

# The Production of Military Equipment: an Introduction and Overview

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

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

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

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

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

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

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

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

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

Herz organises military equipment into two groups according to ownership:<sup>15</sup>

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

### Notes

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

<sup>2</sup> See Groot et al. 2009; Groot – Deschler-Erb 2017; Stallibras 2009, the contributions in Stallibras – Parker 2008 and Vandorpe et al. 2017.

<sup>3</sup> See for instance Dolata 2000.

<sup>4</sup> Seminal works: Bishop – Coulston 1993 and 2006. Examples of studies in partial fields are Gschwind 1997; van Driel-Murray 2002; Armstrong 2017.

<sup>5</sup> James 1988, 259–260.

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

<sup>7</sup> James 1988, 265–266.

<sup>8</sup> James 1988, 266. 268–269.

<sup>9</sup> Hoss 2016, 115–116; Hoss 2017.

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

<sup>11</sup> Tacitus, Hist. I, 57.

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

<sup>13</sup> Pfahl 2012, 72–77.

<sup>14</sup> Breeze et al. 1976, 93; Nicolay 2007, 166–171; Rathbone 2007, 163. 168.

<sup>15</sup> Herz 2010, 111–112.

<sup>16</sup> Herz 2010, 111–112.

<sup>17</sup> Indicated for the mills at least by an inscription on a handmill from the Saalburg, which reads “CON(tubernium) BRITTONIS”, see CIL XIII 11954a and Junkelmann 1997, 117 fig. 58.

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

## References

### **Alston 1995**

R. Alston, *Soldier and Society in Roman Egypt: A Social History* (London 1995).

### **Armstrong 2017**

J. Armstrong, *The Origins of the Roman pilum Revisited*, *JRomMilSt* 18, 2017, 65–74.

### **Bidwell 1980**

P. Bidwell, *Roman Exeter: Fortress and Town* (Exeter 1980).

### **Bishop 1985**

M. C. Bishop, *The Military fabrica and the Production of Arms in the Early Principate*, in:

M. C. Bishop (ed.), *The Production and Distribution of Roman Military Equipment*, Proceedings of the 2nd Military Research Seminar, BARIntSer 275 (Oxford 1985) 1–42.

**Bishop – Coulston 2006**

M. C. Bishop – J. C. N. Coulston *Roman Military Equipment from the Punic Wars to the Fall of Rome* <sup>2</sup>(Oxford 2006).

**Bödecker 2010**

S. Bödecker, *Waffen für Vagdavercustis, Der Limes*. Nachrichtenblatt der Deutschen Limeskommission 4, 2010, 16–19.

**Breeze et al. 1976**

D. J. Breeze – J. Close-Brooks – J. N. Graham Ritchie, *Soldiers' Burials at Camelon, Stirlingshire, 1922 and 1957 with Appendix: The Ownership of Arms in the Roman Army*, *Britannia* 7, 1976, 93–95.

**Brunt 1950**

P. A. Brunt, *Pay and Superannuation in the Roman Army*, *BSR* 18, November 1950, 50–71.

**Deschler-Erb 2000**

E. Deschler-Erb, *Niellierung auf Buntmetall: Ein Phänomen der frühen römischen Kaiserzeit*, in: R. Thomas (ed.), *Akten des 14. Internationalen Kongresses für Antike Bronzen in Köln* 21. bis 24. September 1999, *KölnerJb* 33 (Berlin 2000) 383–396.

**Dolata 2000**

J. Dolata, *Römische Ziegelstempel aus Mainz und dem nördlichen Obergermanien*. Archäologische und archäometrische Untersuchungen zu chronologischem und baugeschichtlichem Quellenmaterial (Ph.D. diss. University of Frankfurt am Main 2000).

**Fischer 2012**

T. Fischer, *Die Armee der Caesaren* (Regensburg 2012).

**Groot et al. 2009**

M. Groot – S. Heeren – L. I. Kooistra – W. V. Vos, *Surplus Production for the Market? The Agrarian Economy in the Non-Villa Landscapes of Germania Inferior*, *JRA* 22, 2009, 231–253.

