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Marine Lépée, Lucas Guillaud. Craftsmen and Shopkeepers Serving the Army: The Example of the Colony of Lugdunum (First Century AD). Van Limbergen Dimitri; Hoffelinck Adeline; Taelman Devi. Reframing the Roman Economy. New Perspectives on Habitual Economic Practices, Palgrave Studies in Ancient Economies (5), Palgrave Macmillan, pp.55-80, 2022, 978-3-031-06280-3. 10.1007/978-3-031-06281-0_3. hal-03860526

HAL Id: hal-03860526

<https://hal.science/hal-03860526v1>

Submitted on 24 Oct 2024

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Chapter 3 Craftsmen and shopkeepers serving the army: the example of the colony of Lugdunum (1st c. AD)

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Keywords Retail trade, Metal workshop, Metalworking, Roman Army, Military equipment

Abstract

The retail trade has profoundly shaped the urban and economic landscape of the ancient colony of *Lugdunum* (Lyon, France). Between the 1st c. B.C. and the end of the 3rd c. A.D., domestic and monumental blocks coexisted with numerous small ‘shops/workshops’ for ironed and copper alloyed goods production, repair and sale. Among these, some shops were aimed at specific customers: three Augustan shops at ‘Clos du Verbe Incarné’ produced offensive weapons for military use, according to the discovery of unfinished arrowheads. This type of production has not been often recognized in an urban context, especially far from the military lines. The interpretation and the spatialization of the activities carried out in these three shops will be proposed from the artifacts and associated archaeological structures. This study allows us then to question the economic relationship between civilian craftsmen and the Roman army, which is under-explored at the scale of urban centres. The collaboration between producers and unusual customers will be at the heart of our discussion. Several leads regarding the integration of this production into long-distance trade networks or on the contrary into a local market will be discussed, as well as the uncertain identity of the actors involved.

Introduction

The colony of Lyon, founded in BC 43 and promoted to the capital of the province of *Gallia Lugdunensis* under Augustus, was a central trading place in Gaul at the interface between *Gallia Narbonensis* and the more northern territories. It took advantage of the major distribution route constituted by the river Rhône. The settlement was established on the hill of Fourvière, overlooking the river Saône. The plateau of the Sarra, at the top of the hill, contained the residential and monumental settlements. That’s where the economic landscape and the networks of streets are best known (Fig. 3.1). Most of the shops identified worked closely with domestic facilities and also hosted production activities, as working structures and small finds attest.

The particular case of a complex of three shops built during the Augustan period on a site excavated in the 1980s in the upper town - the ‘Clos du Verbe Incarné’ - confronts us here with a small metal industry specializing in the production of weapons for military use on the façade of a residential block. This case study illustrates a retail trade dedicated to specific customers and shows the links uniting the craftsmen of the civil sphere and the army. The functional analysis of these premises combined with the technical study of the objects leads us to understand these discoveries in the context of the colony of Lyon and its strong links with the military world. The purpose of this paper is also to replace these local data in the broader context of the distribution and supply networks of the Roman army at the beginning of the 1st century AD.¹

¹This is a result of both the ongoing PhD work of Marine Lépée (Lépée, *Le commerce urbain de détail dans la Vallée du Rhône*) on the retail trade in the Rhone Valley between the 1st c. BC and the 3rd c. AD and the published dissertation of Lucas Guillaud (Guillaud, *Militaria de Lugdunum*) dealing with the weaponry and military equipment of the Roman period in Lyon.

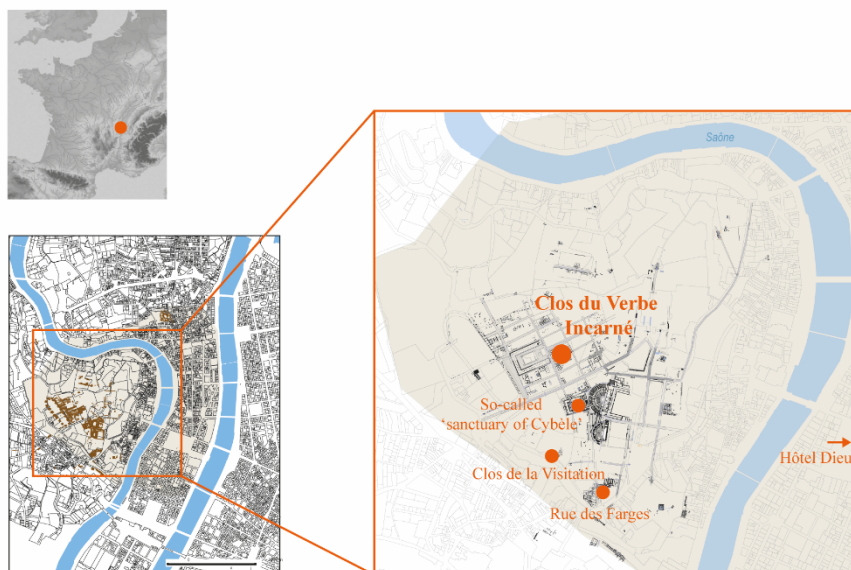


Fig. 3.1. Situation map of the upper town of Lugdunum with archaeological sites mentioned in the paper. (Base map by A. Desbat, M. Lenoble, G. Macabéo; CAD by M. Lépée)

The Shops/Workshops at ‘Clos du Verbe Incarné’: a Local Production of Offensive Weapons

Description and functional analysis

The ‘Clos du Verbe Incarné’ constitutes one of the most complete archaeological sites in Lyon to understand the organization of the urban fabric of the colony. The excavations carried out at the beginning of the 20th century, then extended between 1979 and 1987, revealed several residential blocks occupied mainly between the Augustan period and the middle of the 3rd c. AD.² The network of *cardines* and *decumani* is well known and the porticoes bordering these streets were associated in several places with shops/workshops.

