 2006, 49; Roxburgh *et al*. 2018.
[23] E.g. Orfanou and Rehren 2014; Frahm and Doonan 2013; Fernandes *et al*. 2013; Roxburgh *et al*. 2016; 2017; 2018; Heginbotham and Solé 2017.
[24] Most preferably chronological or typological; Roxburgh *et al*. 2016; ibid. 2017; Pollard *et al*. 2006, 118ff.; Pollard *et al*. 2015.
[25] Rijksdienst voor het Cultureel Erfgoed.
[26] It should be kept in mind that most XRF equipment available was not made specifically with archaeological applications in mind and for some categories of material culture, specific calibrations are needed (Speakman and Shackley 2013, 1437-1438). The factory settings for metals, however, are generally accepted to be sufficient for archaeological studies (Speakman and Shackley 2013, 1439), as the elements of interest in Roman objects are also those relevant to modern users of XRF technology (Roxburgh *et al*. 2017, 248; cf. Piorek 2008).
[27] Cf. Scott *et al*. 2016, 101; Shackley 1998, 305; Speakman and Shackley 2013, 1436; Heginbotham *et al*. 2015.
[28] Roxburgh *et al*. 2018, 60.
[29] Orfanou and Rehren 2014, 396.
[30] Roxburgh *et al*. 2018, 60-61, table 1.
[31] Roxburgh *et al*. 2018, 60.

Several of these are related to the bulk material and any working or surface treatment of the object. Cu, Sn, Zn and Pb are of course the main elements to be expected in the bulk alloy. Sb, As, Ag and Ni may be present in varying amounts as impurities, although any significant reading of Ag may also reflect silver plating of the object. Lead may be part of an alloy not as an intended ingredient, but as an impurity present in the original copper ore.[32] Figuerido *et al.* state that 2% may be the threshold for identifying intentionally added lead,[33] while according to Brown,[34] lead contents below 3% will not significantly alter the alloy properties. On copper alloys, tin and lead may also be found on the surfaces of objects as remains of solder.[35]

Other elements such as silver (Ag), arsenic (As) and antimony (Sb) are also often encountered in small and variable amounts in Roman copper alloys (usually around 0.1%).[36] For looking into treated or enhanced surfaces, gold (Au) is also of interest and so is mercury (Hg), as it was used in fire gilding.[37] Iron (Fe) is often present on the surface as part of the corrosion product, although it may also have been part of the copper ore as an impurity too.[38]

Other trace elements of interest may be bismuth (Bi), cobalt (Co), manganese (Mn), sulphur (S) and gold (Au).[39] Nickel can also be included as an impurity of copper ore.[40] A range of other elements were also included in the spectrum,[41] but were either present in extremely low quantities (below 0.1%) or failed to meet the limit of detection at all.[42] The data was normalised by recalculating the chosen elements to 100%. This first step already purged a lot of zero values from the dataset. Other zeros in the dataset were replaced by the LOD (limit of detection) value of that particular element in each individual matrix.

Internal consistency of results

Before moving onto the archaeological questions that the pXRF dataset can address, the internal consistency of the data and the effectiveness of the analytical protocol followed during the collection of the data will be illustrated. Within certain inevitable boundaries of variability, the pXRF data presented here shows that the analysis taken can be relied upon to answer archaeological questions and not just reflect differences in soil type, levels of preservation and different cleaning practices. The consistency of the results as impacted by possible instrumental drift between and within different sessions can be ascertained by looking at the readings taken from a standard brass 9 mm. bullet casing before each session. As this is a modern, industrially made, standardised and uncorroded brass, it cannot be used to calibrate the results from the archaeological objects. It can, however, be used to show any significant shifts in instrumental capacity between sessions. The readings taken from the casing at each session are presented in appendix 5.1.

Although these readings cannot be used to calibrate the pXRF data from the archaeological samples (comparing measurements from corroded with clean surfaces would not be particularly meaningful), they do provide a strong indication that the instrumental drift between and within analytical sessions was minimal. For the easily depleted bulk elements copper and zinc the standard deviation was 0.26 and 0.19 respectively and the coefficient of variation factor 0.36 and 0.65%. In comparison, when the factory calibration of the scanner was tested on the CHARM reference set,[43] the standard deviations for lead, tin and zinc remained within a few percentage points.[44] There, the most significant deviations were found in the lead content, likely due to its uneven distribution in copper alloys.

One further way of demonstrating the internal consistency of the archaeological data gathered for this thesis specifically is by comparing different readings of the same object (or same part of a composite object). Repeated readings of the same object returned consistent results in detecting the same alloy types and, with some expected variation of a few percentage points, the same quantities of major alloying ingredients. The identified variation could be due to a number of factors, including the heterogeneity of the corrosion product. The only cases where the data interpretation was impacted was when low amounts of alloying ingredients were present, most notably zinc and lead. This resulted in some readings recording just above or below the 1% threshold on the same object, affecting the alloy label (for example the foot of a brooch recording as leaded bronze and the bow and axis mount as leaded gunmetal due to low zinc levels). This highlights the presence of low-zinc and low-lead alloys in a dataset that is otherwise dominated by alloys with large amounts of alloying ingredients (especially lead; see below). In some individual cases there appeared to be some form of selective corrosion at play, for instance when the front and back of objects consistently

[32] Figuerido *et al.* 2007, 725.
[33] Figuerido *et al.* 2007, 725.
[34] Brown 1976, 25.
[35] Lopes *et al.* 2018; Bayley and Butcher 2004, 26.
[36] Bayley and Butcher 1981, 29.
[37] Anheuser 1997; Lins and Oddy 1975.
[38] Gosh *et al.* 2021.
[39] Bray 2022, 92.
[40] Bray *et al.* 2015; Riederer 1987.
[41] Barium (Ba), cadmium (Cd), cobalt (Co), chromium (Cr), indium (In), manganese (Mn), molybdenum (Mo), niobium (Nb), palladium (Pd), platinum (Pt), selenium (Se), titanium (Ti), vanadium (V), tungsten (W) and zirconium (Zr).
[42] Rousseau 2001.
[43] Heginbotham *et al.* 2015.
[44] Roxburgh *et al.* 2018, 60.

registered as different alloys. These fluctuations in the data should not negatively impact the detection of any major trends, as any further interpretation do not focus on the comparison of individual objects.

Review of protocol

Above, the lack of impact of instrumental drift and the internal consistency of the results in identifying alloys has been illustrated. Taking multiple readings per object on different parts of the object proved useful in eliminating problematic readings. Several measurements contained implausibly high levels of lead, for example, likely because a lead globule was targeted resulting in its overrepresentation. Comparing such readings with other measurements from the same object allowed me to understand the cause behind certain elements presenting in a certain way, and if necessary, exclude problematic readings. Using multiple readings per object or part of an object also helped to negate outliers in the dataset.

As argued above, the consistency of the dataset is high and the inherent variation in using pXRF on corrosion materials is low enough that the data can be used to identify patterns in metal use in objects with different dating, social connotations or functions. The increased counting time of 40 seconds on two different filters was found to be successful in consistently detecting the bulk ingredients within objects. Whenever different readings per object resulted in different alloy labels, this was most often caused by variations in the zinc content. Despite initially low expectations regarding the successful detection of trace elements, arsenic, antimony and silver were all reliably detected using this protocol. A general absence of nickel was noted, but this is a common result for copper alloys from the Roman period[45] so is taken as a true absence rather than a failure to detect.

Late Roman copper alloys and the possibility of recycling

One of the primary questions behind this study is to see whether we can find evidence that the chemical composition of objects was designed by the makers:[46] how able were Late Roman smiths to choose the raw materials and decide on the relative proportions of metals used in the various alloys? Alloys can be arrived at randomly (using whatever material available at the time), or by using recipes with fixed amounts of ingredients.[47] Whichever the case, objects made during the same production 'batch' will present a similar composition, even when we take analytical imprecision and inherent variation within a batch into account.[48] This, together with the potential (in) availability of raw or scrapped material will have greatly influenced the variation in alloy composition within the assemblage.

From Pliny's Natural History, we know that some recipes for brass existed,[49] but his descriptions of ingredients give little insight in the technology behind them. Most scholars have therefore focussed on studying the technological properties of certain alloys and investigate links between different alloy categories and object types,[50] for example the link between brass and the (early) Roman military.[51] Functional characteristics of certain objects, for instance, may necessitate the use of alloys with specific properties,[52] whether it be for manufacturing purposes or mechanical strains on objects during use. Every alloy displays different technological properties according to the relative levels of additives. Pure copper is a very soft and ductile material but can be hard to work in solid form. The addition of tin makes a copper alloy harder,[53] with critical levels cited in the literature ranging from 13.2% to 15-20%.[54]

Low-level tin-bronzes (up to 10%) are ductile enough to be worked cold, whereas higher levels of tin will improve casting performance.[55] Gunmetals combine the technological characteristics of both bronze and brass. Lead, finally, both lowers the alloy's melting temperature and increases its fluidity.[56] Because lead is not absorbed well in copper, it tends to form a separate metallic phase within the alloy, which weakens it.[57] Highly leaded alloys are therefore not suitable for objects that needs to withstand great mechanical stress.[58] Bayley and Butcher, however, found that gross compositional inhomogeneity was not frequently encountered in smaller objects such as brooches.[59]

All this enables us to propose some expectations of (Late) Roman alloys. Cast bronzes will likely contain a significant amount of lead, whereas cold-worked bronzes are more likely to contain low levels of lead and tin.[60] Bronzes that were subjected to decoration after casting, such as engraving, may be expected to contain

45 Riederer 1988.
46 Hughes 1991, 99; Martinón *et al.* 2012, 536; Roxburgh *et al.* 2017, 254.
47 Riederer 2002b; Jouttijärvi 2017.
48 Martinón-Torres *et al.* 2012, 548; Jouttijärvi 2017, 813.
49 Plin. *Nat.* XXXIV.1-5.
50 See for this approach to Roman brooches Bayley and Butcher 2004; Roxburgh *et al.* 2016.
51 Dungworth 1997, 903; Caley 1964, 92; Istenič 2009; see also Dungworth 1996 on zinc decline.
52 Fernandes *et al.* 2013.
53 Martinón-Torres *et al.* 2012, 546.
54 Brown 1976, 25 and Cowell and La Niece 1991, 75; Ponting and Segal 1998, 113 respectively.
55 Ponting and Segal 1998, 113.
56 Cowell and La Niece 1991, 78; Guerra 2000, 399.
57 Cowell and La Niece 1991, 78.
58 Cowell and La Niece 1991, 78.
59 Bayley and Butcher 2004, 16.
60 Brown 1976, 25.

higher levels of lead, above 10-20%.[61] Lead contents above 25% are, however, rare in Roman copper alloys[62] and contents upwards of 30% will result in a highly segregated, unstable alloy.[63] The appearance of different alloys may also have played a part. What objects looked like would have been important for items like brooches, belt buckles and hairpins, as they were highly visible accessories.[64] Polished brass, for example, gives an appearance very much like gold, and could have been used to convey high status. Similar effects could be achieved through surface enhancing techniques, such tinning or gilding.

Most scholars assume that craftspeople in the past made informed, or 'conscious' decisions regarding which raw materials to use and in what proportions to combine them.[65] It is also thought that they could visually identify different binary alloys (bronze, brass etc.)[66] and that specific choices were made to use particular alloys for particular objects.[67] Some of the possible reasons behind these above, such as visual effects, particular object-related physical properties or manufacturing procedures have already been explored.[68] A well-known example is brass, access to which is generally assumed to have been controlled by the Roman state and army in the Early Roman period.[69] A challenging aspect in this regard is the practice of recycling scrap metal.[70] For the Roman period, various studies have come to different results, as some seem to indicate that although scrapping and recycling did take place, careful sorting of the material ensured that the different alloy categories stayed relatively pure.[71] Precisely because of this dichotomy, it is useful to deal with the problem of recycling in a bit more detail, and more specifically how to observe its practice in the archaeological record.

Mixed alloys, particularly leaded gunmetals may be taken as a sign of recycling.[72] A trend of declining brass use from the end of the 1st century AD and an increase in (leaded) gunmetals from the 3rd century AD onwards is identified in a number of large studies into the composition of copper-alloyed objects from (post-) Roman Britain.[73] Whether this increase in leaded alloys is entirely caused by recycling is not entirely clear, however, as changes in technological choices may also have played a role. Late Roman military fittings, for instance, are more often cast and therefore require the presence of lead.[74] Others have suggested that lead was increasingly used in later periods as a cheap additive to increase bulk production.[75] Furthermore, more in-depth studies on Roman Britain such as those by Bayley and Butcher[76] and Dungworth[77] show that even in the Late Roman period, some alloys were kept relatively pure by careful separation and sorting of scrap before re-use[78] and in some cases the production of leaded gunmetal may have been deliberate.[79]

Corrosion processes in (Late) Roman copper alloys

Without taking destructive samples of all the finds presented in chapters 6 and 7, it is impossible to exactly calculate the difference in composition between corrosion layer and bulk material. As this was not feasible for this study given the scope, there are some other, comparable studies that may be looked at for some indications of the corrosion processes on (Late) Roman dress accessories in the study area. Several studies into the corrosion processes on Roman copper-alloy brooches and other small finds from the Netherlands,[80] used a combination of non-destructive and destructive analysis to compare the composition of the corrosion product to that of the bulk material. On average, copper alloys lost up to 10% zinc and 25% copper in their corrosion layer. Variations in tin and lead were also noted, but no systematic deviations could be recorded for these elements.[81] Roxburgh *et al.*'s study on Early Roman brooches from Nijmegen showed an average depletion of Cu in tin-alloyed brooches of 35%, while this was 18.5% in brooches with tin and zinc. In this latter group, zinc was found to deplete on average with 0.7%, with an average zinc depletion in brooches containing zinc of 9%.[82]

Nicholas and Manti identified zinc depletion in brasses and copper depletion and tin enrichment in alloys containing tin.[83] Campanella *et al.* identified that sufficient amounts of tin may inhibit dezincification in copper alloys.[84] In some studies, the lead content of the corrosion layer of leaded bronze has been

[61] Brown 1976, 26.
[62] Bayley and Butcher 2004, 14.
[63] Brown 1976, 26.
[64] Roxburgh *et al.* 2017, 257.
[65] Martinón *et al.* 2012, 536; Roxburgh *et al.* 2017, 254; Hughes 1991, 99.
[66] Kuijpers 2017; Mödlinger *et al.* 2017.
[67] For instance, the use of leaded alloys in 2nd and 3rd-century military brooches (Roxburgh *et al.* 2017, 255-256).
[68] Cowell and Niece 1991, 75; Roxburgh *et al.* 2017, 257.
[69] Dungworth 1997, 903; Caley 1964, 92; Bayley 1998, 19; Fernandez Reyes 2014; Istenič 2009.
[70] Pollard *et al.* 2015; Fernandes *et al.* 2013.
[71] Such as Bayley and Butcher 1981, 34; Dungworth 1997, 909; see also Pollard *et al.* 2015, 703, figure 1e on evidence for increasing rates of recycling throughout the Roman period.
[72] Pollard *et al.* 2015, 703; Fernandes *et al.* 2013.
[73] Caley 1964; Pollard *et al.* 2015, 703.
[74] Dungworth 1997, 907.
[75] Ponting and Segal 1998, 115.
[76] Bayley and Butcher 1981; Bayley and Butcher 2004.
[77] Dungworth 1995; Dungworth 1996; Dungworth 1997.
[78] Bayley and Butcher 1981, 34.
[79] Dungworth 1997, 909.
[80] Fernandes *et al.* 2013; Roxburgh *et al.* 2018.
[81] Fernandes *et al.* 2013; Roxburgh *et al.* 2017, 249.
[82] Roxburgh *et al.* 2018, 64. A small number of objects from both oxidising and reductive burial environments were analysed for an MA thesis, which indicated that those buried in an oxidising environment displayed greater disparity in composition between cleaned surface and patina (Caspers 2010).
[83] Nicholas and Manti 2014, 5.
[84] Campanella *et al.* 2009.

also shown to be higher than the original alloy.[85] In summary, these results suggest that de-zincification and decuperification are the most likely processes to take place in Roman copper-alloy objects from archaeological contexts. Decuperification is by far the most common and active process, while the loss of zinc in brass alloys seems to be less extensive. An active loss of copper is also more prevalent in bronzes than in brasses, due to their different production method. As opposed to brass, bronze is a multi-phase system (with different elements in the alloy solidifying at different temperatures during cooling) and consists of alternating microscopic layers of tin and copper.[86]

Sampling strategy and object choice

Due to a variety of practical considerations,[87] a number of decisions were made during the gathering of the pXRF data to include or exclude certain finds. First of all, the key focus of the research question was the collection of data on military dress accessories, with data on civilian objects a secondary priority to provide comparative background material. Military dress accessories are generally rare in Germania Magna (see chapter 4), and consequently the majority of the dataset was gathered from sites located in Germania Secunda. Within the military category, the focus lay predominantly on the belt fittings, as these had never been targeted with pXRF before on a large scale. Several collections of crossbow brooches (Nijmegen; Museum Burg Linn; Gallo-Romeins Museum Tongeren) were also included in order to provide material that could be compared to a recent large-scale pXRF study of crossbow brooches from the Netherlands and Flanders by Lycke and Van Thienen.[88]

To provide a broader background dataset of Late Roman dress accessories, a selection of civilian dress accessories was also targeted for pXRF. Not all types discussed in chapter 3 were selected for this. Tutulus and saucer brooches, for example, commonly feature surface treatments such as gilding, tinning or silver-plating, are partially made of silver or feature parts made of iron.[89] Analysing those as comparative material would introduce too much variation in the dataset. Furthermore, tutulus brooches and Cortrat and Tongeren hairpins are quite rare in the study area and the focus was placed early in the project on collecting as large a dataset as possible while also making sure it was internally consistent. I favoured collecting lots of data on a few object types over analysing small numbers of lots of different object types. This way, data per object type could be split up based on a variety of criteria (context, site type, chronology, social label etc.) while still maintain comparative groups of a reasonable size. Initially, I aimed for at least 20 individual objects per find category, although in the end availability of material[90] meant that I settled for a minimum of 10. A list of chosen objects is presented in chapter 7. To maximise the application of the pXRF dataset, care was taken in the sampling approach to gather as much metadata about the objects as possible (including find context, date, typological information and conservation state).

There are general questions to be asked about metal use, availability and technology in the Late Roman West, which may be answered by looking at the dataset as a whole. One aspect of this might be looking at the different functions of objects or their production methods (casting, hammering), which would inform us about the ability of smiths to deliberately choose their raw materials. In line with this is the inquiry how widespread the practice of recycling was and how it influenced the ability to make informed decisions on the above. Working from the hypothesis that the Late Roman military production chain was at least partially separate from local civilian workshops, we may also ask whether objects with a different social label (related to the wearer) also show consistent differences in chemical composition (related to the producer). This could focus on whether particular objects show a preferred alloy or mix (either related to look or function) and whether particular trace element signals show up consistently in either group, which could indicate a different supply line of material.

Before analysis, each object was given a score based on its corrosion and preservation state.[91] This was done to make sure that after data collection had been

[85] Figuerido *et al.* 2007, 726.
[86] Scott 1991, 15.
[87] Including but not limited to the availability of equipment, accessibility of finds (also influenced by travel restrictions and the closure of archives during the Covid pandemic), the number of finds available for analysis per archive and the general ubiquity or lack thereof of certain types of finds.
[88] Van Thienen and Lycke 2017.
[89] The elaborate construction of the tutulus brooch using a central iron pin means they are often found in a severely fragmented state and cannot be identified to a specific subtype. When only the plate on which the pin is mounted is found, it is difficult to tell the difference between a tutulus and a composite saucer brooch. The central construction of the tutulus brooch of a central iron pin connecting the plate to the cone was also found to cause 'blooming', with large amounts of iron corrosion covering the outside of the brooch. Iron pins on the backs of saucer brooches would have had the same obscuring effect, as this was also identified in several belt plates and decorative fittings. Even when measuring in the centre of a square plate, considerably elevated levels of iron were recorded due to the four small iron nails that would have been used to fasten the plate onto the belt at each corner (even despite these nails not having survived). Finally, in most cases of saucer brooches only the plate was found, in which case it is often difficult to make a distinction between Late Roman or early medieval saucer brooches, saucer brooches or tutulus brooches or even between Late Roman saucer brooches and Roman disc brooches.
[90] The realities of archaeological archives and museums mean that at any given point, some objects will be lost, on display or are undergoing conservation or, when they can be located, they turn out to be simply too corroded for analysis.
[91] Following Fernandes *et al.* 2013, table 1.

completed, deviant readings could be checked against the state of the object to ascertain whether there had been a machine error, or whether poor surface preservation played a role. Purely gold or silver objects were generally not included, as the focus of these chapters is on copper alloy use. Objects with treated surfaces were included but usually by accident, as these were often found to be so poorly preserved that it was impossible to identify them macroscopically.

Sampling protocol

To ensure an accurate and consistent analysis, several measurements were taken on each object or part of an object. During analysis, an Excel spreadsheet was maintained where the reading numbers were listed together with a description of the item (type, site) as well as the location of the reading, a description of its state (complete, heavily corroded etc.) and any issues with the object. It was attempted to target the same specific areas of each objects category repeatedly to obtain as much consistent data as possible, although only when this was suitable. Objects or parts of objects that were too small, irregular in surface, too heavily corroded or covered in other materials were not excluded from analysis.

For brooches, at least 3 readings were taken and whenever possible these were done on fixed locations. As several of the brooch types in question were multi-piece, readings were taken from the foot/catch-plate, bow and support axis or spring to test for variation between parts (which may have required different compositions due to their function or the construction method of the brooch as a whole). As incomplete brooches make up a significant portion of the dataset, as many readings as possible were taken from those, usually two (the foot and bow generally preserved best, with the pin and spring/support axis most frequently missing). Hairpins were subjected to three-four readings depending on the conservation of the object. Readings were taken of the knob and top, middle and bottom parts of the shaft to test for variation within the object.

Buckles were subjected to at least four readings if possible: a minimum of two on the front of the frame and two on the back. The same procedure was followed for belt plates. Most decorative belt fittings were too small for two readings on each side, so initially only one measurement was taken on each side of the decorative fittings and suspension mounts, as well as one reading of the connecting strip wherever possible. It was generally found that the backs of decorative fittings and plates contained significant iron corrosion from the small nails with which they were fastened onto the leather belt, so often two readings were instead taken from the front. For tubular mounts, one or two readings (depending on how fragmented the object was) were taken on the outside of the tube and the corresponding plates.

Sampled collections

Six major and two smaller collections were targeted for the pXRF dataset (table 5.1). The first two collections analysed were two of the largest private metal detectorist collections recorded in PAN (the Portable Antiquities of the Netherlands scheme). In accordance to the PAN academic user agreement,[92] only the municipality, not the exact find location are reported on in the appendices and generalised coordinates were used for mapping. Both collections were analysed over several days, often in between pXRF campaigns at other institutions. At the provincial archaeological archive in Nuis, a combination of finds from commercial excavations and two large private collections (donated to the archive) were sampled over the course of one day.

The collection of the Valkhof Museum included several finds from the old ROB excavations[93] on the Late Roman cemeteries of Nijmegen,[94] as well as finds from several more recently excavated rural settlements and villa sites within the province of Gelderland. The analysis of the Valkhof collection took one day. The collection sampled from the municipal archive in Nijmegen also included finds from isolated graves from the city centre in Nijmegen.[95] The bulk of the data collected here, however, came from the unpublished ROB excavation Nijmegen-Kelfkensbos (the Late Roman *castellum* in Nijmegen) and several municipal excavations on the Late Roman phases of Ulpia Noviomagus (also largely unpublished at the time of writing). This took two days to complete. A small collection of finds from outside the Empire were sampled at the Provincial Archive Utrecht in Utrecht, all from rural settlement contexts. A one-day session was held at the Gallo-Romeins Museum in Tongeren, where the Late Roman belt fittings from the urban cemeteries were analysed. Finds from the Late Roman military cemetery of Krefeld-Gellep were analysed over the course of four days, targeting all the accessible suitable Late Roman dress accessories from the cemetery that could be located in the museum's archive and galleries. In the final stages of data collection, one-day trips to the Nuis Archeologisch Depot and Haus der Geschichte in Kamen were organised to include settlement and stray finds from outside of the Empire. The collection at Kamen also included a number of finds from excavations and metal detectorist activities.

[92] https://portable-antiquities.nl/pan/#/public/about.
[93] Rijksdienst voor Oudheidkunding Bodemonderzoek (State Service Archaeological Research).
[94] Steures 2013.
[95] Böhme 1974.

Collection	N readings
Museum Burg Linn	879
Nijmegen Municipal Archive	196
private collections/PAN	296
Valkhof Museum/PDB Gelderland	262
Provincial Archive Utrecht	26
Gallo-Romeins Museum Tongeren	173
Nuis Noordelijk Archeologisch Depot	87
Kamen-Westick	187
Total	2106

Table 5.1. Number of readings collected from different archive and museum collections.

The dataset includes finds from a variety of soil types, site types and levels of preservation. The settlement finds from the Provincial Archive Utrecht, Nijmegen Muncipal Archive and the Krefeld cemetery are largely from sandy soils, while the finds from PAN are mainly from the clay soils of the Rhine and Meuse deltas. There are also differences to consider in the preservation, post-excavation treatment and storage between finds from different collections. Finds from the PAN database were collected by private metal detectorists. This means that these are surface finds (maximum of 30 cm deep), likely affecting the conservation of the object by introducing starker differences in water levels, temperature and oxygen than finds from excavations (which are typically found in much deeper strata). The two PAN collections sampled belong to detectorists who routinely clean their finds superficially, using non-destructive tools. This will have removed a large portion of the soil contamination, but not of the corrosion product.

The Dutch national and regional archives that were visited all comply with the same national guidelines on finds storage and treatment, meaning all finds were stabilised and cleaned and stored in appropriate climate-controlled conditions. The exception to this are any finds from excavations carried out by the former ROB which are almost always untreated and uncleaned. In this dataset, a small number of such finds have been included from the provincial and municipal archives in Nijmegen and discretion was used to determine which objects were well-preserved enough to be included. Finally, there are the museum collections from Krefeld-Gellep (Museum Burg Linn) and Tongeren (Gallo-Romeins Museum). Here, finds were sampled from both the museum archives (stored in a climate-controlled environment) and from the display cases in the museum galleries. The museum at Kamen included both stabilised finds from official excavations and untreated material collected by metal detectorists.

These differences in storage and cleaning practices are reflected in the data. On average, finds from private metal detectorists recorded more than twice as much iron as those from museum collections and archaeological excavations. Stray finds consequently recorded marginally lower levels of all main alloying ingredients, although this remained within a few percentage points. This shows that privately owned finds, which are more likely to be cleaned less deeply, recorded a bit more background noise, but that their compositional data are not so deformed by the corrosion that these cannot be used.

Methods for presenting data

In total, 2106 pXRF readings were taken on identifiable objects. For the following chapters, the normalised data will be used (see above), presented in percentage by weight (wt%). The first sorting of the data may be done by labelling objects or individual readings with alloy types. Although in much archaeological literature, 'bronze' is used as an umbrella term to cover a multitude of copper alloys,[96] several authors have set up systems with which to distinguish and label copper alloys,[97] occasionally in an attempt to identify alloy recipes written down by Plinius the Elder[98] or define specific alloy types for specific objects.[99]

The first group encompasses a series of studies aiming to delineate between different types of alloys (bronzes, brasses and gunmetals) and their components by setting minimum and maximum thresholds for alloying ingredients.[100] Several German authors have approached Roman metallurgy from a different perspective,[101] defining for instance different types of bronzes (low, medium and high-tin, or making distinctions between bronze meant for casting or cold-working)[102] with again precisely defined upper and lower thresholds for alloying ingredients. Although these approaches have proved to be useful in understanding Roman metallurgy in some contexts,[103] they ultimately must rely on absolute quantitative amounts and are therefore best applied to destructive sample analyses.

Alloy categories

To circumvent these issues, the alloy labelling format as proposed by Pollard *et al.*[104] is used in this thesis. Here, the threshold for the three main alloying ingredients is set at 1% (see table 5.2 for the eight alloy types defined in this manner), which the authors claim removes

[96] Scott 2002, 3.
[97] Dungworth 1997; Mortimer 1991; Bayley and Butcher 2004.
[98] Jouttijärvi 2017.
[99] Voß *et al.* 1998; Riederer 1993.
[100] Dungworth 1995; Mortimer 1991; Bayley and Butcher 2004.
[101] Hammer und Voss 1997; Riederer 1993.
[102] Hammer and Voss 1997.
[103] See Riederer 2002b, table 1 on Pompeian casseroles.
[104] Pollard *et al.* 2015, table 2.

Alloy label	1% ≤ tin (Sn)	1% ≤ zinc (Zn)	1% ≤ lead (Pb)
copper	-	-	-
leaded copper	-	-	+
bronze	+	-	-
leaded bronze	+	-	+
gunmetal	+	+	-
leaded gunmetal	+	+	+
brass	-	+	-
leaded brass	-	+	+

Table 5.2. Definition criteria for alloy types (after Pollard *et al.* 2015).

much of the modern bias in labelling ancient alloys.[105] Although the 1% line could be a challenge in the case of zinc (when depleted on the surface), the fact that multiple measurements were taken per object ensured that zinc-containing alloys were reliably detected.

The use of one alloy terminology also avoids issues when comparing this dataset to those collected in other studies. Many large metallurgical studies have devised alloy classification systems informed by their data and methodology[106] and may therefore not be appropriate for my data. Using one shared vocabulary to describe a varied collection of different datasets allows patterns to be identified, after which methodological factors can be considered. The low thresholds of the FLAME system mean that, potentially, objects with varying compositions may be classed together, but the method does allow for large groups of similarly composed items to be compared and contrasted. It is especially useful in highlighting the presence of mixed alloys in the dataset.[107] In the following chapters, these alloy labels will be used as a shared vocabulary to discuss alloy compositions, not as fixed analytical categories. As will become clear, some of the pXRF data hints at alloy groups that extend beyond these classifications, such as certain high-tin alloys appearing in both the leaded bronze and leaded gunmetal categories.

Trace element signals

A further method to sort metals into different groups proposed by the FLAME project is to map the occurrence of different trace elements (table 5.3). While alloy labels represent (intentional) actions by craftspeople in terms of mixing various ingredients, trace elements are introduced into the alloy largely through copper ores (although recycling and mixing of raw materials also influence the presence/absence of trace components). As such Bray *et al.* highlight the presence/absence of

'Copper space'	Contains
1	none
2	As
3	Sb
4	Ag
5	Ni
6	As/Sb
7	Sb/Ag
8	Ag/Ni
9	As/Ag
10	Sb/Ni
11	As/Ni
12	As/Sb/Ag
13	Sb/Ag/Ni
14	As/Sb/Ni
15	As/Ag/Ni
16	As/Sb/Ag/Ni

Table 5.3. Definition criteria for trace element categories (after Bray *et al.* 2015).

arsenic (As), antimony (Sb), silver (Ag) and nickel (Ni) as most informative in understanding ancient metal use (although cobalt (Co) may also behave played a role, this element was not detected in significant amounts in the dataset).[108] Together, these four trace elements may be present or absent in an object in varying combinations. Rather than use the presence or absence of certain trace elements in order to suggest a particular provenance of raw materials, these 'copper spaces' as they have been termed allow us to trace similar groups of metals through time, space and typology.[109]

Visualisation

Further presentation of the data will be done visually, using a variety of graphs and plots to show how individual elements or alloy groups may behave. For a first visual representation of for instance a particular object type, ternary plots are often deployed.[110] The plots show the relative presence of zinc, tin and lead (normalised to 100%), eliminating the corrosion variation caused by copper. The downside is that objects high in copper and low in alloying elements are grouped together with those that may contain higher absolute amounts of alloying ingredients. Objects that are in actuality very dissimilar may be placed together in a ternary plot due to this distortion, which disproportionally impacts alloys that contain only one alloying ingredient (bronze, brass, leaded copper), while more mixed alloys (gunmetal, leaded bronze/brass/gunmetal) present more faithfully in ternary plots. For ease of reading, the ternary plots in chapters

[105] Pollard *et al.* 2015.
[106] Bayley and Butcher 2004; Voß *et al.* 1998; Dungworth 1995; Mortimer 1991.
[107] Bray *et al.* 2015, 206.
[108] Bray *et al.* 2015.
[109] Bray *et al.* 2015.
[110] E.g., Teegen 1997; Roxburgh *et al.* 2016.

6 and 7 are colour-coded, with each dot representing an individual reading and the colour indicating the alloy label.[111] Because ternary diagrams often present very clear patterns, they will be used below as a first introduction to a particular part of the dataset, while any patterns emerging will then be explored further using other visual representations that skew less.

One of these is the principal component biplot. Principal components analysis (PCA) is a statistical tool that groups analyses together based on how much variation within the dataset they explain.[112] This has the benefit of eliminating any preconceived notions of which alloys are similar or where the line between alloy delineations should be drawn. At the same time, PCA's can also be a bit of a black box and the resulting biplots can only be properly understood by consulting the underlying calculations. Much like ternary diagrams, PCA's often provide interesting and dramatic diagrams, but other methods of presentation may be necessary to more clearly show why certain readings are clustering.

To show how a particular element behaved within a particular group of objects (for instance a functional or typological group, or a particular alloy), bar plots are very useful. When comparing various elements within a population, line graphs are better. In chapter 7, when these types of diagrams are used, all values are expressed as percentages of the assemblage to ensure that smaller groups are also adequately represented. For smaller groups of objects, when it is less possible to rely on the size of the dataset to even out its inherent variation, plots that illustrate this variation may be more suitable. In chapter 7, boxplots are used for this, as they show the minimum and maximum values of a particular population, as well as the average values. Statistical outliers are represented in these plots by circles. To trace further trends of individual alloying ingredients within larger groups of objects, density graphs (with a bandwidth set at 1.5) are also used throughout the next two chapters.

[111] Cyan: bronze; blue: leaded bronze; red: leaded gunmetal; orange: gunmetal; green: leaded brass; yellow: brass.
[112] See for successful examples of PCA tests on archaeometallurgical studies Nicholas 2016; Van Thienen and Lycke 2017.

Chapter 6
Shape of the pXRF dataset

Following from the methodological discussion on pXRF and its possible applications in archaeology in chapter 5, this chapter aims to give a general description and characterisation of the data that were collected. This starts with an exploration of how the various main alloying ingredients interact within the dataset, which alloy groups or types were most commonly identified and what their general composition was. A brief section will be devoted to aspects of technology and the potential evidence within the data for decorative surface treatments, such as gilding, tinning and silver-plating. The final section of this chapter compares these patterns with compositional data published by previous scholars on copper alloys from the Early and Middle Roman period to further characterise Late Roman copper alloys, particularly when it comes to evidence for recycling.[1]

The last section of the chapter tackles the first of the two research questions formulated for this dataset: are there identifiable differences between the alloy compositions of military and civilian dress accessories that may be reflective of a different organisation of production? The first three sections of this chapter make use of all data collected, while the last section (on comparing military and civilian items) only uses the data collected from objects from Germania Secunda as metal use may have been different in Germania Magna. Finds from outside of the Empire are discussed separately in chapter 7, which further builds on chapter 6 in a more explicit analysis of function, chronology, and production organisation.

In total, 2106 readings were taken from 686 objects sourced from at least 59 site complexes, giving information on 15 main components (after normalisation) within the alloys.[2] The objects selected for pXRF analysis, their distribution dates, and social connotations are summarised in table 6.1. Apart from a variety of military belt fittings from both the 4th and 5th centuries, a selection of the most commonly found civilian dress accessories was also chosen for comparison (see chapter 1 for more on selection criteria).

The composition of the dataset

On average, a Late Roman copper alloy (as calculated from the corrosion product) contained around 37.79% in alloying ingredients. It is important, therefore, to outline how these ingredients were used and if any patterns may be suggestive of deliberate practices. In this section, the behaviour of the four main alloying ingredients (copper, tin, zinc and lead) will be discussed in an attempt to understand their roles within Late Roman copper alloys and this dataset. The grouped absolute amounts of tin, zinc and lead found in the 2095 readings on copper alloys (excluding readings of silver-alloy objects) are plotted in bar charts below).

Alloying ingredients

Fewer than 5% of all readings recorded below 1% tin (figure 6.1), with the majority registering between 5 and 30%. Given that up to 15% tin is usually the norm Roman copper alloys (see chapter 5), this elevation is a likely result of corrosion enrichment. The long tail end of figure 6.1 may indicate additional processes, such as deliberate tinning when found on multiple parts of the same object. Incidental results of 25-40/50% tin may be the result of measurements targeting remains of soldering or potentially tin sweating.

As elevated tin levels are commonly associated with corrosion processes (see chapter 5), the variety of collection types that were visited for the pXRF study could potentially be a contributing factor. Finds from private collectors, museums or government archives may all be cleaned, stabilised and stored to different standards. As simple two-piece Armbrust brooches were found in significant numbers in almost every collection that was sampled, they may serve as a good case study to assess the impact of this variety of conservation histories. On average, simple two-piece Armbrust brooches from private collections recorded 26.33% tin. Archive finds on average recorded 29.30% tin, while museum finds recorded an average of 31.18% (see figure 6.2). The general pattern that I wanted to emphasise here is that finds from private metal detectorists are as suitable for surface pXRF as those from professionally kept collections and that corrosion processes can be deemed to affect them to an equal degree.

Finally, there are a handful of objects that recorded more than 50% tin. If this were to reflect the true tin level in the bulk, the objects would have been extremely brittle.[3] Surface enrichment will have played a role, although such high tin levels on the corroded surface do signal a relatively high tin content of the bulk material

[1] Pollard *et al.* 2015.

[2] Copper, tin, zinc, lead, arsenic, antimony, silver, nickel, mercury, gold, iron, cadmium, bismuth, cobalt and manganese. On average, this spectrum represented 99% of each reading prior to normalisation.

[3] Bayley and Butcher 2004, 15.

Object	Interpretation (chapters 2 and 4)	N readings
civilian objects		
footless brooch with high catch-plate	Germanic origin, imported?	73
simple two-piece Armbrust brooch	Provincial-Roman production?	398
two-piece Armbrust brooch with elaborate foot	Provincial-Roman production?	13
supporting-arm brooch	Provincial-Roman production?	57
Fécamp hairpin	Germanic origin, imported?	40
Wijster hairpin	Provincial-Roman production?	78
Cortrat hairpin	Provincial-Roman production?	2
Hairpin (unclassified)	Provincial-Roman production?	5
Subtotal		666
military objects		
buckles	Provincial-Roman production, state-controlled?	594
strap ends	Provincial-Roman production, state-controlled?	184
general fittings	Provincial-Roman production, state-controlled?	492
crossbow brooch	Provincial-Roman production, state-controlled?	170
Subtotal		1440
Grand total		2106

Table 6.1. List of objects discussed in chapters 6 and 7 with social interpretations/hypotheses on production organisation (after chapters 3 and 4).

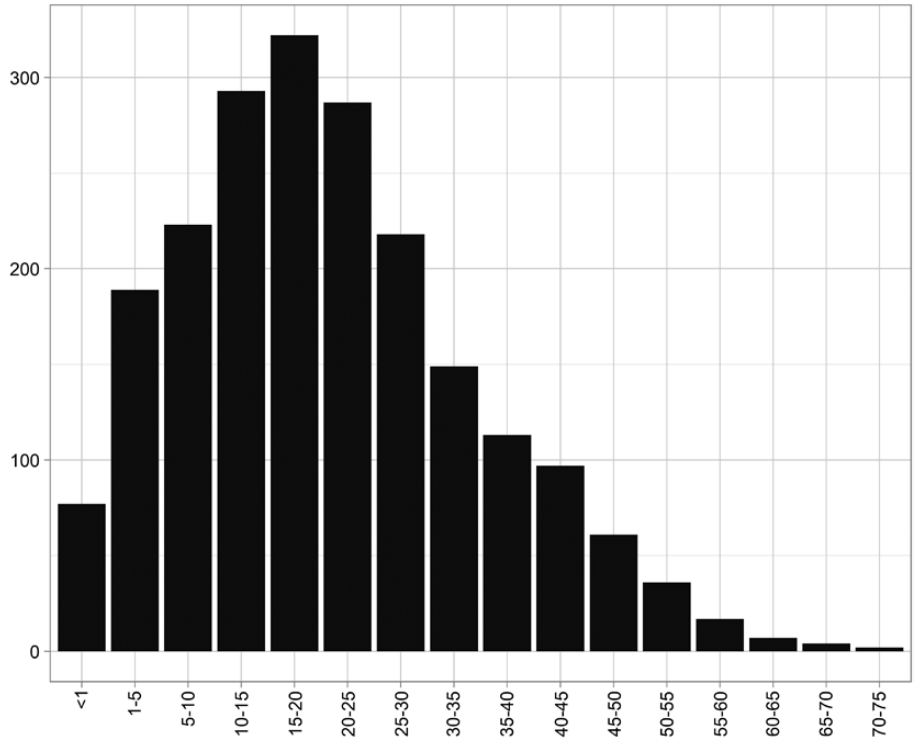


Figure 6.1. Bar chart of tin levels in 2095 readings (silver excluded).

as well. It is also possible that these extremely high-tin level objects were covered in tinplating but that this was no longer visible with the naked eye. Potential indicators of this, as well as gilding and silver-plating are discussed below.

Figure 6.3 tracks the amount of zinc found in the dataset. Around half of the objects did not contain zinc at all and when it was detected, it was usually found in very low quantities (1-5%). Pure brass or leaded brass were very rare (see below) and most of the zinc-containing alloys in the dataset were (leaded) gunmetals. Zinc tends to preserve better in corrosion products of alloys that also contain tin in sufficient amounts,[4] so this may indicate that Late Roman gunmetals generally contained low levels of zinc (rather than those low levels being the result of selective corrosion, although this will have contributed to some extent).

[4] Campanella *et al.* 2009.

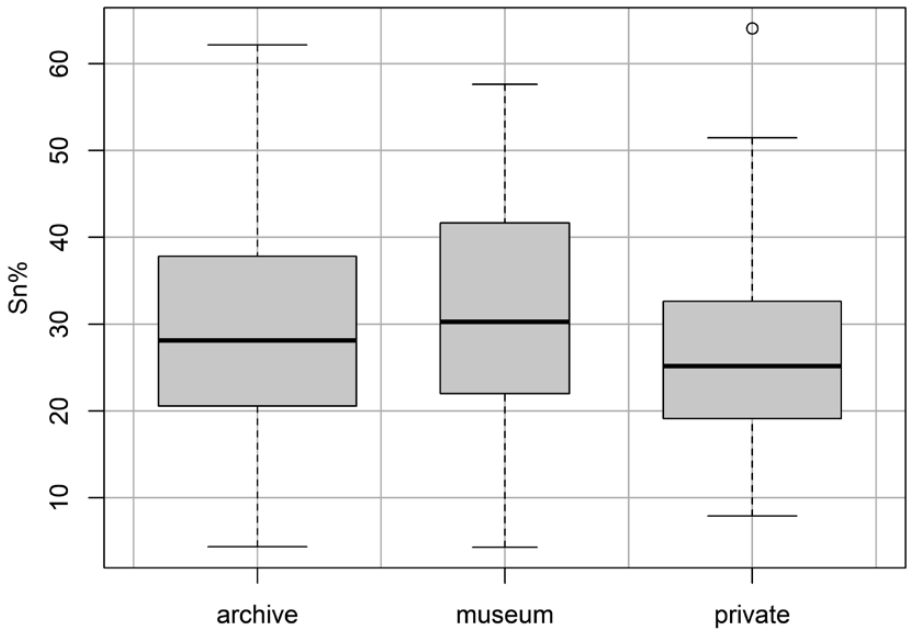


Figure 6.2. Boxplot of tin contents in simple two-piece Armbrust brooches from different collection types (n = 398 readings).

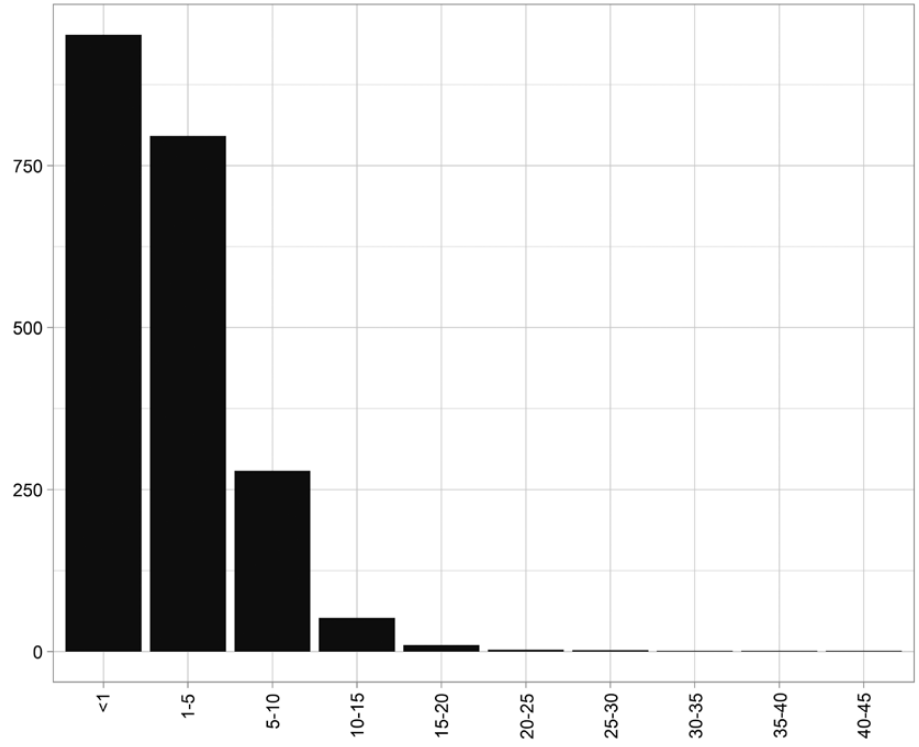


Figure 6.3. Bar chart of zinc levels in 2095 readings (silver excluded).

Lead, finally, shows a long tail of occasional high contents, but without the central peak around the modal point of the plot identified in the tin contents (figure 6.4). Although the vast majority of objects were leaded, most contained less than 10% lead. Some other groups may be recognised (10-25%, 25-40%), and these may be related to object types or functional groups, as in particular certain types of military dress accessory seem to have been especially highly leaded (see below and chapter 7). Overall, the number of outliers is low and in the case of the few objects registering more than 50% lead this might be caused by accidental targeting of separate lead phases. In conclusion, most Late Roman alloys included in this study were leaded but different groups representing low, medium and high lead amounts can be recognised. A variety of tin contents were used, some of which were potentially related to surface tinning for decorative purposes. Zinc was found to be a generally low-level but constant factor in Late Roman copper alloys, possibly caused by the prevalence of mixed alloys.