**Groot – Deschler-Erb 2017**

M. Groot – S. Deschler-Erb, *Carnem et circenses – Consumption of Animals and their Products in Roman Urban and Military Sites in two Regions in the Northwestern Provinces*, *Environmental Archaeology* 22, 2017, 96–112. doi: 10.1179/1749631415Y.0000000027.

**Gschwind 1997**

M. Gschwind, *Bronzegießer am raetischen Limes, Zur Versorgung mittelkaiserzeitlicher Auxiliareinheiten mit militärischen Ausrüstungsgegenständen*, *Germania* 75, 1997, 607–638.

**Herz 2010**

P. Herz, *Die Versorgung der römischen Armee mit Waffen und Ausrüstung*, in: A. Eich (ed.), *Die Verwaltung der kaiserzeitlichen römischen Armee*. Studien für Hartmut Wolff. *Historia Einzelschriften* 211, 2010, 111–132.

**Hoss 2014**

S. Hoss, *CINGULUM MILITARE*. Studien zum römischen Soldatengürtel des 1. bis 3. Jh. n. Chr. (Ph.D. diss. Leiden 2014, Leiden Open Access Repository <<https://openaccess.leidenuniv.nl/handle/1887/23627>> (18.08.2020).

**Hoss 2016**

S. Hoss, Dressing the Roman Soldier, in: X. Pauli-Jensen – Th. Grane (eds.), *Imitation and Inspiration. Proceedings of the 18th International Roman Military Equipment Conference, Copenhagen 2013*, *JRomMilSt* 17, 2016, 115–120.

**Hoss 2017**

S. Hoss, On Making Honour Visible, in: A. Parker (ed.), *Ad Vallum: Papers on the Roman Army and Frontiers in Celebration of Dr. Brian Dobson*, BAR 631 (Oxford 2017) 19–34.

**James 1988**

S. James, The Fabricae: State Arms Factories in the Later Roman Empire, in: J. Coulston (ed.), *Military Equipment and the Identity of the Roman Soldier* (Oxford 1988) 257–331.

**Junkelmann 1997**

M. Junkelmann, *Panis Militaris. Die Ernährung des römischen Soldaten oder der Grundstoff der Macht* (Mainz 1997).

**Mackensen 1987**

M. Mackensen, *Die frühkaiserzeitliche Kleinkastelle Nersingen und Burlafingen an der oberen Donau. Münchener Beiträge zur Vor- und Frühgeschichte* (Munich 1987).

**Moore 2017**

T. Moore, Alternatives to Urbanism? Reconsidering Oppida and the Urban Question in Late Iron Age Europe, *Journal of World Prehistory* 30, 2017, 281–300.

**Nabbefeld 2008**

A. Nabbefeld, *Römische Schilde. Studien zu Funden und bildlichen Überlieferungen vom Ende der Republik bis in die späte Kaiserzeit. Kölner Studien zur Archäologie der römischen Provinzen* 10 (Rahden 2008).

**Niblett 1985**

R. Niblett, *Sheepen. An Early Roman Industrial Site at Camulodunum*, CBA Research Report 57 (London 1985).

**Nicolay 2007**

J.A.W. Nicolay, *Armed Batavians. Use and Significance of Weaponry and Horse Gear from Non-military Contexts in the Rhine Delta (50 BC to 450 AD)*, Amsterdam Archaeological Studies 11 (Amsterdam 2007).

**Oldenstein 1976**

J. Oldenstein, *Zur Ausrüstung römischer Auxiliareinheiten*, *Berichte der Römisch-Germanischen Kommission* 57, 1976, 49–284.

**Pfahl 2012**

S.T. Pfahl, *INSTRUMENTA LATINA ET GRÆCA INSCRIPTA des Limesgebietes von 200 v. Chr. bis 600 n. Chr.* (Weinstadt 2012).

**Phang 2001**

S.E. Phang, *The Marriage of Roman Soldiers (13 BC–AD 235): Law and Family in the Imperial Army* (Leiden 2001).