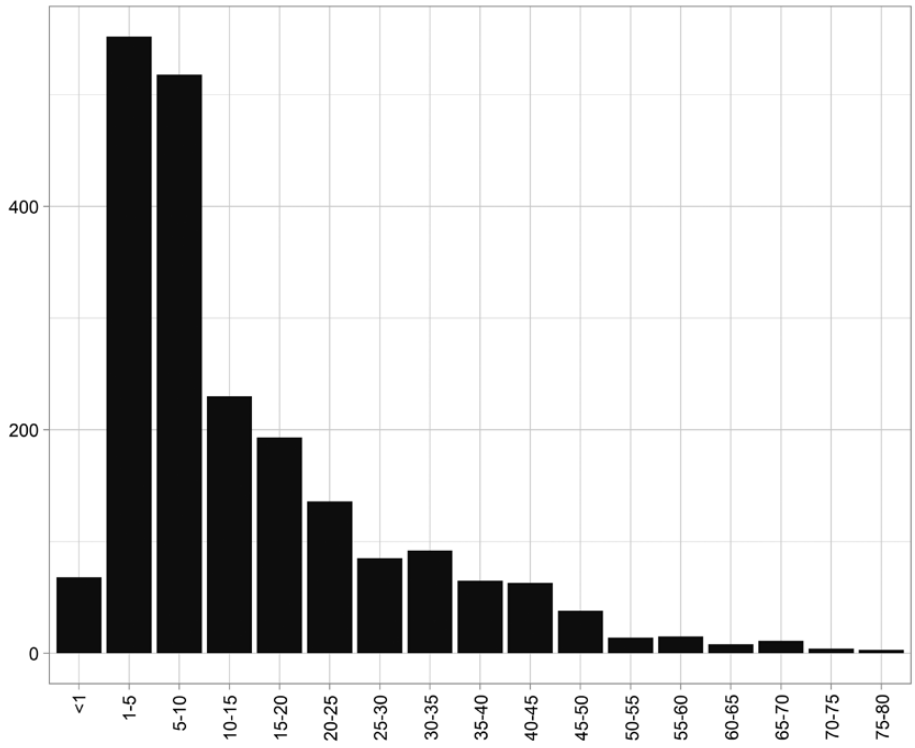


Figure 6.4. Bar chart of lead levels in 2095 readings (silver excluded).

Alloy labels

A first indication of what types of metal were used can be gleaned from assigning alloy labels, using a threshold for major alloying ingredients of 1%.[5] This shows first of all that leaded gunmetal was the most common alloy type across both the civilian and military objects (table 6.2). Leaded bronze was the second biggest category overall but made up a larger percentage of the civilian alloys than the military ones. Although the amounts are insignificant compared to tertiary (leaded brass, leaded bronze) or quaternary alloys (leaded gunmetal), it is noticeable that primary alloys (brass; bronze) and secondary alloys (gunmetal; leaded copper) were mostly identified in the military category.

Alloys	civilian N	civilian %	military N	military %
brass	4	0,6	4	0,28
bronze	11	1,65	39	2,71
gunmetal	4	0,6	6	0,42
leaded brass	10	1,5	56	0,21
leaded bronze	331	49,7	569	39,51
leaded copper			3	0,21
leaded gunmetal	302	45,34	756	52,5
silver	4	0,6	7	0,49
Total	666	100%	1440	100%

Table 6.2. Alloys found in the dataset (n = readings; parameters after Pollard *et al.* 2015, table 2); split out according to social labels.

[5] Pollard *et al.* 2015.

Given this overlap, it is worth exploring to deconstruct these alloy labels and explore their composition. For example: did a 'civilian leaded gunmetal or leaded bronze' look significantly different from a 'military leaded gunmetal or leaded bronze'? Generally speaking, it seems that despite the noted overlap, military alloys tended to contain less tin (figure 6.5) and more lead (figure 6.6). These differences are discussed in more detail for the finds from Germania Secunda below. The correlation between tin and lead content, social labels and object typology is explored further in chapter 7.

Trace elements

A second method of sorting the pXRF analyses into groups reflecting metal use consists of a simple presence/absence system on the four most commonly present trace elements, namely arsenic (As), antimony (Sb), silver (Ag) and nickel (Ni). These are generally found in copper alloys as impurities from the ore used.[6] The presence/absence of these four elements can be summarised in 16 categories (see table 6.3 with tallies). These groups can be traced across sites, periods or typological groups giving us important insights into metal use and technology in antiquity. Following Bray *et al.*, the threshold for presence is set here at 0.1%.[7]

Other trace elements from copper ores have also been suggested to be of interest, namely Co (cobalt), Bi

[6] Bray *et al.* 2015, 205.
[7] Bray *et al.* 2015, figure 1.

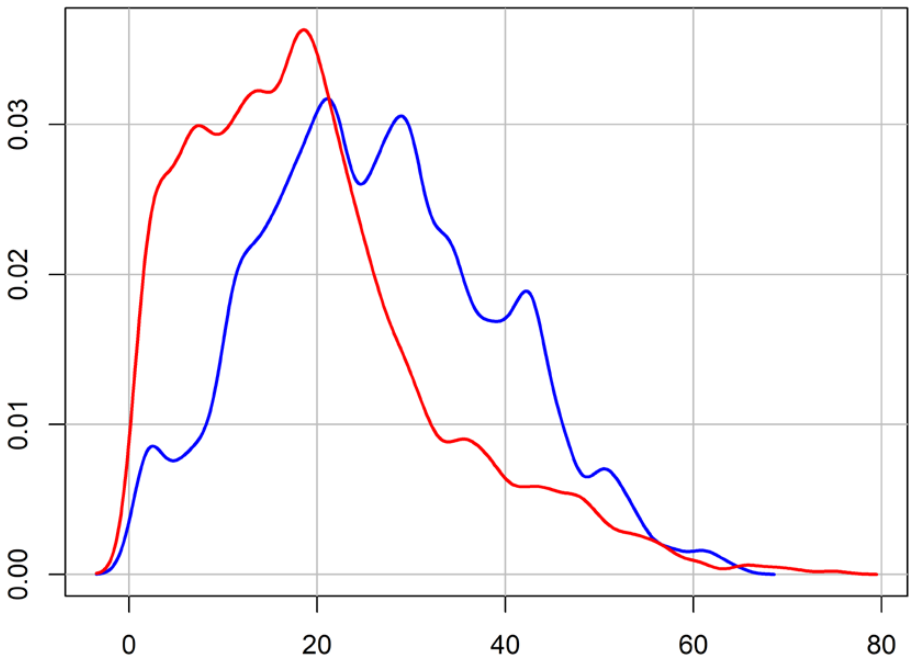


Figure 6.5. Density graph of tin levels (x-axis) in tin-containing civilian and military dress accessories (bronze; gunmetal; leaded bronze; leaded gunmetal; n = 2018 readings). Red: military; blue: civilian. Bandwidth set at 1.5.

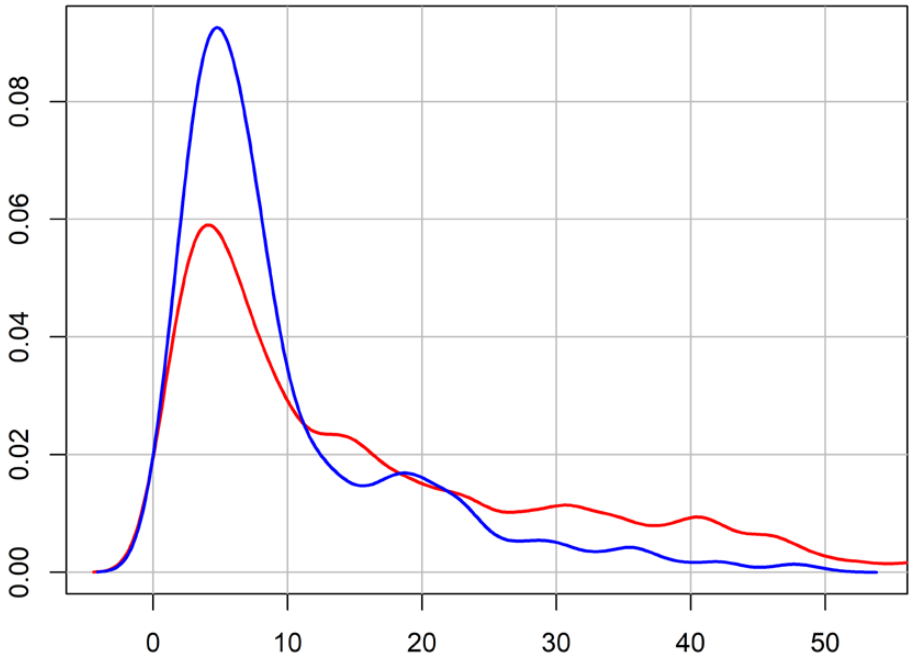


Figure 6.6. Density graph of lead levels (x-axis) in tin-containing civilian and military dress accessories (bronze; gunmetal; leaded bronze; leaded gunmetal; n = 2018 readings). Red: military; blue: civilian. Bandwidth set at 1.5.

(bismuth) and iron (Fe).[8] Any trace elements of iron will be dwarfed out in the analysis by iron present from soil contamination and cannot really be extracted from the data in this manner. In the raw, non-normalised pXRF output, bismuth was detected in 61 readings, but reached above 0.1% in 12 readings. It was found consistently across all readings on only two objects (a crossbow brooch Swift 3/4D from grave 3025 from Krefeld-Gellep and a propellor-shaped belt fitting from Kamen-Westick no. BD 31/PK 345). This suggests that bismuth might not have played a significant role in (Late) Roman copper alloys, much like nickel.[9] Cobalt was detected once, but not above the 0.1% threshold.[10]

Nickel was hardly ever detected (15 readings above 0.1%), an absence that is also noteworthy in other large datasets of northwest European Roman copper alloys.[11] The most stable element was silver, present above

[8] Bray 2020.

[9] Riederer 1987.

[10] For reference, cobalt was not included in the spectrum of analysis by Van Thienen and Lycke (2017) or Voß *et al.* (1998) and was extremely rare in Roxburgh's dataset as well (2019).

[11] Dungworth 1995; Voß *et al.* 1998; Roxburgh 2019; Riederer 2002b, table 1; Riederer 2001; cf. Rieder 1987.

Copper space	Contains	N readings	% readings
1	none	87	4,15
2	As	63	3,01
3	Sb	63	3,01
4	Ag	205	9,79
5	Ni		
6	As/Sb	74	3,53
7	Sb/Ag	486	23,2
8	Ag/Ni		
9	As/Ag	151	7,21
10	Sb/Ni	1	0,05
11	As/Ni		
12	As/Sb/Ag	951	45,39
13	Sb/Ag/Ni	5	0,24
14	As/Sb/Ni	1	0,05
15	As/Ag/Ni		
16	As/Sb/Ag/Ni	8	0,38
Total		2095	100%

Table 6.3. Copper 'spaces' as defined in Bray *et al.* 2015 (n = readings; silver objects excluded).

CS	Contains	civilian N	civilian %	military N	military %
1	none	10	1,51	77	5,37
2	As	5	0,76	58	4,05
3	Sb	16	2,42	47	3,28
4	Ag	82	12,39	123	8,58
5	Ni				
6	As/Sb	28	4,23	46	3,21
7	Sb/Ag	226	34,14	260	18,14
8	Ag/Ni				
9	As/Ag	47	7,1	104	7,26
10	Sb/Ni	1	0,15		
11	As/Ni				
12	As/Sb/Ag	240	36,25	711	49,62
13	Sb/Ag/Ni	5	0,76		
14	As/Sb/Ni			1	0,07
15	As/Ag/Ni				
16	As/Sb/Ag/Ni	2	0,3	6	0,42
Total		662	100%	1433	100%

Table 6.4. Copper 'spaces' as defined in Bray *et al.* 2015 (n = readings; silver objects excluded); split out according to social labels.

0.1% (excluding silver or silvered objects) in 86.11% of all analyses, followed by antimony (75.61%) and arsenic (59.47%). Almost half of all readings contained trace elements of all of these (copper space 12). The prevalence of this mixed signal may be an indication that a lot of the copper alloy used in the Late Roman period had a long recycling history of scrapping and mixing, resulting in consistent low levels of the same spectrum of trace elements across the board. Below, some chronological context will be provided, comparing these data to analyses of Early and Middle Roman objects from the same region.

These copper spaces may also be split out according to social labels (table 6.4). The pattern remains largely the same: copper spaces 4, 7 and 12 are the most common (the latter especially) in both categories, although individual percentages differ somewhat. Silver and antimony remained a stable component in both social spheres (silver was present above 0.1% in 83.88% and 90.93% of military and civilian copper alloys respectively; antimony in 74.76% and 77.79% of readings respectively), but some small differences may be observed in the presence of arsenic. The detection of arsenic above 0.1% was more common in military alloys than civilian alloys: 64.62% and 48.34% respectively.

According to McKerrell and Tylecote, the selective evaporation of arsenic and antimony may be a side effect of remelting copper alloys.[12] The relatively better survival of arsenic in military alloys may be an indication that these were made from materials that had gone through fewer cycles of scrapping, remelting and mixing, although the absolute arsenic levels across the dataset are quite low. Factors in the low detection of arsenic also include the role of corrosion and the issues associated with detecting arsenic with XRF. As these factors influence all objects equally, the difference in arsenic detection between military and civilian alloys may be attributed to genuine differences in alloy use.

Decorative surface treatments

Before moving on to specifics, there are several technological aspects of the data that may be explored to further understand Late Roman metalworking, most importantly the identification of decorative surface treatments. Visual indicators of gilding or silver-plating are quite rare on military fittings in the Late Roman period, but they may occasionally be found on other dress accessories, such as hairpins.[13] Several objects recorded heightened values for mercury, gold, silver and tin, suggesting they had decorated surfaces that were no longer macroscopically visible.

Gilding

Gilding may be expected as a rare occurrence in Late Roman dress accessories. It is known from crossbow brooches[14] and Wijster hairpins[15] but is generally not encountered in significant numbers. Several measurements suggest the presence of visually undetectable gilding, for instance in the detection

[12] McKerrell and Tylecote 1972.

[13] See Böhme 1974 and Van Hemert 2010 for a number of examples.
[14] Bayley and Butcher 2004.
[15] Böhme 1974.

Object	Context	Alloy	Hg	Ag	Au
Fécamp hairpin	Krefeld-Gellep grave 4756	silver	8,95	44,93	43,89
strap end Sommer Bc1	PAN-00041086	silver	3,19	42,33	37,51
Wijster hairpin	PAN-0003205	leaded bronze	0,1	1,66	23,44
Wijster hairpin	PAN-0003205	leaded bronze	0,1	2,34	12,92
Wijster hairpin	PAN-0003205	leaded bronze	0,2	4,06	22,81
crossbow brooch Swift 6ii	Krefeld-Gellep grave 3031	leaded gunmetal	0,38	0,2	6,83
belt stiffener	Kamen-Westick	silver	2,93	78,87	15,92
Fécamp hairpin	Geldermalsen	leaded brass	0	0	2,36

Table 6.5. List of readings registering significant levels of Hg, Au and/or Ag.

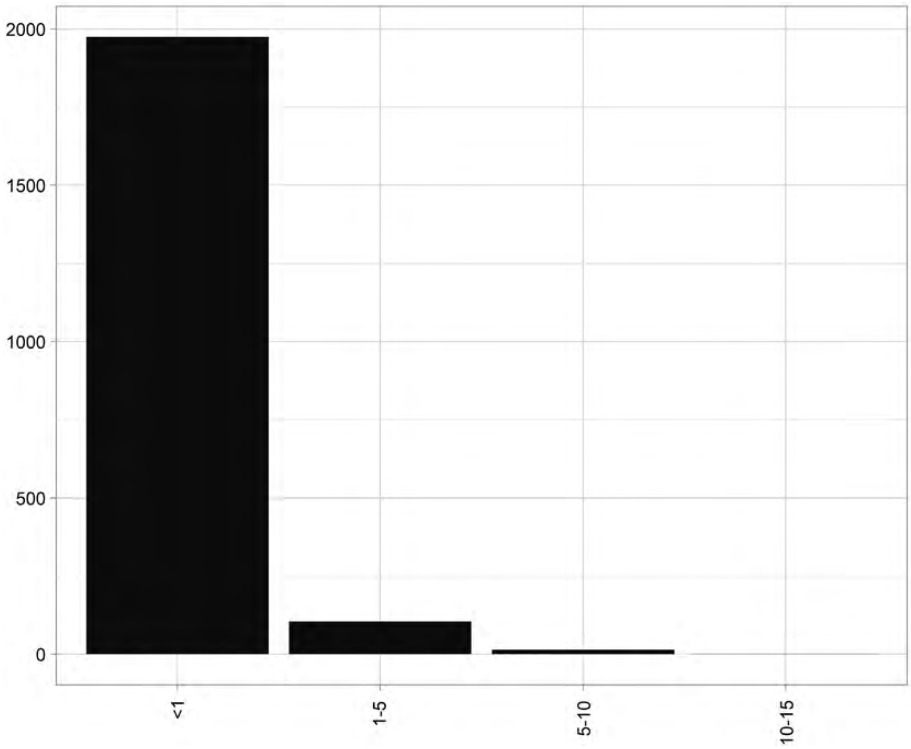


Figure 6.7. Levels of silver in 2095 readings (silver objects excluded).

of mercury (indicative of fire gilding, where mercury functions as an adhesive between the copper-alloy object and the gilt layer).[16]

Only three objects recorded mercury above 1% (see table 6.5), with three more objects registering between 0.2 and 0.4%. One of these was a 5th-century crossbow brooch made of leaded gunmetal, which registered 0.38% mercury and 6.83% gold. Curiously, these readings were not replicated on the other parts of the brooch. The bow and axis mount registered 0.16 and 0.42% gold respectively and the foot was also the only reading that recorded mercury above the limit of detection. Three objects turned out to be made of silver (this was not obvious from looking at the object). In the case of the strap end[17] and the belt stiffener (Kamen-Westick; KW2009.194/PK 332), gold and mercury were only recorded on the front of the objects and not on the back. Two other objects registered elevated levels of gold without the presence of mercury. One of these was a leaded brass Fécamp hairpin from a rural settlement in Geldermalsen. A leaded bronze Wijster hairpin from PAN,[18] consistently recorded several percentage points of silver and up to 23% gold on different parts of the shaft and knob.

Silvering

There is also the possibility of silver plating of objects. As discussed above, silver was a very stable trace element throughout the dataset, but a small number of objects registered it above 5% (see figure 6.7). In the majority of these cases, however, elevated silver levels were not recorded consistently within objects, suggesting that either the silver layer was preserved very badly (either

[16] Anheuser 1997; Lins and Oddy 1975.
[17] PAN-00041086.
[18] PAN-00003205.

Context	Alloy	Ag	Sn	Pb	Location	N readings
Buckles						
Krefeld-Gellep 5589	leaded bronze	7,81	24,52	4,73	front frame	2
Krefeld-Gellep 5590	leaded gunmetal	8,18	11,48	18,74	front frame	1
Krefeld-Gellep 5590	leaded gunmetal	7,3	12,99	18,45	front plate	2
Krefeld-Gellep 5590	leaded gunmetal	6,32	8,16	10,91	tube	2
Krefeld-Gellep 5590	leaded gunmetal	9,65	10,72	13,54	tube	2
Wijchen-Centrum 13.34a	leaded brass	7,22	0,09	10,5	front plate	1
Krefeld-Gellep 1107a	leaded gunmetal	8,3	7,48	11,97	front frame	2
Strap ends						
Krefeld-Gellep 1382	leaded gunmetal	7,38	5,14	10,18	front	1
Supporting-arm brooch						
PAN-00044870	leaded gunmetal	5,99	27,4	19,62	foot	1

Table 6.6. List of objects registering 5%< silver on at least one reading (excluding silver objects). Sn and Pb amounts are also listed; amounts are averaged.

through use or corrosion) or that it was only applied to parts of the object.[19] La Niece describes various techniques that were available to the Late Roman smith for silvering, including silver foil, mercury silvering and silver plating.[20] No direct correlations were found between high amounts of silver and the presence of mercury, ruling out mercury silvering. Silver foil tended to be placed on a prepared surface of a high-tin or high-lead solder[21] and this method seems to be the most likely candidate for most of the objects presented in table 6.6. Foil silvering is also known from Germania Magna,[22] but no evidence was found for this in the samples taken for this project.

In the other cases, a mechanical process of silver plating may be suspected (either through hammering, rubbing heated foil or by heating silver and copper to diffuse the two layers into a silver-copper alloy).[23] The use of silvering pastes and depletion silvering through the selective erosion of copper are also known from the Roman world,[24] although without more invasive analytical techniques it is not possible to definitively identify the specific technique used. The majority of objects with indications for silvering date to the 5th century. Notably, on flat objects like backplates, heightened silver levels were only found on the front, clearly indicating that it was part of a visible decorative surface. Two of the buckles only yielded silver on the frame, not on the backplate. One buckle that appeared to have silver-plating on both frame and backplate and was part of a larger set (Krefeld-Gellep grave 5590), which also included two tubular mounts with signs of silvering.

[19] Partial silvering has been found on Late Roman Wijster and Fécamp hairpins (Böhme 1974; Van Hemert 2010).
[20] La Niece 1993, 201-210.
[21] Mišta-Jakubowska *et al.* 2019; La Niece 1993, 202-204.
[22] Voß *et al.* 1998, 196.
[23] La Niece 1993, 206.
[24] La Niece 1993, 209.

Tinning

Meeks outlined several possible explanations for high tin concentration on the surface, including deliberate tinning using a variety of methods, 'tin sweat' and selective corrosion.[25] Without destructive analysis, it is difficult to distinguish which process might be at play for each individual object, but a general assessment of the data might give some suggestions. The very local nature of tin sweat means that it might be recognised when one reading from an object records elevated tin levels, while the other readings consistently present a much lower tin value. Deliberate tinning of objects might be identified using various variables, depending on which method was used. There are no indications in the chemical data of mercury amalgam tinning, as no elevated mercury and tin levels were found together. Simple tinning through wiping or dipping seems more appropriate for these objects.[26]

Reviewing the bar plot in figure 6.1, it seems probable that the bars to the right of the plot represent tinned objects, as enrichment to levels of 30-40% or more would indicate levels of tin in the bulk material more commonly known from mirrors.[27] The question is where to draw the line between suspected tinning, tin sweat, remains of tin soldering, tin-enriched corrosion and genuine high-tin alloys. Following the bar plot in figure 6.1, we might place the minimum threshold for tinned objects at 30% (indicating anything below that as part of the alloy-related corrosion), as there is a clear drop in readings recording tin contents above that.

485 readings recorded more than 30% tin. Of these, 19 came from objects classified as bronze, 314 from leaded bronze and 152 from leaded gunmetal. There was no

[25] Meeks 1986.
[26] Cf. Giumla-Mair 2005, 360-361.
[27] Bayley and Butcher 2004, 14.

	civilian N	civilian %	military N	military %
bronze	6	2,43	13	5,46
leaded bronze	155	62,75	159	66,81
leaded gunmetal	86	34,82	66	27,73
Total	247	100%	238	100%

Table 6.7. Count of readings registering 30%< tin per alloy.

clearly observable preference for tinning particular types of alloys between the two social labels (table 6.7), but it is noteworthy that high tin contents were found slightly more often in the civilian-associated objects, despite the fact that around twice more readings were taken from military objects. This suggests that decorative tinning was disproportionately more common in non-military dress accessories, possibly to mimic silver-plating (which, although extremely rare, was more often found in military items). The clear overrepresentation of leaded bronze in table 6.7 does suggest that not all of these high tin contents may have been the result of decorative tinning, but that tin sweat or other localised enrichment processes may also have been involved.

	hairpin	brooch (civilian)	brooch (military)	buckle	strap end	fitting
knob	13					
upper shaft	31					
lower shaft	1					
foot		69	8			
bow		84	4			
axis mount		49	5			
front				59	4	60
back				35	5	45
other						13
Total	45	202	17	94	9	118

Table 6.8. Count of readings with elevated tin levels (30%<) per functional object category and location.

To further understand why these objects showed such increased tin levels, we may split out different functional groups and locations on which the tin enrichment was found (see table 6.8). Hairpins appeared to be most often tinned on just the top half (as also seen on gilded silver examples),[28] although it should be noted that often the lower half of the pin was missing or unsuitable for analysis.[29] Almost 40% of all readings on civilian brooches (footless, Armbrust and supporting arm) recorded tin levels above 30%, while this was only 10% for crossbow brooches. In both groups, elevated tin levels were found on all parts of the brooch, suggesting that the entire brooch was tinned rather than specific parts of it. The same was found for belt fittings, strap ends and buckles, where tinning was identified on the back of the objects almost as often as it was on the front.

While indicators of tinning generally decreased among military objects between the 4th and 5th centuries (see table 6.9; overall numbers go down, with the exception of miscellaneous fittings), [30] they increased in popularity over that same period in civilian dress accessories, notably hairpins. Considering the lack of silvered civilian objects in the 4th century (see above), this could potentially indicate an increased appetite for silver-coloured dress accessories among certain sections of the population in the 5th century. The increase of tinning indicators in military decorative fittings may be linked to a simultaneous shift in metal use for military fittings (see chapter 7), namely the increased use of leaded bronze.

Object	IV	V	IV-V
hairpin	11	34	
brooch (civilian)	10	19	135
brooch (military)	17		
buckle	62	18	14
strap end	6	3	
fitting	10	45	63
Total	114	119	211

Table 6.9. Count of readings with elevated tin levels (30%<) per functional object category and period.

A chronological perspective

In broad terms, the shape of the pXRF dataset may be compared to data gathered by other studies on copper-alloy objects from the Roman period to understand

[28] Van Hemert 2010.

[29] The lower halves of hairpins are generally very thin and may not cover the scanner completely, resulting in increased background noise when analysed. Complete hairpins with the lower half intact were also generally too long to fit in the protective covering at all and hairpins where only the lower half remained were impossible to identify to type.

[30] Fécamp hairpins are grouped here in the 4th-century category; Wijster hairpins in the 5th-century category. For more on issues with dating of hairpins, see chapter 2 and chapter 7.

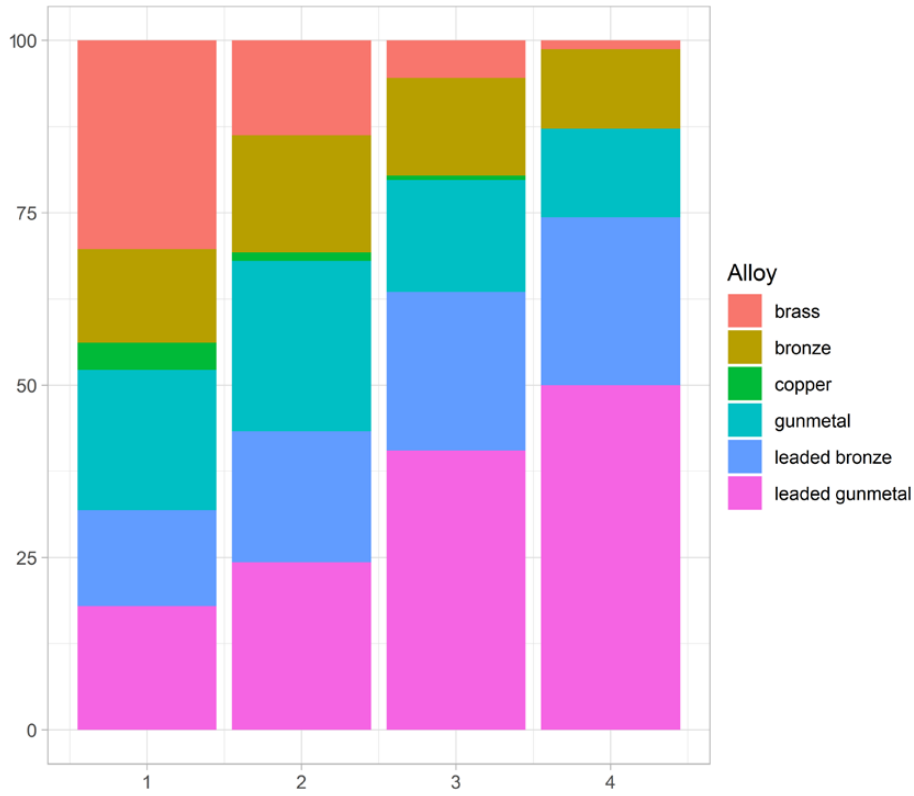


Figure 6.8. Chronological patterns in Roman alloys from Northern Britain (using data from Dungworth 1995, appendix 5; alloy classifications after Pollard *et al.* 2015).

how much of the patterns in alloy use described above are period-specific and unique to the Late Roman period. For this purpose, previously published chemical datasets of Roman co

pper alloys were collated to form a dataset of chemical compositional data from a variety of object types from the northwestern provinces. Collating data from different studies carried out over a longer period of time comes with certain challenges regarding the quality of the data, especially where it concerns dating, typological identifications and provenance. Additionally, a lot of attention in compositional studies of Roman copper alloys has traditionally focused on coins, vessels and statues/statuettes,[31] which may offer less compelling comparisons for the material in this thesis than dress accessories or other small finds.

Alloy use

The main patterns characterising my own dataset of Late Roman objects are the prevalence of leaded alloys generally and leaded gunmetal specifically. These patterns can be embedded chronologically by looking at comparative data. David Dungworth analysed a large number of finds from Northern Britain[32] and his metadata contains precise dating which allows for chronological patterns to be discerned. Applying the FLAME alloy categorisation system to Dungworth's raw data[33] results in a stacked bar chart of alloy types (figure 6.8). The increased use of leaded alloys, especially leaded gunmetal, over time is clear. Other diachronic studies of Roman copper alloy use also identified an increased reliance of recycling and use of mixed alloys after the Early Roman period,[34] especially in brooch production in the Roman Empire.[35]

The lack of leaded alloys in the Early Roman period can also be identified in other datasets. The military complex at Haltern yielded a large number of brooches and other copper-alloy objects, which were analysed using AAS by Riederer.[36] The brooches are dominated by early types such as the Aucissa brooch, Almgren 19 and 22 types and simple wire brooches. The early date of this complex is reflected in the alloys: almost all brooches were unleaded (97%) and three-quarters were made of brass. The other objects from this site (including vessels and lamps, tools, casting remains, pieces of armour, bracelets, bells and other miscellaneous pieces of plate and wire) already show a more varied pattern of alloy use (all objects are presented in figure 6.9). A variety of alloy types was also identified in the finds from Oberesch/Kalkriese. The measurements published by Riederer include a number of buckles, horse fittings,

[31] Riederer 2001; Ponting and Butcher 2005; Den Boesterd 1956.
[32] Dungworth 1995.
[33] Dungworth 1995, Appendix 5.
[34] Fernandes *et al.* 2013; Jouttijärvi 2017, 824.
[35] Teegen 1997, 31; Stupperich 1997, 13; Bayley and Butcher 2004, 208-210.
[36] Riederer 2002.

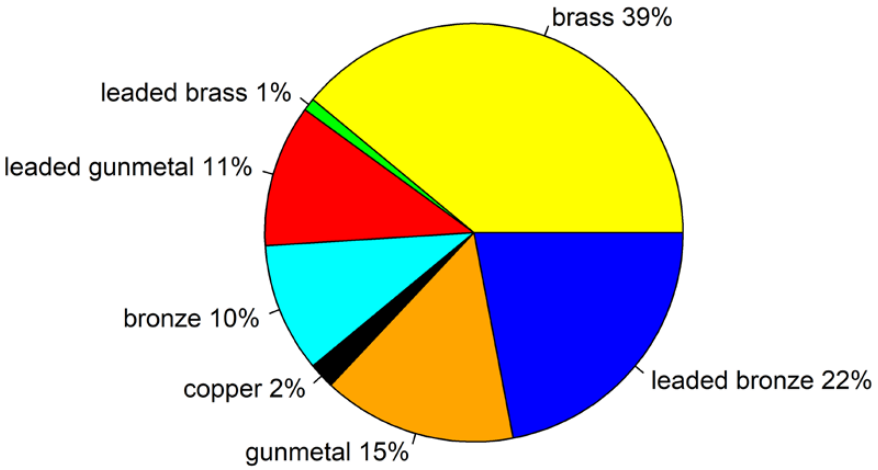


Figure 6.9. Alloys identified in copper alloys from Haltern (n = 302 readings; data from Riederer 2002a).

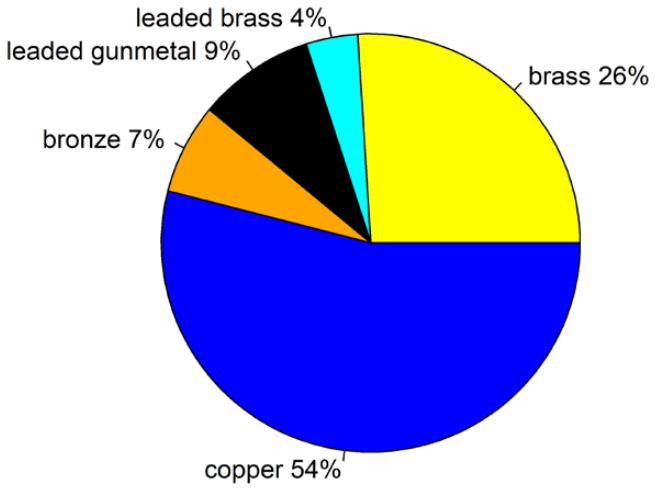


Figure 6.10. Alloys identified in copper alloys from Oberesch/ Kalkriese (n = 87; readings data from Riederer 2001).

vessels and tools (figure 6.9), with brass the most common alloy.[37] Brass was also the predominant alloy (79%) found in the Kalkriese finds (mostly shield bindings and helmet fittings) analysed by Fernández Reyes.[38]

Finally, the closest comparative dataset in terms of regionality and methodology is the study by Roxburgh *et al.*,[39] who surveyed a large number of Roman brooches from the Netherlands. Brass use was identified by the authors predominantly in earlier brooch types, such as the Aucissa series, eye brooches, Knickfibeln, the Almgren 19/20 series, early wire brooches, the Almgren 22a/b series and Van Buchem 13Ce.[40] Some early brooch types in bronze were also noted (Almgren 15; which continued into 2nd century).[41] They further noted a development towards bronze use instead of brass around the end of the 1st century AD, as indicated by Van Buchem 23 and 24 series[42] as well as those later Almgren 15 simple wire brooches.

The lead author was kind enough to share the raw data for all Roman-period objects analysed as part of his broader project into historical copper alloys,[43] which also included a number of other objects. This allowed me to sort their data according to the FLAME system. A large number of objects in the Roxburgh dataset could be dated to either the 1st, 2nd/3rd, or 4th/5th century and the alloys found in those chronological periods are plotted in a stacked bar chart below (figure 6.11).[44] The increase of leaded alloys in the Middle Roman period is also clear here, as well as the sharp drop-off of brass after the 1st century AD. Surprising, however, is the predominance of leaded bronze in the Middle Roman samples. Leaded gunmetal showed a steep increase in use between the Middle and Late Roman period.

Mixed alloys were also the main category in the decorative door fittings of the *Prunkportal* of Ladenburg,[45] which was dated to the mid-2nd century. The composition of the brooches from Xanten (broadly from the 1st-3rd century)[46] similarly show a wide range of alloys, including leaded and mixed alloys (figure 6.12). Voß *et al.*[47] included 142 analyses of brooches, military gear and other items from the fortifications at Oberstimm, Zugmantel and Saalburg from the 1st to 3rd centuries: leaded alloys and especially leaded bronze dominates the spectrum (figure 6.13).

[37] Riederer 2001.
[38] Fernández Reyes 2014, appendix 2.
[39] Roxburgh *et al.* 2016; Roxburgh *et al.* 2017.
[40] Roxburgh *et al.* 2016, 419; see for dating and typological categorisations Roxburgh *et al.* 2017.
[41] Roxburgh *et al.* 2016, 419.
[42] Roxburgh *et al.* 2016, 419.
[43] Roxburgh 2019.
[44] Objects in this dataset found outside of the Empire were excluded.
[45] Künzl and Künzl 2003.
[46] Boelicke 2002.
[47] Voß *et al.* 1998.

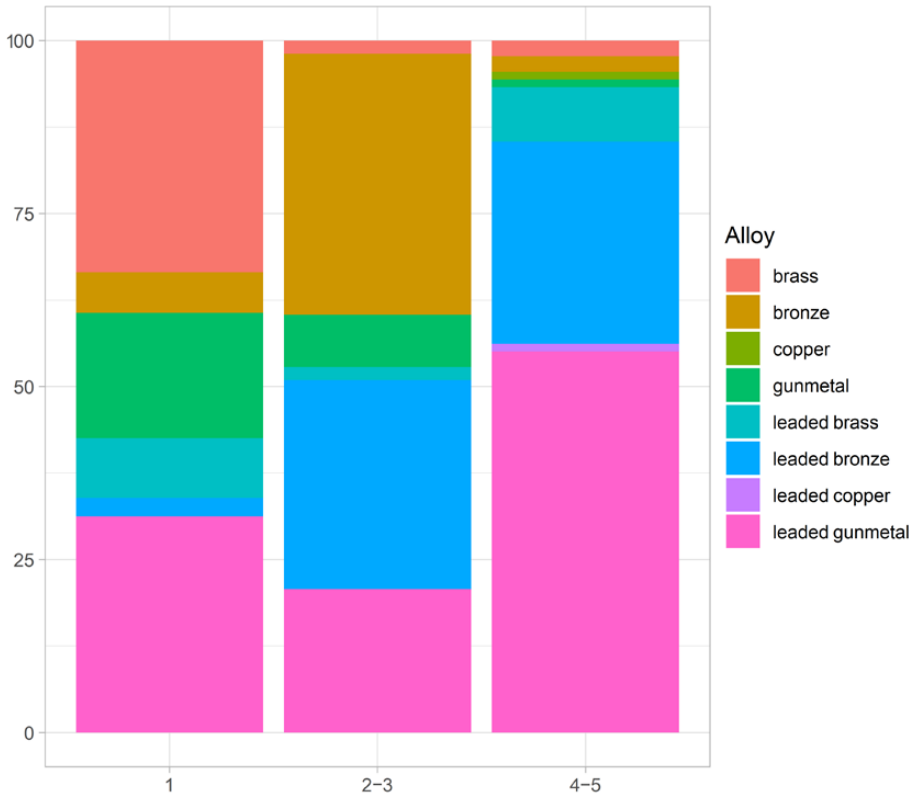


Figure 6.11. Stacked bar chart of Roman copper alloys from the southern Netherlands (unpublished data from Roxburgh 2019). 1st century: n = 245 readings; 2nd/3rd century: n = 76 readings; 4th/5th century: n = 89 readings). Alloy labels after Pollard *et al.* (2015).

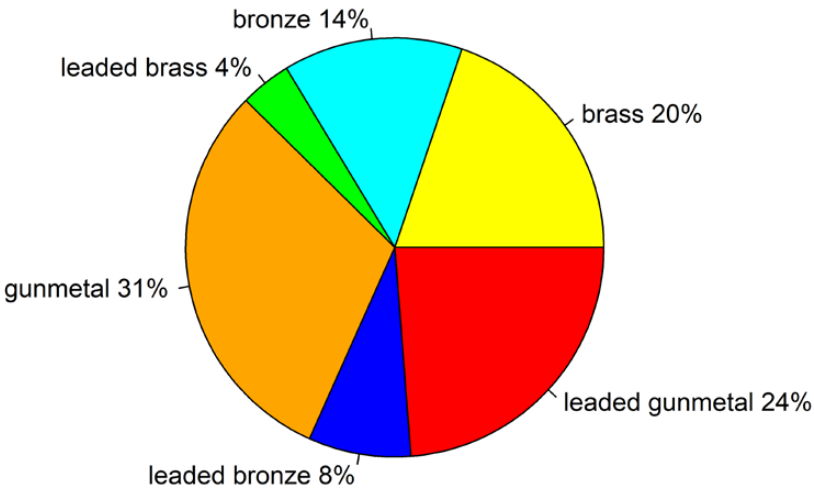


Figure 6.12. Alloys identified in brooches from Xanten (data from Boelicke 2002, n = 51 readings).

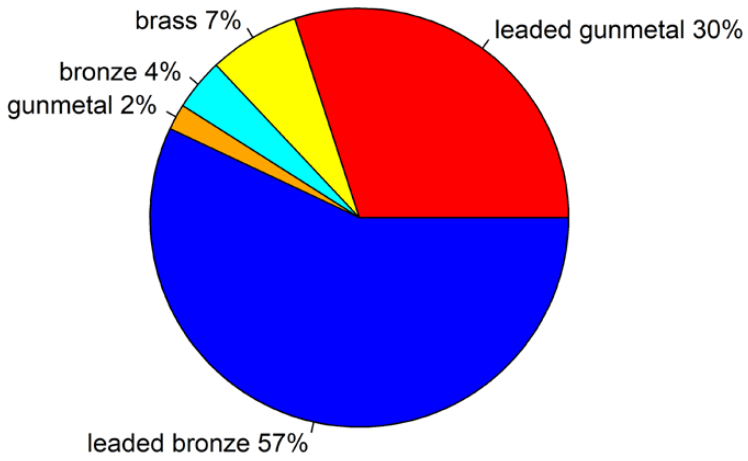


Figure 6.13. Alloys identified in brooches from Saalburg, Zugmantel and Oberstimm (data from Voß *et al.* 1998, n = 142 readings).

The statuettes from the Straubing hoard,[48] which were deposited in first half of the 3rd century were, bar two, all made from leaded bronze. Schmauder and Willer published compositional REM data on a number of chest fittings from the RGM in Cologne, the majority of which were recorded as gunmetals (28 out of 39 readings; only two samples contained lead).[49] 13 samples were taken of objects that could be context-dated to the Late Roman period (late 3rd and 4th century): nine recorded gunmetal, four brass. Dungworth already indicated that brass production did not stop completely after the end of 1st century, although he questioned whether Late Roman brasses were produced from scrap or from raw materials.[50]

In conclusion, it seems that unleaded alloys were far more common in the Early Roman period and began to dominate the alloy spectrum in the Middle Roman period. Brass use was largely found in the 1st century. Mixed alloys such as leaded bronze and leaded gunmetal were well represented in objects dated to the Middle Roman period. Leaded bronze especially appears to have been a constant presence in Roman copper alloys, especially in cast objects.[51] The plots presented above do show that the Late Roman alloys generally showed less variety and more reliance on leaded alloys. For the British evidence, Dungworth linked the increase in leaded alloys in the Late Roman period to a potential 'changing emphasis in the methods of production of objects [...] [*a]s the proportion of cast alloys increased, the proportion of leaded alloys could also be expected to increase'*.[52] The use of leaded alloys, especially leaded bronze on the continent is also well-established in studies of Roman statues.[53]

Trace elements

Embedding the data trace elements within other studies was highly problematic, due to the variety of analytical methods and reported spectra in publications. The reporting on arsenic and antimony was especially variable between different studies and detection limits may have been higher or lower for each trace elements depending on the analytical technique and the time period in which the study was carried out. The comparative data from Haltern,[54] Ladenburg,[55] Straubing[56] and Cologne[57] all reported on the full arsenic, antimony, silver and nickel spectrum, which makes it possible to assign 'copper space' labels to these analyses using Bray *et al.*'s system.[58] Additional spectra on trace elements were found in the *Berliner Archäometrie* dataset,[59] but there the metadata on provenance and dating were often insufficiently detailed to compare with the data collected for this thesis. A large number of analyses in that database are from museum collections without find context, typological information or dating and only a selection was included for comparison. In total, trace element data could be extracted for 1675 measurements from these studies (table 6.10).[60]

CS	Contents	N readings	% readings
1	None	1016	60,69
2	As	219	13,08
3	Sb	82	4,9
4	Ag	81	4,84
5	Ni	24	1,32
6	As/Sb	51	3,05
7	Sb/Ag	87	5,2
8	Ag/Ni	3	0,18
9	As/Ag	27	1,61
10	Sb/Ni	4	0,24
11	As/Ni	3	0,18
12	As/Sb/Ag	69	4,12
13	Sb/Ag/Ni	2	0,12
14	As/Sb/Ni	2	0,12
15	As/Ag/Ni		
16	As/Sb/Ag/Ni	4	0,24
Total		1675	100%

Table 6.10. Copper spaces identified in comparative datasets from the Early and Middle Roman period.

Some patterns in the trace element groups in Early and Middle Roman objects compare closely to the Late Roman objects studied for this work. Nickel was relatively rarely detected above 0.1% (42 readings, 2.4% of all comparative data), while antimony and silver were quite stable components (present in 13 and 15% of all readings respectively). However, a clear distinction between the trace element signals in the comparative data and the Late Roman objects is the overrepresentation of relatively 'pure' alloys in the Early and Middle Roman analyses: the majority of readings in table 6.10 only detected one or even no trace amounts of arsenic, antimony, silver or nickel. The Late Roman data on the other hand was characterised

[48] Riederer 1994.
[49] Schmauder and Willer 2004.
[50] Dungworth 1995, 142, 145.
[51] Dungworth 1995, 143.
[52] Dungworth 1995, 143.
[53] Thomas 2002; Riederer 2001.
[54] Riederer 2002a.
[55] Künzl and Künzl 2003.
[56] Riederer 1994.
[57] Thomas 2002.
[58] Bray *et al.* 2015.
[59] Riederer 2001.
[60] Namely the scrapped bronze statues from Augst (Riederer 2001); brooches and small finds from Oberesch/Kalkriese, Kempten, the Saalburg, Augsburg and Pfyn (Riederer 2001); the bronze hoards of Neupots and Straubing (Riederer 1994; Riederer 2001); the brooches and other finds from the fortifications at Oberstimm, Saalburg and Zugmantel (Voß *et al.* 1998); the doorfittings from Ladenburg (Künzl and Künzl 2003); finds from Haltern (Riederer 2002a); bronze statues from Cologne (Thomas 2002).

by a very mixed signal (especially of copper space 12, containing arsenic, antimony and silver, which made up around half of the dataset). This seems to indicate that Late Roman copper alloys were indeed made from material that had been scrapped and remelted several times, resulting in a mixing of trace elements.

A first comparison between military and civilian alloys

After this first characterisation of the entire dataset, its main alloys and the indications for potential surface treatments, the rest of this chapter will draw out some first broad patterns within those parts of the dataset collected from Germania Secunda (1817 readings on copper alloys; from 554 objects) by using some of the metadata that were collected (finds from Germania Magna are discussed separately in chapter 7). The main question behind the pXRF study was to understand military production in this area in the Late Roman period, so these first tests are built around identifying potential differences in the composition of military and civilian dress accessories in their relative alloy use and the behaviour of the main elements within these alloys. In chapter 7, these broader patterns will be dissected in more detail by looking more closely at chronology and object function.

As already indicated above, a large portion of the dataset is fairly homogeneous, likely due to the level of recycling taking place in the (Late) Roman period. Some consistent differences in composition were identified; however, that could be linked to the chronology, typology or social connotations of the objects. For example, although both leaded bronze and leaded gunmetal were the predominant alloys in the entire dataset, leaded bronze was more strongly associated with civilian dress accessories (see table 6.1). Differences in the tin and lead contents of military tin-containing alloys were also identified. These broader patterns will be discussed in this section, while typological and chronological patterns will be dealt with in chapter 7.

For a first general visualisation of potential differences, all readings recording leaded alloys in Germania Secunda were put through a PCA, resulting in a biplot reproduced here twice: one with the alloys labelled and one with the social associations labelled (figures 6.14-15). The PCA test presented below included all main alloying ingredients after normalisation. The main contributor in PC1 was copper, while lead was the main contributing factor in PC2 (see table 6.11). The importance of lead here is surprising, given that all non-leaded alloys were excluded from the test, so this suggests that despite the relative steep cut-off of lead shown in figure 6.4, there is significant variation of lead in these alloys that needs to be explained.

The role of zinc seems to be limited in the PCA calculations. Figure 6.14 shows a clear distinction along the y-axis of leaded bronze, leaded gunmetal and leaded brass, suggesting that rather than zinc, tin is the more distinguishing factor, with leaded bronzes containing more tin than leaded gunmetals, resulting in a cluster of alloys without tin (leaded brass, leaded copper) at the bottom left of the plot. Overlaying these patterns with the social labels attached to the artefacts shows that the civilian leaded bronzes have their own restricted distribution. They are mostly clustered around the top of the plot, while the military leaded bronzes spread out much further, especially on the x-axis, again suggesting tin was a major factor in distinguishing military from civilian alloys within the leaded bronzes. Secondly, the leaded gunmetals form a clear transition between leaded brass and leaded bronze but it does seem that the military leaded gunmetals cluster more towards the left side of the plot towards the leaded brasses (indicating they might be higher in zinc). Of course, some skewing is inherent due to the different sample sizes: the plots in figures 6.14-15 are based on 460 readings on civilian-associated items and 1296 military-associated items.

Despite this, however, these differences in distribution are worth analysing further, assessing any potential differences between civilian and military leaded bronzes, leaded brasses and leaded gunmetals. One way of visualising the relative amounts of alloying ingredients is by ternary diagram. These diagrams again skew the data by only showing relative amounts, but by removing copper, the main variation factor of PC1 is removed. From these plots, three alloy 'groups' emerge that transcend the FLAME alloy labels and highlight the same patterns as the PCA biplots (figures 6.16-17).

The civilian alloys in figure 6.16 present a very uniform image, with little difference in relative composition between most leaded gunmetals and leaded bronzes. Zinc appears to have played a very limited role, as also seen in the PCA biplots; instead a high-tin, low-lead alloy seems to be favoured (top left of the plot) that includes both leaded gunmetals and leaded bronzes. The military plot (figure 6.17) shows a lot more variation. Both highly leaded low-tin bronzes and low-lead, high-tin bronzes were found, reflecting the wide distribution of this

	PC1	PC2	PC3	PC4
Cu	-0,6449389	0,2724567	-0,3314719	-0,6324141
Sn	0,5288428	0,4917955	0,4215678	-0,5484005
Zn	-0,4350805	-0,3791484	0,8043639	-0,1412448
Pb	0,3392405	-0,7349497	-0,2557452	-0,5285444

Table 6.11. PCA calculations behind figures 6.14-15.

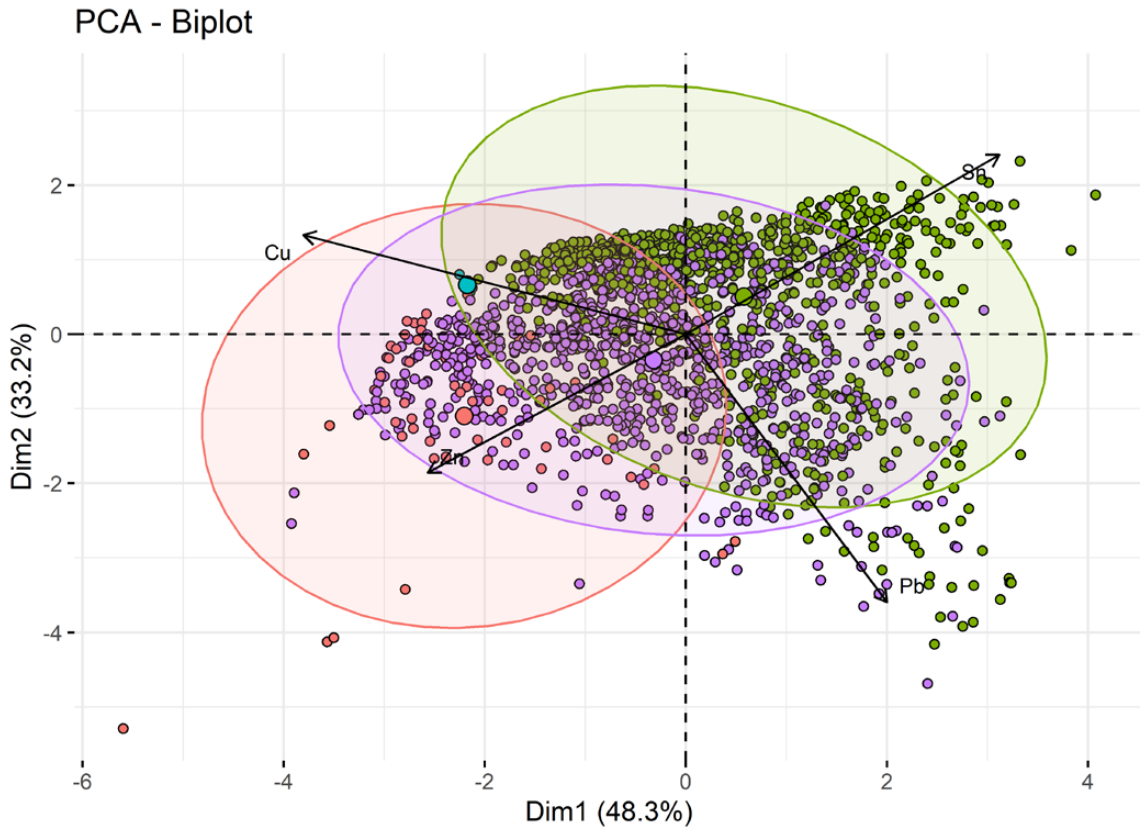


Figure 6.14. PCA biplot of all readings recording all leaded alloys from Germania Secunda (n = 1756 readings), with alloy types colour-coded (spectrum Cu-Pb). Red: leaded brass; green: leaded bronze; blue: leaded copper; purple: leaded gunmetal.

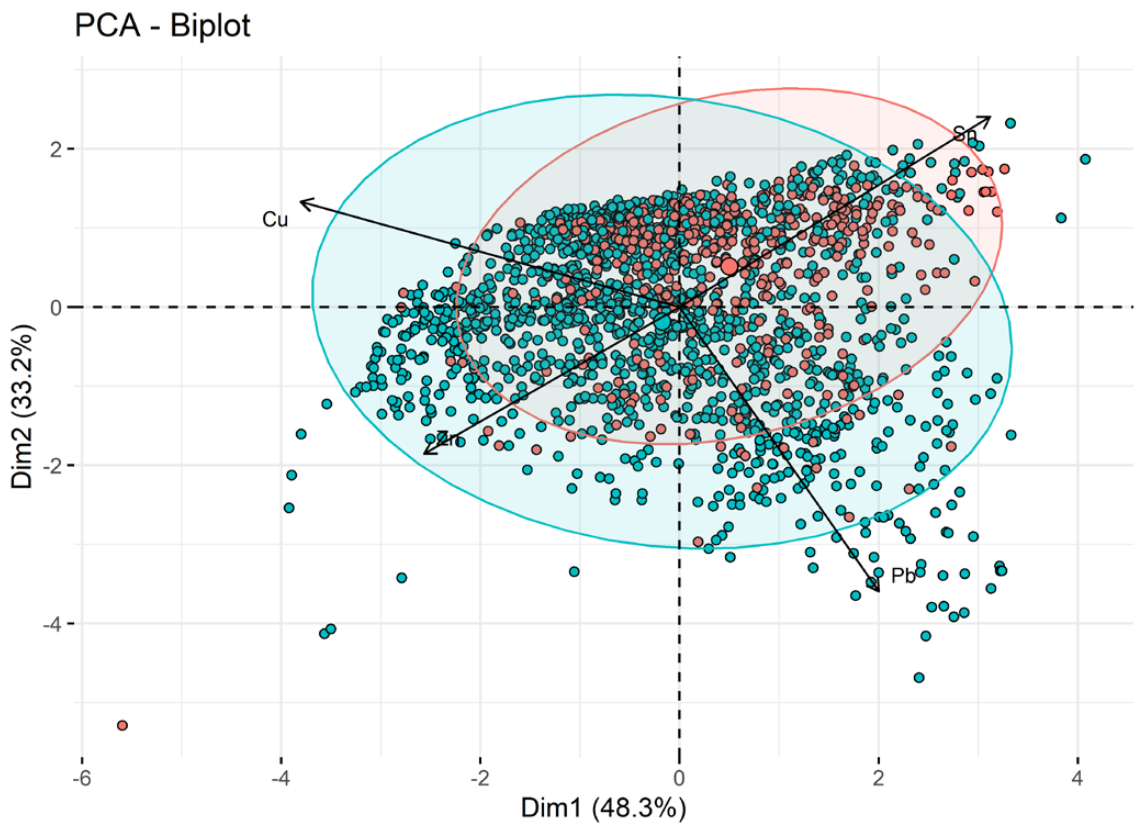


Figure 6.15. PCA biplot of all readings recording all leaded alloys from Germania Secunda (n = 1756 readings), with social labels colour-coded (spectrum Cu-Pb). Blue: military; red: civilian.

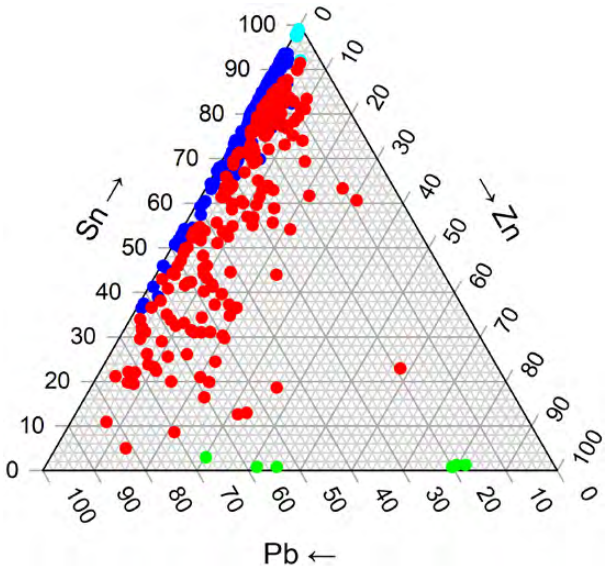


Figure 6.16. Ternary plots of all readings on civilian objects (n = 471 readings) from Germania Secunda, excluding silver.

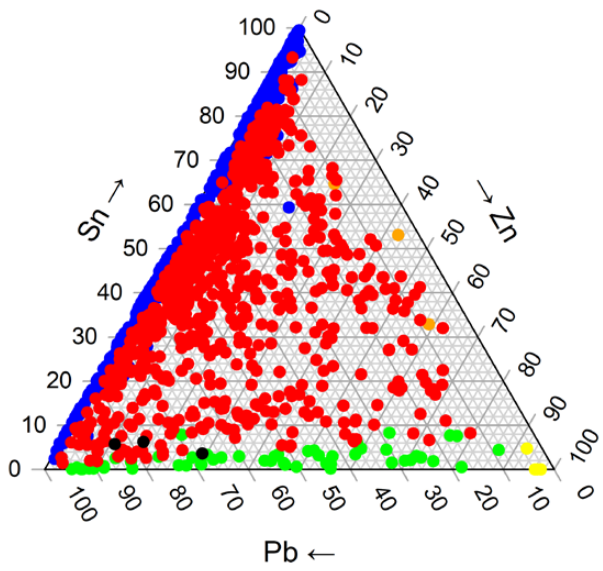


Figure 6.17. Ternary plots of all readings on military objects (n = 1332 readings) from Germania Secunda, excluding silver.

alloy group in the lower right-hand corner. The military alloys in figure 6.17 also show the some overlap between leaded bronzes and leaded gunmetals, although here a significant portion of the leaded gunmetals shows some variation on the zinc axis. A sizable group of military leaded gunmetals contained high lead amounts with a variable zinc content comparable to the leaded brasses also found (lower left of the plot); these are also found in the civilian objects, but are significantly rarer there. The last major category that was found in the military alloys was a leaded gunmetal group with lower lead amounts and a varying zinc content (right side of the plot). d.

One of the main conclusions from the PCA biplots and ternary diagrams (figures 6.12-13) is the tendency for civilian-associated artefacts to be associated with more tin. This is in part due to the fact that these objects were more frequently made of leaded bronze, which was shown to contain higher tin levels than other alloys. Increased tin levels as potential signs for decorative tinning were also recorded more frequently on civilian objects (see chapter 6). The problem with both methods of plotting used so far is that they either use heavily processed data (PCA) or recalculated relative amounts (ternary diagram) and therefore do not give a clear view of the 'true' composition of the corrosion surface. Figure 6.18 presents a line chart of tin levels in all leaded bronze military and civilian objects, illustrating that while the majority of military items fell within the 5-30% range for tin, most civilian items contained between 20 and 40% tin.

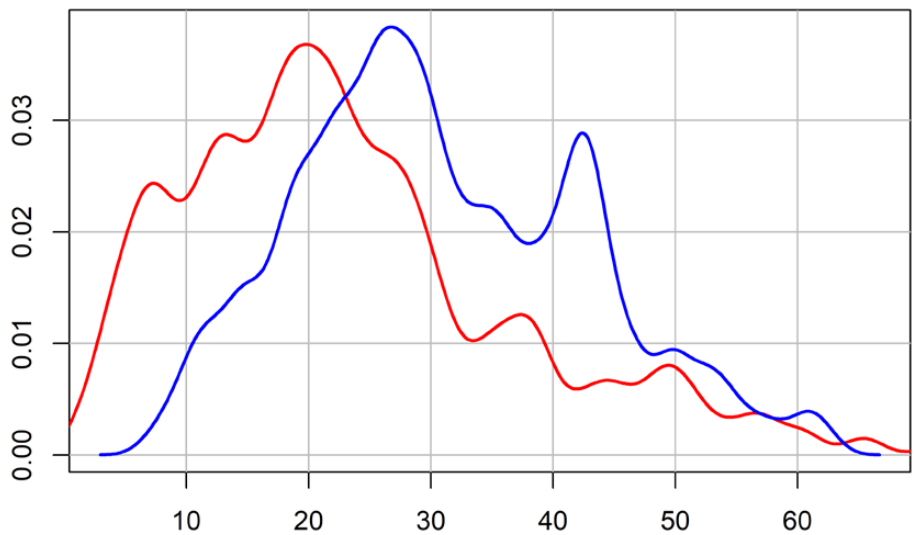


Figure 6.18. Density graphs of tin levels (x-axis) in military (red) and civilian (blue) leaded bronzes from Germania Secunda (n = 758). Bandwidth set at 1.5.

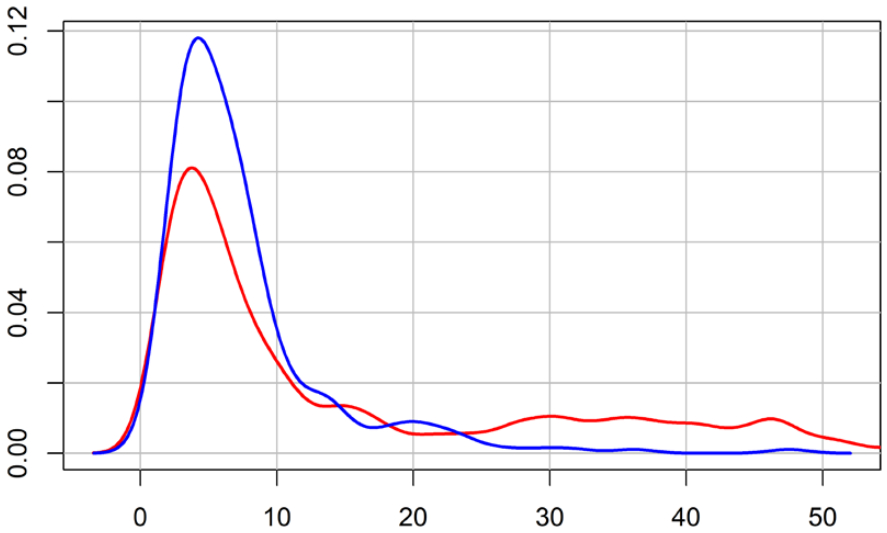
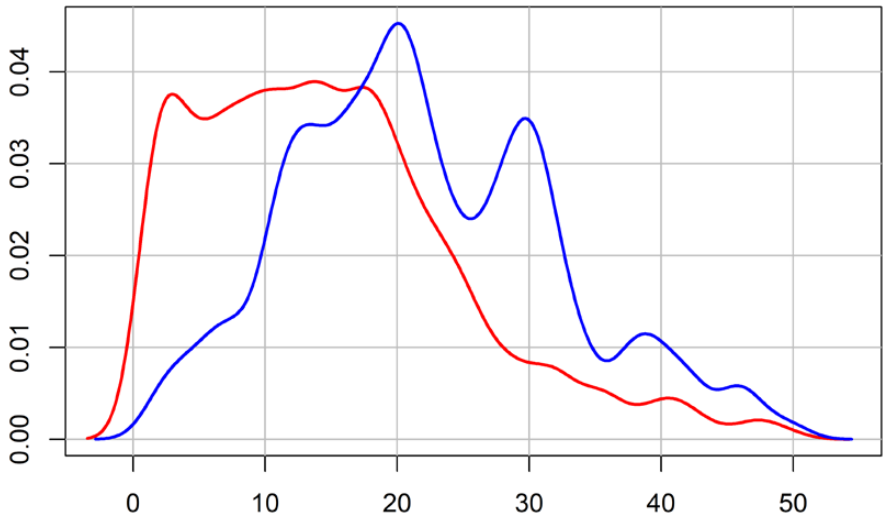


Figure 6.19. Density graphs of lead levels (x-axis) in military (red) and civilian (blue) leaded bronzes from Germania Secunda (n = 758). Bandwidth set at 1.5.

High-tin civilian alloys

The graph in figure 6.19 indicates that in leaded bronze military dress accessories this lack of tin was replaced by lead: whereas the vast majority of civilian leaded bronzes contained between 1 and 10% lead. The tail of the military objects indicates a much greater variety above the 10% level. Further line graphs show these same social patterns for leaded gunmetals (figures 6.20-21), although in the lead contents, a second smaller peak around the 20% mark indicates the presence of some high-lead civilian alloys.

Figure 6.20. Density graphs of tin levels (x-axis) in military (red) and civilian (blue) leaded gunmetals from Germania Secunda (n = 935). Bandwidth set at 1.5.



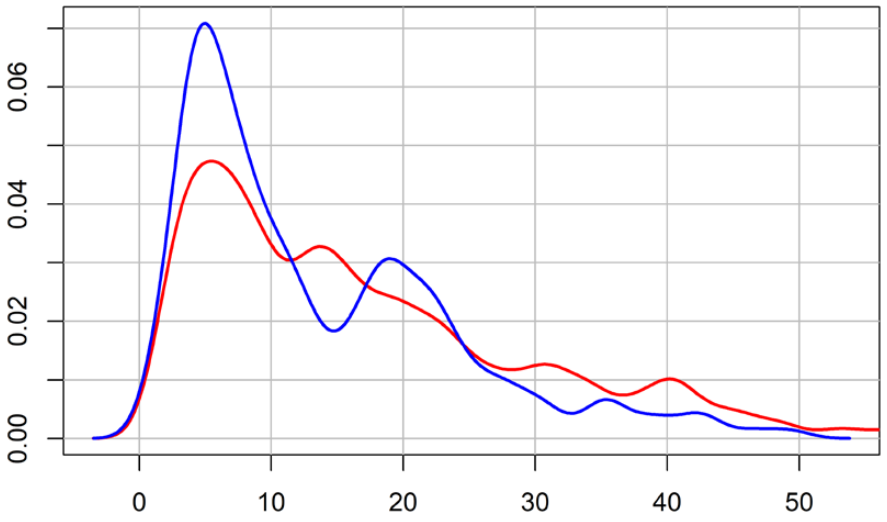


Figure 6.21. Density graphs of lead levels (x-axis) in military (red) and civilian (blue) leaded gunmetals from Germania Secunda (n = 935). Bandwidth set at 1.5.

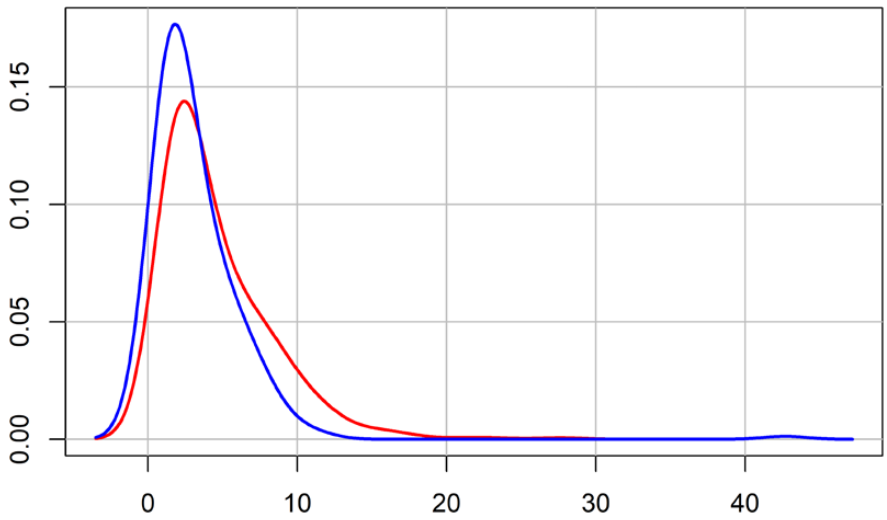


Figure 6.22. Density graphs of zinc levels (x-axis) in civilian (blue) and military (red) zinc-containing alloys from Germania Secunda (brass, gunmetal, leaded brass, leaded gunmetal; n = 1002). Bandwidth set at 1.5.

Highly- and lowly-leaded military alloys

The consistent but variable presence of lead in military objects has been noted several times above in this chapter as a recurring feature of military alloys, whether they contained zinc (leaded brass; leaded gunmetal) or not (leaded bronze). The ternary diagrams in figures 6.16-17 further divided the leaded alloys in two rough groups: those high in lead and those lower in lead. The inclusion of large amounts of lead in an alloy may have been a technological decision: a great number of Late Roman belt fittings were potentially cast with well-defined decoration added to the mould (see chapter 4), necessitating a highly viscous alloy in its molten state (necessitating the addition of significant amounts of lead). This may be the case for many of the fairly bulky buckle frames with animal-headed terminals (see further discussion chapter 7). However, a number of contemporary civilian objects, namely supporting-arm brooches and hairpins were similarly thick and also featured such intricate decoration that casting may be presumed to have been the main production method. Regardless, these items contained on average at least half the amount of lead as contemporary belt fittings (discussed in more detail in chapter 7). Consequently, the lack of technological difference between these objects suggests that the difference in lead content is socially informed instead. One possible reason for the use of lead in military alloys is availability. As lead is a common by-product of silver mining through cupellation,[61] the Late Roman state and army may have had a lot of lead to spare.

The role of zinc in military alloys

Finally, there is the question of zinc and its potential relation to the Roman army. Previous studies have highlighted the restricted use of brass for objects associated with the military (especially brooches and armour plating),[62] although this practice seems to have been almost exclusive to the very Early Roman Empire. In the comparative dataset presented in chapter 6 on Early and Middle Roman copper alloys, pure brass was largely associated with Aucissa brooches as well as very early, military complexes like Haltern and Kalkriese. As already noted above, pure brass and leaded brass were only sparsely found in the dataset and with the exception of three 4th-century Fécamp hairpins, (leaded) brass use appears to have been largely restricted to military dress accessories. The apparent restriction of leaded brass to military and high-status civilian items is noteworthy, bearing in mind how closely interwoven both communities were in the Late Roman frontier zone (see discussions in chapters 2 and 4). Most of the zinc-containing alloys were leaded gunmetals, which contained variable, but mostly low amounts of zinc. If we compare the zinc levels of military and civilian alloys in all (leaded) brasses and gunmetals (figure 6.22), it is clear that across both categories, most objects contained very low amounts of zinc, with the military alloys skewing slightly more towards a higher zinc content (on average 4.58% compared to 3.18% in civilian zinc-containing alloys).

The starkly different plotting of leaded gunmetal (figures 6.16-17, reproduced with just the leaded gunmetal in figures 6.23-24) highlights that whereas civilian leaded gunmetals plotted towards a high-tin group, military leaded gunmetals displayed a great deal more variation, including significant numbers of low-tin and high-lead alloys. This illustrates a landscape in which low-zinc alloys appear to have circulated widely among different artefact types of various social connotations, with low tin and high lead levels setting military alloys apart from civilian ones. As pure brasses were seemingly no longer being produced from scratch,

[61] Hughes and Hall 1979.

[62] Dungworth 1997.

it appears zinc was recycled down to widely occurring trace element in the Late Roman period that no longer influenced any practical or technological decisions of the smith.

The marked differences in tin and lead, however, could be an indication that the recycling and mixing practices of different communities (including potentially different sources of raw or scrapped materials and different levels of intensity of recycling) were largely successful at keeping certain types of alloys apart, resulting in different practices of metal use in different spheres of the metal economy. The greater variety in alloy types found in the military sphere suggests those workshops producing for the Roman army were able to draw on a much wider network of metal sources for their copper alloys.

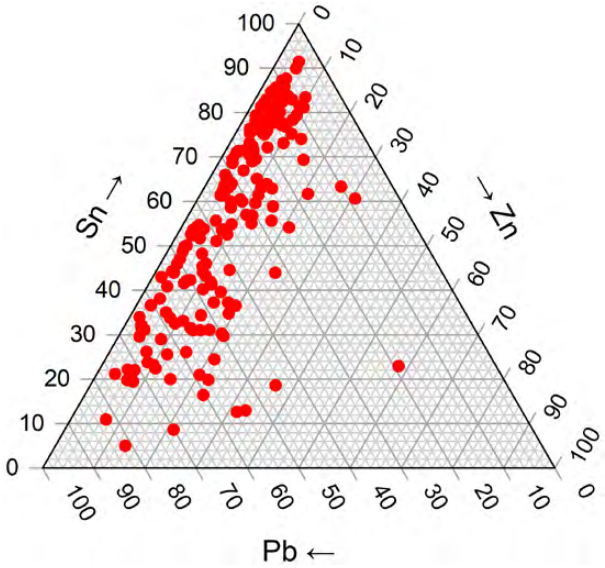


Figure 6.23. Ternary diagram of civilian (n = 205) leaded gunmetals from Germania Secunda.

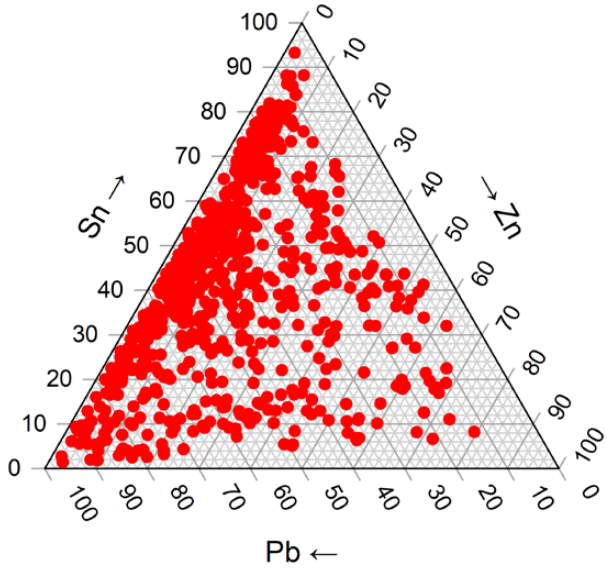


Figure 6.24. Ternary diagram of military (n = 730) leaded gunmetals from Germania Secunda.

Chapter 7
Compositional patterns of production in copper-alloy dress accessories

In chapter 6, the general shape of the dataset was characterised and some general distinctions (as well as a certain amount of overlap) in alloy use between civilian and military dress accessories were noted. Generally, civilian objects showed a slight tendency towards leaded bronzes, whereas military objects were more closely associated with leaded gunmetals. Generally speaking, leaded bronzes used for civilian-associated objects also tended to be higher in tin than leaded bronzes used for military-associated objects. Military leaded gunmetals tended to contain more lead than leaded gunmetals found in civilian objects. All of this suggests that the military and civilian spheres of the metal economy drew on partially different sources of raw and scrapped material and potentially maintained different practices for recycling and sorting scrap metal. The prevalence of highly mixed trace element signals (i.e. copper space 12; containing arsenic, antimony and silver) in both categories also shows that mixing and recycling were common in both spheres.

The central aim of this chapter is to build on these broader patterns and explore in more detail the nature and organisation of production of military dress accessories in both the 4th and 5th centuries and how these compare to contemporary civilian dress accessories from the same region of the Roman Empire (objective 4). Research objective 4 was split into two research questions, the first of which (question 7) was discussed in general terms at the end of chapter 6. Question 8 focuses on identifying differences in object dimensions and compositions between military dress accessories of the 4th and 5th centuries. Additional data is reported on civilian dress accessories to put this chronological comparison into perspective. This may put into contrast whether any patterns found in the military dataset are reflective of general alloying practices in the Late Roman West or whether they are specific to military production organisations. A small number of finds from Germania Magna are also discussed as a further comparison.

The design of the pXRF experiment was largely focused on broader chronological questions (4th vs. 5th century) and social spheres (military vs. civilian dress accessories). However, the chemical data that was collected came with a wealth of metadata that allowed for more specific comparisons to be made, including typological groups, differences in composition between different parts of the same composite object, functionality and find context. This opened up the possibility of presenting a much more contextualised analysis of the pXRF data, delving into specifics of metal use related to factors which I believe to be important and relevant to the research questions. Below, each major sub-group in the data is described separately and, in each section,, subsections are devoted to typological, chronological, functional or social differences identifiable in the chemical composition. Each section ends with a brief recap of the major patterns identified in that section. An analysis of object dimensions using coefficient of variation calculations to study standardisation and variation was also carried out, which are presented separately below.

Military dress ornaments

The vast variety of different elements that were part of the Late Roman military dress assemblage, combined with an even wider variety of forms, styles and decorative schemes, means that the analysis of military dress accessories needs to be split into different groups. First of all, a division may be made between belt accessories such as suspension and tubular mounts, belt stiffeners, strap ends and other miscellaneous fittings and on the other hand 'fasteners', namely brooches and buckles. Although this division is somewhat arbitrary, it is based on assumption that without a buckle or brooch, a belt or cloak could not be worn, while this would technically be possible without any additional fittings, strap ends etc. This division is further supported by the different distribution patterns of fasteners and accessories. 83% of all belt graves in Germania Secunda contained either a buckle on its own or a buckle with one or more additional fittings. Only 17% of graves in the same region contained one or more belt fittings without a buckle. As pointed out in chapter 4, the opposite pattern is true for Germania Magna.

This division thus allows us to understand whether the essential fasteners of the Roman military dress code were made differently from the more decorative fittings, potentially because the latter could be procured from a wider variety of (regional) workshops, while hypothetically, the fasteners could have been produced in a more limited, state-controlled environment. It is also possible that differences in alloy composition are related to material constraints and functionality, with fasteners needing to withstand more significant pressure or torsion than more decorative items.

	4th century				5th century				
	Sorte 1/2		Sorte 3		Sorte 1/2		Sorte 3		
Alloy	N	%	N	%	N	%	N	%	Total
bronze	13	3,47							13
leaded brass	20	5,33			4	6,78	1	1,67	25
leaded bronze	133	35,47	19	79,17	20	33,9	32	53,33	204
leaded copper	2	0,53							2
leaded gunmetal	207	55,2	5	20,83	35	59,32	27	45	274
Total	375		24		59		60		518

Table 7.1. Copper alloys found in dated buckles Sommer *Sorte* 1 and 3 (n = readings).

For the aims of this chapter, belt fittings were mainly typologically dated, and context dates (when found with datable objects in closed contexts) were used to pin down objects that could not be precisely dated typologically.

Functional elements: fasteners

For the first research question (shifts between 4th- and 5th-century belts), buckles are the best category to illustrate any patterns as they are the most numerous and most often datable on typological grounds. There are two main types of buckles in the study area (Sommer types 1 and 3), both of which circulated in the 4th and 5th centuries (although type 1 was the main type in the 4th century and type 3 in the 5th century; see chapter 4). This allows for a comparison of metal use across construction type and chronology.

As table 7.1 makes clear, type 1 and 2 buckles show a clear preference for leaded gunmetal in both periods. Type 3 buckles, on the other hand, were predominantly made in leaded bronze in both periods. A purely chronological explanation is difficult to impose due to the much smaller sample size of 5th-century buckles, but generally it appears that leaded gunmetal became slightly more common in type 3 buckles in the 5th century. It is possible that the changes in alloy use are related to the shift from composite to fixed buckle types. The type 3 buckles have much thicker plates due to their casting method, making leaded bronze an understandable choice. The metal plates of the type 1 and 2 buckles may have lent themselves better to a zinc-containing alloy. These technological factors are discussed in more detail below.

With the Sommer 1 and 2 types, it is possible to distinguish different technological decisions made for different parts of the buckle. A PCA analysis of Sommer type 1 and 2 buckles of only the main alloying ingredients clearly shows two distributions for the various parts of the buckle (figure 7.1). Buckle frames cluster more towards a higher lead content than backplates and pins, which varied widely but tended to be more strongly associated with tin and zinc.

A further dissection of the two main buckle components (frame and backplate) per century is presented below in a series of ternary diagrams (figures 7.2-3). In composite buckles from the 4th century, the frames appear to show a direct negative correlation between zinc and lead that does not show in the back-plates. This can be seen in the much wider distribution of especially the leaded gunmetal plates in the lower right corner of the ternary plot. Tin levels appear comparable in both groups, but the frames appear to cluster more towards the lower left corner of the plot (high in lead; as also indicated by figure 7.1). The same pattern can be identified in the 5th-century composite buckles (figure 7.3), despite the much smaller sample size.

4th-century composite buckle frames contained on average 25.34% lead, while an average of 6.97% lead was detected in the backplates. In 5th-century composite buckles the same difference was found, albeit less extreme: 10.31% and 17.93% in backplates and frames respectively. A boxplot (figure 7.4) of just the lead contents of composite buckle frames and back-plates as well as decorative belt plates and crossbow brooches puts these differences into focus. With the exception of military crossbow brooches, buckle frames contained the highest amounts of lead of all military dress accessories, while backplates contained the smallest amounts. On average, backplates and decorative plates contained at least 10-15% less lead than contemporary buckle frames. This suggests that the decision to use more heavily leaded alloys for buckle frames was deliberate.

The frames of these buckles were often decorated with animal heads, *Kerbschnitt* and other highly plastic decorative schemes that may have required a higher lead content to improve the casting quality of the alloy. Secondly, composite plates tended to be thinner than the bulky frames and were probably not always cast but could also be hammered, negating the importance of a high lead percentage for a clean casting result. A high lead content could also have made a hammered plate too brittle.

Absolute tin levels were comparable in back-plates and frames in composite buckles in both periods (figure 7.5),

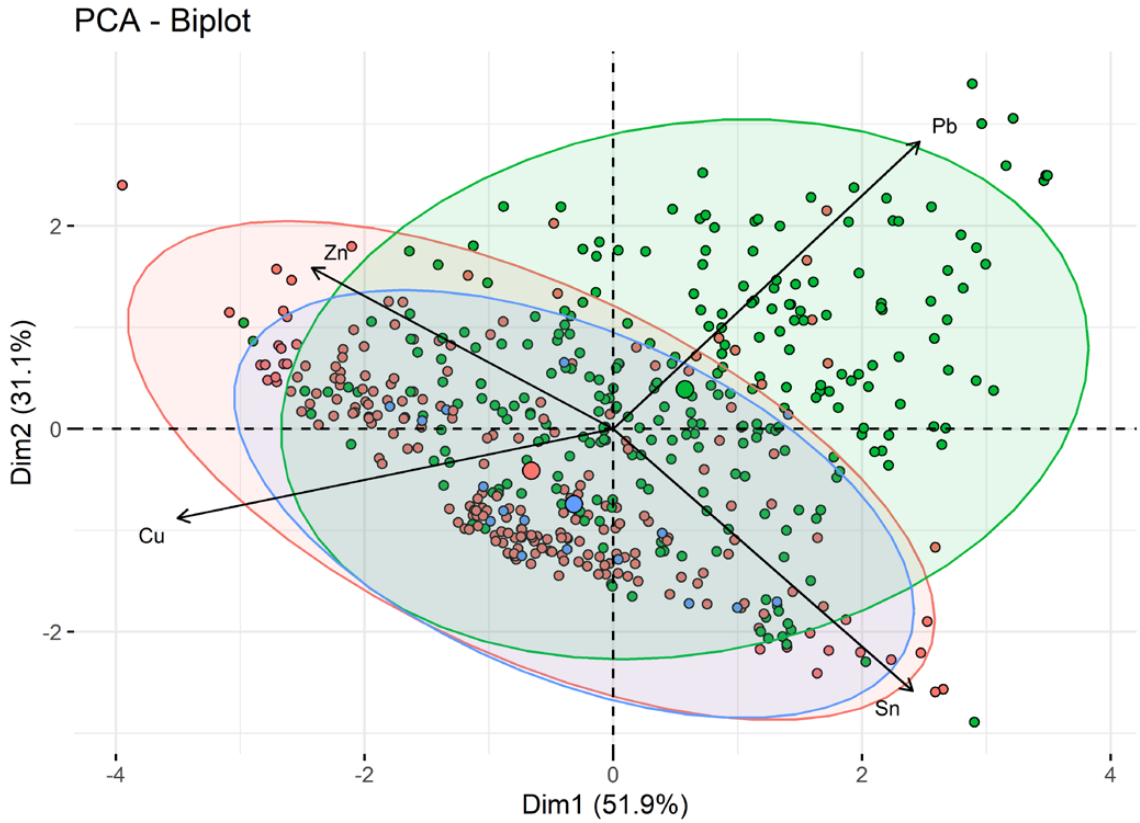
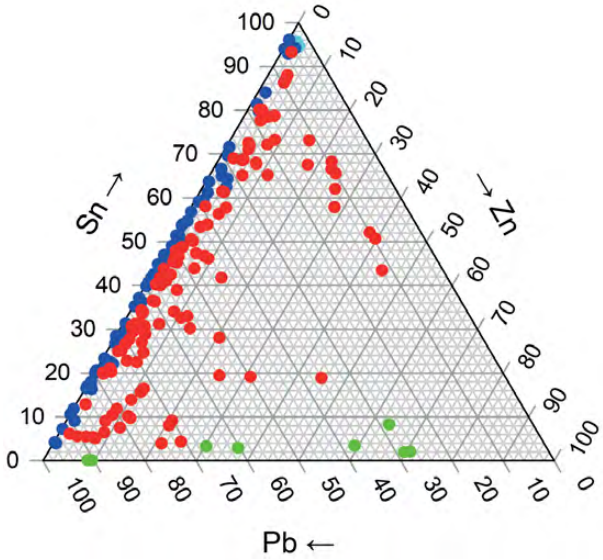


Figure 7.1. . PCA biplot of main alloying ingredients in composite buckles of all periods from Germania Secunda (Sommer *Sorte* 1 and 2; n = 504 readings; spectrum Cu-Pb). Green: frame; red: backplate; blue: pin.

although these increased somewhat in leaded bronze buckles in the 5th century. Unfortunately, only a very small number of 5th-century composite buckles could be analysed and it is therefore possibly that outliers unduly influence that pattern. The very high tin levels recorded on the buckle in grave 78.A.14 in Tongeren, for example, are possibly indicative of decorative tinning (37.36-57.85%). More data are available for the 5th century in the Sommer type 3 buckles (figures 7.6). One-piece buckles (Sommer *Sorte* 3) are mostly found in 5th-century contexts, but the Sommer 3e type dates to the 4th century. All readings of this type (figure 7.6) may be characterised as relatively heavily leaded alloy with relatively little tin. This composition falls within the same scope of the more numerous 4th-century composite buckles (figure 7.2).

Exploring the absolute lead values a bit more (figure 7.8) shows that 4th-century Sommer 3e buckles contained similar amounts of lead (30% on both backplate and frame), as the frames of the 4th-century composite buckles. The high lead content of the backplates in the Sommer 3e buckles is due to the fact that the frame and backplate were cast in one piece: the 4th-century fixed backplates contained the same levels of lead as contemporary composite buckle frames. Tin levels were low (on average 9.80% on backplates and 12.43% on frames), again very similar to contemporary composite buckles, although the limited number of datapoints on Sommer 3e buckles inhibits any definitive interpretation.

A ternary plot of the 5th-century Sommer type 3 buckles (figure 7.7) shows a partial shift of some one-piece buckles towards an alloy with more tin and less lead than before, while a significant group still fell within the high-lead, low-tin range. Again, this was only found in the leaded bronze buckles, where the average tin content increased from 11.39% in the 4th century to 21.04% in the 5th century. This increase was not identified in the leaded gunmetal one-piece buckles. This suggests a diversification of material in the 5th century, with some buckles, regardless of construction type, continuing to be made of a high-lead leaded gunmetal-type material and a second, smaller group emerging consisting of a more high-tin leaded bronze-type material. At the same time, the chemical composition of buckles showed significant continuity and consistency throughout the Late Roman period. The overall composition of leaded gunmetal buckles remained stable across both centuries and both composite and one-piece buckles. The lead content, which was identified in chapter 6 as very characteristic for military alloys, also remained stable over the course of the 4th and 5th centuries in both types of buckles.



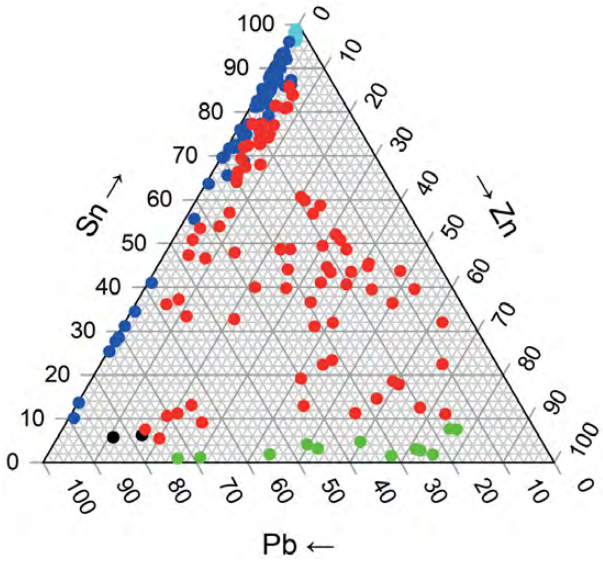
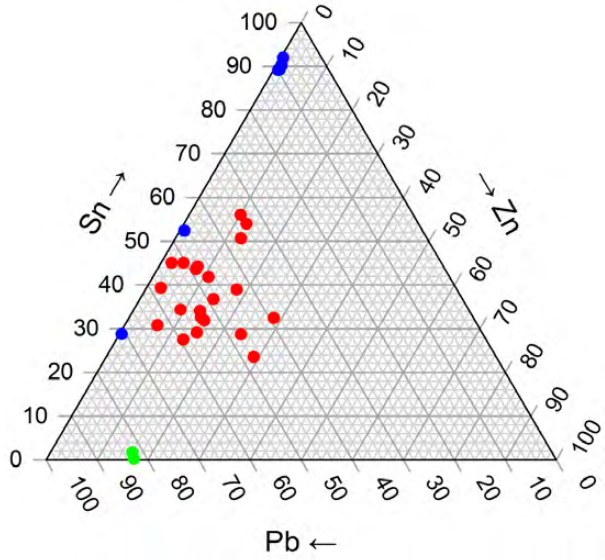


Figure 7.2. Ternary plot of 4th-century composite buckle frames (top; n = 196 readings) and backplates (bottom; n = 174 readings).



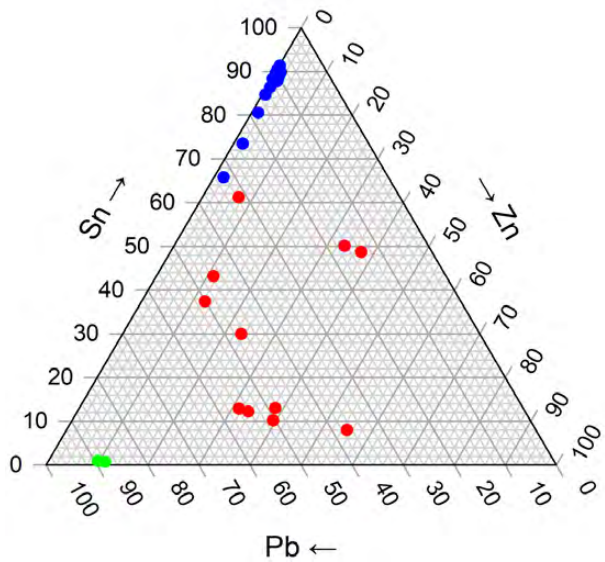


Figure 7.3. Ternary plot of 5th-century composite frames (top; n = 29 readings) and backplates (bottom; n = 26 readings).

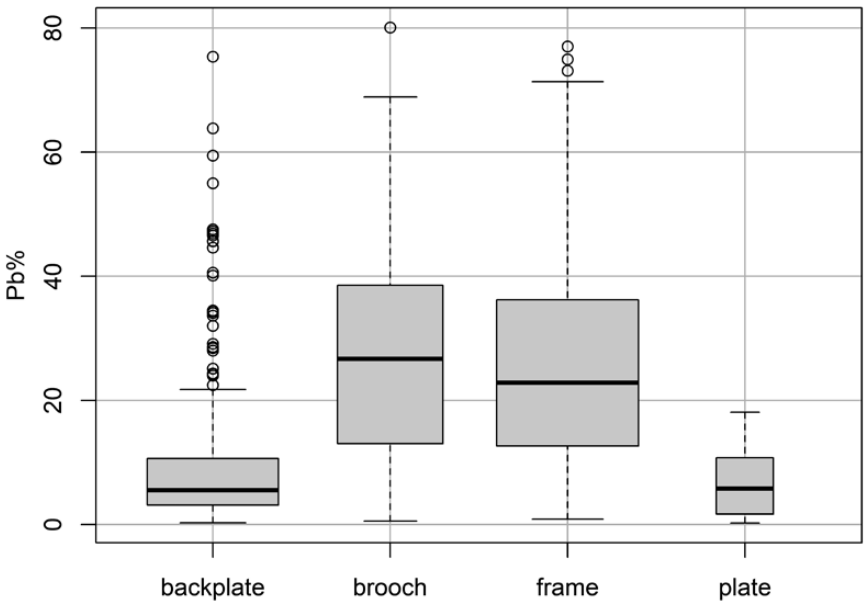


Figure 7.4. Boxplot of lead in composite backplates and frames, crossbow brooches and decorative plates from all periods (n = 792).