**Pitts – St. Joseph 1985**

L. F. Pitts – J. K. St. Joseph, *Inchtuthil. The Roman Legionary Fortress Excavations 1952* (London 1985).

**Rathbone 2007**

D. Rathbone, Military Finance and Supply, in: Ph. Sabin – H. van Wees – M. Whitby (eds.), *The Cambridge History of Greek and Roman Warfare 2* (Cambridge 2007) 158–175.

**Reddé et al. 2006**

M. Reddé – R. Brulet – R. Fellmann – J. K. Haalebos – S. von Schnurbein (eds.), *Les fortifications militaires. L'architecture de la Gaule romaine*, Documents d'archéologie française 100 (Paris 2006).

**Sanader 2013**

M. Sanader (ed.), *XVII ROMEC Zagreb 2010*, Proceedings of the 17th Roman Military Equipment Conference: Weapons and Military Equipment in Funerary Context, Zagreb, 24th–27th May 2010 (Zagreb 2013).

**Schönberger 1978**

H. Schönberger, *Kastell Oberstimm. Die Grabungen von 1968 bis 1971*. Limesforschungen (Berlin 1978).

**Scott 1985**

I. Scott, First Century Military Daggers and the Manufacture and Supply of Weapons for the Roman Army, in: M.C. Bishop, (ed.), *The Production and Distribution of Roman Military Equipment*, Proceedings of the 2nd Military Research Seminar. BARIntSer 275 (Oxford 1985) 160–213.

**Stallibrass 2009**

S. Stallibrass, The Way to a Roman Soldier's Heart: Did Cattle Droving Supply the Hadrian's Wall area?, in: J. Hendriks (ed.), *TRAC 2008*. Proceedings of the 18th Annual Theoretical Roman Archaeology Conference, Amsterdam 2008 (Oxford 2008) 101–112.

**Stallibrass – Parker 2008**

S. Stallibrass – S. Th. Parker (eds.), *Feeding the Roman Army: the Archaeology of Production and Supply in North-West Europe* (Oxford 2008).

**Stauner 2004**

K. Stauner, *Das offizielle Schriftwesen des römischen Heeres von Augustus bis Gallienus (27 v. Chr.–268 n. Chr.)* (Bonn 2004).

**Vandorpe et al. 2017**

P. Vandorpe – Ö. Akeret – S. Deschler-Erb, Crop Production and Livestock Breeding from the Late Iron Age to the Late Roman Period in North Western Switzerland, in: S. Lepetz – V. Zech-Mattern (eds.), *Archéologie des plantes et des animaux. Productions agro-pastorales, pratiques culturelles et élevage dans le nord de la Gaule du deuxième siècle avant J.-C. à la fin de la période romaine* (Quint-Fonsegrives 2017) 135–152.

**Van Driel-Murray 1988**

C. van Driel-Murray, A Fragmentary Shield Cover from Caerleon, in: J.C. Coulston (ed.), *Military Equipment and the Identity of Roman Soldiers*, Proceedings of the 4th Roman Military Equipment Conference, BARIntSer 394 (Oxford 1988) 51–66.

**Van Driel-Murray 1994**

C. van Driel-Murray, Wapentuig voor Hercules, in: N. Roymans – T. Derks, *De Tempel van Empel. Een Hecules-heiligdom in het woongebied van de Bataven (s-Hertogenbosch 1994)* 92–107.

**Van Driel-Murray 2002**

C. van Driel-Murray, The Leather Trades in Roman Yorkshire and beyond, in: P. Wilson – J. Price (eds.), *Aspects of Industry in Roman Yorkshire and the North* (Oxford 2002) 109–123.

**Van Driel-Murray – Gechter 1984**

C. van Driel-Murray – M. Gechter, Funde aus der fabrica der legio I Minervia am Bonner Berg, in: *Beiträge zur Archäologie des römischen Rheinlands 4, Rheinische Ausgrabungen 23* (Bonn 1984) 1–84.

**Woolf 1993**

G. Woolf, Re-thinking the oppida, *OxfJA* 12, 1993, 223–234.