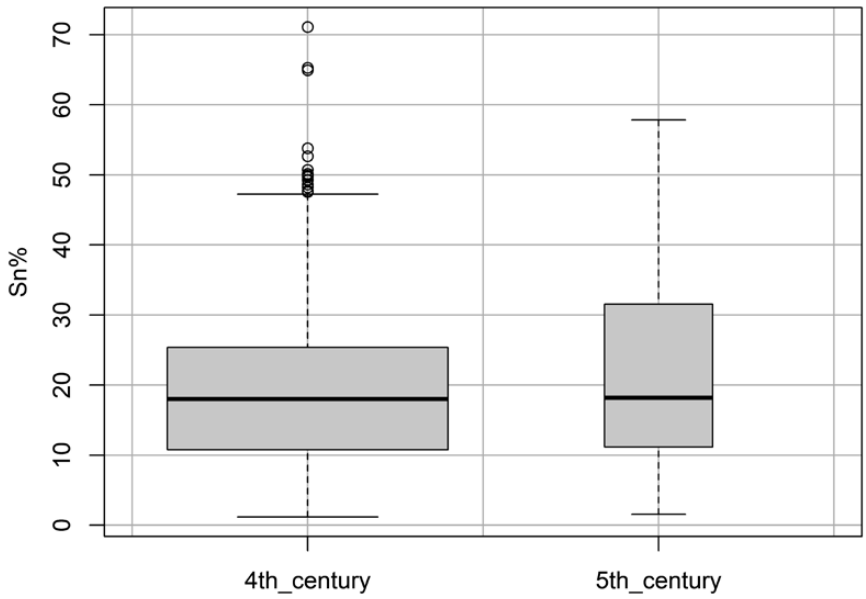
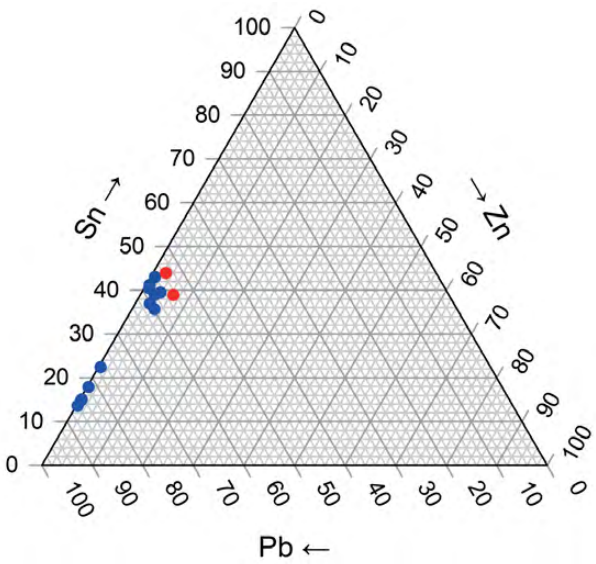
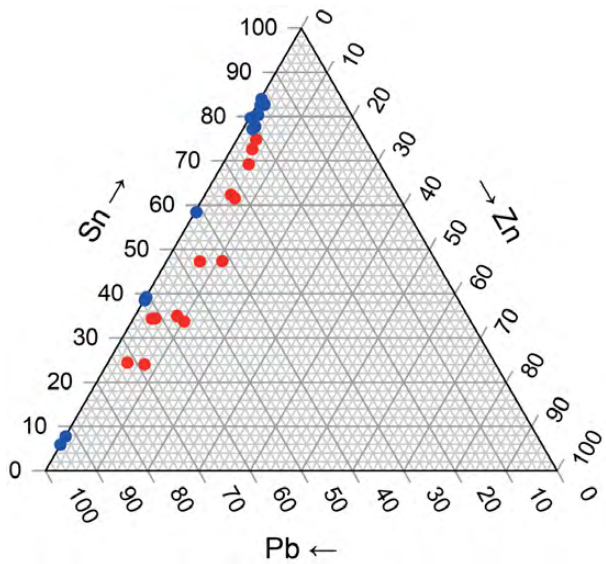


Figure 7.5. Boxplot of tin levels in tin-containing 4th- and 5th-century Sommer *Sorte* 1 and 2 buckles (frames and backplates; n = 411).





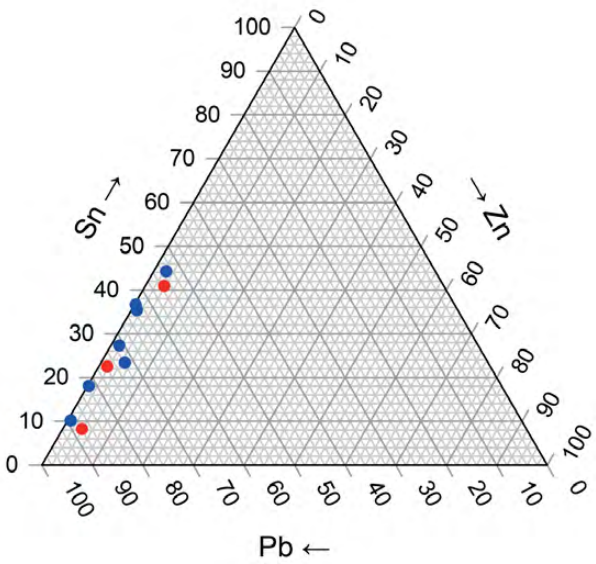


Figure 7.6. Top: ternary plot of 4th-century Sommer 3e type buckles. Left: frames (n = 14 readings); right: counter-plates (n = 10 readings).

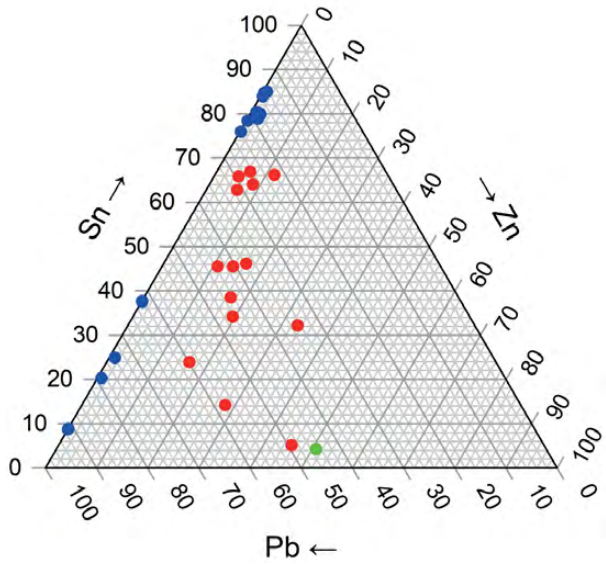


Figure 7.7. Ternary plots of 5th-century Sommer type 3 buckles. Left: frames (n = 29 readings); right: plates (n = 31 readings).

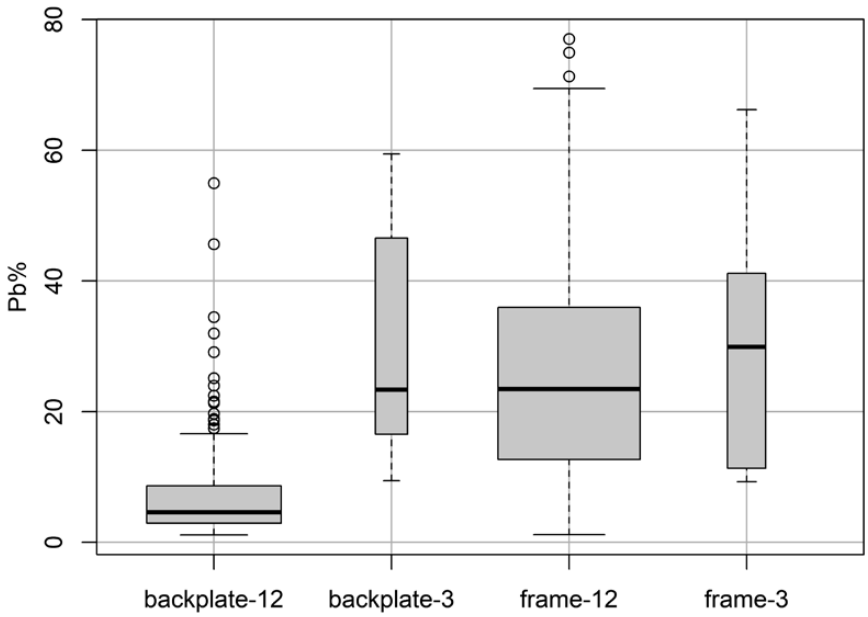


Figure 7.8. Boxplot of lead in frames and backplates of 4th-century composite and one-piece buckles (Sommer 1-2 and 3 types) leaded alloys (n = 392).

Table 7.2. Alloy types identified in crossbow brooches (n = readings).

Brooch type	unleaded		leaded				Total
	gunmetal	bronze	copper	brass	gunmetal	bronze	
Swift 1						3	3
Swift 2					6		6
Swift 2i					1	5	6
Swift 2ii							
Swift 2iii					14	1	15
Swift 3/4				3	12	20	35
Swift 3/4A					14	13	27
Swift 3/4B				9	37	14	60
Swift 3/4C							
Swift 3/4D	2	1					3
Swift 5							
Swift 5i			1	1		1	3
Swift 5ii						6	6
Swift 6							
Swift 6i					3		3
Swift 6ii							
unclassified						3	3
Total	2	1	1	13	77	66	170

A wealth of compositional data from Late Roman crossbow brooches has been published in recent years.[1] To these regional and site studies, analytical data on crossbow brooches from Tongeren and Nijmegen[2] and Krefeld-Gellep could be added. An overview of all alloys identified in the original dataset (table 7.2) clearly illustrates a preference for leaded alloys, leaded gunmetal in particular. Leaded gunmetal is well represented here in all types of crossbow brooches. The lead content averages around 26.70%, comparable to the buckle frames and in line with previous studies. Destructive AAS analyses on German

[1] Van Thienen and Lycke 2017; Roxburgh *et al.* 2017 especially; see also Bayley and Butcher 2004; Riederer 2001; Riederer 2002. See also Giumlia-Mair *et al.* 2007 on evidence for crossbow brooch production in Socchieve, Italy in the form of lead models.

[2] Due to the large amount of compositional data already available on Late Roman crossbow brooches (see for Britain also Bayley and Butcher 2004; for Flanders and the Netherlands Van Thienen and Lycke 2017), crossbow brooches were not originally part of the research design as it was felt at the start of the project that the potential for generating new insights was limited. However, a significant number of crossbow brooches that had not yet been chemically analysed turned out to be available at several of the archives and museums that were visited and the chance to measure these, especially the crossbow brooches from Krefeld-Gellep, was deemed too good an opportunity to pass up. Some overlap in this dataset exists with the datasets from Van Thienen and Lycke (2017; Nijmegen and Tongeren) and Roxburgh *et al.* (2017; Nijmegen), who partially targeted the same collections.

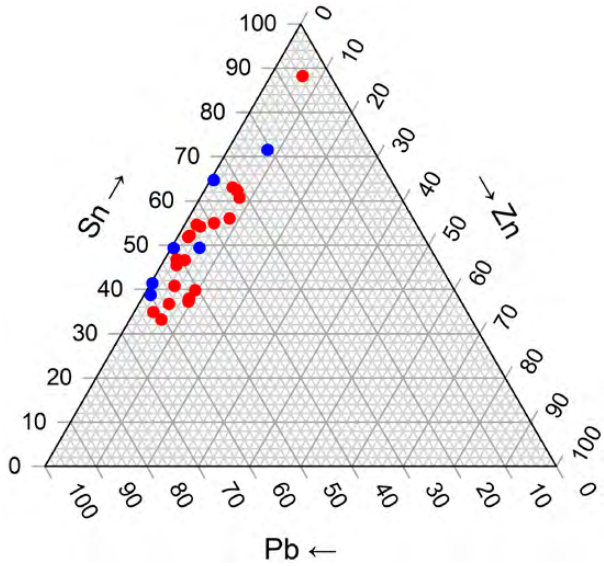


Figure 7.9. Ternary plot of Swift type 2 crossbow brooches (AD 300-360; n = 27 readings).

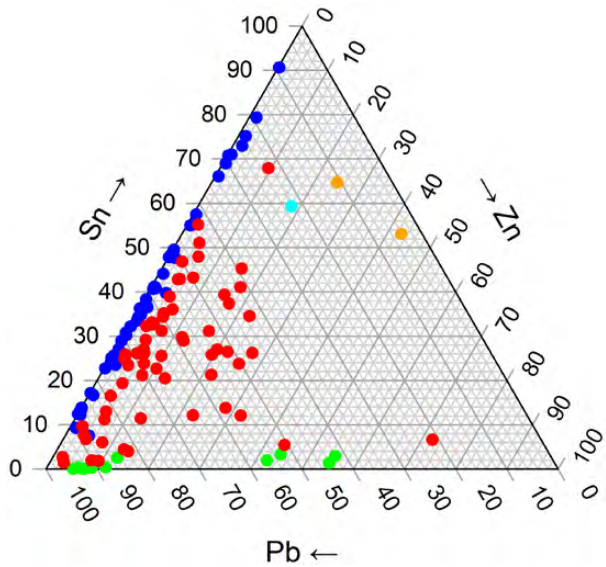


Figure 7.10. Ternary plot of Swift type 3/4 crossbow brooches (AD 340-400; n = 125 readings).

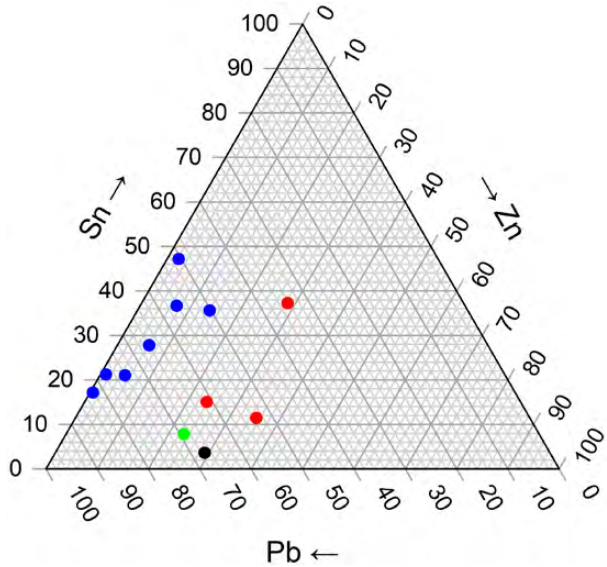


Figure 7.11. Ternary plot of Swift types 5-6 crossbow brooches (AD 390-500; n = 12 readings).

and British crossbow brooches show a wide range of lead contents of up to 32%.[3] To further assess how similar these crossbow brooch compositions are to the buckles, ternary plots may give a first insight (figures 7.9-11). These show a largely similar distribution, with measurements of leaded bronze and leaded gunmetal brooches clustering within the high-lead, low-tin alloy group. This alloy was also very common in the buckles presented above.

The closely datable nature of the crossbow brooch also enables us to chart metal use throughout the brooch's circulation period. Van Thienen and Lycke already noted different compositional patterns for the Swift 2, 3/4, and 5/6 brooches.[4] They recognised that the earlier types showed a wide alloy variety, indicating regionality, especially in some Swift type 2 brooches.[5] Furthermore, they found zinc and lead to have had the most pronounced influence on the distribution of Swift 3/4 brooches in a PCA biplot of zinc, tin and lead,[6] with variation declining steeply compared to earlier types.[7] The distribution of later brooch types, on the other hand, was found to be more influenced by lead and tin in their PCA analysis, despite showing the same degree of uniformity as earlier types. This was taken by the authors as a sign of a more regionalised organisation of production.[8]

The ternary diagrams of figures 7.9-11 show largely the same pattern, with later crossbow brooches, especially the Swift 3/4 group, shifting towards a relatively higher lead content. The ternary diagram of the latest types Swift 5 and 6 already show a less strong role for lead in the distribution and the raw data shows that in fact those brooches contained quite low amounts of lead (three recorded on average around 5.98% lead; one 43.18%). This could potentially be related to developments in the brooch construction: many of the later Swift 5/6 brooches have hollow bows made of sheet bronze (Heeren and Van der Feijst 2017, 180).

A PCA biplot of all readings on crossbow brooches colour-coded for typology (figure 7.12) largely shows a chronological order for the distribution of various types. Although the Swift 3/4 group dominates the entire plot and, as the largest group, shows the most

[3] Bayley and Butcher 2004; Riederer 2001; Riederer 2002.
[4] Van Thienen and Lycke 2017, 54-58.
[5] Van Thienen and Lycke 2017, 57.
[6] Van Thienen and Lycke 2017, 54.
[7] Van Thienen and Lycke 2017, 57.
[8] Van Thienen and Lycke 2017, 58.

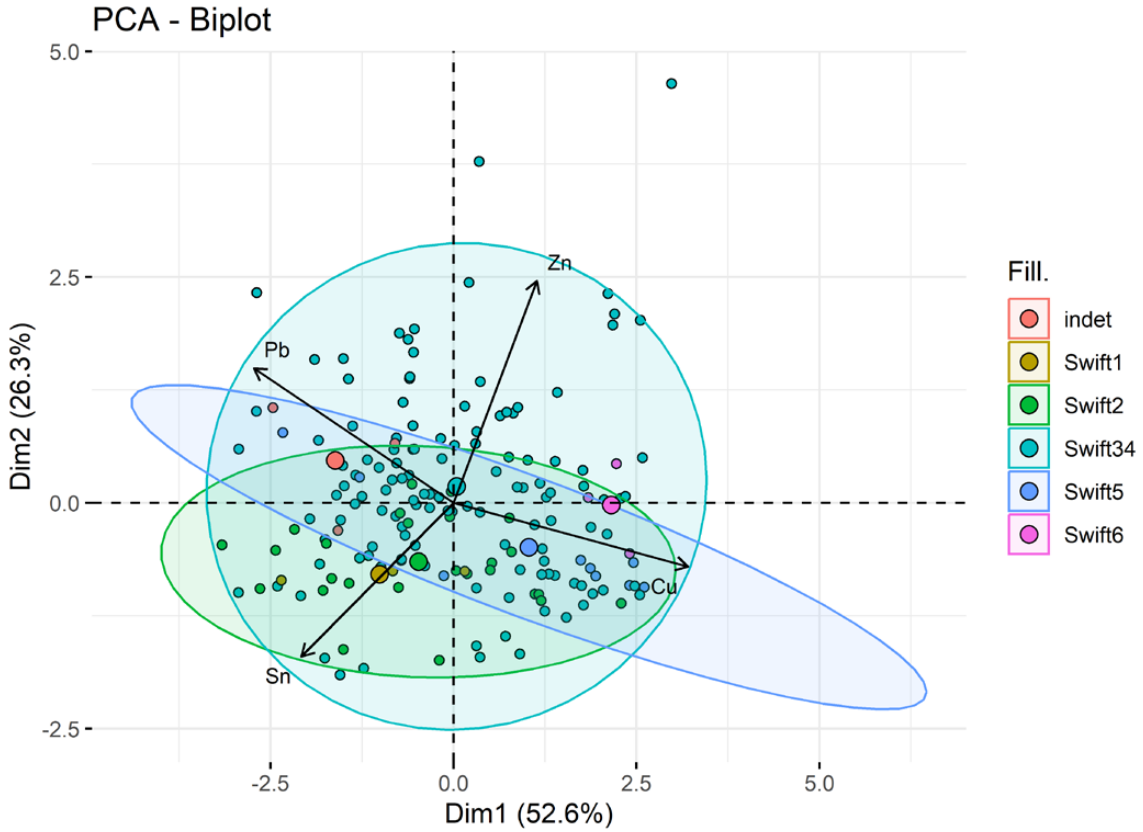


Figure 7.12. Biplot of principal component analysis of crossbow brooch types (spectrum Cu-Pb). Colour-coded for Swift typology (n = 170 readings).

variation, some distinction along the x-axis can be made between various typological groups. Swift types 1 and 2, the earliest types, tend to associate stronger with tin, while the latest types Swift 5 and 6 associate more with copper. Type Swift 3/4, meanwhile, overlaps significantly with both these distributions, but is also the only brooch type with readings that plot towards the top righthand corner (indicating the influence of zinc).

In conclusion, the crossbow brooches show a clear chronological development in their alloy composition, from relatively highly leaded (Swift 1-4) to more lowly leaded (Swift 5-6) compositions. The crossbow brooches from the second half of the 4th century especially (Swift 3/4) show the clearest comparisons to the military buckles discussed above, containing very high absolute lead percentages and low amounts of tin. Whereas a small group of military buckles showed an increase in tin in the 5th century, contemporary crossbow brooches did not. The data gathered on 5th-century crossbow brooches here is limited, so these results should be interpreted with care. For the later crossbow brooch types, namely the Swift 5 and 6 groups, Van Thienen and Lycke proposed a more regionalised organisation of production.[9]

[9] Van Thienen and Lycke 2017, 58.

Decorative elements: belt accessories

The decorative items on the Late Roman military belt may be split into a variety of categories, some of which lend themselves better to a chronological comparison than others. Strap ends, which can often be dated typologically, will be discussed separately, while the other fittings, which are often not more closely datable than the entire Late Roman period, will be lumped together.

Table 7.3 summarises the various alloy labels given to dated strap ends. In both periods, leaded bronze and leaded gunmetal make up the bulk of the material as also seen above in the buckles and crossbow brooches. Split out according to strap end type, however, it becomes clear that amphora-shaped strap ends, the largest category of all strap ends analysed, shifted more towards leaded bronze in the 5th century than any other strap end type. Although only a small number of 5th-century strap ends of the Sommer D type were analysed, they were all made of leaded gunmetal.

The 4th-century strap ends (figure 7.13, top) show a clear preference for leaded gunmetal, although their relative composition is quite variable (much like the backplates of composite 4th-century buckles). There is a distinct group of measurements with relatively

Table 7.3. Alloys identified in dated strap ends from Germania Secunda (n = readings).

	unleaded brass	leaded brass	bronze	gunmetal	Total
4th century					
A			10	26	36
B			11	36	47
C			4	4	8
D			7	6	13
Total			32	72	104
5th century					
B	1	4	17	21	43
D			6		6
Total	1	4	23	21	49
Grand total	1	4	55	93	153

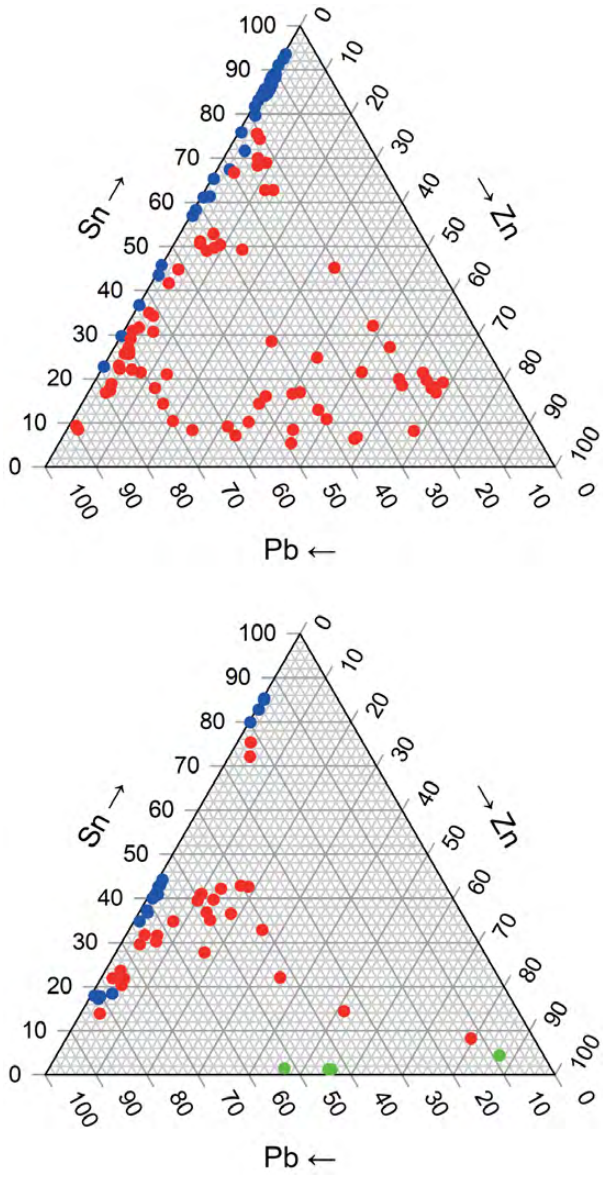


Figure 7.13. Ternary plots of 4th-century (top; n = 104) and 5th-century (bottom; n = 49 readings) strap ends.

high zinc contents, as well as a group with higher lead contents. Leaded bronzes distribute quite distinctly from leaded gunmetals in 4th-century strap ends and seem to have favoured higher tin levels. The 5th-century strap ends (figure 7.13, bottom) largely show the same preference for more heavily leaded alloys, but these appear to show less variation across the zinc and lead axes.

As also seen in the buckles, tin levels were higher in leaded bronze strap ends compared to leaded gunmetal ones (on average 20.18 compared to 11.55% respectively), but no significant increase was found in tin content over time. Overall, the strap ends showed remarkable consistency in composition between the 4th and 5th centuries (figures 7.14-15) with a focus on leaded gunmetal alloys. Quite notable in this regard are also the two 5th-century strap ends (Sommer Bc2) recorded as (leaded) brass, which were found to be substantially higher in zinc (between 18.68 and 27.96%) than any contemporary leaded gunmetal Sommer Bc strap ends (3.55% on average).

The decorative fittings of the Late Roman belt also encompass suspension and tubular mounts (most common), decorative plates and belt stiffeners (relatively common) and hinges (rare). As in all other categories discussed before, leaded bronze and leaded gunmetal were the most common material for these objects (table 7.4). A portion of these could not be dated precisely using typology (see chapter 5), while for others their find context or associated material allowed

Alloy	N	%
brass	3	0,72
bronze	25	6
gunmetal	1	0,24
leaded brass	9	2,16
leaded bronze	144	34,53
leaded gunmetal	235	56,35
Total	417	100

Table 7.4. Alloys identified in belt fittings from Germania Secunda (n = readings).

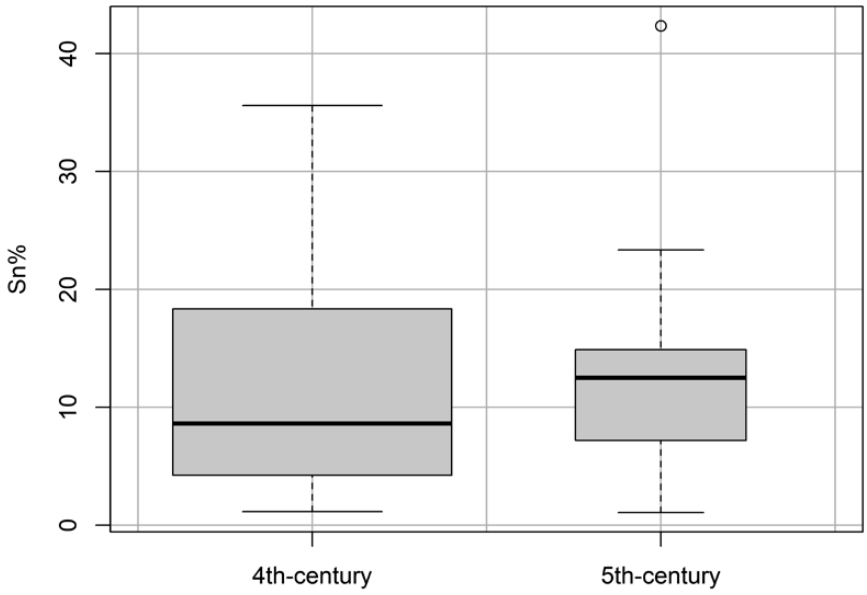


Figure 7.14. Boxplot of tin content in dated leaded gunmetal strap ends (n = 99 readings).

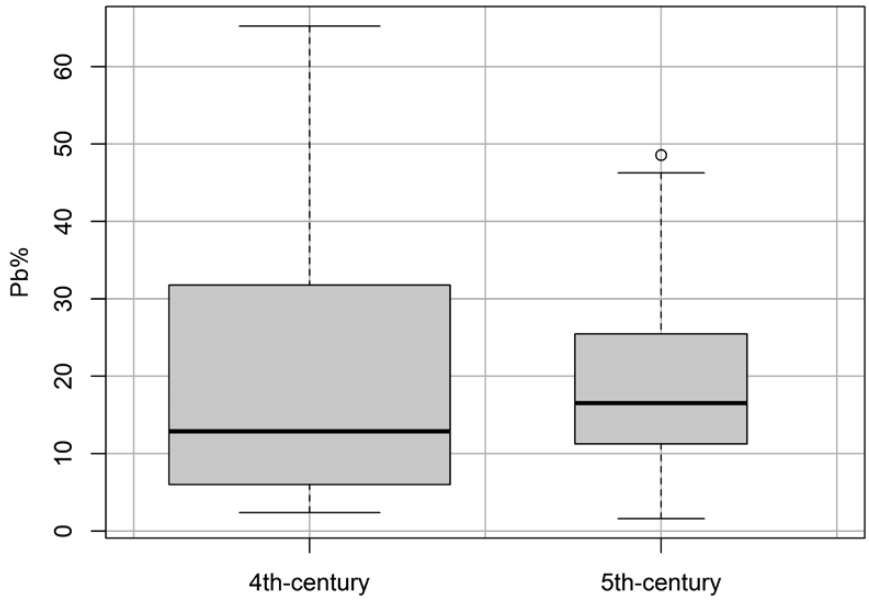


Figure 7.15. Boxplot of lead content in dated leaded gunmetal strap ends (n = 99 readings).

them to be dated to either the 4th or 5th century. Both centuries yielded roughly equal numbers of datable fittings made up of roughly equal numbers of belt stiffeners, plates, tubular mounts, suspension mounts and belt slides. A first separation of dated examples into ternary plots shows a some distinction between both periods (figure 7.16).

The 4th-century fittings were predominantly made of leaded gunmetal and showed a wide distribution across the plot, including alloys already identified above as typical for military belts in this period: high-lead or high-zinc and relatively low in tin. The 5th-century fittings on the other hand show a clear move away from the right and bottom portions of the diagram towards the top left: high in tin and low in lead. This shift is first of all marked by an increase in high-tin leaded bronzes (on average 26.45% tin) and secondly by a group of leaded gunmetals that behave similarly to leaded bronzes in the ternary diagram. These leaded gunmetals cluster towards the top of the ternary plot and towards the tin axis in much the same way as the binary leaded bronze, despite the nominal presence of zinc.

The change in composition seen in the leaded gunmetal is mainly due to a drop in overall alloying ingredients, including zinc (figure 7.17), which dropped from an average from 4.28% in the 4th century to 3.38% in the 5th century. Lead levels also declined slightly, while tin appears to have been fairly stable (figures 7.18-19). It seems that an increasing number of 5th-century belt fittings were made from a high-tin, low-lead alloy that was also commonly found in 4th- and 5th-century Armbrust brooches (see below). In the 4th century, relatively high-zinc leaded gunmetals were

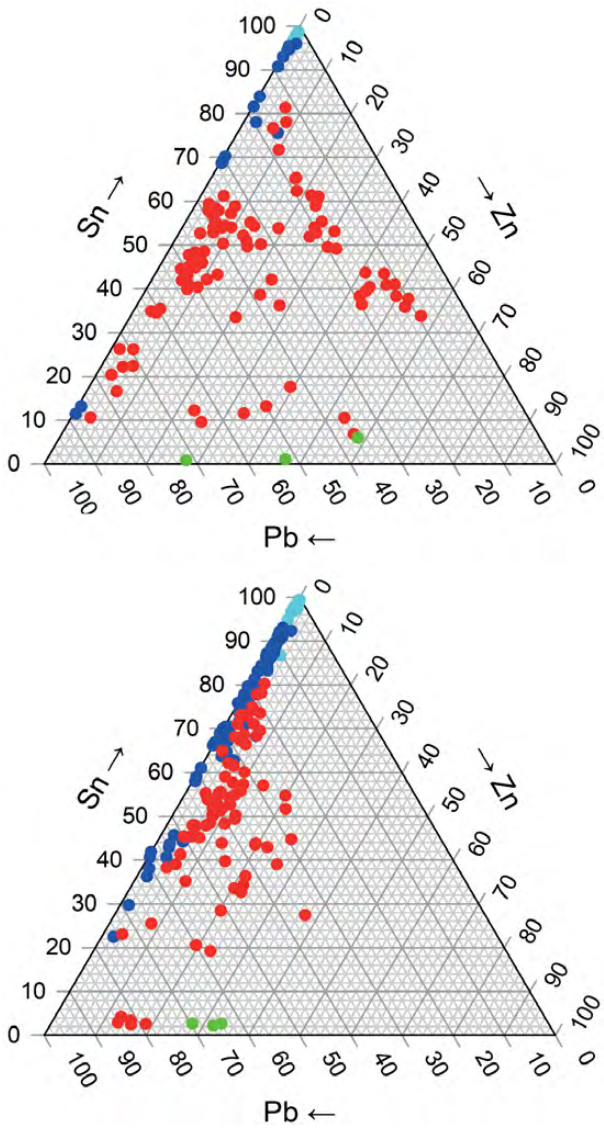


Figure 7.16. Ternary plot of 4th-century (top; n = 116 readings) and 5th-century (bottom; n = 196 readings) belt fittings.

more commonly used for strap ends, in close parallel to the prevalence of such alloys in 4th-century buckle backplates. It is possible that a preference for higher zinc contents in leaded gunmetals was related to a desire to achieve a gold-like colour in these objects. Its decline in the 5th century may be related to changing tastes or a lack of access to such materials (despite its relatively frequent use for certain types of hairpins, see below).

It is notable, however, that while an increased use of leaded bronze and alloys with higher tin levels in the 5th century were identified in almost all categories of military dress accessories (buckles, strap ends, fittings), this shift was most dramatic in the miscellaneous fittings. In the other categories, the majority of objects showed continuity with alloy use of the 4th century: mostly leaded gunmetal and containing relatively large amounts of lead. The 5th-century general fittings were the only group where a significant number of measurements were comparable to the alloys typically seen in civilian dress accessories.

Summary

Before we move on to comparisons with other object groups and regions, a brief summary of the main conclusions about alloy use in military dress accessories and its relation to function and chronology might be prudent. The 'functional' military dress accessories (i.e., the fasteners: belt buckles and brooches) showed a great deal of continuity and consistency between the 4th and 5th centuries. Despite the differences in construction between the majority of 4th-century (composite) and 5th-century (one-piece) buckles, both generally showed the same patterns in terms of metallurgy. In each period, most of the readings on buckles indicated

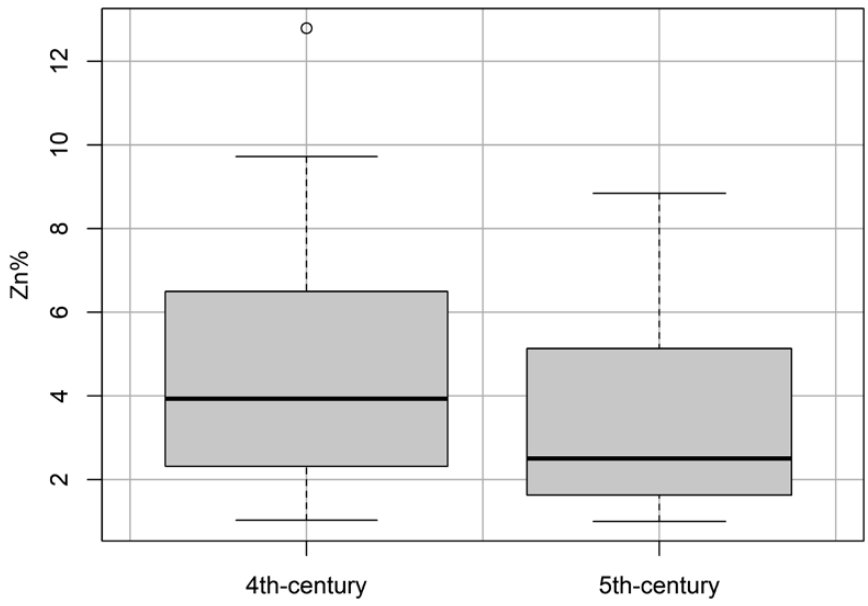


Figure 7.17. Boxplot of zinc levels in 4th- and 5th-century leaded gunmetal belt fittings (n = 171 readings).

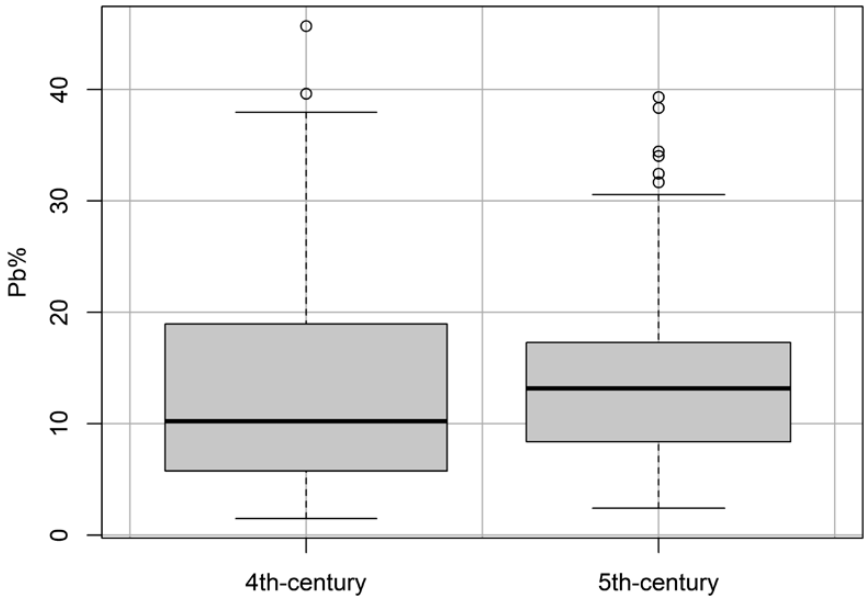


Figure 7.18. Boxplot of tin content in 4th- and 5th-century leaded gunmetal belt fittings (n = 171).

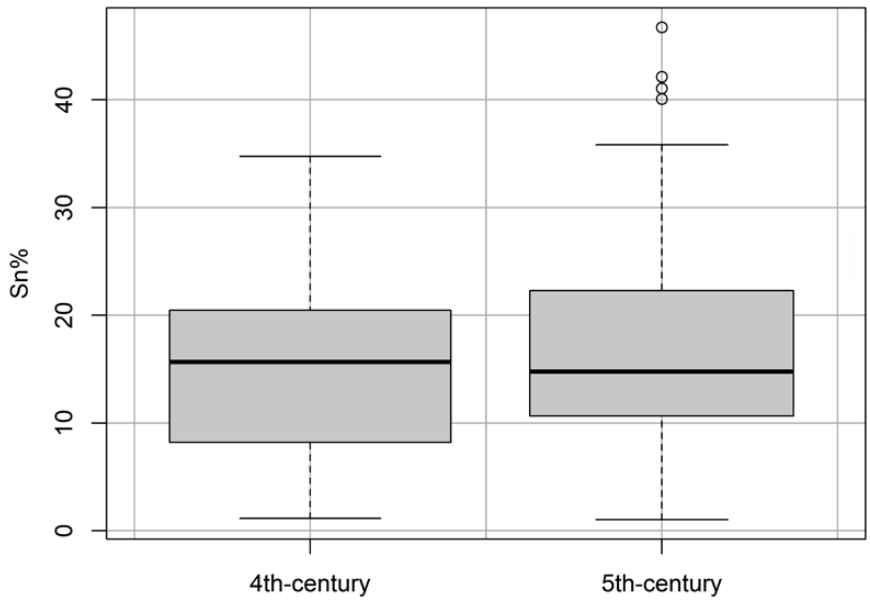


Figure 7.19. Boxplot of lead content in 4th- and 5th-century leaded gunmetal belt fittings (n = 171).

the use of relatively high-lead, low-tin alloys, most of which were classified as leaded gunmetals. A slight increase in the use of leaded bronze with higher tin levels in the 5th century was also identified in both buckle construction types. The use of highly leaded alloys and the predominance of leaded gunmetals was also identified in the crossbow brooches, although the same pattern of increasing tin levels in the 5th century was not replicated.

The strap ends largely followed the metallurgical patterns of the fasteners. Leaded gunmetal was the predominant alloy in both the 4th and 5th centuries, with alloys high in tin and/or zinc and low in tin being the most common group in both periods. Again, the leaded bronzes that were identified showed higher tin contents compared to the leaded gunmetal alloys, both in the 4th and 5th centuries. No clear increase in tin values over time was found, however. The miscellaneous fittings (tubular and suspension mounts, decorative plates) were the only category that significantly deviated from this narrative. The 4th-century material largely fitted within the military alloy 'style' seen above and in chapter 6: mostly leaded gunmetal and a large number of measurements with high zinc and/or lead values. The 5th-century material, however, showed a significant increase in the use of leaded bronze and the use of leaded gunmetals that metallurgically were very similar to leaded bronze (low zinc values).

The stability of composition in brooches, buckles and strap ends may suggest a standardised or controlled production environment. The changes in composition between decorative fittings of the 4th and 5th centuries

indicate that for these objects, something might have changed over time in their production organisation, potentially increased privatisation or localisation of production (a possibility supported by finds of production refuse). Decorative fittings were also more likely to be found in non-military contexts and were more common than buckles and strap ends in funerary contexts outside of the Empire, suggesting use and production may have been less tightly restricted. Although an increased use of leaded bronze was also identified in the other categories of military dress accessories, this was far less dramatic there, with leaded gunmetals and highly leaded alloys still making up the majority of material in both the 4th and 5th centuries. This continuity and consistency suggest that the production organisation of buckles, strap ends and crossbow brooches did not undergo any significant changes between the 4th and 5th centuries.

The rest of this chapter will put the patterns of metal use in military dress accessories and the potential indicators for production organisation into further contrast and context by highlighting:

- The standardisation of dimensions, which are possibly related to mould and model use as well as the level of specialisation in workshop environments;
- Metal use in contemporary civilian objects (already briefly touched upon above and in chapter 6), split out against typological and functional groups (brooches and hairpins);
- Comparison with objects found outside of the Empire (both civilian and military).

Coefficient of variation: dimensions

Standardisation of material culture and how it relates to production organisation and craft specialisation have long been studied by archaeologist's 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.[10] This includes understanding the role in society of domestic/part-time or specialised/full-time production, specifically the notion 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 were more likely to be able to specialise in one particular aspect of the manufacturing process, introducing a level of standardisation into the process. An assessment of specialisation and production intensity can include looking at material composition, manufacturing techniques, forms, dimensions and surface decoration.[11] Low variability in any of these categories may be assumed to reflect a high number of 'hands' involved in the production sequence.[12] Although this method has been applied to a number of studies of prehistoric material (including copper-alloy dress accessories),[13] it has not been often applied to material from the Roman period.[14]

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 it is largely unknown for many parts of the Late Roman belt whether re-usable moulds or the *cire perdue* method were used.[15] Reusable moulds, however, would potentially not have had particularly long life spans, introducing potential for variation. 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, is generally assumed to be common in more centralised production centres[16] 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[17] and each will have been differently organised in differently sized workshops. It is also well known that some army gear was made to personal order,[18] and this is the sort of production sequence we might expect at smaller, local workshops operating closer to the frontier. Swift has also highlighted potential scenarios for how similarity may be achieved in the manufacturing of metal objects, including the role of central production areas, while also considering the role of state requirements and user preferences.[19]

Methodology

The coefficient of variation (CV) is calculated by dividing the standard deviation of any variable within a dataset with its mean. This value expresses the extent of variation present in a dataset and its use in archaeology stems from the idea that humans are often unable to accurately judge sizes, areas, or weights without using measuring aids,[20] with an estimated error margin of around 3% (Eerkens and Lipo 2005,

[10] Roux 2003, 768.

[11] Roux 2003, 768.
[12] Costin and Hagstrum 1995, 622.
[13] Eerkens and Bettinger 2001.
[14] See for exceptions Van Thienen and Lycke 2017; Cool 1983.
[15] Böhme 1974, 93; Böhme 2021, 134; cf. Bullinger 1969, 12-17.
[16] Martinón-Torres *et al.* 2012, 534; see also Roux 2003 and Kuijpers 2017 on the role of specialisation in workshops.
[17] Eerkens and Bettinger 2001, 494.
[18] Bishop and Coulston 2006, 267.
[19] Swift 2000, 88.
[20] Eerkens and Bettinger 2001, 494-495.

321). 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 implies the use of automation or measuring aids[21] (a range of 2.5-4.5% of variation has been estimated as the typical minimum error degree in manual production).[22]

A similar approach on crossbow brooches[23] was successful in identifying standardisation of production, especially of mid-4th century brooches. As is clear from any catalogue of Late Roman military belts, the range of types, decorations and sizes is immense.[24] Measuring the standardisation of heights and widths on their own is therefore less interesting, as we know these could be very variable. Rather, this section aims to investigate whether the material reflects a shared notion of what a buckle or strap end should look like.

Some aspects of overall object dimensions and ratios will also have been checked by functionality and by typology. Taking Weber's fraction of 5% and the 'random uniform line' of 57.7% as parameters, Van Thienen and Lycke judged that their average CVs for most crossbow brooch types of between 10 and 15% signalled an overall strong degree of control over production (bearing in mind both the complexity of the items and the likely use of moulds).[25] For the belt fittings, overall maximum and minimum lengths and widths were measured at fixed points on each part of the object that was cast or made in one piece (see below for images) to study how standardised the complete objects were. Several dimensional values related to decoration were also measured.[26]

In their assessment of the crossbow brooch data, Van Thienen and Lycke[27] noted that although the coefficient of variation values per measurement were sometimes quite high, once these were averaged per entire brooch type, they were much lower. They interpreted this as evidence for scaling: if certain parts of the brooch were made larger or smaller, the dimensions of the rest of the object were adjusted to accommodate that. The notion of scaling and overall dimensions is especially interesting in the case of military belt fittings, as a lot of these objects will have been cast. The use of moulds, models and copying will have helped in achieving standardised dimensions. Copying of objects especially will have influenced individual height or width measurements, but the ratio between those two measurements would have remained the same. Below, the coefficient of variation measurements of individual values and ratios of a variety of civilian and military dress accessories (chapters 3 and 4) are presented.

Dataset and discussion

Dimensional data was collected during the pXRF sessions, using a calliper on a number of predefined fixed locations on the chosen objects (see schematic drawings in figures 7.20 and 7.21).[28] Measurements were collected on all suitable objects that were included in the pXRF experiment, as well as a selection of objects from the *Société archéologique de Namur* (SAN). The measurements were noted in millimeters and were repeated once or twice to make sure that the error margins were minimal. Only objects that were complete enough to calculate at least one ratio aspect (height:width) were measured. As this experiment is only based on objects that were physically available during the pXRF sessions, the dataset is rather small.[29] Especially for the various smaller belt fittings, complete objects that were not bent or damaged were hard to come by. The immense diversity of object types in the military belt fittings was also found to be problematic, and the data described below are lumped together into broader form groups. Table 7.5 lists how many objects within each broad finds category were measured. It should be noted that not all objects were complete and that calculations of the height and height:width values for, for example, a group of belt plates may be based on differently sized datasets (due to missing width values).

Several object categories jump out of. There appears to have been a difference in production standards for buckle frames and backplates, with the latter showing significantly higher CV values (for both composite and one-piece buckles), indicating less standardisation. Although heights and widths of buckle frames were highly variable (as expected), the dimensional relation between those two measurements was not. This might indicate that there was a shared concept between producers of what a buckle frame should look like or what overall size and shape it should have. This could perhaps have been a practical consideration. It

[21] Eerkens and Bettinger 2001, 496.
[22] If on the other hand, theoretically, production would have been completely random, the CV level would be expected to be around 57.7%; Eerkens and Bettinger 2001, 496; see also Eerkens 2000.
[23] Van Thienen and Lycke 2017.
[24] Cf. Bullinger 1969; Böhme 1974; Sommer 1984.
[25] Van Thienen and Lycke 2017.
[26] Such as the minimum width of amphora-shaped strap end types (which is determined by the style of 'handles') or the diameter of tubular mounts on Sommer type D strap ends.
[27] Van Thienen and Lycke 2017.
[28] Heights of all brooches were taken as indicated for the footless brooch with high catch-plate, measurements on Fécamp hairpins followed the same protocol as on Wijster hairpins as drawn and belt plate were measured in the same way as backplates.
[29] To ensure internal consistency of the results, measurements published by others were not included. Incomplete or damaged objects or those that could not be identified to type were also excluded. Measurements were also taken from a number of crossbow brooches, these are not further dissected in typological groups, as the overrepresentation of Swift 3/4 type brooches makes any chronological comparison moot, especially compared to Van Thienen and Lycke's much larger dataset.

Object category	N (total)
hinged buckles (Sommer *Sorte* 1 and 2)	109
buckles with fixed backplate (Sommer *Sorte* 3)	15
heart-shaped strap ends (Sommer A)	7
amphora-shaped strap ends (Sommer B)	34
square strap ends (Sommer D)	7
propellor-shaped belt stiffeners	34
tubular mounts with plates	45
round suspension mounts	51
rectangular suspension mounts	16
rectangular belt plates	31
crossbow brooches	58
belt stiffeners (miscellaneous)	28
footless brooches	36
Armbrust brooches	113
Fécamp hairpins	15
Wijster hairpins	29
supporting-arm brooches	7
Total	635

Table 7.5. Count of measured objects for coefficient of variation calculations (n = number of measurements on which the values are based).

Given the complexity of the items and the wide variety of styles, shapes and decorative stylings, a CV value of 16.58 for composite buckle frames and 19.62 for one-piece buckle frames is quite remarkable and not much higher than the 10-15% held by Van Thienen and Lycke[30] as indicative of controlled production (which could be repeated for the small sample of crossbow brooches; table 7.8). Measurements related to decorative stylings of objects also appear to have been less standardised than those of functional, overall dimensions of objects (mirroring similar patterns found by Van Thienen and Lycke for crossbow brooches).[31]These values are especially meaningful when contrasted with those for the backplates of these same buckles, which show much more variability.

Typology is also a factor here, as buckles are included with square, rectangular or bag-shaped plates. CV values for the most common plate type (the square Sommer 1C group) are similarly high, however (on height:width ratios: 55.25 and 40.90% for minimum and maximum width), while the bag-shaped plates scored lower (18.93 and 22.49% for minimum and maximum width).

Table 7.6. CV scores on military buckles and strap ends.

	Height	Width	Height:width
Composite buckle frames	33,05	28,08	16,58
Composite buckle plates (minimum width)	32,29	46,59	35,36
Composite buckle plates (maximum width)	32,29	40,00	28,41
One-piece buckle (frames)	32,12	26,30	19,62
One-piece buckle plates (mimimum width)	26,85	74,57	49,14
One-piece buckle plates (maximum width)	26,85	49,65	56,45
strap end (heart-shaped)	58,45	49,02	4,48
strap end (amphora-shaped; minimum width)	27,10	34,36	34,47
strap end (amphora-shaped; maximum width)	27,10	25,13	25,93
strap end (square)	45,84	47,86	16,50

	Height	Width	Height:width /diameter	Diameter
tubular mount (tube)	32,16		43,42	25,46
tubular mount (plate)	21,36	31,02	53,16	
suspension mount (round)				21,65
suspension mount (rectangular; width bottom)	16,81	61,84	30,03	
suspension mount (rectangular; width top)	16,81	45,36	39,56	
belt stiffeners (propellor; width terminals)	15,16	23,58	25,56	17,76
rectangular belt plates	31,68	38,09	60,69	
belt stiffeners (other)	50,31	38,58	65,67	

Table 7.7. CV scores on military mounts and fittings (n = number of measurements on which the presented values are based).

is notable, however, that these data in include buckle frames from a number of different types, including oval, D-shaped, square, and saddle-shaped frames as well as those with animal-headed terminals or centrally opposing animals. Despite this variety in typology, the ratio between buckle frame height and width in composite and one-piece buckles remained the same.

This may suggest that the styling of the backplate was more open to interpretation, depending on the type. Curiously, the CV calculations for the backplates of one-piece buckles are also considerably higher than the one-piece frames. As the name indicates, these buckles

[30] Van Thienen and Lycke 2017.
[31] Van Thienen and Lycke 2017.

	Length		Width					Ratios	
Type	Total	Foot	Bow	Foot	Axis	Knobs	Height	Length:	Height:
Crossbow brooch	14,26	21,50	25,51	25,51	14,43	23,94	12,71	12,30	10,52

Table 7.8. Coefficient of variation measurements from Late Roman crossbow brooches.

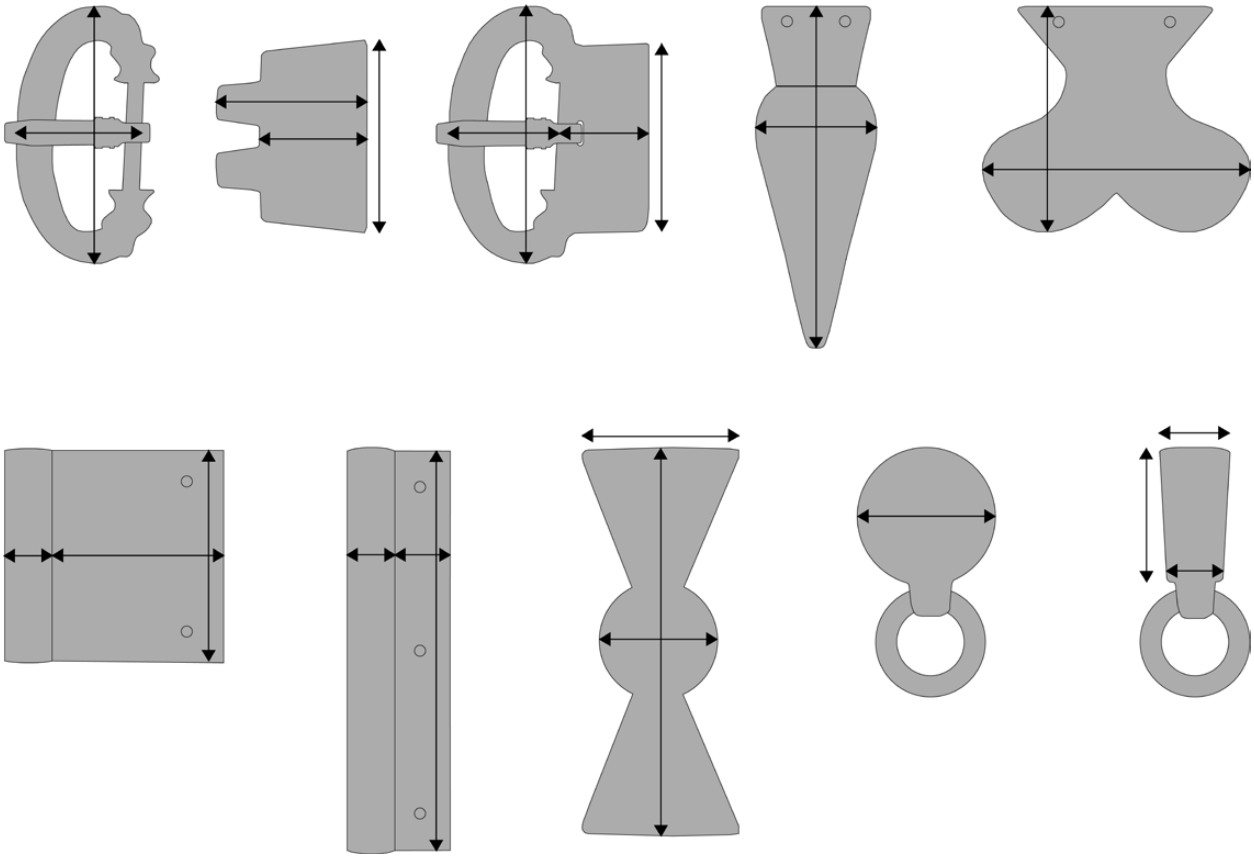


Figure 7.20. Schematic representation of measurements taken from Late Roman military belt accoutrements. From left to right: top row: Sommer *Sorte* 1 buckle frame and backplate; Sommer *Sorte* 3 buckle with fixed plate; amphora-shaped strap end Sommer Bc; heart-shaped strap end Sommer A. Bottom row: square strap end Sommer D; tubular mount with plate; propellor-shaped belt stiffener; round suspension mount; rectangular suspension mount. Not to scale.

were cast in one piece, so the expectation was that as frames were standardised, so were plates. This seems to suggest that even though both parts were cast as one, more stylistic freedom was still taken for the plates when making the moulds.

Low variation scores were also found for the height:width ratio of several strap end types (heart-shaped and square), both relatively simple types; a relatively fixed height:width ratio would be expected of a square type of strap end. The more complex amphora-shaped strap ends, which may feature a variety of different decorative elements (handles, terminal knobs) consequently scored much higher (despite the evidence for models).[32] However, numbers for the square and heart-shaped strap ends were very limited,[33] so again more data are needed to more accurately interpret them.

Several of the decorative belt fittings (table 7.7) also scored relatively low (15-20%) on individual measurements and ratios (propellor-shaped stiffeners, round suspension mounts, tubular mounts). This is likely due to the fact that these data included a large number of complete belt sets, which consisted of a number of matching fittings. That will have brought the variation down considerably, and more data would be needed to put this into perspective.

[32] Böhme 2021.

[33] Seven heart-shaped strap ends were analysed, all from Krefeld, five of which were complete enough to calculate dimensions for. Six square strap ends were measured, five of which were complete enough for ratios to be calculated.

	Length		Width			Ratios	
Type	Total	Foot	Bow	Foot	Height	Length:height	Height:width
Footless brooch	18,62	23,42	23,42	50,31	19,33	6,30	25,07
Simple two-piece	19,98	24,54	30,28	61,84	24,94	18,17	30,06
Supporting-arm	11,20	8,09	31,74	61,84	17,09	26,32	14,09
Fécamp hairpin (knob)			18,52		23,56		36,34
Wijster hairpin (knob)			19,69		25,81		34,76

Table 7.9. Coefficient of variation measurements for civilian dress accessories.

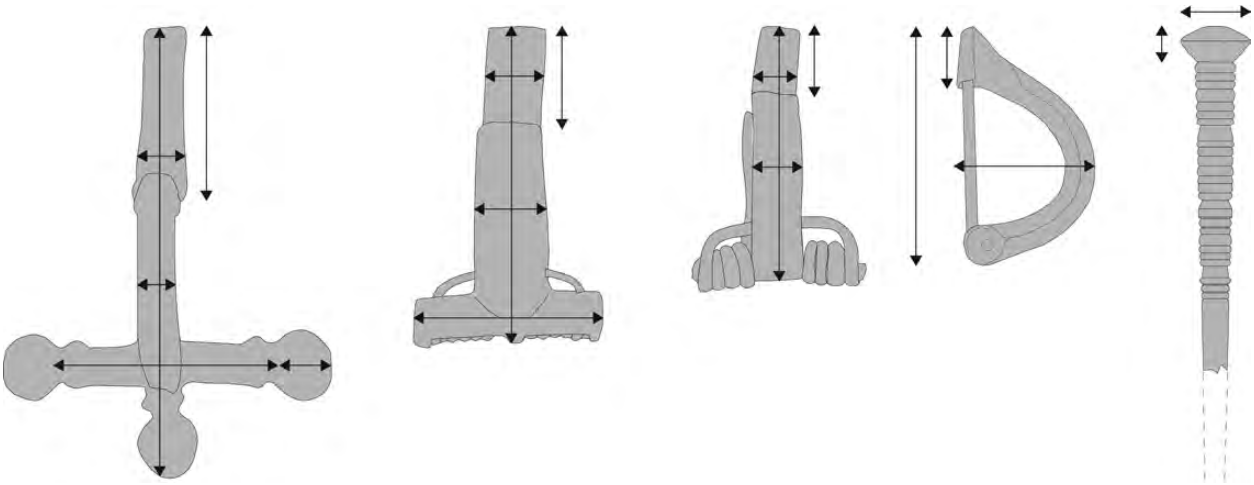


Figure 7.21. Schematic representation of measurements taken from Late Roman brooches and hairpins. From left to right: crossbow brooch; supporting-arm brooch; simple two-piece Armbrust brooch; footless brooch with high catch-plate; Wijster hairpin. Not to scale.

The higher scoring belt fittings are all those that we might expect need to be more frequently repaired or replaced (plates, stiffeners, tubular mounts). The low CV value for the height of rectangular suspension mounts is rather odd, considering their width and overall dimensions scored much higher. Apart from that outlier, most decorative belt fittings seem to score above 25% on variability (barring those where the data were skewed by matching sets of objects). The increased variation in several of the more decorate belt parts may be sign that these were less stringently controlled or that they were subject to more frequent repairs or replacements, which may have been carried out locally rather than centrally.

For comparison, a selection of civilian dress accessories were also measured. The majority of measurements on civilian categories scored around 20% or higher. Fragmentation and deformation were especially impactful for the footless brooch with high catch-plate and the simple two-piece Armbrust brooch, so only limited data could be gathered on the dimensions of these objects. Both brooch types show quite similar levels of variation as the military fittings on individual measurements such as total length and width, as do the measurements of knob diameter of Fécamp and Wijster hairpins. The ratios between height and width of many civilian dress accessories are consistently higher than those of many of the military items, however, suggesting less standardised approaches to their overall size and scale. All civilian brooches yielded relatively low variation values on the length:height ratio and high variation on the height:width ratio (the complete opposite of the crossbow brooch; see table 7.8). This could potentially be a functional characteristic but given the very small number of brooches behind table 7.9 this was not further explored.

The next step was to ascertain whether any chronological patterns may be found in these data as well. For example, composite buckles circulated predominantly in the 4th century, while one-piece buckles almost solely appear in 5th-century contexts.

Table 7.10 summarises the available CV data for dated objects (which lowers the number of finds per category significantly).

This brings the patterns described above in clearer focus. Backplates and frames of both 4th- and 5th-century buckles show significantly different coefficient of variation values. The backplates score very similarly to the amphora-shaped strap ends, while heart-shaped strap ends and buckle frames show more signs

Object	Height	Width	Height:width
4th century			
composite buckles Sommer 1A frames	26,73	21,93	14,83
composite buckles Sommer 1A plates (minimum width)	30,43	17,50	18,93
composite buckles Sommer 1A plates (maximum width)	30,43	22,42	22,49
composite buckles Sommer 1C frames	34,66	25,05	20,34
composite buckles Sommer 1C plates (minimum width)	37,14	48,68	55,25
composite buckles Sommer 1C plates (maximum width)	37,14	43,64	40,90
strap ends (heart-shaped)	58,45	49,02	4,48
strap end (amphora-shaped; minimum width)	33,49	53,19	35,11
strap end (amphora-shaped; maximum width)	33,49	33,34	30,34
5th century			
one-piece buckles Sommer 3f frames	28,7	30,25	6,99
one-piece buckles Sommer 3f plates (minimum width)	33,10	19,61	34,11
one-piece buckles Sommer 3f plates (maximum width)	33,10	35,54	34,61
strap end (amphora-shaped; minimum width)	22,31	22,82	33,02
strap end (amphora-shaped; maximum width)	22,31	19,59	22,42

Table 7.10. Coefficient of variation measurements for chronological groups of military belt fittings.

of standardisation of dimensions. The fact that 5th-century buckle frames show a CV value well below 20% is a good indication that the production of these at least was subject to the same control over production as the buckles in the 4th century. The earlier Sommer 1A buckle backplates do score lower, while the largest group (Sommer 1C) does show significant variation in the backplates. The lumping together of the Sommer 1C likely contributes to some of this variation, but dividing further along typological lines was not feasible given the limited size of the dataset.

A comparison with contemporary civilian dress accessories

In order to put some of the patterns identified in the composition of the military dress accessories in context, a selection of the most common contemporary civilian dress accessories in Germania Secunda was also analysed. In chapter 6, some broad differences were already highlighted, most notably the higher tin and lower lead content of many civilian artefacts. In a line graph of leaded gunmetal civilian alloys, a group of relatively high-lead civilian artefacts was also noted (figure 6.21). An additional challenge here is that several of the civilian dress accessories are not closely datable typologically to either the 4th or 5th century, so a more general comparison is provided here.

The civilian-associated dress accessories sampled in the pXRF experiment include both hairpins and brooches from the 4th and 5th centuries. Some of these were relatively rare in the study area (Fécamp hairpins, supporting-arm brooches) and may be thought of as more high-status than some of the more common artefacts (simple two-piece Armbrust brooches; potentially even Wijster hairpins). The supporting-arm brooch with *stabförmigen Bügel* has been linked to military identities in the past[34] (see also chapter 3), but due to the small sample size, all supporting-arm brooches are lumped together in this section for the purposes of comparison.[35] Broadly speaking, brooches in this period seem to have been mostly made of leaded bronze alloys, while leaded gunmetal was favoured for hairpins (table 7.5). Unleaded alloys were a rarity (11 readings on five brooches). Five readings on three Fécamp hairpins recorded leaded brass, which is quite atypical for civilian alloys, and which potentially underscores their high status and slightly earlier dating (see chapter 3).

Generally, the alloys identified in civilian dress accessories fall into two categories: a low-lead, high-tin alloy (which includes both leaded bronzes and leaded gunmetals) and a smaller contingency made up of leaded gunmetals and leaded brasses which were lower in tin and lead (see chapter 6). Whereas most Armbrust brooches tended to fall within the high-tin category, more high-status civilian dress accessories such as supporting-arm brooches and hairpins showed more diversity in metal use. This is discussed in more detail below.

Two line graphs of all civilian brooches and hairpins (figures 7.22-23) show a propensity for low-lead, high-tin alloys. Both the leaded bronze and leaded gunmetal data show a very long 'tail', indicating a range of different alloy compositions. Most civilian objects contained relatively little lead, especially the leaded

[34] Böhme 1974, 51; Heeren and Van der Feijst 2017.

[35] A total of 23 supporting-arm brooches were analysed, eight of which were of the supposedly military type. No major differences in metal use were found between the different subtypes of supporting-arm brooch (see below).

Table 7.11. Alloys identified in civilian dress accessories from Germania Secunda (n = readings).

	Unleaded	Leaded			
Object	Bronze	Brass	Bronze	Gunmetal	Total
footless brooch with high catch-plate	3		5	9	17
simple two-piece Armbrust brooch	8		198	107	313
Armbrust brooch with elaborate foot			5	5	10
supporting-arm brooch		1	21	22	44
Fécamp hairpin		5	4	15	24
Wijster hairpin			15	41	56
Cortrat hairpin				2	2
hairpin (unclassified)			1	4	5
Total	11	6	249	205	472

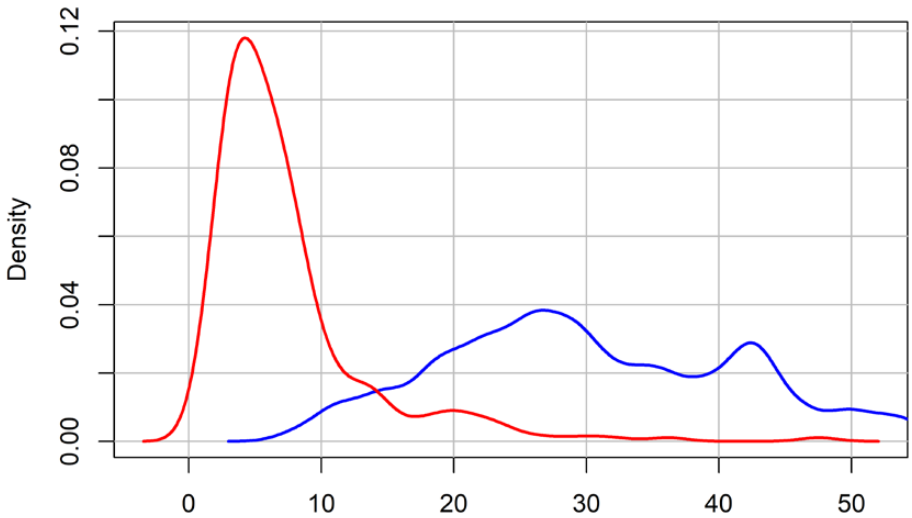


Figure 7.22. Density graph of lead (red) and tin (blue) levels (x-axis) in leaded bronze (n = 249 readings) civilian brooches and hairpins. Bandwidth set at 1.5.

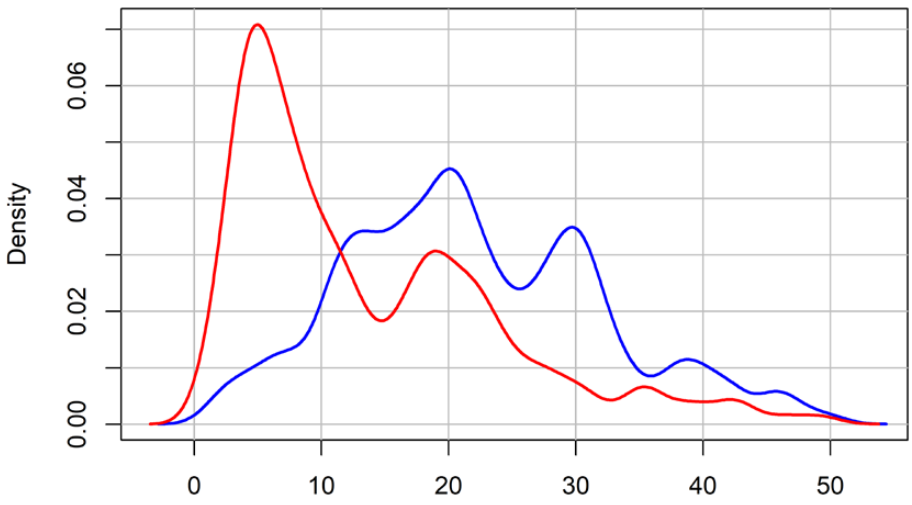


Figure 7.23. Density graph of lead (red) and tin (blue) levels (x-axis) in leaded gunmetal (n = 205 readings) civilian brooches and hairpins. Bandwidth set at 1.5.

bronzes (where lead peaked largely between 1 and 10%). The lead content of leaded gunmetal seems a bit more variable, with the main peak occurring around the 20% mark. In both alloys, however, the tin levels behave almost completely differently from lead, falling largely between 15 and 45%, with very few objects containing less tin than that. This stands in a marked difference with the decorative military fittings, which largely contained between 5 and 20% tin. A density graph of tin content in all civilian artefacts and functional 4th- and 5th-century military objects (figure 7.24) shows that despite a certain amount of overlap, both 4th- and 5th-century military objects tended to favour lower tin contents.

The leaded gunmetals used for civilian brooches and hairpins looks largely similar to the low-lead leaded gunmetal found in military dress accessories. The leaded bronze, on the other hand, appears to have been a quite different material, consisting of relatively high

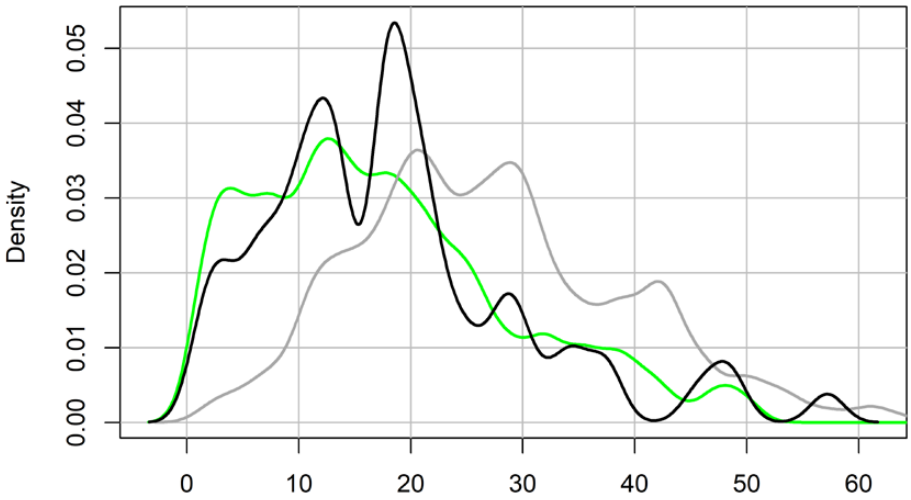


Figure 7.24. Density graph of tin values (x-axis) in civilian and military alloys (only functional objects) in tin-containing alloys. Light grey: all civilian objects (n = 465 readings); green: 4th-century military objects (n = 353 readings); black: 5th-century military objects (n = 70 readings). Bandwidth set at 1.5.

amounts of tin and little lead (as also indicated by the ternary plots in figures 7.25-7.26). The lead content of most civilian dress accessories was also relatively low (see figures 7.22-23 above), certainly compared to the high-lead buckle frames and crossbow brooches.

Low-lead, high-tin leaded alloys

The low-lead, high-tin group was identified to some degree in almost all types of civilian-associated dress accessories, but it was especially well-represented in the family of Armbrust brooches and footless brooches (figures 7.25-26). The earlier type, the footless brooch, contained on average 27.65% tin, with only 1.63% zinc and 5.66% lead. This is similar to the average values found in simple Armbrust brooches (on average 27.91% tin, 1.06% zinc and 7.72% lead). Very few elaborate Armbrust brooches were measured, but there the values are again similar: 30.59% tin, 1.10% zinc and 5.42% lead.

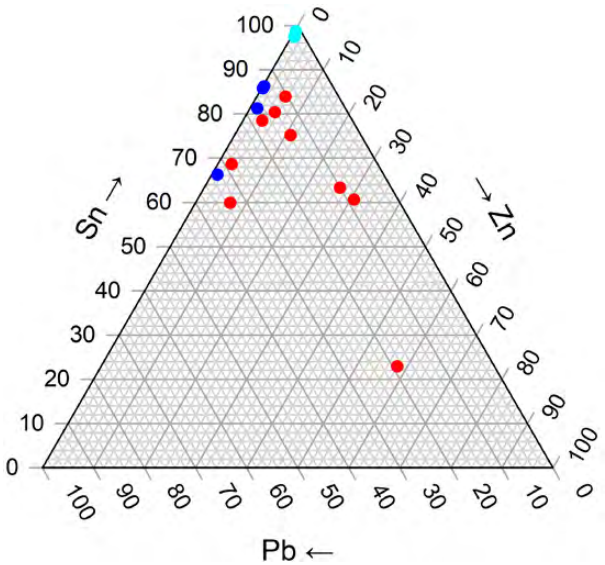


Figure 7.25. Ternary plot of footless brooches with high catch-plates (n = 17 readings).

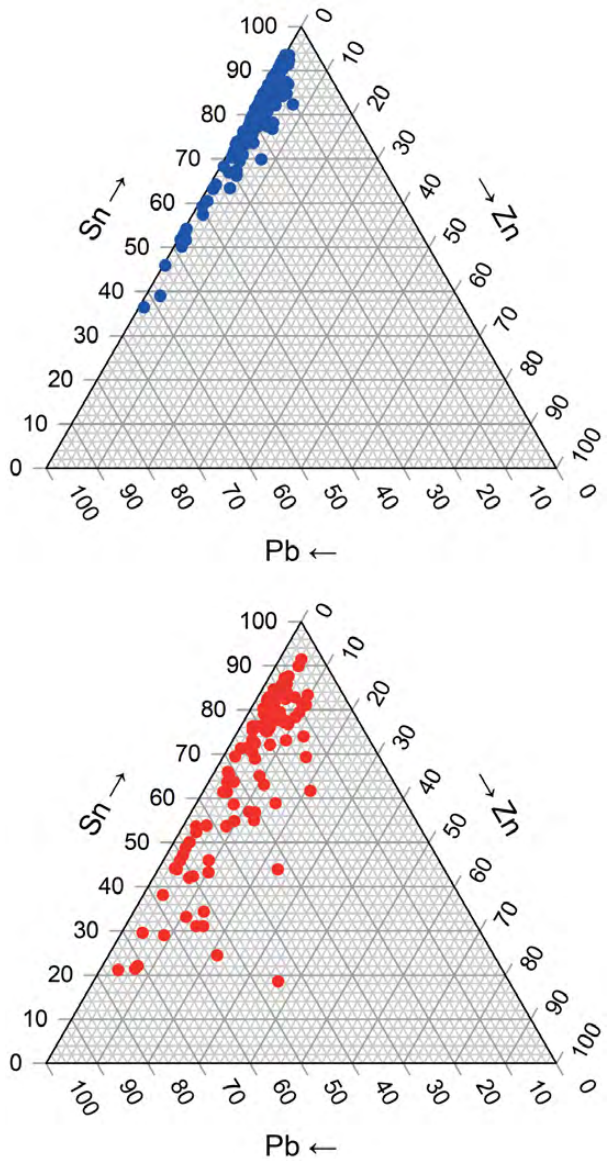


Figure 7.26. Ternary plots of simple two-piece Armbrust brooches. Top: (leaded) bronze (n = 206 readings). Bottom: leaded gunmetal (n = 107 readings)..

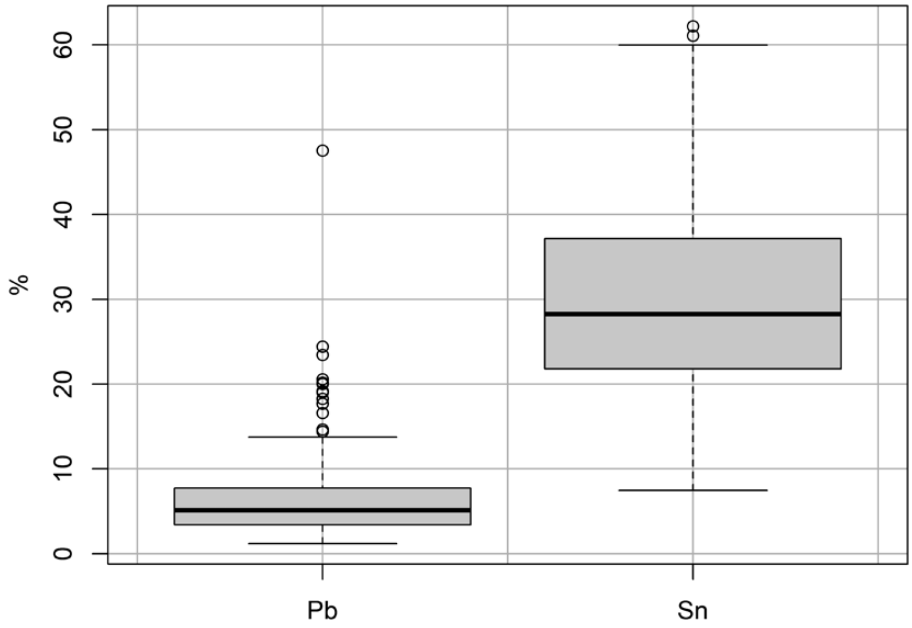


Figure 7.27. Boxplot of absolute percentage of tin and lead in leaded bronze simple two-piece Armbrust brooches (n = 198 readings).

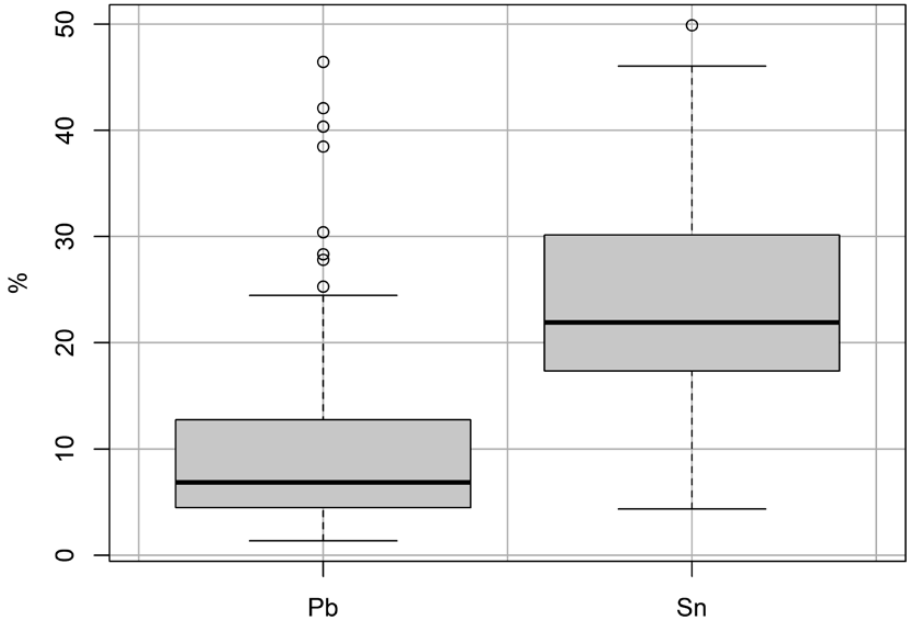


Figure 7.28. Boxplot of absolute percentage of tin and lead in leaded gunmetal simple two-piece Armbrust brooches (n = 107 readings).

This low-lead, high-tin alloy extends beyond the alloy boundaries set at 1% (see chapter 6) and include both leaded bronzes and leaded gunmetals, despite the latter including zinc. The absolute zinc levels identified in these civilian leaded gunmetals were very low (see previous paragraph) and it seems that these low-zinc leaded gunmetals were used interchangeably with leaded bronzes in the production of these civilian dress accessories (and in some of the 5th-century military fittings).

Ternary diagrams only represent the relative amounts of alloying ingredients and a close cluster of measurements may hide a range of different compositions. The homogeneity of these alloys, however, is also evident from a range of boxplots using the absolute percentage of tin and lead in leaded bronze and leaded gunmetal simple two-piece Armbrust brooches (figures 7.27-28). Just as in the ternary diagrams, the leaded gunmetal brooches show a bit more variation, including a slightly wider range of lead contents compared to the leaded bronze brooches.

The boxplot of this latter group clearly shows what the ternary diagram also highlighted: a preference for low lead levels and a range of tin contents with a tendency towards higher tin levels. The question is how these homogeneous alloys with relatively high tin and low lead levels with either no (leaded bronze) or very little zinc (leaded gunmetal) came to circulate so widely in

the civilian sphere. It is a possibility that these alloys reflect the effects of prolonged recycling of copper alloys in the Late Roman West. Remelting and mixing alloys of a different composition over a longer period of time is likely to result in a relatively 'flat' alloy: each mixing event produces an alloy that represents the averages of the ingredients present in the alloys that were mixed. Zinc levels, additionally, is known to decline upon remelting,[36] which may explain the low zinc levels in these alloys.

High-lead or high-zinc alloys

Although the bulk of the civilian-associated dress accessories were made of this high-tin, low-lead material, it was already noted above that some did not fit into this category. Several hairpins, for example, were found to be made of leaded brass (table 7.3). Some relatively high-zinc or high-lead gunmetals were also identified and are particularly well presented in the hairpins and supporting-arm brooches. These items are, compared to the Armbrust brooches, relatively rare in the study area and in some cases did not circulate widely outside of the frontier zone. The hairpins also frequently appear in richly furnished burials and occasionally feature gilding or silver-plating.[37] As such, these might be classified as more high-status dress accessories.

The circulation dates of the Fécamp and Wijster hairpins overlap in part, but a comparison between the two may still be of interest. Both hairpin types included some alloys classified as low-lead, high-tin, but the majority were found to be of a rarer alloy, containing more significant amounts of lead and/or zinc (figure 7.29). The ternary plot of the Fécamp hairpins, furthermore, shows several specimens made from leaded brass and a sizable number of leaded gunmetal pins with relatively low tin levels. The Fécamp hairpin is rarer than the Wijster pin and its circulation period also starts earlier, and both factors may explain the use of this rare material (especially in the Late Roman period and outside of the military sphere).

As far as actual composition is concerned, the hairpins fit well within the expectations of civilian alloys. As the absolute alloying amounts in figure 7.30 shows, Late Roman hairpins contained moderate to high amounts of tin (on average 17.81% for the Fécamp and 25.44% for the Wijster pin) and low zinc contents (5.27 and 3.18% respectively). The main observable difference is in the lead content, which is moderately higher in these hairpins (12.95 and 16.25% respectively) than in the Armbrust brooches (7.72%). This is most likely a technological phenomenon, as these relatively thick

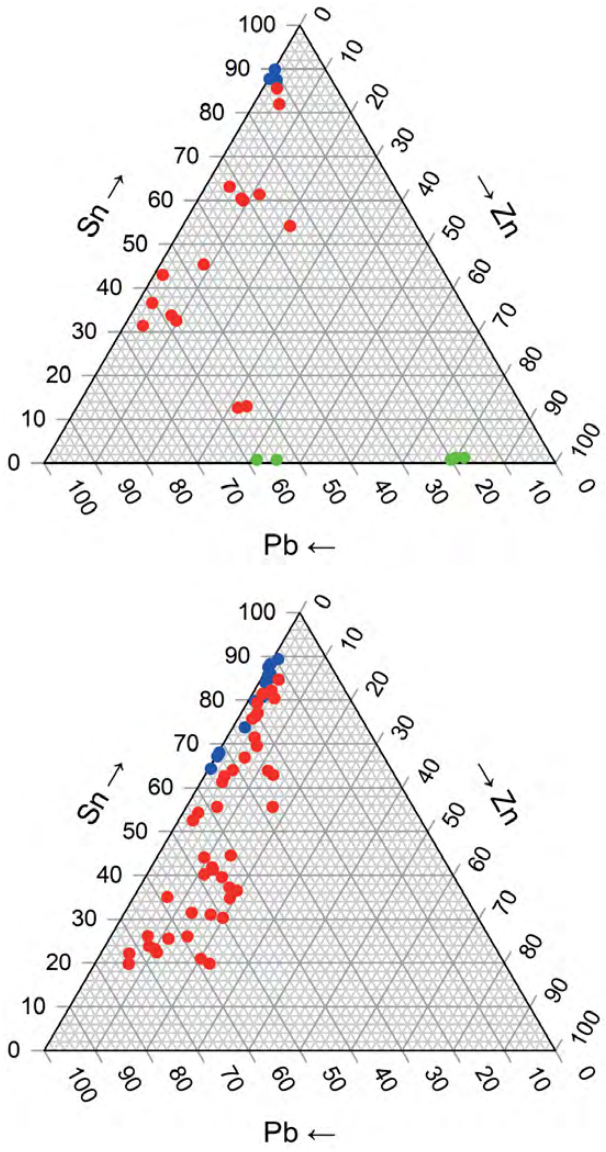


Figure 7.29. Ternary plots of earlier (Fécamp; top; n = 24 readings) and later (Wijster, Cortrat; bottom; n = 58 readings) hairpins.

hairpins would have been cast in highly detailed moulds. However, as highlighted above, the lead content in these hairpins is still markedly lower compared to the levels identified in contemporary military belt buckles (see above). The tin levels in figure 7.30 are broadly comparable to those the simple two-piece Armbrust brooches above.

This same pattern was also observed in supporting-arm brooches (figure 7.31). The supporting-arm with *stabförmigen Bügel* (HF 78c) tends to be linked to men, while other types (*mit Trapezförmigen Fuß* and *mit gleichbreitem, bändförmigem Fuß, ohne Achsenträger*; HF 78a and 78b) have been linked to female burials in some parts of Germania Magna.[38] These gendered categories are not clearly reflected in the metallurgy of the

[36] Caley 1964, 83.
[37] Böhme 1974; Van Hemert 2010.
[38] Böhme 1974, 10-14; Heeren and Van der Feijst 2017, 203.

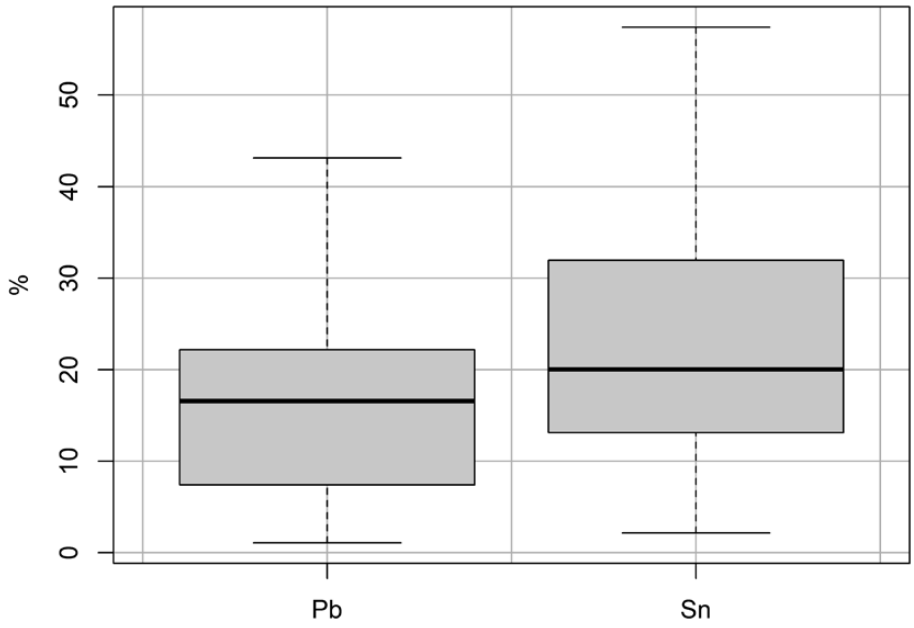


Figure 7.30. Boxplot of tin and lead in leaded bronze and leaded gunmetal hairpins from Germania Secunda (Fécamp, Wijster, Cortrat and unclassified; n = 82 readings).

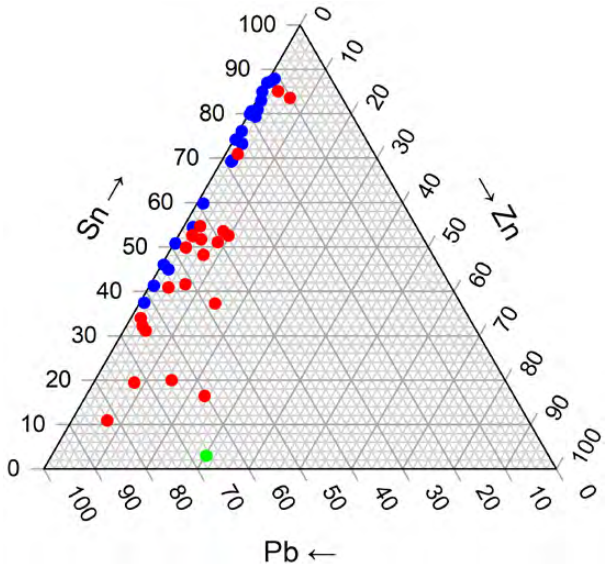


Figure 7.31. Ternary diagram of supporting-arm brooches (n = 44 readings).

brooches (see figure 7.31). In a PCA biplot of the various supporting-arm brooch types (figure 7.32), the military and civilian subtypes do form clear clusters reflective of different compositions. As the military-associated brooches are the most numerous, figure 7.32 effectively plots the difference between these and everything else fed into the analysis, which is in fact very useful archaeologically because that is also the main social distinction made (see above).

The expectation based on the social interpretations of these brooches would be for the HF 78c to be mostly associated with zinc and lead (as found for the majority of military alloys), but this was not exclusively the case. Variation in zinc and lead content appears to have been the primary clustering factor for the female-associated HF 78a brooches, while the clustering and distribution of the female-associated HF 78b brooches was predominantly influenced by tin. The military HF 78c brooch shows the widest distribution, encompassing all variation of the HF 78a and 78b.

The supporting-arm brooch group is characterised by relatively high tin contents (on average 25.91%) with low zinc levels (1.78%) and a moderate amount of lead (17.84%), comparable to the hairpins discussed above. Again, however, the lead contents found here are low compared to those in contemporary military belt buckles (figure 7.33),[39] even though several of the supporting-arm brooch subtypes (such as the HF 78c) are similarly bulky. This indicates that objects with many technological similarities (buckle frames, hairpins, certain brooch types) but with different social connotations (military vs. civilian) were genuinely made of different materials. Of course, the amount of recycling and scarcity of raw material in the Late Roman West means there is a certain amount of overlap between all categories, but the differences observed between civilian and military dress accessories are consistent.

In attempting to distinguish between military and civilian alloys, the emphasis has been on the role of lead and tin. There is also zinc, however and leaded gunmetal was a common alloy across all social, functional and chronological groups of artefacts. In some rare cases, leaded brass was even identified. Table 7.12 summarises the percentage of zinc in a range of civilian and military leaded gunmetal alloys. First of all, it is clear that the

[39] The average lead content of HF 78a and HF78b supporting-arm brooches from Germania Secunda was 17.33%, compared to 18.46% for HF 78c brooches from this region.

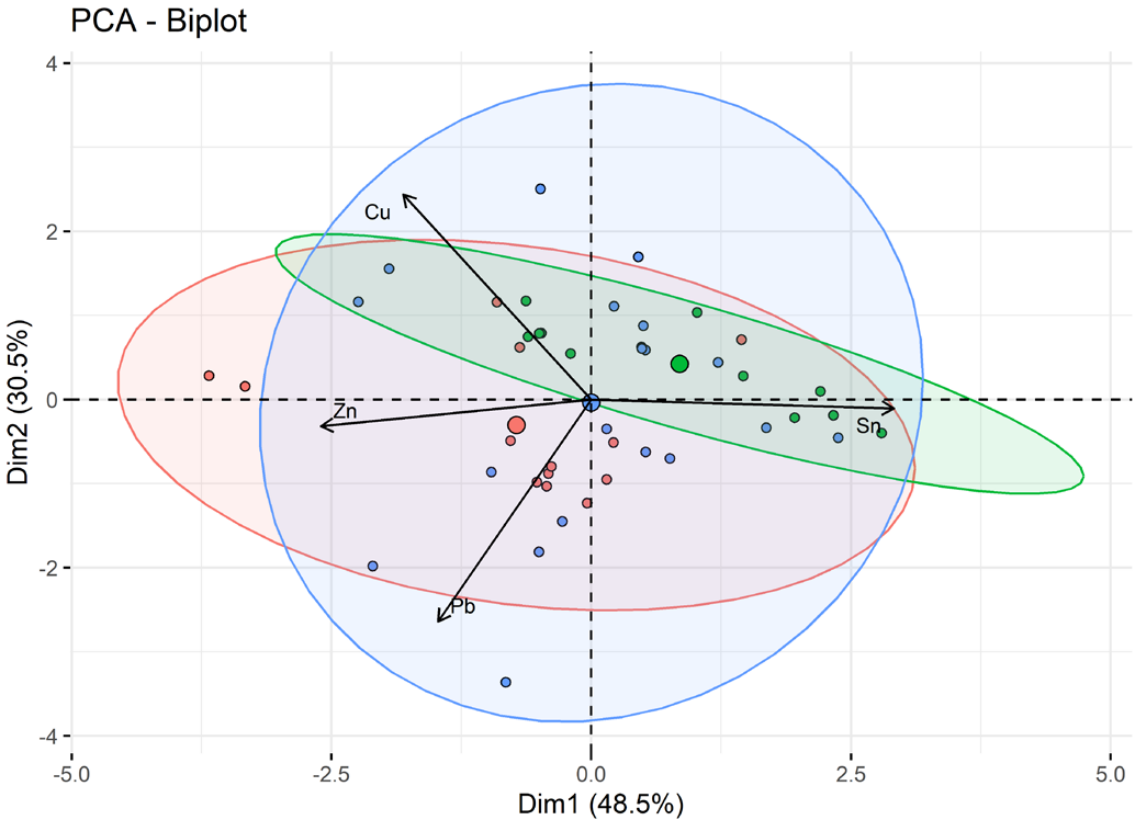


Figure 7.32. PCA biplot of female (HF 78a; red and HF 78b; green) and male (HF 78c; blue) supporting-arm brooches (spectrum: Cu-Pb; n = 44 readings).

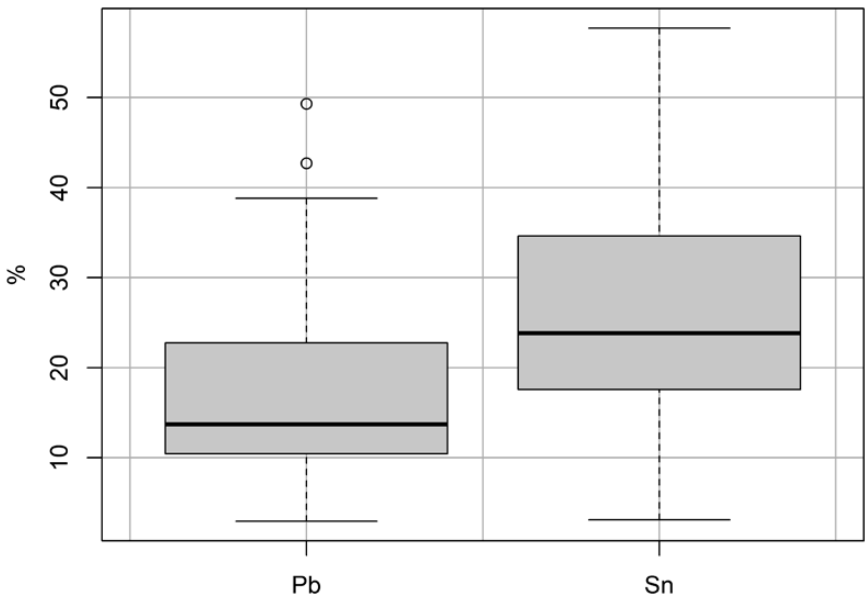


Figure 7.33. Boxplot of lead and tin levels in leaded bronze and leaded gunmetal supporting-arm brooches (n = 43 readings).

majority of Late Roman objects contained little zinc, especially compared to Early or Middle Roman objects and compared destructive measurements (chapter 6). Some differences between various categories can be seen, however.

Generally, flat belt items (backplates, strap ends and to some extent also fittings), contained on average more zinc compared to crossbow brooches and buckle frames. It is possible that these higher-zinc alloys had a more gold-like colour comparable to brass and that this was reserved for objects with larger surfaces for the best visual effect. Armbrust brooches contained the absolute lowest amounts of zinc, a possible side effect of the recycling already discussed above. Supporting-arm brooches also did not record particularly high

Object	Average Zn percentage	N readings
hairpins	3,79	93
footless brooches	4,38	43
simple Armbrust brooches	2,27	131
elaborate Armbrust brooches	2,5	8
supporting-arm brooches	3,18	27
crossbow brooches	3,85	87
buckle frames	3,1	177
buckle (back)plates	5,28	157
strap ends	5,06	112
belt fittings (misc.)	4,11	215
Total/average	3,75	1050

Table 7.12. Zinc percentage in different categories of leaded gunmetal objects from Germania Secunda.

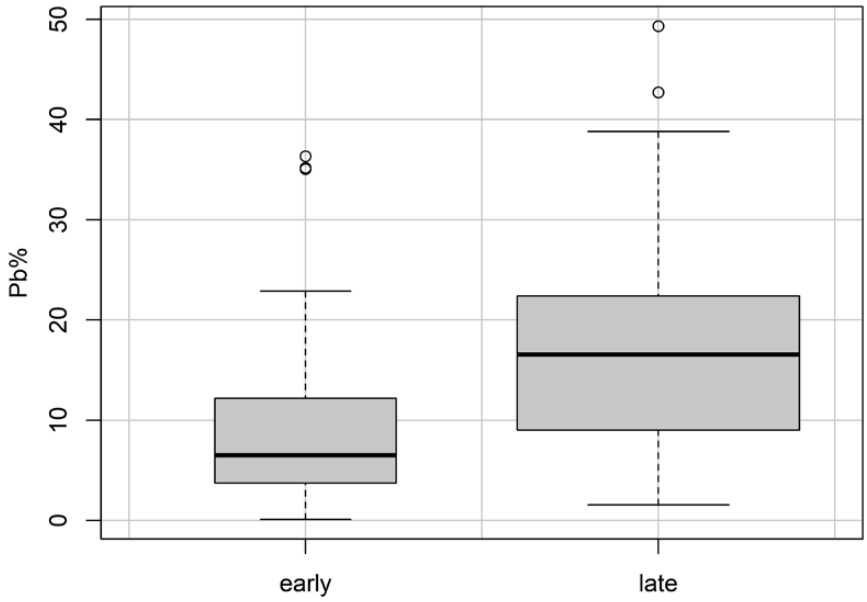


Figure 7.34. Boxplot of lead levels in earlier and later civilian dress accessories (n = 144 readings).

zinc levels, generally comparable to military buckle frames and crossbow brooches. Of the civilian objects, hairpins and footless brooches contained the most zinc, confirming their high status and early date respectively. This sets the hairpins apart from the Armbrust brooches and also supporting-arm brooches as a potentially much more high-status dress ornament: in some cases, these were made from materials not usually widely available to smiths catering to a civilian/rural market. The rarity of high-zinc leaded gunmetals could have been the main allure, but the more gold-like appearance could also be a factor.[40]

Summary and chronology

As there was considerable chronological overlap between different object types associated with female or civilian dress, a comparison of purely 4th- vs. 5th-century objects is more difficult to achieve than for the military dress accessories. Generally, however, we may distinguish between earlier items (Fécamp hairpins and the footless brooches with high catch-plate) and later items (Wijster and Cortrat hairpins and the supporting-arm brooches). The main question is whether these objects showed any significant changes in alloy composition over time and how these developments compare to the chronological patterns identified in the military assemblage outlined above. As civilian leaded gunmetals and leaded bronzes differed less from each other in terms of composition compared to the military dress accessories, both alloys are lumped together here in the plots (this also ensures the sample sizes are big enough). Objects that could not be dated more specifically than to the entire Late Roman period are also included for comparison.

Lead levels in civilian dress accessories changed the most (see figure 7.34), while tin levels remained quite stable (figure 7.35). The consistency of the tin is likely in some part due to the fact that they already were very high, reaching the limit on what made a functional alloy. The changes in lead content are difficult to interpret, as this subsection of the dataset is rather small and typological and functional factors are likely having a larger impact than chronology. The category of earlier objects includes some objects that are generally smaller and thinner than those in the later category.[41] Rather than chronology, the main dividing factors in alloy use in civilian dress accessory

[40] Böhme 1974; Hemert 2010.

[41] Footless brooches compared to supporting-arm brooches for example, Fécamp and later hairpins are relatively similarly sized.

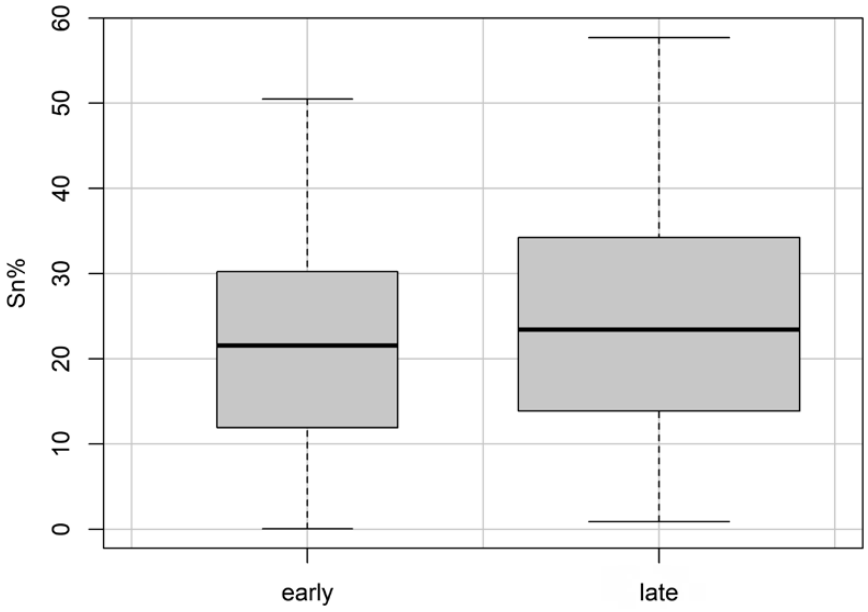


Figure 7.35. Boxplot of tin levels in earlier and later civilian dress accessories (n = 144 readings).

appear to be social status and the relative rarity of the object type. Common brooch types, such as the simple two-piece Armbrust brooch and the relatively early footless brooch were predominantly made of a low-lead alloy, while rarer items such as the earlier Fécamp hairpin and the later Wijster hairpin were more often made of alloys higher in lead. Tin levels were considerably higher across all civilian object categories compared to any of the military dress accessories that were analysed.

A brief look towards the north

The initial design of the project was aimed at analysis of the production of military dress accessories in Germania Secunda and intended to include a selection of contemporary civilian dress from the same contexts for comparison. As the project developed and the exchange links of materials, styles and technologies between Germania Secunda and Germania Magna came into clearer focus, a small amount of finds from across the frontier were included in the analysis as well. These are not the main focus of the thesis but make for an interesting additional case study that raises further points of investigation for future research.

It is generally accepted that the Germanic copper-alloy industry was heavily dependent on secondary sources of raw materials, most notably scrapped objects from the Roman Empire[42] coinciding with an exchange of technological know-how, a process that intensified over the course of the Roman period.[43] Very little is known, however, about how trade of raw materials was organised and where it took place, especially in the Late Roman period.[44] The most authoritative source on Germanic metalworking remains the dataset gathered by Voß *et al.* from circa 800 objects from a range of sites in northern Germany (as well as a smaller number of Roman sites in southern Germany), focussing on finds from the 2nd and 3rd centuries.[45] More recently smaller studies focusing on individual sites have been added to this repertoire[46] and these also include a small number of Late Roman finds. Roxburgh's unpublished dataset also includes a number of Late Roman finds from the northern Netherlands.[47]

Könemann drew on comparisons between his own data from Kamen-Westick, the dataset from Voß *et al.*[48] and the chemical analyses of the Bad-Pyrmont hoard (mostly brooches) to understand Germanic metal use throughout the Roman period. He noted that generally in northern Germany, dress accessories of the 4th and 5th centuries were most commonly made of *Mischbronze*,[49] while in his own analyses of Late Roman finds from Kamen-Westick, *Schmiedebronze* was the predominant alloy. He also noted that *Messing* became less common by the end of the Early Roman period (although it was still found relatively commonly in footless brooches with a high catch-plate in the Bad-Pyrmont hoard).[50]

These alloy definitions are taken from Hammer *et al.* and describe different alloys based on their casting

[42] Kyritz 2014, 159-160.
[43] Voß *et al.* 1998.
[44] Kyritz 2014, 160.
[45] Voß *et al.* 1998.
[46] Schuster 2006; Könemann 2018; for numbers of relevant objects see table 7.6.
[47] Roxburgh 2019.
[48] Voß *et al.* 1998.
[49] Könemann 2018, 148-149.
[50] Teegen 1997.

Object	Unleaded			Leaded				Total
	brass	gunmetal	bronze	brass	gunmetal	bronze	silver	
footless Armbrust brooch with high catch-plate								
Schuster 2006			1		4	4		9
My data	4	4		4	34	7	3	56
Total	4	4	1	4	38	11	3	64
simple two-piece Armbrust brooch								
Könemann 2018			3		6	4		13
My data					24	61		85
Total			3		30	65		98
supporting-arm brooch								
Könemann 2018					2	1		3
My data		2			5	8		13
Total		2			7	9		22
Fécamp hairpin								
Könemann 2018		2			2	1		5
My data					15			15
Total		2			17	1		20
Wijster hairpin								
Könemann 2018					1			1
My data					16	6		22
Total					17	6		23
Military fittings								
My data		3	1	2	26	60	3	95
Total		3	1	2	26	60	3	95

Table 7.13. Chemical analyses on Late Roman copper alloy dress accessories collected from Germania Magna (additional data from Schuster 2006; Könemann 2018).

and melting properties.[51] *Mischbronze* contains at least 3% tin, zinc and lead and is therefore comparable to leaded gunmetal in Pollard *et al.*'s alloy typology.[52] Leaded gunmetal is indeed the most common alloy type in the Late Roman period in the Roman provinces (see above), so Könemann's statement shows a similar development towards more mixed alloys in Germania Magna. *Schmiedebronze* is defined by Hammer *et al.* as containing 5-14% tin and up to 5% lead and/or zinc (in the FLAME system this could mean bronze, leaded bronze, gunmetal or leaded gunmetal).[53] A relatively high-tin alloy with low lead and/or zinc levels sounds reasonably similar to the high-tin, low-lead alloys described above, although this remains speculative.

The use of *Messing* is even more difficult to connect to Pollard *et al.*'s method of alloy categorisation. *Messing* is defined by Hammer *et al.* as containing 5-20% zinc, up to 5% lead and tin in up to equal measure as zinc.[54] This range potentially encompasses brass, leaded brass, gunmetal and leaded gunmetal although colloquially at least, *Messing* tends to be translated as 'brass'. It has been described for other regions of Europe and the Roman Empire how brass or high zinc-containing alloys were used less and less after the end of the 1st century AD,[55] and we may interpret Könemann's statement in this light as well. My own data also showed that the footless brooches with high catch-plate were occasionally made of brass-like alloys (see below), interpreted similarly as a chronological phenomenon (these brooches are the oldest category included in this study).

In short, it appears that the developments in alloy use in Germania Magna closely mirror those of the Roman Empire: zinc use declined as time progressed, with an increased use of more mixed alloys from the Middle Roman period onwards. More specifically, the use of *Schmiedebronze*, an alloy containing significant amounts of tin and low levels of zinc and/or lead was identified in several studies of Germanic material.[56]

To add some more data to this narrative, a small amount of pXRF data was gathered from objects found in Germania Magna (289 readings), which may be embedded in the findings of other datasets that

[51] Hammer *et al.* 1998.
[52] Pollard *et al.* 2015.
[53] Hammer *et al.* 1998.
[54] Hammer *et al.* 1998.
[55] Jouttijärvi 2017.
[56] Teegen 1997; Voß *et al.* 1998; Könemann 2018.

included Late Roman material from Germania Magna.[57] It should be emphasised again that each of these studies applied different methodologies and analytical techniques.[58] The available data from other studies and my own Germanic dataset are summarised below in table 7.6. Generally, this meta-analysis of Late Roman finds from Germania Magna shows the same patterns as seen in Germania Secunda. Most alloys are leaded, with leaded bronze and leaded gunmetal dominating. Unleaded and brass-like alloys are rare and mostly found in military or early material (footless brooches with high catch-plate). Several object categories from table 7.6 can be highlighted and compared to similar finds from Germania Secunda, namely the footless Armbrust brooches with high catch-plate, simple two-piece Armbrust brooches, hairpins and military belt fittings.

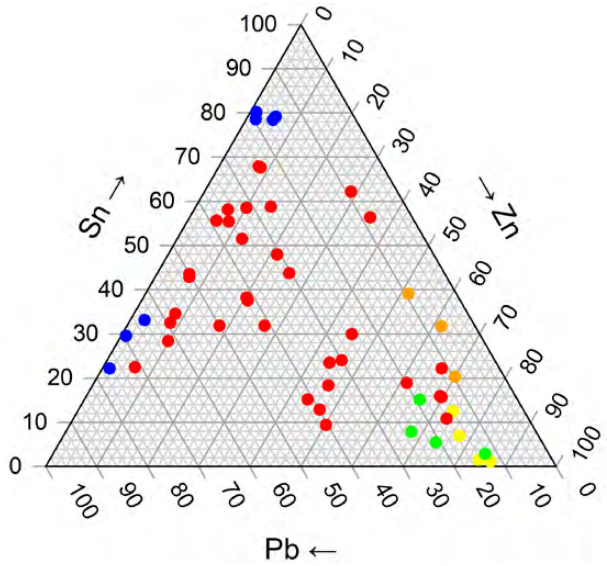


Figure 7.36. Ternary diagram of footless brooches with high catch-plate from Germania Magna (n = 56 readings).

Brooches

From the distribution study in chapter 3, it was already clear that the footless Armbrust brooch with high catch-plate was most often found in Germania Magna and was much rarer in the Roman provinces. It is also the earliest brooch type included in this analysis, circulating in Germania Magna from the late 2nd and early 3rd century onwards until the mid-4th century.[59] The distribution study in chapter 3 was largely concerned with the subtypes of this brooch family that appear in Germania Secunda in the Late Roman period: the Almgren VII 3.5/Böhme 37e/Heeren and Van der Feijst 71a type. However, many of the brooches analysed from Germania Magna were very heavily fragmented (catch-plates and axis mounts were almost always missing), meaning that although they displayed several characteristics of that group (bow profile and cross section, transition between bow and catch-plate), their identification to subtype is somewhat unsure and a different identification to an earlier type could not be excluded.

In terms of composition, the footless brooches from Germania Magna present a very different image compared to those found in Germania Secunda (figure 7.36). Zinc-containing alloys and unleaded alloys are well-represented, and several brooches also recorded as brass, gunmetal or leaded brass, alloy types that were very rare to non-existent in all other object categories analysed for this chapter. The footless brooches from Germania Secunda on the other hand plot much more closely to other, later Armbrust brooches (such as the simple two-piece). The zinc levels in the leaded gunmetal footless brooches are also slightly higher in Germania Magna (4.32% compared to 1.63%), potentially indicating that metals used for these earlier brooches had been recycled less intensively. Not much other publicly available raw data for these brooches was found to put these findings into perspective, although chronology is the most likely factor behind this starkly different metallurgical composition: VII 3.5 footless brooches from Germania Magna may date to the Late Roman period as well as to a significantly earlier period[60] and a number of brooches were included where a Late Roman date was also not completely secure. The compositions are broadly comparable to those identified by Schuster,[61] which included mostly leaded and mixed alloys.

As the simple two-piece Armbrust brooches was one of the most common Late Roman brooch types across the frontier, a sizable sample of these could be analysed from a variety of sites in Germania Magna. The 30 simple two-piece Armbrust brooches from Germania Magna present a very similar picture as those found in Germania Secunda. All brooches were made from either leaded bronze or leaded gunmetal, with on average 8.65% lead and 31.05% tin. The leaded gunmetal brooches only contained on average 2.23% zinc. A ternary diagram of these high-tin, low-lead and low-zinc alloys displays the same extreme clustering around the top left of the diagram as the same brooches from Germania Secunda (figure 7.37). It does seem that leaded bronze was slightly more common for this brooch type compared to in Germania Secunda. In chapter 3 it was argued that these simple two-piece Armbrust brooches (predominantly Schulze group

[57] Schuster 2006; Könemann 2018; Voß *et al.* 1998.
[58] Schuster (2006) used raster electron microscopic analysis, Könemann (2018) destructive core AAS and Voß *et al.* (1998) a combination of destructive core AAS and surface XRF.
[59] Heeren and Van der Feijst 2017.
[60] Schulte 2011.
[61] Schuster 2006, table 7.6.

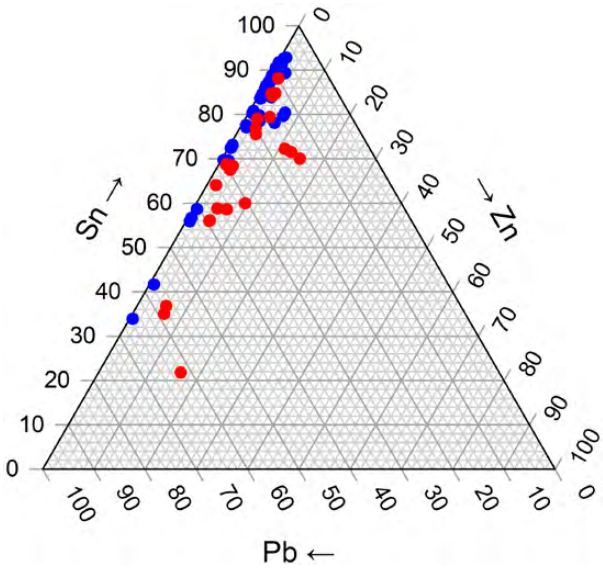


Figure 7.37. Ternary diagram of simple two-piece Armbrust brooches from Germania Magna (n = 85 readings).

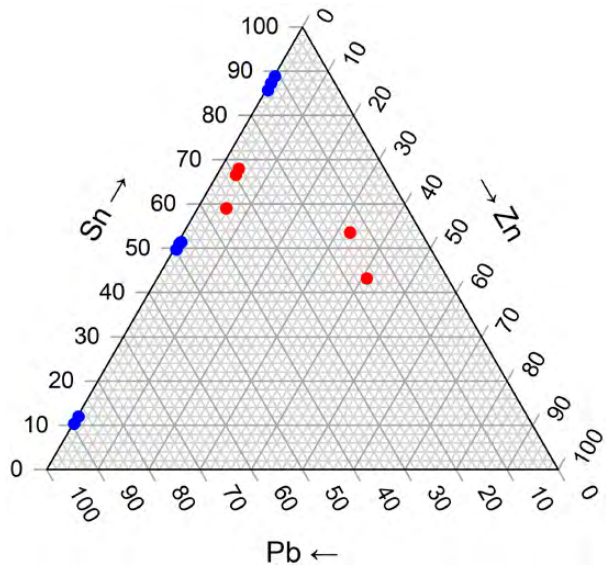


Figure 7.38. Ternary diagram of alloys found in supporting-arm brooches in Germania Magna (n = 13 readings).

35/36) were contemporary in Germania Secunda and Magna, dating broadly to the 4th and 5th centuries and potentially becoming more common in the 5th century. This later chronology is likely reflected in the increased use of highly mixed alloys, when compared to the footless brooches from Germania Magna (above) and the contemporary 4th- and 5th-century hairpins (see below). Low-zinc leaded gunmetal and leaded bronze were also the main alloys found in Könemann's destructive AAS data, although his data also included a number of very high-zinc alloys.[62]

Finally, there are a number of supporting-arm brooches from Germania Magna (figure 7.38). These all recorded as leaded bronze and leaded gunmetal, with quite substantial zinc levels in one case (8.39-9.91% from a HF 78b brooch). Although the data collected outside of the Empire is very scarce, some differences between alloy use in Germania Magna and Secunda may be observed. As with the footless brooches with high catch-plate, supporting-arm brooches may have circulated in Free Germany slightly earlier than in Germania Secunda, and in both regions the majority of supporting-arm brooches appear to have circulated in the late 4th and 5th centuries (see chapter 3). This may explain the presence of some relatively high-zinc gunmetals and leaded gunmetals in Germania Magna (see figure 7.38), that are completely absent in Germania Secunda. The AAS cores analysed by Könemann on three supporting-arm brooches from Kamen-Westick also skew more towards a relatively low-tin, high-zinc alloy (two leaded gunmetal brooches; one leaded bronze).[63]

[62] Könemann 2018, appendix.
[63] Könemann 2018.

Hairpins

The inclusion of material from Germania Magna provided an opportunity to include more Fécamp hairpins, which tend to be much rarer in the Roman provinces than the later Wijster type. All six Fécamp hairpins from Germania Magna were made of leaded gunmetal (figure 7.39). Although some individual hairpins appear to have been more heavily leaded (30% or more), the amounts of zinc and tin were reasonably similar in all Fécamp hairpins from Germania Magna. Largely, the alloys used appeared to be characterizable as the same high-tin, low-lead and low-zinc alloy as the simple two-piece Armbrust brooches above, but two hairpins stood apart from the rest by recording 5-7% zinc. This is comparatively high for zinc in Late Roman civilian leaded gunmetals and compares well with the absolute zinc levels in the three leaded brass Fécamp hairpins from the *limes* area.

The later Wijster hairpins do not show this occasional spike in zinc on either side of the frontier (figure 7.40). Apart from a number of leaded bronzes, the zinc levels in the leaded gunmetals recorded within the same 1-3% range as seen in other contemporary civilian dress accessories. The tin (16-43%) and lead (2-16%) contents of the Wijster pins also reads very similar to the high-tin alloy found in contemporary brooches. The Wijster hairpins from the *limes* area, however, showed a little more variation in the lead and zinc content. This difference is a likely factor in the increased tin content in Wijster hairpins from Germania Magna (on average 30.86% compared to 25.44% in Germania Secunda).

This shows that the hairpins in Germania Magna followed the same patterns for metal use as those

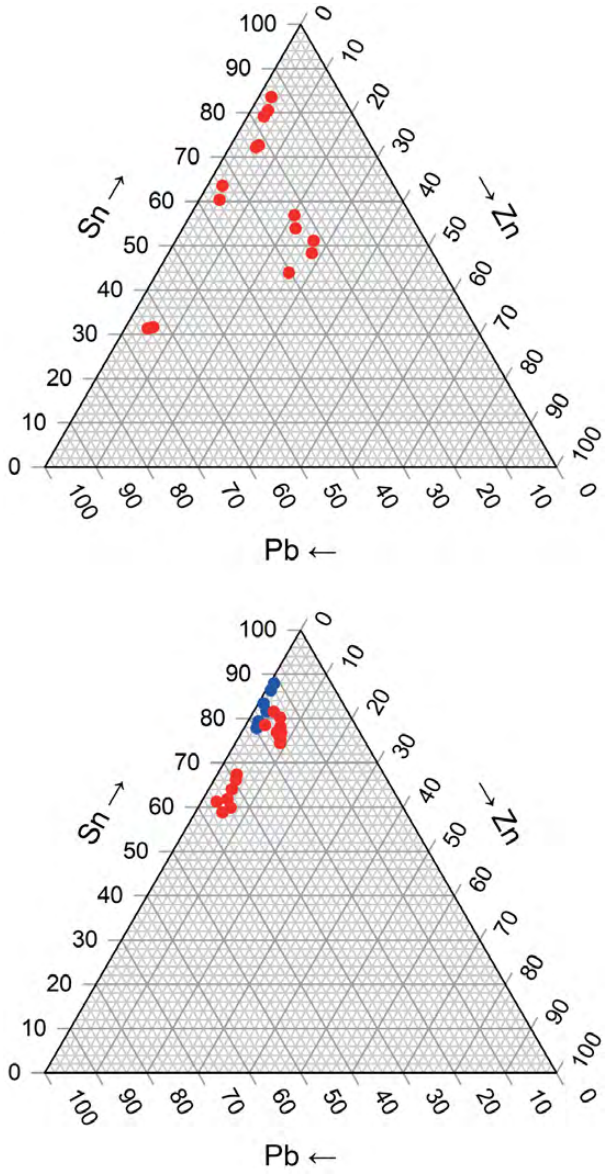


Figure 7.39. Ternary diagram of Fécamp (top; n = 15 readings) and Wijster (bottom; n = 22 readings) hairpins from Germania Magna.

in Germania Secunda (above), moving towards a more homogeneous, recycled alloy. Together with supporting-arm brooches, these generally rarer and more regionally restricted items display the most evidence in the 4th and 5th centuries for anything other than the generic high-tin alloy found in all other civilian dress accessories. Könemann also included one AAS analysis of a Fécamp hairpin from Kamen-Westick, which was made of a very low-lead leaded bronze.[64]

Military fittings

Finally, a small dataset of 95 readings on military decorative fittings from Germania Magna (from Kamen exclusively) was collected, which may be compared to military fittings found in provincial contexts. These include a number of suspensions mounts, strap ends and belt stiffeners (predominantly of the propellor type). With the exception of two strap ends dated to the first half of the 5th century, none of these finds could be dated closer than 4th-5th century.

It is immediately clear from the alloys identified in figure 7.41 that these military fittings are related much more closely to the military fittings found in Germania Secunda than the civilian objects they were found alongside with in Kamen. This suggests that these objects were in all likelihood imported. First of all, the variety of alloys detected is much wider and also includes some silver and non-leaded alloys (although these are admittedly rare). As in all categories in the Late Roman period, leaded bronze and leaded gunmetal dominate, with an average zinc content in the latter of 2.93%. Some relatively high-zinc gunmetal and leaded brass objects were also identified recording 6-12% zinc). The lead content of these military fittings was consistent with lead levels of similar fittings found within the Roman Empire (see above). A ternary diagram of these decorative fittings shows a prevalence of some high-tin and some high-lead alloys and a small number of readings plotting further to the right (indicating relative importance of zinc). This is not dissimilar to the bulk of 4th-century belt fittings from Germania Secunda.

The most notable regional difference is that military fittings found in Germania Magna were more often executed in leaded bronze rather than leaded gunmetal (as also noted for supporting-arm brooches). The dataset of military finds from Germania Magna is very limited of course (in overall numbers and in number of sites), but it could be speculated that in allowing certain metals to flow out of the Empire (either through trade, veterans or other ways), care was taken by the Romans to retain as many higher quality alloys (i.e., zinc-containing alloys) as possible.

Conclusion

The data laid out in this chapter and chapter 6 may be combined to answer the two main research questions for the pXRF and CV datasets. Across all object categories, periods and social labels, the chemical composition of these Late Roman copper alloys contained considerable amounts of alloying ingredients (tin, zinc, lead). Although surface enrichment and depletion will have skewed the absolute percentage somewhat, this is a clear indication that across the board, Late Roman smiths attempted to stretch out a dwindling supply of copper, as mines closed,[65] with other additives. However, different types of objects and objects from

[64] Könemann 2018, appendix.

[65] Edmondson 1989.

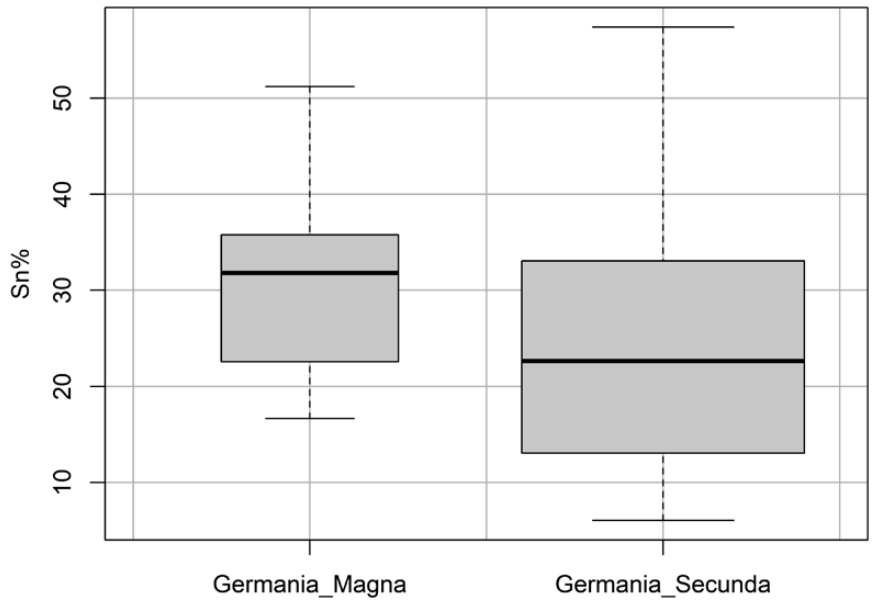


Figure 7.40. Boxplot of tin contents in Wijster hairpins from Germania Magna (n = 22 readings) and Germania Secunda (n = 56 readings).

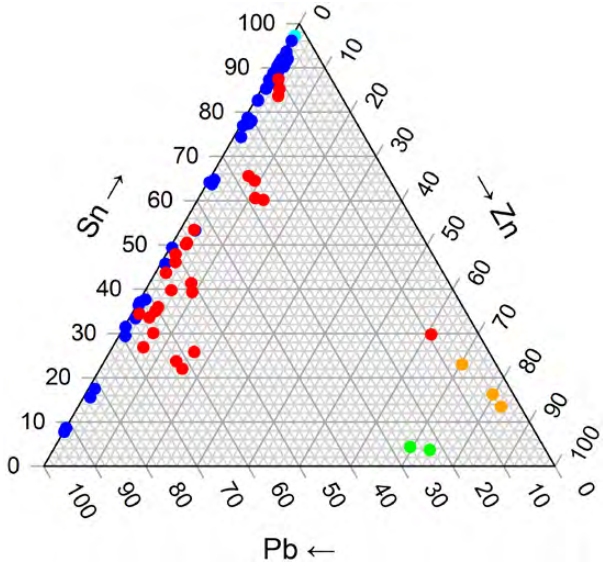


Figure 7.41. Ternary diagram of copper-alloy military fittings from Germania Magna (n = 91 readings).

different social spheres did show evidence for different alloy practices, indicating that some technological choices or other preferences were still possible. The military dress accessories showed a much greater range of materials in comparison to the civilian objects, and these could occasionally be linked to particular functionalities (high-lead buckle frames and brooches for instance) or visual effects (high-zinc plates). This seems to be an indication that craftsmen working on those types of objects had a greater range of material available to them. Consequently, they were able to a much greater extent to choose particular materials for particular object types rather than have to rely on one type of material. Because most of the objects discussed in this chapter were cast (brooches, buckles, hairpins), there is no immediate technological reason for this selective sorting of material, suggesting that other factors played a role.

Decisions due to object functionality or production technology were mostly identified in the different choices made around lead addition. Objects that were completely or partially hammered (such as certain belt plates and simple two-piece Armbrust brooches) were generally found to be low in lead, as the addition of large amounts of this element are more commonly associated with casting. In cast belt elements, such as the buckle frame and other bulky military items such as the crossbow brooch (especially the Swift 3/4), this high lead content was indeed found. However, a secondary factor in high-lead objects may be related to functionality or social expression. Similarly detailed and bulky cast objects from the civilian sphere, such as the Wijster hairpins and supporting-arm brooches generally recorded lower lead contents but were instead more closely aligned with the composition of simple two-piece Armbrust brooches and other low-lead items. This could be an issue of availability (with the army controlling silver production and its associated by-product of lead).

As to the organisation of production, the alloy composition and CV values may be used as supporting evidence (see appendices 5 and 6). For the functional items, the dimension measurements showed good evidence for a certain amount of control over the size and shape of the objects, notably buckle frames and crossbow brooches,[66] as far as these related to the base manufacturing of the item. Measurements related to aspects of decoration were far more varied (buckle backplates, decorative fittings, strap ends).

[66] Van Thienen and Lycke 2017.

The coefficient of variation values calculated for these more decorative items were in fact more comparable to those for civilian brooches and hairpins, which were indicative of a largely non-standardised production process. The amount of decoration on these items is one factor behind these higher values, the fact that they are easily replaced or added to a belt set may be another.

The data on alloy composition broadly support this narrative for different production organisation of military vs. civilian dress accessories. The military objects showed a wider range of alloy labels (bearing in mind that more data was gathered), which included purer alloys, non-leaded alloys and generally fewer indications for heavy recycling, with more variation identified within alloy groups. Contemporary civilian dress accessories showed a pattern more suggestive of smaller, regionally organised production that had less draw on supra-regional supply lines and was more reliant on recycling. Not only were leaded bronze and leaded gunmetal completely dominant in the spectrum, but these alloys were also more homogeneous, indicative of being the result of more prolonged recycling. These types of alloys were of course also recorded across all military object categories, but they appear to have been less predominant there.

Some chronological patterns in alloy use were also identified. In 5th-century military objects, relatively more highly tinned leaded bronze (more associated with civilian objects) was introduced, despite low-tin leaded gunmetal remaining the norm in most object categories. Only in the decorative fittings was this shift identified in a significant manner, perhaps indicative of a democratisation of production or even wearing (coinciding with shifting depositional patterns; chapter 4). Apart from a shift towards more recycled alloys in the hairpins, no clear chronological shifts in alloy use were identified in the civilian dress accessories, as these were already made of a fairly homogeneous material.

This all leads towards the first research question and the key aim for undertaking the pXRF and CV experiments. Overall, the main impression given by the compositional data of military dress accessories is that of consistency and continuity, with some minor shifts. The types of alloys found and the tin, zinc and lead contents found in these were generally the same in both the 4th and the 5th century. Especially the high lead content associated with several categories of military belt fittings (as well as some crossbow brooches) remained high in both 4th- and 5th-century belt parts compared to contemporary civilian material. In the strap ends and buckles, an increase in the use of alloys with more tin or alloys that were classified as leaded bronze was found in the 5th century, but not on a major scale.

The high-lead and leaded gunmetal alloys remained the predominant alloy choice in this period and some leaded brasses were even identified. This indicates that despite some diversification into more highly tinned alloys, there seems to have been a great deal of continuity in terms of which materials were used for both 4th- and 5th-century buckles and strap ends. Regardless of construction method, some leaded bronze buckles showed an increase in tin and a decrease of lead in the 5th century compared to the 4th century. At the same time, the composition of leaded gunmetal buckles remained stable across both centuries and both composite and one-piece buckles.

The main difference between 4th and 5th centuries military material was found in the decorative fittings (suspension mounts, stiffeners, tubular mounts etc.). Here, the 4th century material looked very similar to contemporary buckles and strap ends, while the 5th century material shifted more towards low-lead, low-zinc and high-tin alloys. Taken all military objects together, however, the tin values found across that dataset remain significantly different from those in the civilian objects. As these changes transcended typology, technology and chronology, they are not taken as indicative of a major shift in production organisation between the 4th and 5th centuries. There were also no differences found in metal composition in military dress accessories from different finds contexts or site types. Despite the fact that military objects ended up deposited in a wide variety of contexts, there were no indications that this is reflective of a wide variety of production sites or moments. No clear indications were found that military items from rural sites were copies or imitations of objects found in military contexts, for example.

The crossbow brooches fit within the patterns of metal use also found in larger metallurgical studies of this brooch type, showing a clear chronological development in their alloy composition, from relatively highly leaded (Swift 1-4) to lowly leaded (Swift 5-6) compositions. The crossbow brooches from the second half of the 4th century especially (Swift 3/4) show the clearest comparisons to the military buckles discussed above, containing very high absolute lead percentages and low tin values. Their shift to a more 'civilian style' alloy in the 5th century[67] coincides with perceived differences in social connotations,[68] shifting from a predominantly military association to one more aligned with provincial bureaucracy and changes in construction (from solid to hollow bows). A corresponding shift was not found in the composition any of the functional belt elements (buckles) or strap ends, although it was identified in the miscellaneous

[67] Also found in Van Thienen and Lycke 2017.
[68] Heeren and Van der Feijst 2017, 182.

belt fittings (suspension mounts, tubular mounts, decorative plates) in the 5th century.

The continuity in alloy choices and levels of standardisation of dimensions in 4th- and 5th-belt buckles and strap ends can be interpreted as reflective of similarly organised production circumstances, which stands in contrast to contemporary civilian material. These largely separated flows of metal towards objects of different social groups do seem to suggest that production of these dress accessories was largely separated, at least where it concerns the production of 'functional' items. There are some archaeological indications for production of decorative belt fittings in rural settlements or fortifications (moulds and semi-finished products),[69] which fits with the increasing use of a more 'civilian-style' high-tin alloy in decorative fittings in the 5th century. Given the lack of excavated workshops producing belt fittings in the Late Roman West (or outside of the Empire), it remains unclear how these chemical data should be interpreted in the light of Böhme's proposal that some earlier *Kerbschnitt*-decorated sets were likely produced centrally, simpler 5th-century material was increasingly produced in smaller, regional workshops.[70]

The shifts seen in the crossbow brooches, belt buckles and strap ends to include more leaded bronzes in later periods may be seen as indicative of this, but could equally be down to issues of supply (and highly leaded and zinc-containing alloys were still widely available). The consistency in standardisation of the dimensions of several 4th- and 5th-century belt accoutrements further indicates that central control over military dress accessories remained strong in the 5th century. This could be achieved through maintaining a low number of workshops, or through circulating models. Only in the case of the decorative fittings, which showed a more dramatic change in composition in the 5th century compared to earlier, does such a big change in production organisation seem more likely.

In summary, it seems that despite generally high dependency on recycled material across the entire dataset, in some settings, craftsmen producing items for the Roman army were able to exercise a certain amount of control and choice when it came to the manufacturing of copper alloy dress accessories (buckles, crossbow brooches). This is highly suggestive of the involvement of some form of centralised control in their production. Lacking any solid excavation evidence for workshops, we are left to speculate as to the precise nature of organisation of production. It could be that all dress accessories were produced centrally and then shipped to the frontier, where they were sold or worn as they were or finished and decorated further by a local smith (as indicated by some finds of semi-finished objects). Alternatively, and possibly more speculatively, it might be that rather than the objects themselves, moulds, models and ingots were issued by a central authority to production centres located closer to the troops, where the objects were smithed locally. In any scenario, the data presented in this chapter indicate that care was taken by the Roman state to achieve some semblance of uniformity in their belt and buckles and that they were able to procure raw materials to produce these that were unavailable to others. This could have been an effect of 'uniform requirements' (although the variety of decoration counters this)[71] or of shared workshop traditions operating under the banner of the Late Roman state.

Although more data are needed, the analysed objects from Germania Magna were found to be very comparable to the civilian objects from Germania Secunda in terms of composition, suggesting that the same materials and technological knowledge were available to them. The import of provincial-Roman metal artefacts to the north for scrapping has been noted before[72] and it has been well established that in the 2nd and 3rd centuries AD, Germanic craftsmen were employing many of the same metalworking techniques as their provincial-Roman counterparts.[73] Based on the limited evidence collected here, the same appears to have been the case for the Late Roman period.

[69] Sommer 1984, 102; Böhme 2021.
[70] Böhme 2021, 137.
[71] See also Bishop and Coulston 2006, 266-267; Coulston 2013, 464 on the lack of uniformity in Roman military dress.
[72] Könemann 2018.
[73] Voß *et al.* 1998.

Chapter 8
Conclusion

Chapter 1 formulated a number of research objectives and related questions, with the underlying theme of (dis)continuity and change between the 4th and 5th centuries in the province of Germania Secunda as seen through the lens of migration and Germanic and military identities. Although questions relating to developments of the militarised frontier and the rural hinterland were dealt with in separate research objectives and chapters, the developments sketched within each chapter are closely interrelated. Below, each research question will be answered using the insights presented in the previous chapters. At the end, the central thesis themes and objectives will be reiterated based on the evidence outlined.

Bridge the gap between the 4th and 5th centuries in the migration debate, focusing especially on the rural settlement landscape

The Late Roman rural settlement landscape is often described in quite dramatic terms, such as impoverishment[1] and abandonment.[2] The chapter devoted to the Late Roman settlements in Germania Secunda (chapter 2) instead highlights the partial continuity of settlement activity from the late 3rd to the 5th century in some areas of the province of Germania Secunda. It also challenges the interpretation of several settlement features commonly found in Late Roman rural settlements by tracing their origin and development throughout the Roman period on both sides of the frontier. Two research questions were formulated.

Question 1. How do specific aspects of the settlement landscapes (architecture, diet) develop in Germania Secunda and Germania Magna alongside each other and what role did they play in the development of the Late Roman rural settlement landscape in Germania Secunda?

Three key elements of Late Roman migration-related settlements (SFBs, rye and house plan typologies) were traced back to the Late Iron Age/Early Roman period on both sides of the frontier to put their introduction or increased occurrence in the Late Roman provinces into perspective. There is no doubt that the sunken feature building (SFB) as a settlement feature appeared earlier and more frequently in Germania Magna than within the Empire; its Germanic roots are well-established. However, the chronological overview presented in chapter 2 showed that a small but significant number of SFBs appeared within the province of Germania Inferior/Secunda before the Late Roman period (figures 3.4-3.5). These were mostly found close to the Lower Rhine frontier in the earliest period, before spreading further to the south in the Middle Roman period. The SFB became one of the most common settlement features in Late Roman settlements in Germania Secunda, frequently appearing together with and without other potential markers of Germanic identities such as handmade pottery and three-aisled longhouses.

The same chronological pattern was also found to some extent in Germania Magna. Although SFBs are far more numerous there in the Early and Middle Roman period compared to the provinces, they also underwent a significant increase in the Late Roman period in Germania Magna (figures 2.4-2.5). In several sites with good stratigraphical evidence, SFBs were mostly or even only found in Late Roman layers. This seems to indicate that rather than just a purely 'Germanic' phenomenon, SFBs are also a period-specific phenomenon.[3] SFBs within the Empire were also relatively frequently found without any other indication for non-Roman identities,[4] which could suggest that they were also adopted by non-migrant communities. The wide distribution of SFBs across the study area does not necessarily reflect the distribution of communities with Germanic roots but can also be seen as a Late Roman settlement development more widely.[5]

The evidence for rye cultivation also presented distinct chronological developments. Whereas the first evidence for cultivation were found in the Early and Middle Roman period in Germania Magna, most datable contexts with significant amounts of rye remains were dated to the Late Roman period there (although major issues with dating were found, limiting diachronic comparisons). Multi-period sites also gave indications that rye was increasingly grown in Germania Magna in the Late Roman period, coinciding with its widespread adoption in Germania Secunda. Diet is often closely linked to cultural identities in the Roman world.[6] There are additional reasons, however, for why rye may have been a more desirable or practical crop to grow over millet or wheat. The Late Roman period saw the expansion of rural settlements into areas characterised

[1] Van Ossel 2006.
[2] Heeren 2015; Heeren 2017.
[3] Cf. Van Ossel and Ouzoulias 2001, 238.
[4] Cf. Opsteyn 2003, 138; Van Ossel and Ouzoulias 2011, 238.
[5] Cf. Van Ossel and Ouzoulias 2001, 238ff.
[6] Heeren 2017, 162; Eckardt and Müldner 2016, 206; Cool 2006a, 172ff.; Cool 2006b, 75.

by poor sandy soils, both in Germania Magna (central Lower Saxony and Drenthe) and Germania Secunda (Flanders and Noord-Brabant). Together, these developments may have led to an increasing need for a staple crop known for being able to grow on depleted or unfavourable soils.[7] Other cereals continued to be cultivated (including *Hordeum vulgare* and *Panicum miliaceum*), indicating that the cereal diet diversified in the Late Roman provinces, possibly in response to economic insecurity (favouring a lower, but more secure harvest over more insecure, surplus production) or arrangements around land ownership and soil quality.[8]

Some previous works on migration theory have posited that the presence of foreign house plans is a clearer indication for migration than other aspects of material culture and society.[9] While there was somewhat of a dichotomy in house architecture style between Germania Magna and Germania Secunda/Inferior, this was not absolute, which complicates the interpretation of house plans. The overview of the house plans from migration-related settlements furthermore reflects a wide diversity of construction types and states of preservation. Among the houses where links to Germanic architectural styles were clearer, a wide variety of types and regional origins were identified.[10] Animal stalls, a key characteristic of Germanic longhouses, were very rarely found, despite the similarity in soil conditions between the emigration and immigration area. Key architectural aspects of 'northern' building, such as the replacement of central posts with doubled sets of wall posts, were also not frequently found, although poor preservation of many of the house plans may be a limiting factor.

Several houses in migration-related settlements were also impossible to pin down in regional typologies. Houses with a combination of a two- and a three-aisled section are found in various regional traditions: Oss-Ussen 9C;[11] Typ Vreden;[12] Midlaren[13]). Several one- or two-aisled houses were identified in Late Roman settlements, some of which could typologically be clearly placed in the native Roman traditions. In other cases, however, this was not so certain and one- and two-aisled houses are known from Germania Magna in the Roman period.[14]

Differently built houses were also sometimes found within the same settlement. This opens up the question how rigid or regionally restricted the origins and traditions of these houses were. The decision to build a provincial-Roman or Germanic-style house could have been informed by a myriad of factors, such as functionality, availability of construction materials and attempting to either show off regional origins or to fit in with local customs. Prien also theorised that adaptation of houses would start occurring after a generation.[15] The evidence from timber-built houses in Germania Secunda is not complete enough, or closely datable enough, to work with that idea. What was shown is that Germanic-style house plans entered the province already in the 3rd century and possibly earlier.[16] Those houses that could be identified well with Germanic regional typologies continued to be built throughout the Late Roman period in a traditional style, but they were not the sole type of longhouse in this period.

Germanic-style handmade pottery was also found from the 2nd and 3rd centuries,[17] hinting at a long period of interaction. 'Germanic' in the provinces does not necessarily mean Late Roman, and vice versa. Several studies of Late Roman Germanic-style pottery from Germania Secunda have highlighted the complex nature of this find group. In some cases, specialist reports indicated that the Germanic-style pottery from a migration-related settlement did not fit well within Germanic regional typologies[18] or that it displayed stylistic characteristics of multiple regional typologies.[19] When fabric analysis was carried out, material that was stylistically Germanic was sometimes found to have been made in local fabrics. De Paepe and Van Impe interpreted Germanic-style pottery in local fabrics as a sign that the Germanic migrants had stayed long enough within the Empire to know the qualities of the local soil for pottery production.[20] It can also be argued that local production of Germanic-style handmade pottery simply indicates that this type of material was used in Germania Secunda and does not say a great deal about the regional origins or background of the user: handmade pottery had to some extent always been used in the Roman frontier provinces. Although pottery can relate to culturally specific ways of preparing and consuming food,[21] the Germanic-style material from Late Roman migration-related settlements does not give many indications for this.

Issues with dating plague much of the data collected for this research objective. Features such as house plans and SFBs are notoriously hard to date due to the lack

[7] Behre 1992, 149; Squatriti 2016, 167.
[8] Squatriti 2016, 167.
[9] E.g., Burmeister 2000, 542; Prien 2005, 308.
[10] House plans with typological similarities to houses built in Drenthe, Lower Saxony, Westfalia and the Dutch river area were all found.
[11] Wesselingh 2000.
[12] Nüsse 2014, 50ff.
[13] Nicolay and Waterbolk 2008.
[14] Nüsse 2014, 32-33, 52.
[15] Prien 2005, 308.
[16] Cf. Schotten and Machiels 1994.
[17] Van Thienen 2020; De Paepe and Van Impe 1991.
[18] E.g., Bink 2005.
[19] E.g., Hendriks 2023; Van Es 2021.
[20] De Paepe and Van Impe 1991, 170.
[21] Eckardt and Müldner 2016, 206; Prien 2005, 311.

of closed contexts[22] and often due to a lack of material. Late Roman wheel-turned pottery is not always closely datable and handmade pottery, a staple in Late Roman settlements, is especially problematic for dating, due to its fragmentation and lthe ong-term traditional nature of the material.[23] All these developments need to be seen in the context of the partial continuity of provincial-Roman settlements in Germania Secunda.

Question 2. How do the 'migration-related settlements' compare to each other in terms of (dis)similarity of the archaeological evidence?

The application of a holistic approach (targeting material culture, architecture and diet) allows for the comparison of multiple features. Many of the migration-related settlements discussed in this chapter also yielded finds and features that could not be clearly fitted in a singularly 'Germanic' narrative. Several house plans were found in the provincial-Roman style, occasionally alongside Germanic-style pottery or SFBs. Wheel-turned pottery was found in almost all settlements, sometimes making up the bulk of the material with handmade Germanic-style pottery absent or present in only small amounts. Local handmade pottery was also attested, as well as a number of fascinating case studies where pottery in a Germanic style were found to have been made in local fabrics. Cereals other than rye were still grown and consumed and, in some cases, only insignificant amounts of rye or no rye at all were reported. All these inconsistencies and deviant settlement features need to be fully considered when discussing these settlements as a single category.

Chapter 2 outlined how these settlements appear across the entire Late Roman period and how each settlement is unique in the combination of features and finds. There was significant survival of provincial-Roman rural settlement activity and there was no clear case to be made for a rural population being replaced by migration. Instead, the migration-related settlements of Germania Secunda were interpreted as the end result of small-scale, intermittent migration over a long period of time, combined with interaction between newcomers and the local population. This cross-border interaction was not uni-directional: people living in the frontier zone may have been exposed to new ways of doing things by movement of people in both directions.

The resulting settlement landscape combined elements of rural settlement traditions from both sides of the frontier, including architecture, agriculture and material culture. The sizes of these settlements are limited and not indicative of mass migration on a significant scale, but rather of individuals or family units.[24] In some cases, the 'Germanic' phases follow previous provincial-Roman settlement activity, while in others the settlements appear to have been newly founded. Spatial clusters of migration-related settlements such as around Tongeren may indicate the presence of pioneer settlements and what Anthony termed migration 'towards known targets'[25] and the formation of pockets of activity around 'founder communities'.[26]

Prien has also defined 'specialist migration', a form of career migration of a people with a specific career, such as trader, crafts person or soldier.[27] The rural settlements in Germania Secunda did not yield any direct evidence for such processes. The archaeological record suggests these were 'normal', agriculturally based rural settlements inhabited by a cross-section of society. Some have linked these settlements to the appearance of the *foederati* in the Late Roman period.[28] The link between these militarised groups and the rural settlements is not immediately clear from the archaeological data: military belt sets were not found there in any significant numbers. Rather than reflecting a specific, career-motivated type of migration, these settlements are hypothesized to represent the interconnectivity between the Roman border provinces and Germania Magna. This relationship had always existed throughout the Roman period,[29] but likely intensified in the Late Roman period.

Placing the introduction of new settlement features in the Late Roman provinces in this long-term perspective of interaction means we might have to re-evaluate what the terms 'Roman' and 'Germanic' mean on the Late Roman frontiers. As already discussed in chapter 1, the timber-built rural settlements of Germania Inferior were far from static across the 1st-3rd centuries. House architecture changed and developed throughout that period, with many regional and local variations presenting themselves at different times. House plan styles also crossed the frontiers on various occasions. With this background, we can question how much of the Roman-Germanic dichotomy actually reflects real life on the frontiers or whether it is more of a construct of modern scholarship. Although migration played a role in disseminating new ways of life over a wider geographical area, the changes in rural settlements seen in the Late Roman period do fit in a longer pattern of adaptability and hybridity of these locales. With interaction and hybridity baked into the system of provincial-Roman life, I would argue that

[22] Tipper 2004, 7.
[23] Krol 2021; Hendriks 2023.
[24] Cf. Adams *et al.* 1978, 488.
[25] Anthony 1997, 24.
[26] Anthony 1997, 27; cf. Burmeister 2000, 549.
[27] Prien 2005, 47-48.
[28] Heeren 2017, 164; see also Halsall 2014, 525; Mills 1996, 166 on the *foederati* and career migration.
[29] Galestin 2010; Erdrich 1998; Nieuwhof 2020.

the developments in the settlement landscape of the Late Roman period form another phase of this process rather than a departure from the norm.

Explore whether differences in material culture can be attributed to migration or wider developments

This objective aimed to challenge the sometimes explicitly ethnic and gender labels attached to several types of Late Roman brooches and hairpins. A long-term perspective was taken to trace the adoption of specific styles of dress on both sides of the frontier from the late 3rd to 5th century to analyse the role of migration, individual vs. communal expression and fashion throughout the region. Two research questions were formulated:

Question 3. How can we trace the typological development of dress accessories typically associated with Germanic women (brooches; hairpins) in the study area from the late 3rd to the 5th century?

Question 4. Can the spatial distribution and depositional patterns of these objects challenge the various identity labels traditionally attached to them (including 'Germanic' and 'female') and inform us about the adoption and adaptation of dress accessories in a Germanic style in the study area?

The styles of copper-alloy dress accessories in Germania Secunda (chapter 3) indicate a long process of interaction between the two regions, dating back at least to the mid-3rd century with the development of the footless brooches with high catch-plate (Schulte A VII 3.5). The brooches found in the study area on both sides of the frontier are part of a wider 'brooch language' in northwestern Europe.

The footless brooches with high catch-plate (Schulte A VII 3.5) and the Armbrust brooches (simple and elaborate)[30] especially were part of broader brooch developments throughout the Roman and early medieval period in Germany, Eastern Europe and Scandinavia. In terms of distribution, previous regional studies have placed the study area at the periphery of main distribution areas for many of the types discussed in chapter 3.[31] The specific subtypes found in the studied part of Germania Magna (northern Netherlands and northwestern Germany) are a relatively narrow reflection of this diversity, with only a limited number of brooch types identified compared to elsewhere (question 1). The situation south of the frontier is even more uniform however, reflecting an even further reduction of Germanic-style brooch subtypes in the Late Roman period. In terms of gender associations, burial evidence links these brooches to both men and women in the study area.

This pattern of reduced variety is also seen in the later simple two-piece Armbrust group, which are very similar in appearance (form, decoration), although construction and production may vary (and even there, Armbrust brooches with hammered feet dominated the spectrum). My work shows that these uniform simple two-piece Armbrust brooches appear most frequently in the immediate frontier zone (question 2) yet traditionally tend to be associated with Germanic identities when found on Roman soil.[32]

However, this narrative is not supported by my analysis of finds contexts. The Armbrust brooches are the most common brooch type across the Late Roman period and are found in huge quantities across a wide variety of contexts (contra tutulus and supporting-arm brooches, which are most commonly found in burial contexts; question 2). The osteological data also indicates that the brooch was worn by both men and women. Although the origins of the Armbrust brooch family are well-established outside of the Empire,[33] the appearance of a large number of brooches, which are very homogenous in form and decoration in Germania Secunda and especially the frontier zone seemingly suggests that these brooches developed there (question 2). The finds from the PAN database disproportionally came from the Dutch river area, resulting in a significant cluster of finds there. However, the Dutch river area had always been more 'finds-rich' than other areas of the Netherlands, due to a combination of factors.[34]

Supporting-arm and tutulus brooches show a combination of Germanic and Roman style and technology to produce a new, Late Roman, hybrid type of brooch. While the tutulus brooch most likely developed from Germanic box brooches,[35] there are no clear regionalised distributions for the earlier tutulus brooch types (Ortbrook-Nijmegen), which are in fact found on both sides of the frontier. The later developed types do show some regionalisation, however, as some are only found in Germania Magna (Issendorf-Babilonie) and others are found on both sides of the frontier (Cortrat-Oudenburg). Halsall has suggested that this indicates export of tutulus brooches into Germania Magna, which developed a copy.[36] This work posits that the Issendorf-Babilonie types are regionalised subtypes of a wider brooch style and that the origin of the tutulus brooch lay in Germania Magna. The presence of niello

[30] Schulze 1977.
[31] Schulte 2011; Przybyła 2018.
[32] Böhme 1997; Böhme 2003; Böhme 2009.
[33] Schulze 1977.
[34] Better preservation in wet contexts, relatively accessible land; more intense excavation activity in recent years and like more intense activity in the Roman period.
[35] Böhme 1974, 19; Heeren and Van der Feijst 2017, 197.
[36] Halsall 2009, 116.

decoration on some tutulus brooches may indicate that some were produced within the Empire.

The development of supporting-arm brooches in the study area also displays elements of both Germanic and Roman brooch styles. They are frequently found along the frontiers, where they may have developed as a frontier style.[37] The niello inlay on some supporting-arm brooch types relate them to provincial-Roman origins[38] and there appears no clear chronological development in the supporting-arm brooches and their distribution to suggest they were dispersed from Germania Magna to the south. Although Böhme originally distinguished between Gallic and *Niedersachsische* subtypes of the supporting-arm brooch with trapezoidal foot,[39] it was found that the Gallic types were rare in Germania Secunda, and that the *Niedersächsische* types instead were found across the study area. The Gallic subtypes are generally rarer, although are also occasionally found outside of the Empire (compared to the distribution of tutulus brooches).

The distinction between supporting-arm brooches worn by men (HF 78c) and women (HF 78ab) was generally supported by skeletal evidence, but the association of the male brooch type with military identities was less clear as it was only rarely found in military contexts and its distribution pattern did not deviate significantly from the civilian-associated subtypes. There were also no significant differences between the different types in metallurgical composition. Instead, their general distribution seems to indicate a high-status brooch that was also worn by military personnel, but not exclusively. Its more restricted status is reflected in the depositional patterns: supporting-arm brooches ended up in burial depositions more frequently than more common brooch types such as the simple two-piece Armbrust brooch.

For the Wijster hairpin, Böhme suggests production might have occurred in the Lower Rhine/Meuse area and Westphalia,[40] as this style of hairpin seems to have developed around the frontier.[41] Wijster and Fécamp hairpins are also sometimes linked to Germanic women, usually of high status due to their relative rarity.[42] The introduction of long, thick hairpins with mushroom-shaped heads is a typically Late Roman process, and some have argued that they are based stylistically on provincial-Roman hairpins.[43] The predominant appearance of these pins in the frontier zone at the same time as many other Germanic-style items suggests that they are a unique Late Roman frontier invention. Finding them further away from the frontiers does not seem to clearly signal movement from north to south, but rather that this frontier-style dress accessories were also appreciated elsewhere to the north and south of the frontier, from France to Scandinavia (question 1).

All these objects speak to a widely shared visual and material language which developed in the Late Roman period on both sides of the frontier, which was no doubt spread to a significant degree by mobility. It seems unlikely for the 4th and 5th centuries that all Germanic-style items south of the frontier should be ascribed to people who had moved from Germania Magna or their direct descendants. Instead, this thesis proposes that the majority of Germanic-style items found within the provinces are just that: in a Germanic style and reflective of a shared visual language for dress accessories (and for decorations on material culture more widely). This comes back to Böhme's narrative of the Late Roman *Mischzivilisation*.[44] Any significant differentiation between the various dress accessories were found along lines of restriction: commonality and possible elite status. While some objects were almost exclusively found deposited in graves (tutulus, supporting-arm and elaborate Armbrust brooch[45]), others (simple two-piece Armbrust brooch) were found much more widely, including in rural settlement contexts. Differentiation along gender lines or regional origin/ethnicity was less clear and may have been secondary to other meanings.

On the topic of ethnicity and expression: there is no sound empirical basis to suggest simple two-piece Armbrust brooches for instance were used to express Germanic or non-Roman identities within the Empire: their chronology does not match this north-south movement and the style of this object group is too similar to contemporary provincial-Roman material culture (while also partially rooted in Germanic material culture styles). The same goes for many of the other finds groups discussed in chapter 3. Instead, it was argued in chapter 3 that they represent a uniquely glocalised form of material culture: part of a '*homogenising [...] global culture*',[46] but adapted into local subcultures in a way that altered its meanings and values.

The Roman province of Germania Secunda was clearly undergoing a cultural transformation in the Late Roman period, Germanicising much of its way of life. Mobility across the frontier zone (in both directions)

[37] Cf. Swift 2006, 100; Whittaker 1994, 216.
[38] Werner 1962, 153; Böhme 1974, 52.
[39] Böhme 1974, 10-14.
[40] Böhme 1974, 38.
[41] Cf. Halsall 2000, 171-172.
[42] Klapp 2013; Böhme 1999.
[43] Verlaeckt and Proos 1996, 5; Van Es 1967, 123; cf. Werner 1962, 152, notes 3 and 4 on the Fécamp pin.
[44] Böhme 1974, 205-207.
[45] Note that tutulus brooches preserve badly in any context, but have the best chance of survival in burials, skewing data. However, this does not appear to be a factor for the more sturdy Armbrust and supporting-arm brooches.
[46] Pitts and Versluys 2015b, 14.

undoubtedly played an important role in bringing people with different cultural practices into contact. However, the data presented in this thesis also clearly highlight the impossibility of unequivocally locating migrants and non-Roman identities in the archaeological record. Instead, it is argued that material culture became increasingly similar across the study area in the Late Roman period.[47] The use of the term 'Germanicisation' evokes many of the same complications as 'Romanisation'. Its use here is not meant to suggest that the inhabitants of Germania Secunda became ethnically Germanic,[48] rather that the material remains left behind by them shared specific commonalities with material found in Germania Magna, similar in intent to Miller's definition of the term 'barbarisation' as '*the emergence of a culture-type that is of the frontier but that is not necessarily produced by a floodtide of barbarian intrusion*'.[49]

Bridge the gap between the 4th and 5th centuries in terms of frontier policy and the relationship between the Roman state and Germanic *foederati.*

It is common in the archaeological literature to draw a dichotomy between the 'Roman' 4th century and the 'Germanic' 5th century.[50] For the military aspect of the Lower Rhine frontier, this dichotomy was addressed in this thesis in two specific ways: the typological developments and distribution of military dress accessories in both centuries (chapter 4; questions 5-6) and changes in production organisation of military dress accessories in both periods (objective 4; chapters 6-7). Given the size of this dataset, a relatively large amount of contextual dating evidence could be collated, making use of recent improvements in the dating schemes of Late Roman material culture.

***Question 5. Can the spatial distribution and depositional patterns of Late Roman military-associated dress accessories (crossbow brooches; military belt sets) inform us about the organisation of the Late Roman Lower Germanic frontier, specifically regarding the role of Germanic* foederati?**

The distribution of crossbow brooches and military belt fittings were taken as reflective of military activity along the frontier and in its hinterland. This limited spatial distribution was true for both the 4th and 5th centuries and some chronological developments were identified. Very few belt fittings could be securely dated to the first half of the 4th century, although the well-established presence of crossbow brooches in the same region in this period suggests this is an absence created by dating rather than a true absence (many belt parts cannot be dated more precisely than '4th-century' on typological or context grounds). There are also very few finds of military belt fittings in Germania Magna in this early period.

The number of belt fittings dated to the second half of the 4th century increased sharply on both sides of the frontier, mirroring the same patterns found in crossbow brooches (Swift type 3/4). Finds from rural settlements in the provincial hinterland of the frontier are rare; the vast majority of military dress accessories in this period are firmly associated with the frontier and its fortifications, including those located further to the south along the Cologne-Bavay road.

Only the western Dutch river area remains relatively empty in this period, where fortifications ceased to be maintained.[51] The investments in and maintenance of the rest of the Lower Germanic frontier is clear, however. The increase in finds of military belt accoutrements fits in this wider pattern of frontier refurbishment. Most are found in cemeteries, notably those associated with large military or urban centres. Significantly more datable material than before was also found in this period in Germania Magna, potentially signifying intensification of movement between the Roman provinces and Germania Magna. In contrast to the provinces, settlement finds are relatively common in Germania Magna in addition to the deposition of belt fittings in graves.

The overall distribution of belt fittings in the 5th century does not differ significantly from the second half of the 4th century. Their distribution is still focused along the frontier and its fortifications, as well as the *Höhensiedlungen* in Wallonia. Against expectations, perhaps, no clear increase in material from rural or settlement contexts could be identified. There are no clear indications that belt fittings were disseminated amongst a wider selection of the population in the 5th century or were brought into the rural hinterland in increased numbers by *foederati* living there and there is no clear correlation between belt fittings and 'migration-related settlements'. The majority of military activity was still focused on the Roman frontiers and its fortifications.

However, there is a relatively sharp drop-off of material within the Empire, coinciding with a relative increase in the number of belt fittings found in Germania Magna compared to the later 4th century, in both cemeteries and settlements. This is highly suggestive for this timeframe, as finds of militaria outside of the Empire are usually interpreted as Germanic veterans returning home.[52] This may be related to Roymans'

[47] Cf. Theuws and Hiddink 199.
[48] Cf. Woolf 1998 on 'becoming Roman'.
[49] Miller 1996, 163.
[50] Cf. Halsall 2012, 29.
[51] Van der Meulen 2017.
[52] E.g., Halsall 2014, 525.

work on gold coinage as payment for *foederati* groups,[53] seen in the light of the withdrawal of troops from the Lower Rhine frontier.[54] It is noteworthy in this context that marked differences were found between how military belts were deposited in Germania Magna and Germania Secunda. In Germania Secunda, the norm was to inter either just the buckle with the deceased or the buckle with a varying number and assortments of fittings. The reverse was found in Germania Magna, where the majority of belt graves did not contain a buckle, but instead a varying number and assortment of fittings. A small number of these buckle-less belt burials were of women and of these, most dated to the 5th century.

As a route for these items to travel to Germania Magna, the veteran narrative is a very sensible explanation, but the depositional evidence suggests that once objects with military connotations left the Empire, their cultural and social significance may have undergone some shifts. Belts would have functioned most clearly as a visual marker of military identity in the immediate frontier zone, where the population would be most familiar with the visual language of the Roman army. Outside of the Empire, such nuances may have been lost, translated or transformed. The partial deposition of belts (often without the functional buckle) indicates that these were objects of high value,[55] which in addition to any military importance also likely showed off the deceased's ties to the Roman Empire. It could be speculated that the inclusion of these male-associated items in female burials is also an indication that these military insignia could bestow a certain amount of social status on people associated with veterans, like family members.

Question 6. Can changes in form, style and decoration inform us about the organisation of production of Late Roman military belt sets?

There are a wide variety of different types and styles of Late Roman military belt, with an even wider variety of stylistic elements; almost every piece is unique.[56] Some general trends in the province of Germania Secunda can be discerned, however. In both the 4th and 5th centuries, D-shaped buckles with animal-headed terminals, rosette suspension mounts and amphora-shaped strap ends are the most popular types of belt fittings. These objects go through some changes of course: the buckles transition from hinged Sommer *Sorte* 1 buckles to Sommer *Sorte* 3 buckles where the plate and the frame are cast in one piece. 4th-century amphora-shaped strap ends are fairly elaborate and often feature 'handles', while the 5th-century types are much more stylised and angular. The most popular non-*Kerbschnitt* decorative schemes (including dots, dotted circles, concentric circles, faceting and punched triangles) also continue throughout the Late Roman period. Several pieces were also decorated with a form of imitation-*Kerbschnitt*. As noted above, these exact schemes were also typical for many of the dress accessories associated with non-military identities.

These patterns inform us about some parts of the production process of these belts. Most decorated military belt fittings featured schemes and patterns that were applied to the object after casting and finishing (by carving, filing, punching and coring).[57] These activities do not necessarily have to be carried out in the same workshop where the smelting, alloying, and casting took place. The wide variety of schemes found suggests that this later stage of the production process at least was not particularly strictly or centrally controlled: there was a certain degree of individual freedom allowed to the wearer in how they wanted their belt to look. Several individual pieces show particularly individual decoration or decoration that features imperfections. Different parts of the *chaîne opératoire* may have taken place at different workshops and at differently organised workshops. We have a relatively poor understanding of how Roman metal workshops were organised and how this affected the end products.[58] The decoration study highlighted a great deal of variability on the later stages of the production sequence, while the pXRF and dimensional data can inform about the earlier stages (objective 4).

Characterise production environments for Late Roman copper-alloy dress accessories

The production organisation of Late Roman copper-alloy dress accessories was targeted through the gathering of a main dataset of chemical composition using surface pXRF and, as a secondary dataset, the measurements of object dimensions. The aim of both was to see if these data could support or challenge our assumptions about production organisation of Late Roman military belt sets in regard to ideas about the state-run *fabricae* in the 4th century the move towards more localised manufacturing in the 5th century.[59] Two research questions were formulated. The first tackled the distinction between civilian and military production (question 7) and the other the chronological, technological and typological patterns found in the military dress accessories (question 8).

[53] Roymans 2017.
[54] Kulikowski 2000, 326; Roymans 2017, 66; Schwarcz 1995, 295.
[55] Böhme 2021, 167; Gottschalk 2008.
[56] Cf. Böhme 1974, 92.
[57] Cf. Böhme 1974, 92-93; Bullinger 1969.
[58] James 1988; Van der Meulen-van der Veen 2023.
[59] Böhme 1974, 94; Böhme 2021, 137.

Question 7. Can a study of object dimensions and chemical composition of Late Roman dress accessories identify a significant difference in production organisation between objects associated with civilian identities and those associated with military identities?

The majority of the pXRF dataset presented a homogeneous compositional pattern, likely due to the level of recycling taking place in the (Late) Roman period. Mixed alloys, namely leaded bronze and leaded gunmetal dominated the metallurgical spectrum of all objects, regardless of construction, function, typology, social connotations or date. These mixed alloys are often seen as a product of (prolonged) recycling, rather than deliberate products created by mixing raw materials.[60] Recycling of metals in the Late Roman period is to be expected to have taken place at a larger scale compared to earlier periods. The comparison with metallurgical studies of Early and Middle Roman copper alloys showed that although unleaded alloys were more common in those earlier periods, mixed alloys were already quite prevalent then too. The comparison of the Late Roman metallurgy with earlier material on the trace element spectrum revealed a clear distinction: whereas the majority of early finds that were surveyed yielded relatively 'pure' alloys with no traces of arsenic, antimony, silver or nickel at the 0.1% threshold, the majority of Late Roman objects registered a very mixed trace element signal consisting of a combination of arsenic, antimony and silver (nickel was rarely identified at this level, as is common for Roman copper alloys).[61] This very mixed trace element signal was also interpreted as a possible result of prolonged scrapping and mixing. Despite this underlying factor of recycling, however, consistent differences in the chemical composition could be found between objects associated with military identities (crossbow brooches; military belt fittings) and those associated with civilian or female identities (hairpins, supporting-arm and Armbrust brooches). Leaded bronze was foud to have been more strongly associated with civilian dress accessories.

Alloys of objects associated with the military (buckle frames; decorative fittings) tended to contain more lead than contemporary objects associated with the civilian or female population (Armbrust brooches; hairpins), despite the fact that each category included cast objects (in which higher lead contents may be expected). This indicates that the inclusion of lead in military dress accessories may have been a deliberate choice. The availability of lead as a resource may be related to the Roman army's business interests in silver mining, of which lead is a by-product.[62] Despite the predominance of highly mixed leaded alloys, the composition of military dress accessories showed slightly more variation (and use of non-leaded alloys) than the civilian dress accessories. This implies that the manufacturers of military dress accessories were able to draw on a much wider network for the procurement of raw and scrapped materials and were potentially less reliant on heavily recycled material. No clear indications were found that military items from rural sites were copies or imitations of objects found in military contexts.

These patterns are the first indication that throughout the Late Roman period, the first steps of the *chaîne opératoire* for military dress accessories were organised differently to the manufacturing of brooches and hairpins worn by people not necessarily linked to the Roman government or army. It is not a massive leap of the imagination to suggest that the involvement of the Roman state in this stage of the process would be a contributing factor. The wider range of different materials used to make military-associated items could be more easily achieved by centralised government-backed workshops that could source its raw materials Empire-wide, compared to local workshops catering for their immediate community.

Some evidence was also found to suggest some objects from the dataset were treated with a decorative surface, such as silvering, gilding or tinning. The location of elevated levels of silver, gold and tin on different parts of these objects indicates that different methods were used. Possible evidence for mercury gilding were found in the form of elevated mercury levels. Different intensities of surface treatment on flat objects such as belt plates or stiffeners suggested these may have been wiped with additional surface treatments, while three-dimensional objects such as brooches were more likely to have been dipped in a secondary material.

Question 8. Can a study of object dimensions and chemical composition of Late Roman military dress accessories identify significant differences related to production organisation between objects dated to the 4th and 5th centuries in correlation to perceived changes in frontier defence?

Due to the different functions and typo-chronological developments of different parts of the military belt, the metallurgical comparison between 4th and 5th-century material was split out per functional category. Buckles throughout this period develop from mostly hinged (Sommer *Sorte* 1) to mostly fixed (Sommer *Sorte* 3) in Germania Secunda, which impacted the types of alloys found. To produce Sommer *Sorte* 1 buckles, different alloys were used for the different parts of the buckle, while this was not the case for the Sommer *Sorte* 3 types. A comparison of the metallurgy of 4th- and 5th-century

[60] Pollard *et al.* 2015.
[61] Riederer 1987.
[62] Hughes and Hall 1979.

belt buckles and fittings showed a consistency of metal use between the two periods, especially of the highly leaded alloys used for belt buckles. Strap ends similarly remained stable in terms of metallurgical composition, using low-tin alloys and low-lead alloys not widely found in contemporary civilian dress accessories. It was already discussed above that the significant differences in alloy composition between military and civilian copper alloys may indicate that for the military dress accessories, some level of central control was exerted in the procurement of raw materials.

This notion of a central authority executing some level of control over the production of military objects was further supported by the coefficient of variation calculations on these objects. Overall, the dimensions of military dress accessories (especially the buckle frames, certain types of strap ends and suspension mounts) yielded lower variation indicators than contemporary civilian dress accessories or decorative belt fittings. These scores were comparable for objects dated to the 4th and 5th centuries. Combined with the continuity and consistency of the metallurgy (especially the high lead contents not seen in contemporary civilian objects) across this same period, this may indicate that production organisation of military dress accessories was not organised considerably differently between the 4th or the 5th century. The circulation dates of the Sommer type buckles and strap ends do provide indications that this control was maintained until at least the mid-5th century, but as no metallurgical or dimensional data were collected on post-Roman material, it is impossible to pinpoint an exact end date for this particular form of production organisation.

A suggested development from provincial workshops to regional or local ones, potentially even located outside of the Empire[63] was not found. Military dress accessories were made to different dimension standards and from different materials to civilian dress accessories in both the 4th and 5th centuries. It was decided not to include an in-depth comparison with historical evidence for military and state production. It is still something of an assumption that Late Roman military belts were produced in either the *fabricae* or the workshops of the *comes sacrarum largitionum*,[64] so rather than attempting to locate the workshops where this material was produced[65] or reconstruct when they seized production, the finds-based approach taken here was able to illuminate different levels of organisation of different parts of the production chain. This aides in our understanding of the material itself, instead of relating it to a historical narrative that remains largely theoretical as far as production organisation is concerned.

Two object types showed more chronological changes in metallurgy. The closely datable nature of the crossbow brooch allowed for the comparison of three separate phases. The earliest types (Swift 1-4) showed a clear preference for high-lead alloys, which later (Swift 5-6) transitioned to a less leaded alloy. The earlier types, especially the Swift 3/4 which made up the bulk of the data, showed good comparability in alloy composition to contemporary belt buckles, especially the highly leaded frames. Differences in composition between the Swift 5/6 and earlier types was already interpreted by Van Thienen and Lycke[66] as indicative of a more regionalised organisation of production; these data seem to corroborate that.

The second category are the decorative fittings. The 4th-century fittings were predominantly made of leaded gunmetal, and a fairly wide range of zinc and lead contents was found. In the 5th century, leaded bronze became a more significant alloy besides leaded gunmetal. Both alloys showed limited ranges in zinc and lead content and their distribution in ternary diagrams showed similarities to contemporary civilian dress accessories. The decorative fittings (suspension mounts, tubular mounts, hinges, belt plates) are the only category where the chemical composition becomes more similar to contemporary civilian material in the 5th century. All other parts of the belt in either the 4th or 5th century maintain their distinct military signal. Combined with the *pars pro toto* deposition of these belt fittings in graves in Germania Magna, it appears that belt fittings underwent certain changes in social or cultural connotation in the 5th century, while belt buckles and strap ends remained mostly associated with military and governmental power. The changes in metallurgy may indicate a democratisation of production (in smaller, more regional or frontier-based workshops).[67]

A brief comparison in chemical composition to finds from Germania Magna was also made. The very few Late Roman military belt fittings analysed from Germania Magna followed the alloy and compositional patterns of contemporary military belt fittings in Germania Secunda very closely. Although the dataset is very limited, this allows for the possibility that these belt fittings were produced in the same workshops as their provincial counterparts and then followed different life trajectories.

In the discussion of decoration on military belts, it was suggested that the high level of variability in decoration that was applied after casting could be indicative of a more regionalised or localised organisation of that stage of the manufacturing process. The metallurgical

[63] Cf. Böhme 2021, 137.
[64] Swift 2000; Böhme 2021.
[65] Cf. Böhme 2021.
[66] Van Thienen and Lycke 2017, 58.
[67] Cf. Böhme 2021, 136.

and dimensional data that were gathered show more indications for more control over the earlier stages of the manufacturing process, most notably alloying and casting. This level of control appears to have been the same for 4th and 5th-century material, with the apparent exception of decorative belt fittings and mounts. Lacking concrete excavation evidence for historically known metal workshops such as the *fabricae* or the *comes sacrarum largitionum* it would go too far to suggest these data are hard evidence for the production of military belts in state-run production centres. By separating the different stages of the manufacturing process, we can move away from speculations about local vs. state-run workshops, because different types and sizes of workshops may be involved at different times during the production sequence, achieving an overall strong sense of uniformity and centralised control. This allowed the Roman army to produces products that always looked relatively similar and therefore identifiable as military insignia, while also allowing individual soldiers to express their own tastes and preferences when it came to, for example, decoration. The elaborate *Kerbschnitt* is exceedingly rare and was likely kept for more senior officers. The similarities in decoration of military belts and civilian-associated hairpins, brooches and other widely circulating objects such as fire strikers, keys, chest fittings, needle tubes and combs reflects the relative freedom most soldiers would have had in accessorising their belts using styles that were widely popular at the time.

The Lower German frontier is thought to have been maintained in the 5th century by *foederati* and no longer by a standing army of *comitatenses*.[68] As they replaced the Roman army, it makes inherent sense that they would have been dressed similarly, so they would be recognisable to the public (many of whom might have been their own kinsmen) and signalling that they were representatives of the Roman government. Stylistically, 5th-century material is similar to previous military insignia (animal-headed buckles; rosette mounts; amphora-shaped strap ends; similar decorative schemes) and for most objects, the standardisation of dimensions and alloys used were also similar. This does not seem reflective of a situation where 4th-century belts were produced in state-run workshops and 5th-century material in small-scale, local workshops, potentially even located outside of the Empire.[69] If we accept the involvement of the Roman state in the production of military belts in the 4th century, then this must also go for the 5th century. Previous work has highlighted the tight economic ties between Rome and the *foederati* communities in the Lower German frontier zone.[70] The metallurgical and dimensional data presented in chapter 7 may be taken as an indication that part of their arrangements included the provision of military insignia in the form of belts.

Final remarks

The Late Roman world tends to be described in dramatic terminology of decline and fall, barbarian invasions and a faltering economy.[71] The archaeological evidence presented in this thesis has certainly shown parts of the Late Roman world in flux. Settlements became more hybrid and material culture styles became more widely shared, across frontier lines. The Germanicisation of the Roman provinces should not be seen as a loss of 'Romanness': provincial-Roman culture had always been deeply hybrid with the ability to adapt and include new practices and ideas (see discussions above). The transformation of the Late Roman provinces may be described as merely the next step in this process, rather than a sudden shift caused by external forces. Both sides of the frontier became increasingly connected, while still maintaining a certain level of regionality (in certain types of dress accessory, for instance). Appropriate frameworks to discuss these patterns are globalisation and glocalisation.[72]

Previous works have cited the introduction of new styles of material culture or architecture as direct evidence for migration: these were thought to be reflective of people moving, bringing their possessions with them and building in their own traditions.[73] These interpretations mostly seem to address first-generation migrants, but the data presented in this thesis indicate that there is more to these finds. Settlement hybridity and developing styles of material culture signify a world that is 'Germanicising', although it should be emphasised that this term should not be interpreted as the replacement of the provincial-Roman rural population by newcomers. The wide distribution of certain types of Armbrust brooches and the ambiguity of 'migration-related settlements' indicate that these represent the effects of migration on Germania Secunda, not the process itself. The small finds of the Late Roman West show the formation of a unique cross-frontier, pan-Germanic style of material culture that adopted certain aspects of Germanic origins, but which cannot be directly link to any individual or communal identity. The rural settlements themselves, which often combined architectural traditions from both sides of the frontier are also best understood as a rural population adopting new practices introduced by migration.

While some have dated the appearance of new types of settlements and finds in Germania Secunda quite

[68] Roymans 2017; Heeren 2017.
[69] As proposed by Böhme 2021, 137.
[70] Roymans 2017.
[71] MacMullen 1988; Heather 2005; Heather 2009; Ward-Perkins 2005; Goldsworthy 2009.
[72] Pitts and Versluys 2015b; Van Alten 2017.
[73] Lenz 2005; Heeren 2017.

narrowly to the late 4th and early 5th century,[74] the evidence instead points towards a longer period of interaction; while this thesis focused on the Late Roman period, interaction across the frontier had of course been part of its operating procedure for the preceding centuries as well.[75] While the deployment of Germanic soldiers on the frontiers, as gleaned from the distribution of military belts, can indeed be most likely dated to the turn of the 5th century, the developments traced in the settlements and dress accessories started much earlier and are not necessarily directly linked to the *foederati*, but instead reflected wider processes of interconnectivity and movement. This understanding of these settlements and how they developed does not benefit from an integrated approach using dates and geographical origins of historically described migrations and invasions to draw up a chronology of settlements,[76] as these do not provide any insight into the social impact of these settlements on the wider landscape.

Inventories of Late Roman Germanic settlements have recently been compiled for other areas of the Roman Empire, including the Upper Rhine frontier[77] and Gaul.[78] A cross-regional study would likely exacerbate the data issues encountered in this study by introducing even more variability of excavation techniques, publication traditions and research interests inherent to each country or region, but it also has the possibility to find parallels for the cultural adaptation and hybridity identified in Germania Secunda in other areas. A more extensive botanical sampling strategy, systematic thin-section analysis of handmade pottery and more open area excavations to 'catch' house plans are also necessary to improve our understanding of the Late Roman provinces. Systematic registration and publication of finds from private collections such as in the PAN scheme would also be needed so finds distributions from different regions can be compared more thoroughly.

This study also identified that, despite external and internal challenges, the Late Roman state was still able to exert some level of state-led control over the far peripheries of its frontiers. The archaeometry of Late Roman military dress accessories, including those dated to the first half of the 5th century showed good indications that there was still a certain level of centralisation involved in their production, most likely exercised by the Roman state. If we accept the role of Germanic *foederati* in the Lower Rhine frontier zone, then it is possible that these groups were supplied with military insignia (in the form of belts) by the Roman government. This mirrors the finds of solidi hoards across the study area, which have been interpreted as payments by the Roman state to individuals or groups serving in the Roman army.[79]

This study, and several others before it[80] have further shown the data quality and impact that can be obtained with surface pXRF in large enough datasets. For the purposes of this thesis, well-datable and identifiable objects were chosen, but there can be added value in taking a broader approach and include less typologically datable finds from Late Roman contexts, such as finger rings, table ware, tools, miscellaneous fittings etc. This approach has been very successful in previous studies that looked at metal use over longer periods of time.[81] If enough material can be assembled, this could be a very interesting comparative dataset to the composition of dress accessories. Further comparison of the data with other areas of the Roman Empire[82] will also be a good next step for placing the patterns found in a wider regional framework: are the results from Germania Secunda replicable throughout the Empire and along all its frontiers, or are they regionally and provincially specific? The data-led approach to metal production in this thesis may also form the impetus for moving the discourse on *fabricae* and Late Roman army production further, although a full integration of historical sources was outside of scope for this thesis.

Although the focus of the pXRF experiment was to collect a dataset of Late Roman military-associated dress accessories, which had never been attempted at this scale before, valuable data on the composition of civilian-associated dress accessories from both within and without the Empire were also collected. This is a discussion that deserves more attention in future work. Relatively little metallurgical data are available from this region for the Late Roman period and any future work on that could be hugely beneficial to furthering our understanding of Late Roman metal networks and technology and the exchange of knowledge, technology and raw or scrapped materials across the frontiers.

[74] Heeren 2017.
[75] Whittaker 1994.
[76] E.g. Lenz 2005.
[77] Jäger 2019.
[78] Kasprzyk 2017
[79] Martin 2009; Roymans 2017.
[80] Dungworth 1995; Voß *et al.* 1998; Roxburgh 2019.
[81] Roxburgh 2019; Voß *et al.* 1998.
[82] E.g., Presslinger and Gruber 1999.

Appendices

Appendix 1. Inventory of long and short houses from Late Roman settlements in Germania Secunda

Site and type	Description	Date	Reference
Three-aisled, bipartite longhouse			
Gennep-Stamelberg 2	Wijster Aiib	Late 4th-5th century	Heidinga and Offenberg 1992, 78
Breda-West Steenakkers House 42	Wijster A	Middle Roman period	Koot and Berkvens 2004, figure 11.11
Venlo-Blerick Heierhoeve	Three-aisled	2nd century	Schotten and Machiels 1994, 85; Van Enckevort and Hendriks 2014, figure 4
Three-aisled, tripartite longhouse			
Gennep-Stamelberg 1	Peelo A/Wijster B	4th-5th century	Heidinga and Offenberg 1992, 78
Goirle-Huzarenwei 1	Peelo A/Wijster AB	Late Roman period	Bink 2005
Goirle-Huzarenwei 4	Peelo A/Wijster AB	Late Roman period	Bink 2005
Goirle-Huzarenwei 6	Peelo A/Wijster AB	Late Roman period	Bink 2005
Helden-Schrames H35	Peelo A/Wijster B	Late Roman period	De Winter 2010
Helden-Schrames H97	Peelo A/Wijster B	Late Roman period	De Winter 2010
Kuringen-Rode Rokstraat 2	Wijster Aii/Ede B	4th century	Hazen 2016, 32-35
Kuringen-Rode Rokstraat 5	Peelo A/Wijster B	Late Roman period	Hazen 2016, 35-39
Meldert-Zelemsebaan H3	Peelo A/Wijster B	Late Roman period	Smeets and Steenhout 2012
Three- and two-aisled longhouse			
Cuijk-De Nielt 8022	Three- and two, bipartite?	AD 300-350	Habermehl and Van Renswoude 2017
Goirle-Huzarenwei house 10	Three- and two, tripartite	Late Roman period	Bink 2005, figure 19.
Holtum-Noord	Three- and two, bipartite	Late Roman period	Van Enckevort *et al.* 2017, figure 5.20
Neerharen-Rekem	Three- and two, bipartite	AD 300-450	Theuws and Hiddink 1996, figure 62; Stroobant 2013, figure 2
Other constructions longhouse			
Geldrop 2	Two- and one	Late 4th-5th century	Theuws and Hiddink 1996, figure 62
Gennep-Stamelberg 3	Three- and one	Late 4th-5th century	Heidinga and Offenberg 1992, 78
Alphen-Kerkakkers G3	Three- and one, bipartite	AD 375-425	De Koning 2005, figure 11
Alphen-Kerkakkers G4	Three- and one, tripartite	AD 425-475/500	De Koning 2005, figure 11
Weeze-Knappheide	Three- and one, tripartite	Late 4th-5th century	Brüggler 2021
Weeze-Knappheide	Three- and one, bipartite	Late 4th-5th century	Brüggler 2021
Incomplete, three-aisled longhouse			
Baelen-Nereth house E	Three-aisled	4th century	Fock *et al.* 2015, 183
Baelen-Nereth house A	Three-aisled	4th century	Fock *et al.* 2015, 183
Valburg-Molenzicht house 2	Three-aisled	Late Roman period	Van der Feijst and Veldman 2011, 40, figure 4.12
Buggenum-Wijnaerden 1	Three-aisled	Late Roman period	Meurkens 2022, 63, figure 7.2
Buggenum-Wijnaerden 2	Three-aisled	Late Roman period	Meurkens 2022, 64, figure 7.3
Leersum-Middelweggebied structure 21	Three-aisled	Late Roman-early Medieval	Tump 2014, figure 3.7
Meldert-Zelemsebaan H4	Three-aisled?	Late Roman period	Smeets and Steenhout 2012, figure 6.3
Meldert-Zelemsebaan H5	Three-aisled	Late Roman period	Smeets and Steenhout 2012, figure 6.12
Wijk bij Duurstede G36	Three-aisled?	4th century	Van der Velde 2023, 519
One- or two-aisled longhouse			
Aldenhoven	One-aisled	AD 300-350	Lenz 2005

Site and type	Description	Date	Reference
Cuijk-De Nielt 8057	Oss-Ussen 7A	AD 300-350	Habermehl and Van Renswoude 2017
Alphen-Kerkakkers G1	One-aisled	AD 375-425	De Koning 2005, figure 11
Hambach 412 building 26	One-aisled	Late Roman period?	Kaspyrzk 2017, figure 13; Kiessling 2008, 130-131, Taf. 75
Helden-Schrames H24	Two-aisled	Late Roman period	De Winter 2010, 395.
Champion-Hamois	One-aisled	AD 260-320	Van Ossel 2006, figure 12
Holtum-Noord (4x)	One-aisled	Late Roman period	Van Enckevort *et al.* 2017, figure 5.20.
Meldert-Zelemsebaan H5	One-aisled	Late Roman period	Smeets and Steenhout 2012, figure 6.4
Krefeld-Gellep	One-aisled	AD 400-450	Reichmann 1999
Wijk bij Duurstede G5	Two-aisled	Middle-Late Roman period	Van der Velde 2023, 498
Short houses			
Baelen-Nereth	unclassified	4th century	Hanut *et al.* 2012; Fock 2020; Fock *et al.* 2013
Geldrop	unclassified	Late Roman period	Bazelmans 1990, 25-29.
Hasselt-Kuringen-Rode Rokstraat	Wijster Bii	Late Roman period	Hazen 2016
Helden-Schrames H4	Wijster Bii	Late Roman period	De Winter 2010, 383.
Helden-Schrames H6	Wijster Bii	Late Roman period	De Winter 2010, 385.
Helden-Schrames H8	Wijster Bii	Late Roman period	De Winter 2010, 387.
Helden-Schrames H10	unclassified	Late Roman period	De Winter 2010, 390.
Helden-Schrames H12	unclassified	Late Roman period	De Winter 2010, 392.
Tiel-Passewaaij H2	Wijster BIIa	Late Roman period	Heeren 2009, 73, figure 30.
Tiel-Passewaaij H12	Wijster BIIa	Late Roman period	Heeren 2009, 73, figure 30.
Valburg-Molenzicht 1	Wijster Ai	Late Roman period	Van der Feijst and Veldman 2011, figure 4.12
Wijchen-Tienakker	Wijster B	5th century	Heirbaut and Van Enckevort 2011
Buggenum-Wijnaerden 3	unclassified	Late Roman period	Meurkens 2021, figure 7.4.
Leersum-Middelweggebied	unclassified	Late Roman period	Tump 2014
Wijk bij Duurstede-De Geer 29	unclassified	Roman period	Van der Velde 2023, fig. 2.32
Goirle-Huzarenwei	unclassified	Late Roman period	Bink 2005

Appendix 2. Inventory of sunken feature buildings (SFB) from Late Roman settlements in Germania Magna and Germania Secunda

Site	Country	N	Period	Reference
Grobbendonk	Belgium	1	late 2nd-early 3rd century	De Boe 1977, 42
Neerharen-Rekem	Belgium	29	Late Roman period	De Boe 1986; Van Ossel 1992, 297-300
Neerharen-Rekem	Belgium	1	mid-1st century	De Clercq 2009, 96
Rosmeer	Belgium	1	Late Roman period	Fath and Wesemael 2008
Kleine Spouwen Schildstraat	Belgium	1	Middle Roman period	Fath and Wesemael 2008; De Clercq 2009, 98
Baelen-Nereth	Belgium	4	4th century	Hanut *et al.* 2012; Fock 2020, 154
Boutersem-Boskouterstraat	Belgium	1	Late Roman-Early medieval	In't Ven and De Clerq 2005
Wange-Damekot	Belgium	7	Late Roman period	Opsteyn 2003
Meldert-Zelemsebaan	Belgium	2	Late Roman period	Smeets and Steenhoudt 2012
Hove-Keuthegem	Belgium	1	Late Roman-Early medieval	Van Thienen 2018
Almen-De Whemerenk	Netherlands	1	Middle Roman period	Scholte Lubberink 2014
Alphen-Kerkakkers	Netherlands	28	Late Roman-Early medieval	De Koning 2005
Apeldoorn-Arbeidstraat-Groeneweg	Netherlands	13	second half 1st-2nd century	Norde 2013
Apeldoorn-Herderweg	Netherlands	5	Roman period	Norde 2013
Arnhem-De Laar	Netherlands	1	5th century	Schelvis 2000
Baarle-Nassau Klein Bedaf 3	Netherlands	1	Bronze Age?	Van der Veken 2014
Bathmen	Netherlands	2	second half 4th century	Groenewoudt and Lubberding 1996
Beek-Eltenseweg	Netherlands	1	Roman period-Medieval	Diependaal *et al.* 2011
Bergeyk	Netherlands	1	late 4th century	Theuws and Hiddink 1996, 77
Blerick-Heilhoeve	Netherlands	10	2nd century?	Schotten and Machiels 1994, 85-86
Borculo-Industrieterrein Noord	Netherlands	multiple	Roman period	Hulst and Buisman 1991, 74
Breda West-Steenakkers	Netherlands	3	3rd century	Koot and Berkvens 2004, 247-252
Breda West-Steenakkers	Netherlands	4	4th century	Koot and Berkvens 2004, 247-252
Buggenum-Wijnaerden	Netherlands	10	Late Roman period	Meurkens 2021
Coevorden-Diphoorn	Netherlands	1	Roman period	Krist 1989, 37
Cuijk-De Nielt	Netherlands	6	AD 350-400	Habermehl and Van Renswoude 2017; Roessingh and Vanneste 2009
Cuijk-Heeswijkse Kampen	Netherlands	2	Middle Roman period	Roessingh and Vanneste 2009, 13; Ball and Heirbaut 2005, 20
Dalen-De Spil	Netherlands	1	1st century	De Wit 2003, 14
Dalen-Molenakkers	Netherlands	1	Iron Age	Harsema 1995, 52, fig. 4
Dalfsen-Welsum	Netherlands	multiple	3rd-5th century	Van Beek and Van Es 1964; Wüstehube 1998, cat. 506; Trier 1969, 178
De Burg	Netherlands	1	3rd-4th century	Wüstehube 1998, 502
Den Burg-Beatrixlaan	Netherlands	multiple/29	early 4th century	Woltering 1975; ibid. 2017; Wüstehube 1998, cat. 508
Den Burg-Beatrixlaan	Netherlands	multiple/29	AD 100-300	Woltering 1975; ibid. 2017; Wüstehube 1998, cat. 508
Denekamp-De Borchert	Netherlands	3	1st-2nd century	Van der Velde 2011a

Site	Country	N	Period	Reference
Deventer-Colmschate Skibaan	Netherlands	12	AD 200-400	Hermsen 2007, 65
Didam-Aalsbergen	Netherlands	1	Middle-Late Roman period	Bakker 1998
Didam-Kollenburg	Netherlands	30	4th century	Van Enckevort *et al.* 2017
Duiven-Ploen Zuid	Netherlands	1	Iron Age-Early Roman period	Kooi 2014
Ede-Bennekom	Netherlands	1 out of 4	3rd century	Van Es *et al.* 1985, 626-627; Wüstehube 1998, cat. 501
Ede-Bennekom	Netherlands	3 out of 4	4th century	Van Es *et al.* 1985, 626-627; Wüstehube 1998, cat. 501
Ede-Ericahorst	Netherlands	1	AD 405-625	Ten Broeke 2017
Ede-Paasbergterrein	Netherlands	11	Roman period-early Medieval	Hoven 2014
Ede-Uitvindersbuurt	Netherlands	1	Late Roman period	Brouwer 2010; Van Enckevort *et al.* 2017; Ter Wal and Witte 2013
Eerbeek-Kloosterstraat	Netherlands	1	Middle Roman period	Derks 2021
Eext-Vijzelkampen	Netherlands	5	Late Iron Age-Middle Roman period	Trier 1969, 179; Wüstehube 1998, cat. 510
Elsen	Netherlands	1	Late Roman period	Schotten and Groenewoudt 1997
Emelangen	Netherlands	1	around AD 400	Waterbolk 1957, 2-8; Wüstehube 1998, cat. 511; Trier 1969, 179
Emmen-Frieslandweg	Netherlands	9	Middle Roman period	De Wit 2003
Emmen-Noordbarge	Netherlands	multiple	100 BC-AD 100	Harsema 1976, 150-151
Emmen-Noordbarge	Netherlands	multiple	from AD 200 onwards	Harsema 1976, 150-151
Emmen-Noordbargeres	Netherlands	multiple/7	Early Roman period	Krol-Karsten 2021
Emmen-Noordbargeres	Netherlands	multiple/7	Middle Roman period	Krol-Karsten 2021
Enter-Witmoesdijk	Netherlands	1	Late Iron Age-Early Roman period	De Winter and De Jager 2008
Ermelo-De Struikakkers	Netherlands	1	Iron Age-Early Medieval	Dijkstra 2019
Ezinge	Netherlands	multiple/86	Late Iron Age-Early Roman period	Nieuwhof 2020; Trier 1969; Wüstehube 1998, cat. 514
Ezinge	Netherlands	multiple/86	Middle Roman period	Nieuwhof 2020; Trier 1969; Wüstehube 1998, cat. 514
Ezinge	Netherlands	multiple/86	Late Roman period	Nieuwhof 2020; Trier 1969; Wüstehube 1998, cat. 514
Geldrop-'t Zand	Netherlands	13	Late Roman-Early medieval	Bazelmans 1990, 25-29; Heeren 2017; Lenz 2005, 399
Gennep-Centrum/ Houtstraat	Netherlands	1	Late Roman-Early medieval	Mooren 2006, 13; ibid. 2008, 25-26
Gennep-Stamelberg	Netherlands	193	Late Roman-Early medieval	Heidinga and Offenberg 1992
Goirle-Huzarenwei	Netherlands	3	Late Roman-Early medieval	Bink 2005
Haps	Netherlands	1	Late Roman-Early medieval	Verwers 1998-1999
Heeswijk-Havenlaan	Netherlands	1	2nd-3rd century	Ball and Heirbaut 2005, 119; Ball et al 2001
Heeten-Hordelman	Netherlands	20	Middle-Late Roman period	Van der Velde 2008; Verlinde *et al.* 1995; Verlinde and Erdrich 1998; Groenewoudt and Van Nie 1995
Heeten-Telgen	Netherlands	2	2nd-3rd century	Van der Velde 2008
Heeten-Telgen	Netherlands	multiple/12	Roman period	Van der Velde 2008
Helden-Schrames	Netherlands	4	Late Roman period	De Winter 2010
Holtum-Noord	Netherlands	9	Late Roman period	Van Beurden 2009; Tichelman 2012; Wagner/Van der Ham 2010

Site	Country	N	Period	Reference
Horst-Hoogveld	Netherlands	2	Middle Roman period	Verhoeven 2002
Leersum-Middelweggebied	Netherlands	5	Late Roman-Early medieval	Tump 2014
Leesten	Netherlands	1	Iron Age?	Bouwmeester 2000, 13; Fontijn 1996, 49-52
Loenen-Hameinde	Netherlands	1	Roman period-early Medieval	Brouwer 2017
Maastricht	Netherlands	1	5th century	Bakels and Dijkman 2000; Wüstehube 1998, cat. 522
Maastricht-Witmakersstraat	Netherlands	1	5th century	Stoepker 1990
Markelo-Elsen	Netherlands	1	Roman period	Verlinde 1991, 154
Middegaal	Netherlands	1	Roman period	Stokkel 2008
Midlaren-De Bloemert	Netherlands	1	AD 0-100	Nicolay and Waterbolk 2008
Midlaren-De Bloemert	Netherlands	1	AD 0-150	Nicolay and Waterbolk 2008
Midlaren-De Bloemert	Netherlands	1	AD 0-250	Nicolay and Waterbolk 2008
Midlaren-De Bloemert	Netherlands	2	AD 100-150	Nicolay and Waterbolk 2008
Midlaren-De Bloemert	Netherlands	1	AD 100-350	Nicolay and Waterbolk 2008
Midlaren-De Bloemert	Netherlands	1	AD 150-350	Nicolay and Waterbolk 2008
Midlaren-De Bloemert	Netherlands	1	AD 250-350	Nicolay and Waterbolk 2008
Midlaren-De Bloemert	Netherlands	1	AD 300-350	Nicolay and Waterbolk 2008
Midlaren-De Bloemert	Netherlands	7	AD 300-550	Nicolay and Waterbolk 2008
Naaldwijk-Hoogeland/ Hoogwerf	Netherlands	1	AD 290-350	Van der Feijst 2015
Nieuw Wehl-Nieuw Wehlseweg 14	Netherlands	1	Iron Age-Early Medieval	Ten Broeke 2016
Nijmegen-Canisiussingel	Netherlands	1	Late Roman period	Willems and Van Enckevort 2009
Nijmegen-Mariënburg	Netherlands	1	mid-4th century	Van Enckevort and Thijssen 2000, 19
Noordbarge-Hooge Loo	Netherlands	multiple	5th century	Trier 1969, 181
Noordbarge-Traverseplein	Netherlands	3	Late Roman-Early medieval	Krol-Karsten 2021
Oosterhout-De Contreie	Netherlands	1	AD 25-75	Roessingh and Blom 2012, 163
Peelo	Netherlands	1	3rd century	Trier 1969, 181
Peelo- De Es	Netherlands	multiple/53	2nd-6th century	Kooi 1991; ibid. 1994; Wüstehube 1998, cat. 527
Peelo- De Es	Netherlands	multiple/53	2nd-6th century	Kooi 1991; ibid. 1994; Wüstehube 1998, cat. 527
Rhee	Netherlands	multiple	2nd-4th century	Trier 1969, 181; Wüstehube 1998, cat. 528
Sleen-Diphoorn	Netherlands	1	1st-2nd century	Trier 1969, 178
Someren Lierop-Steemertseweg	Netherlands	1	2nd half 3rd century	Verwers 1991b, 200
Son en Breugel	Netherlands	at least 1	550-250 BC	Wüstehube 1998, cat. 532; Van den Broeke 1980
Son-Pastorie	Netherlands	1	Middle Roman period	Van der Weerden 2012
Swalmen	Netherlands	1	5th century	Willems 1983; Wüstehube 1998, cat. 533
Vasse-De Steenbrei	Netherlands	1	Iron Age-Early Roman period	De Wit *et al.* 2004, 11
Veldhoven-Zilverackers WOR	Netherlands	1	3rd century	Van der Veken 2014
Voerendaal-Ten Hove	Netherlands	3	Middle Roman period	Hiddink 2023
Voerendaal-Ten Hove	Netherlands	11	after AD 350/375	Hiddink 2023
Voerendaal-Ten Hove	Netherlands	6	after AD 450	Hiddink 2023
Vorden-Hoek Horsterkamp	Netherlands	1	Early Roman period	Louwe 2018

Site	Country	N	Period	Reference
Vorden-Ruurloseweg	Netherlands	1	Roman period	Louwe 2018
Wehl-Hessenveld	Netherlands	multiple	Middle-Late Roman period	Koster 1997, 29
Wehl-Hessenveld	Netherlands	multiple	Late Roman period	Koster 1997, 29
Wehl-Norman Belvealstraat	Netherlands	14	Middle Roman period	Bouma 2013
Wierden-Enter	Netherlands	1	Roman period	Benerink 2017
Wierden-Enter	Netherlands	3	Late Roman period	Hulst 2004, 44-51
Wijchen-Tienakker	Netherlands	8	first half 5th century	Heirbaut and Van Enckevort 2011
Wijster	Netherlands	140	2nd-5th century	Van Es 1967
Zutphen-Laaksche Veld	Netherlands	10	AD 350-400/500	Bouwmeester 2000, 91-93
Ahrensflucht	Germany	multiple	1st century	Wüstehube 1998, cat. 2; Trier 1969, 178
Albersloh	Germany	8	Middle Roman period	Neujahrsgruß 1971, 18; Neujahrsgruß 1972, 18
Aldenhoven	Germany	1	Late Roman period	Lenz 2005, Abb. 18; Lenz 1999, Abb. 14
Almstorf	Germany	multiple	Late Iron Age-Middle Roman period	Trier 1969, 178
Anreppen	Germany	7	Iron Age-Early Roman period	Neujahrsgruß 1972, 21-22; Wüstebude 1998, cat. 9
Bad Oeynhausen-Werste Bahnenbühne	Germany	3	4th century	Bérenger 2000, 208; Wüstehube 1998, cat. 18
Bad-Sassendorf-Heppen	Germany	multiple	1st century	Mirschenz 2013, 29; Eggenstein 2003, 108
Balve-Garbeck	Germany	multiple	Late Iron Age-1st century AD	Mirschenz 2013, 29; Neujahrsgruß 1985; ibid. 1986, 36; ibid. 1987, 46; ibid. 1989, 45; Wüstehube 1998, cat. 22
Barnkrug	Germany	1	1st century	Wüstehube 1998, cat. 25
Beelen	Germany	1	AD 0-200	Neujahrsgruß 1992, 71; Wüstehube 1998, cat. 26
Bielefeld-Sieker	Germany	3	1st-5th century	Wustehübe 1998, cat. 37
Bielefeld-Sieker	Germany	1	3rd-4th century	Wustehübe 1998, cat. 37; Neujahrsgruß 1984, 40
Bochum-Hiltrop	Germany	2	1st century	Mirschenz 2013; Wustehübe 1998, cat. 41; Eggenstein 2003, 108
Bochum-Kirchharpen	Germany	1	Iron Age-Early Roman period	Mirschenz 2013, 29
Bochum-Riemke	Germany	1	start 1st century AD	Mirschenz 2013, 29
Böhme-Fallingbostel	Germany	multiple	1st-2nd century	Kossack *et al.* 1984, 222
Bonn-Vilich-Müldorf	Germany	2	Roman period	Gechter-Jones and Kempken 2007, 79-82
Borken-Hoxfeld	Germany	1	1st century	Neujahrsgruß 1996, 47
Borken-Hoxfeld	Germany	1	Late Iron Age	Neujahrsgruß 1995, 35
Bottrop	Germany	2	Migration period	Neujahrsgruß 1974, 13
Bremen-Grambke I	Germany	7	4th-5th century	Trier 1969, 178; Brandt 1958; Zimmermann 1992, 158
Bremen-Grambke II	Germany	15	4th-5th century	Trier 1969, 178; Brandt 1962; Zimmermann 1992, 158
Bremen-Hemelingen	Germany	multiple	start 1st century AD	Trier 1969, 178
Bremen-Hemelingen	Germany	multiple	4th-5th century	Trier 1969, 178
Bremen-Mahndorf	Germany	1	Roman period	Geidner 2019, 1-6
Bremen-Mahndorf	Germany	multiple	4th-5th century	Trier 1969, 178; Brabandt 1993, Abb. 30;Wüstehube 1998, cat. 54; Aufderhaar 2016, 162; Brandt 1965
Bremen-Rekum	Germany	multiple	3rd/4th-5th century	Wüstehube 1998, cat. 55
Bremen-RekumUnterm Berg/ Auf dem Mühlenberg	Germany	21	AD 100/200-400	Siegmüller 2017, 17, Abb. 2

Site	Country	N	Period	Reference
Bremen-RekumUnterm Berg/ Auf dem Mühlenberg	Germany	multiple/21	3rd century	Siegmüller 2017, 17, Abb. 2
Brill	Germany	multiple/31	early 3rd century	Lehman 2002, 161
Brill	Germany	most/31	late 4th-early 5th century	Lehman 2002, 161
Brill	Germany	17	1st-4th century	Schwarz 1975, 141-153.
Buchholz	Germany	1	3rd century	Trier 1969, 178; Wustehübe 1998, cat. 59
Buendorf	Germany	multiple	Late Roman-Early medieval	Assendorp and Weiser 2003, 96
Burgdorf	Germany	1	Late Roman-Early medieval	Von Uslar 1949 BJ, note 137
Clarholz-Heerde	Germany	1	1st/2nd-3rd century	Trier 1969, 178; Wüstehube 1998, cat. 69; Neujahrsgruß 1979, 39
Coesfeld	Germany	multiple	Middle Roman period	Neujahrsgruß 1989, 40; Wüstehube 1998, cat. 71
Coesfeld	Germany	mul	Middle Roman period	Neujahrsgruß 1989, 40
Cramme	Germany	2	Middle Roman period	Dirks 2001, 140-141
Cuxhaven-Duhnen	Germany	1	2nd century	Trier 1969, 178; Wüstehube 1998, cat. 74
Damme	Germany	1	Roman period	Friederichs 1997, 340
Daseburg	Germany	6	Iron Age-Early Roman period	Neujahrsgruß 1975, 23; Neujahrsgruß 1976, 21
Delbrück-Anreppen	Germany	6	Iron Age-Early Roman period	Mirschenz 2013, 29; Eggenstein 2003, 53-54
Dorsten-Holsterhausen	Germany	37	Roman period	Mirschenz 2013, 29; Ebel-Zepezauer *et al.* 2009
Dortmund-Mengede	Germany	1	Roman period	Mirschenz 2013, 29; Neujahrsgruß 1988
Dortmund-Oespeler Bach	Germany	30	4th-early 5th century	Brink-Kloke and Meurers-Balke 2003; Mirschenz 2013, 29
Dötlingen	Germany	multiple	Roman period	Eckert 1996a, 313; Eckert 1996b, 313; Eckert 1996c, 313-314.
Düsseldorf-Stockum	Germany	13	2nd-3rd century	Mirschenz 2013, 29; Wüstehube 1998, cat. 92
Emsdetten	Germany	unknown	Iron Age-Early Roman period	Neujahrsgruß 1990, 43-44
Emsen	Germany	multiple	4th-5th century	Wustehübe 1998, cat. 109; Trier 1969
Espelkamp	Germany	5	Iron Age-Early Roman period	Neujahrsgruß 1987, 35
Essen-Überruhr-Hinsel	Germany	2	3rd-5th century	Mirschenz 2013, 29
Feddersen Wierde	Germany	2	3rd century	Wüstehube 1998, cat. 119; Haarnagel 1979; Lehman 2002, 161
Feddersen Wierde	Germany	1	4th-5th century	Wüstehube 1998, cat. 119; Haarnagel 1979; Lehman 2002, 161
Flögeln-Eekhöltjen	Germany	multiple/156	Early Roman period	Zimmermann 1992, 156; Schmid und Zimmermann 1976, 36; Dübner 2013
Flögeln-Eekhöltjen	Germany	multiple/156	Middle Roman period	Zimmermann 1992, 156; Schmid und Zimmermann 1976, 36; Dübner 2013
Flögeln-Eekhöltjen	Germany	multiple/156	Late Roman period	Zimmermann 1992, 156; Schmid und Zimmermann 1976, 36; Dübner 2013
Froitzheim	Germany	1	Late Roman period	Van Ossel 1992, 194
Geseke	Germany	1	Late Roman-Early medieval	Mirschenz 2013, 29; Neujahrsgruß 1975, 31; Wüstehube 1998, cat. 141
Gielde-Am Hetelberg	Germany	25	1st-7th century	Wüstehube 1998, cat. 142; Trier 1969, 179; Kossack *et al.* 1984, 222
Gleidingen	Germany	multiple	1st century	Wüstehube 1998, cat. 147; Trier 1969, 179
Godenstedt	Germany	7	Roman period-early Medieval	Neumann 2006, 63

Site	Country	N	Period	Reference
Grastrup-Hölsen	Germany	2	AD 188-220	Trier 1969, 179; Wüstebude 1998, cat. 156
Greven-Aldrup	Germany	1	Early Roman period	Neujahrsgruß 1993 349; Wüstehube 1998, cat. 158
Greven-Herbern	Germany	1	2nd century	Neujahrsgruß 1979, 39
Gristede	Germany	multiple	1st-4th century	Trier 1969, 179
Gristede	Germany	6	3rd-4th century	Zoller 1961, 114; Zoller 1963
Groß Meckelsen	Germany	2	Middle Roman period	Aufderhaar 2016, 162; Nowatzyk 1987, 383, Abb. 3 NNU 56, 379-392; in Zimmermann 1992, 158
Groß Meckelsen	Germany	2	Late Roman period	Aufderhaar 2016, 162; Nowatzyk 1987, 383, Abb. 3 NNU 56, 379-392; in Zimmermann 1992, 158
Groß Meckelsen	Germany	5	Roman period-early Medieval	Tempel 1998, 430; Tempel 2000, 104
Gross-Meckelsen	Germany	15?	Late Roman-Early medieval	Wüstehube 1998, cat. 167
Gudendorf	Germany	1	Late Roman period	Wendowski-Schünemann 1997, 343
Gudendorf	Germany	1	1st-2nd-century	Wüstehube 1998, cat. 170; Trier 1969, 179
Gudendorf-Köstersweg	Germany	10	Roman-Late Roman period	Aufderhaar 2017, fig. 2
Haffen-Mehr	Germany	2	Roman period	Kyritz 2014, 101
Haffen-Mehr	Germany	1	4th century	Kyritz 2014, 102-103
Haldern	Germany	15	1st-2nd century	Wüstehube 1998, cat. 178; Trier 1969, 179
Hambach 132	Germany	1	Middle Roman period or later	Brüggler 2009, 52-53, fig. 31; Kaszab-Olschewski 2006, 33
Hambach 412 (Niederzier)	Germany	2	AD 100-150	Kiessling 2008, 131-134
Hambühren	Germany	1	AD 200 or younger	Wüstebude 1998, cat. 181; Trier 1969, 180
Hamburg-Bramfeld	Germany	1	Early Roman period	Trier 1969, 180
Hamburg-Farmsen	Germany	1	1st-2nd century	Wüstebude 1998, cat. 185
Hamm-Haaren	Germany	5	Iron Age-5th century	Mirschenz 2013, 29
Hamm-Herringen	Germany	5	Iron Age-4th century	Mirschenz 2013, 42
Hamm-Westhafen	Germany	1	1st century	Cichy 2008, 45
Hamm-Westhafen	Germany	4	Iron Age-4th century	Mirschenz 2013, 29
Harff	Germany	4	Late Roman period	Van Ossel 1992, 196-197
Heek	Germany	multiple	4th-5th century	Neujahrsgruß 1992; Neujahrsgruß 1989, 47; Wüstehube 1998, cat. 190
Heek-Nienborg	Germany	2	Iron Age-Early Roman period	Neujahrsgruß 1988, 45; Wüstehube 1998, cat. 190
Hemsen, Kr. Meppen	Germany	8	4th-5th century	Schlicht 1969; Wüstehube 1998, cat. 202
Herten-Emscherbruch	Germany	multiple	Iron Age	Gaffrey and Holtfester 2010
Herzebrock-Clarholz	Germany	unknown	Late Iron Age-Early Roman period	Mirschenz 2013, 29; Eggenstein 2003, 108
Herzebrock-Clarholz	Germany	1	Late Roman period	Neujahrsgruß 1989, 47; Wüstehube 1998, cat. 205
Hitzacker	Germany	5	Roman period	Nüsse 2010, 95; Nüsse 2006, 68.
Hollenstedt	Germany	1	2nd century	Wüstebude 1998, cat. 210; Trier 1969, 180
Holßel	Germany	1	Roman period	Aufderhaar 2016, 306
Höxter	Germany	multiple	Late Roman-Early medieval	Neujahrsgruß 1995, 92
Hülsen, Ldkr. Verden	Germany	5	Roman period	Nowatzyk 1990, 167-176
Hülsen, Ldkr. Verden	Germany	6	Early Roman period	Nowatzyk 1992, 59-79
Jüchen-Neuholz	Germany	1?	Middle Roman period	Kiessling 2008, 131-134
Jüchen-Neuholz	Germany	1	Early Roman period	Mirschenz 2013; Andrikopolou-Strack *et al.* 1999, 146

Site	Country	N	Period	Reference
Kalletal-Talle	Germany	1	Iron Age	Neujahrsgruß 2004, 73
Kaster-Hasselberg	Germany	1	Late Roman period	Van Ossel 1992, 197
Kevelaer-Grotendonk	Germany	1	2nd-3rd century	Brüggler *et al.* 2017, 50
Klethen	Germany	1	4th-5th century	Wüstehube 1998, cat. 236; Trier 1969, 180
Kneblinghausen	Germany	7	early 1st century AD	Trier 1969, 180; Wüstehube 1998, cat. 239
Krempel	Germany	multiple	Late Roman-Early medieval	Aufderhaar 2016, 307
Lage-Lückhausen	Germany	4	Roman period	Neujahrsgruß 1993, 50; Wüstehube 1998, cat. 254
Leer	Germany	1	Roman period	Bärenfänger 1998, 440, Abb. 57
Lemgo	Germany	1	start 1st century AD	Neujahrsgruß 1998, 57-58
Lemgo	Germany	1	2nd century	Neujahrsgruß 1998, 57-58
Lemgo-Hörstmar	Germany	1	Middle Roman period	Neujahrsgruß 2008, 56
Letter	Germany	1	1st century	Wüstehube 1998, cat. 266; Trier 1969, 180
Letter	Germany	1	4th century	Wüstehube 1998, cat. 266; Trier 1969, 180
Leverkusen-Schlebusch	Germany	6	2nd century	Mirschenz 2013, 29
Loxstedt-Littstücke	Germany	16	1st century	Dübner 2017, 204; cf. Dübner 2015; Zimmermann 1992a, 158
Loxstedt-Littstücke	Germany	27	2nd-4th century	Dübner 2017, 204; cf. Dübner 2015; Zimmermann 1992a, 158
Loxstedt-Littstücke	Germany	85	4th-6th century	Dübner 2017, 204; cf. Dübner 2015; Zimmermann 1992a, 158
Lückhausen	Germany	4	Middle Roman period	Neujahrsgruß 1994, 61
Mahlstedt, Ldkr. Oldenburg	Germany	multiple	Early Roman-Migration period	Wegner 1981, 43-63; Wüstebude 1998, cat 455
Meensen	Germany	2	1st-2nd century	Grote 1996, 323.
Meilsdorf	Germany	2	start 1st century AD	Trier 1969, 180; Wüstebude 1998, cat. 284
Midlum-Northum	Germany	20	4th-5th century	Wüstehube 1998, cat. 291; Aufderhaar 2016, 162; Trier 1969
Midlum-Northum	Germany	1	1st century	Wustehübe 1998, cat. 291; Trier 1969, 181; Aufderhaar 2016, 162
Milte	Germany	3	4th-5th century	Wüstehube 1998, cat. 292; Trier 1969, 181
Morken	Germany	1	Early Roman period	Hinz 1969, 21-22, fig. 8
Münster	Germany	multiple	3rd-4th century	Neujahrsgruß 1976, 34
Neu Wulmstorf	Germany	multiple	Roman period	Thieme 1996, 323
Neuss-Hochneukirch	Germany	2	early 4th century	Keller 1997
Niederkassel	Germany	3	mid-1st century	Frank 2013
Northeim	Germany	1	Roman period	Teuber 1996, 323.
Ohrum	Germany	1	Late Iron Age-Early Roman period	Reese 2000, 110
Oxstedt	Germany	multiple	1st century	Trier 1969; Wüstehube 1998, cat. 335; Aufderhaar 2016, 162; Lehman 2002, 161
Oxstedt	Germany	multiple	5th century	Trier 1969; Wüstehube 1998, cat. 335
Paderborn	Germany	1	3rd-4th century	Neujahrsgruß 1976; Wüstehube 1998, cat. 336
Paderborn	Germany	1	3rd century	Neujahrsgruß 1979, 42; Wüstehube 1998, cat. 338
Petershagen Lahde-Heyden	Germany	1	2nd century	Bérenger 2000, 180
Petershagen Lahde-Heyden	Germany	4	2nd-3rd century	Bérenger 2000, 192
Petershagen Lahde-Heyden	Germany	2	4th-early 5th century	Bérenger 2000, 208
Petershagen-Lahde	Germany	7	1st-3rd century	Neujahrsgruß 1983, 27; Wüstehube 1998, cat. 342

Site	Country	N	Period	Reference
Petershagen-Neuenknick	Germany	3	2nd century	Bérenger 2000, 180
Petershagen-Raderhorst	Germany	2	Roman period	Neujahrsgruß 2003, 61
Pulheim-Brauweiler	Germany	4	2nd-3rd century	Andrikopoulou-Strack *et al.* 2000, 430-431
Rastede	Germany	1	1st-2nd century	Wüstehube 1998, cat. 352; Trier 1969, 181
Rees-Haldern	Germany	17	Roman period	Mirschenz 2013, 29
Rehme	Germany	1	Middle Roman period	Trier 1969, 181
Rehme	Germany	multiple	around AD 400	Wüstehube 1998, cat. 358
Remlingen	Germany	1	Middle Roman period	Oppermann and Steinmetz 1996, 324.
Rethmar	Germany	1	Late Roman period	Rasink 1996, 325
Rhede	Germany	1	Iron Age-Roman period	Ebel-Zepezauer *et al.* 2009, 39
Rheinberg-Alten Landstrasse	Germany	2	1st century	Binding 1968, 121-152
Rheine-Altenrheine	Germany	3	Iron Age-Early Medieval	Neujahrsgruß 2001, 82; Neujahrsgruß 1994, 49
Rodenkirchen	Germany	1	4th century	Van Ossel 1992, 222
Ronnenberg	Germany	multiple	2nd century	Trier 1969, 181; Wüstebude 1998, cat. 373
Rullstorf, Ldkr. Lüneburg	Germany	multiple	Bronze Age-Migration period	Gebers 1998, 446, Wüstehube 1998, cat. 207; Klappauf *et al.* 1981, 362
Rullstorf, Ldkr. Lüneburg	Germany	multiple	Middle Roman-Migration period	Gebers 1985, fig. 3; 6; Wüstehube 1998, cat. 375
Rüthen-Kneblinghausen	Germany	unknown	Late Iron Age-Early Roman period	Mirschenz 2013, 29; Eggenstein 2003, 108
Saerbeck	Germany	7	Iron Age-Early Roman period	Neujahrsgruß 1991, 38; Neujahrsgruß 1990, 34
Salzgitter-Lobmachtersen	Germany	1	3rd-4th century	Wüstehube 1998, cat. 379; Trier 1969, 181
Salzkotten-Thüle	Germany	3	Iron Age-Early Roman period	Neujahrsgruß 1976, 20; Wüstehube 1998, cat. 380; Mirschenz 2013, 29; Eggenstein 2003, 108
Sassenberg	Germany	1	Early Roman period	Neujahrsgruß 1981, 42; Wüstehube 1998, cat. 383
Sassenberg-Dackmar	Germany	unknown	Late Iron Age-Early Roman period	Mirschenz 2013, 29
Schöppingen	Germany	4	Late Iron Age	Neujahrsgruß 1994, 51
Seelze	Germany	1	1st century	Trier 1969, 182; Wüstehube 1998, cat. 393
Sendenhorst-Albersloh	Germany	unknown	Late Iron Age-Early Roman period	Mirschenz 2013, 29; Eggenstein 2003, 108
Sievern-Langenacker	Germany	1	Roman period?	Aufderhaar 2016, 160
Sievern-Langenacker	Germany	1	mid-2nd-mid-4th century	Aufderhaar 2016, 163
Soest-Ardey	Germany	2	4th century	Neujahrsgruß 1978, 28; Wüstehube 1998, cat. 397; Mirschenz 2013, 29
Soest-Gelmen	Germany	unknown	Late Iron Age-Early Roman period	Mirschenz 2013, 29; Eggenstein 2003, 108
Spieka-Knill	Germany	multiple	Roman-Late Roman period	Aufderhaar 2017, 142-143
Stederdorf	Germany	2	1st-3rd century	Wüstehube 1998, cat. 402
Stederdorf	Germany	2	1st-2nd century	Wüstehube 1998, cat. 402; Trier 1969, 182
Stotel	Germany	1	4th-5th century	Schuster 2003, 107
Telgte-Raestrup	Germany	3	Roman period	Neujahrsgruß 1977, 13; Wüstehube 1998, cat. 418
Uthlede, Kr. Wesermünde	Germany	5	1st-3rd century	Meyer and Tempel 1980, 172; Wüstehube 1998, cat. 430

Site	Country	N	Period	Reference
Voerde	Germany	1	1st-2nd century	Mirschenz 2013, 29
Voerde-Mehrum	Germany	3	Early Roman period	Brand and Schönfelder 2008, 79
Waltrop	Germany	unknown	2nd-3rd century	Trier 1969, 182; Wüstehube 1998, cat. 440
Warburg-Daseburg	Germany	12	AD 0-50	Mirschenz 2013, 29; Wüstehube 1998, cat. 442
Warendorf-Milte	Germany	multiple	Late Roman period	Grünewald 2010; Neujahrsgruß 2008, 74
Weeze-Knappheide	Germany	5	Late Roman period	Brüggler 2019
Weeze-Vorselaer	Germany	2	1st-3rd century	Brüggler 2016; Brüggler *et al.* 2017, 47
Westen	Germany	1	Late Roman period	Krumland 1996, 349
Westerholt	Germany	3	Late Roman period	Bärenfänger 2003, 93
Westerohrestedt	Germany	1	Early Roman period	Wüstehube 1998, cat. 448; Trier 1969, 182
Wingst Am Geestberg	Germany	multiple	Late Roman period	Aufderhaar 2016, 162; Lehman 2002, 161; Zimmermann 1992, 158
Wittstedt	Germany	108<	Middle Roman-Migration period	Schön and Jöns 2017, 175-177
Wolfenbüttel-Fümmelse	Germany	2	Early Roman period	Weski 1988, 242-283; Wüstehube 1998, cat. 457
Wolfenbüttel-Groß Stöckheim	Germany	3	Roman period	Weski 1990, 183-186
Wolfenbüttel-Groß Stöckheim	Germany	1	Early Roman period	Weski 1990, 186

Digital appendices

Appendix 3. Inventory of Late Roman civilian-associated dress accessories from Germania Magna and Germania Secunda

http://doi.org/10.32028/9781803279916Appendix3

Appendix 4. Inventory of Late Roman military-associated dress accessories from Germania Magna and Germania Secunda

http://doi.org/10.32028/9781803279916Appendix4

Appendix 5. pXRF dataset on Late Roman copper-alloy dress accessories from Germania Magna and Germania Secunda

http://doi.org/10.32028/9781803279916Appendix5

Appendix 6. Dataset of object dimensions of Late Roman copper-alloy dress accessories from Germania Magna and Germania Secunda

http://doi.org/10.32028/9781803279916Appendix6

Plates

Plate 1. Selection of decorated brooches from the Portable Antiquities of the Netherlands. Nrs 1-7: simple two-piece Armbrust brooch; 7-10: elaborate Armbrust brooch with trapezoidal foot; 11-13: supporting-arm brooch. 1: PAN-00036424; 2: PAN-00059204; 3: PAN-00057991; 4: PAN-00022959; 5: PAN-00022961; 6: PAN-00022408; 7: PAN-00022963; 8: PAN-00063840; 9: PAN-00040458; 10: PAN-00007517; 11: PAN-00064270; 12: PAN-00010143; 13: PAN-00034269. All images reproduced under CC4 license from PAN; scale 150%

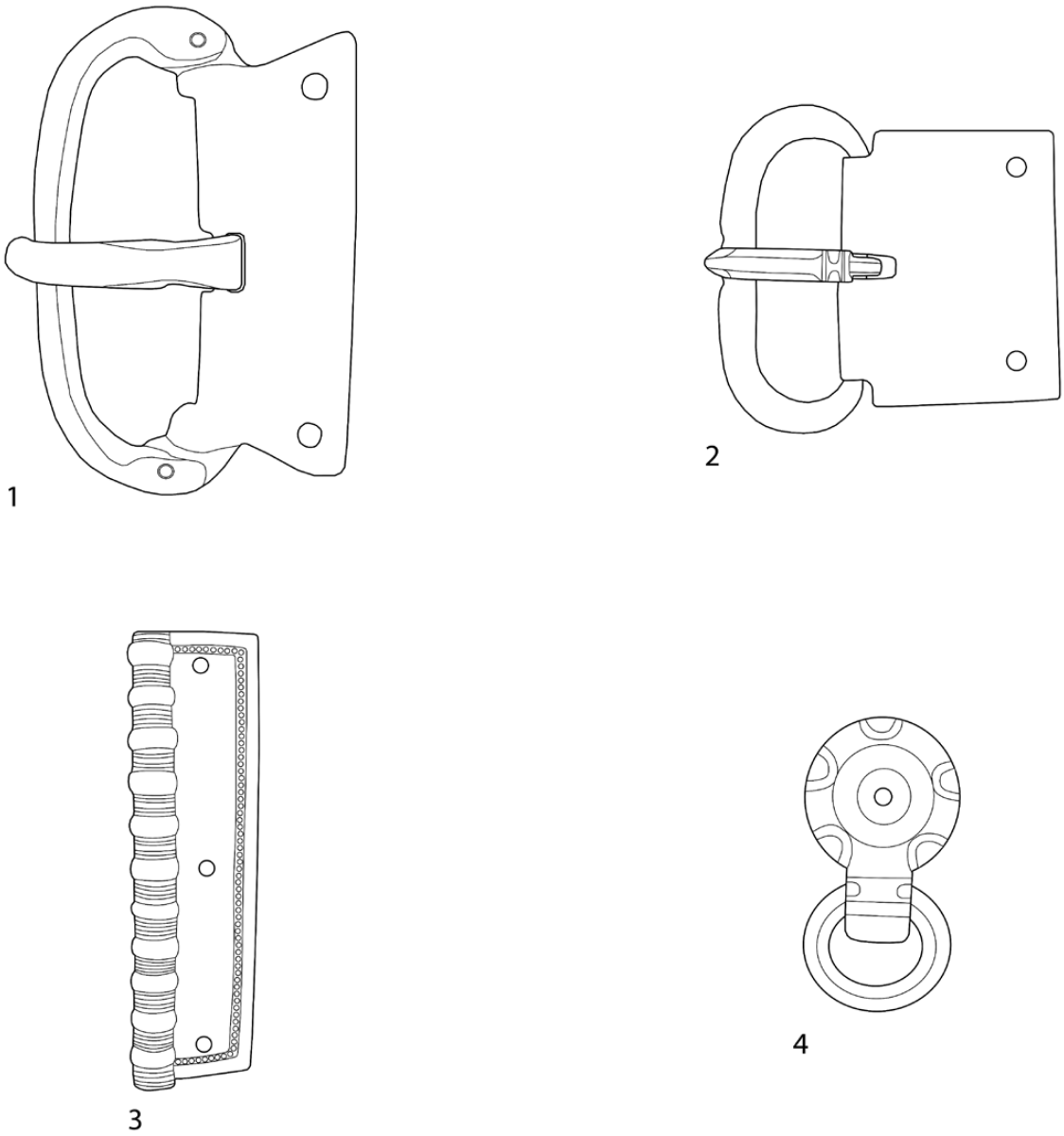


Plate 2. Schematic drawings of different typological groups of belt buckles and assorting fittings. Not to scale.

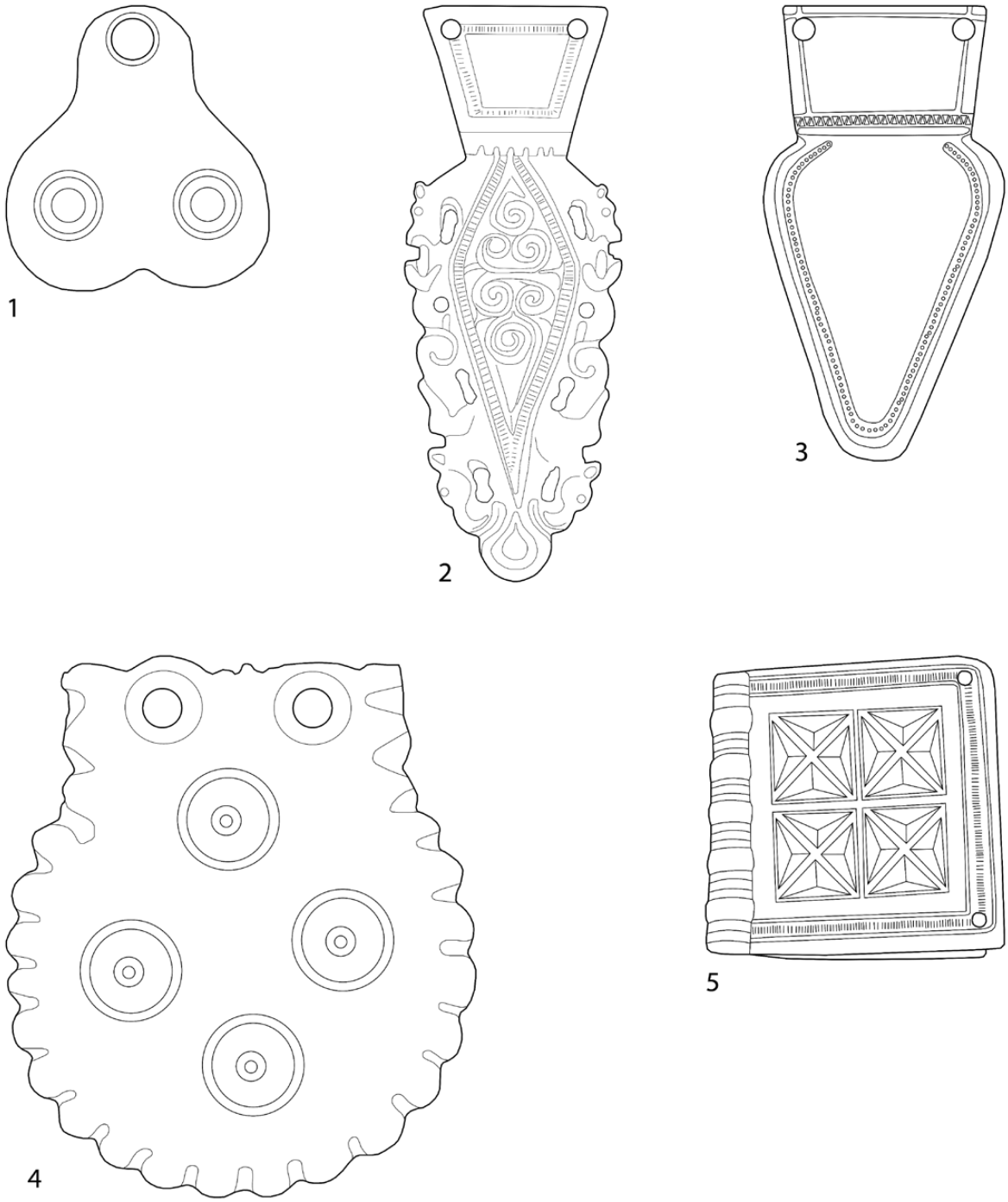


Plate 3. Schematic drawings of different typological groups of strap ends. Not to scale.

Plate 4. Selection of decorated belt buckles, strap ends and as*Sorte*d fitting. 1: Nijmegen- Hugo de Grootstraat 189/26; 2: Krefeld-Gellep 5589; 3: Krefeld-Gellep 1330; 4: Krefeld-Gellep 1100; 5: Krefeld-Gellep 1382; 6: Krefeld-Gellep 2832; 7: PAN-00028582; 8: PAN-00012288; 9: PAN-00013413; 10: PAN-00046155; 11: PAN-00014418; 12: PAN-00018320; 13: PAN-00030786. PAN images reproduced under CC4 license from PAN. Scale: buckles and strap ends 2:3; mounts 1:1.

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