The plot 3 extended in block XIV over an area of 351 m² and followed a slight eastward slope (Fig. 3.2). The granite wall socles and adobe walls were built in BC 15-10.³ The back of the plot probably sheltered a very levelled domestic settlement. The front of the plot developed in front of the ‘rue de la Fontaine’ and included three shops/workshops devoted to metalworking. The premises were widely opened onto the street through wooden thresholds framed by pillars built in mixed *opus*, as shops in the upper town of *Lugdunum* attested at that time.⁴ The floors were made of beaten earth and delimited rooms of similar size with a surface area of 21 to 25 m². We should assume that a 1.4 m wide passage existed to the east of room 2, crossed by a wooden gutter and allowing access to the living quarters. Such commercial units gathered on the facade of houses were common features in the upper town.⁵ The neighboring plot to the west had a similar organization in the shape of a corner complex of shops.

²Delaval, *L’habitat privé de deux insulae de la ville haute*.

³This first stage of building ended at the beginning of the reign of Tiberius. From the middle of the 1st c. AD, the dwelling place at the rear of the plot became a house with an inner courtyard (“the House with a Heated Bench”) that remained in use until the end of the 3rd c. AD: on the front, the artisanal complex was still active. Metalworking was attested in a more anecdotal way, although it was no longer dedicated to the production of weaponry. Only the Augustan stage will therefore be the focus of our discussion.

⁴The shops developing at the back of the Odéon and those at ‘Clos de la Solitude’ confirm this building mode.

⁵Clément, “L’architecture domestique à *Lugdunum*”.

The identification of the working structures is based above all on the excavation notebooks carried out in the field as well as on the master's degree of G. Bailly-Comte.⁶ No precise inventory of the features has been made. The suggested plan is therefore very schematic and probably does not take into account the complexity of the workshops. The protocol expected today for the treatment of metalworking areas has not been scrupulously applied in the field (sediment sampling, mapping of waste areas and distribution of waste).⁷ Hypotheses on the organization of these activities are therefore very limited.

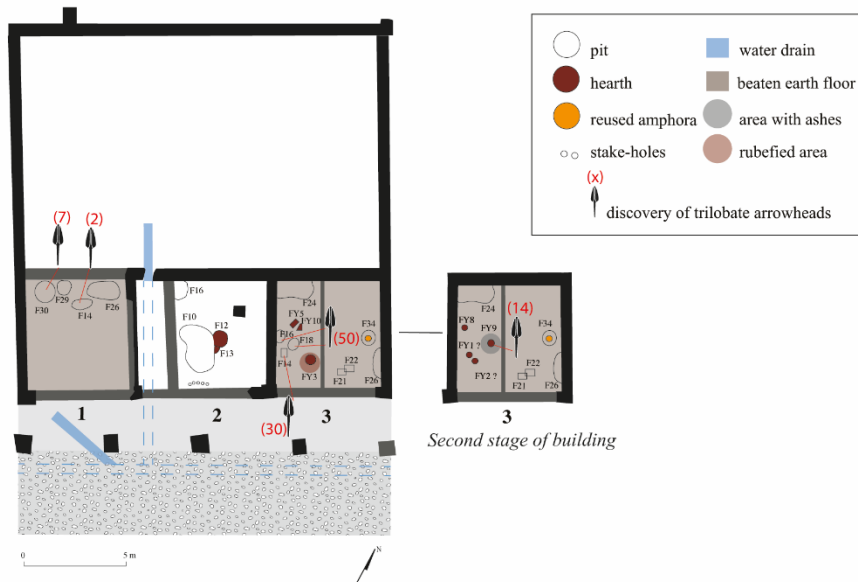


Fig. 3.2. Plan of the remains at 'Clos du Verbe Incarné' (block XIV, plot 3) during the Augustan time. (Base map by G. Bailly-Comte; CAD by M. Lépée)

Rooms 1 and 2 offered some working structures but the main workshop settled in room 3, to the east and slightly below. It was the best preserved of the three and was divided by a north-south partition wall, destroyed by a later pit. A concentration of excavated hearths (circular and quadrangular) and specialized ironwork for the production of arrowheads was noted in the western part. The study of the remains highlighted the existence of two successive settlement phases in this area, given the density of the hearths and their tendency to overlap. The presence of a working area consisting of an ashen floor and *tegulae* was also noticed, as well as several concentrations of scaling showing the potential location of an anvil (F14). The eastern part presented several working structures: refuse dumps, storage pits with negatives of wooden planks and stake-holes (F21-22)⁸ and a quenching structure based on a Dr. 20 amphora bottom, half-buried with a filling rich in iron oxides and coals (F34).

The analysis of metal waste combined with that of archaeological structures made it possible to illustrate almost all the stages of the operative chain of a main iron craft associated with a smaller-scale copper alloy craft. The scraps of iron sheets and bars distributed in the three rooms as well as the concentration of scaling and micro-waste reflected the hammering and cutting process. A copper alloy craft also left its marks, mainly in room 2. Bronze runoffs, fragments of crucibles and shapeless cast objects revealed foundry work, while sheet metal scraps illustrated brassware activity. The type of production is unfortunately impossible to reconstitute, given the lack of semi-finished products, probably removed or recycled.

⁶Bailly-Comte, *Etude d'ateliers de forgerons et de bronziers à Lugdunum*.

⁷Anderson *et al.*, *Des artisans à la campagne*; Mangin, *Le Fer*.

⁸These could be storage facilities for coal or recycled material, according to parallels recognized in Bliesbrück or Autun (Chardon-Picault, Pernot, *Un quartier antique d'artisanat métallurgique à Autun*, 208).

The three rooms may have constituted a single post-reduction workshop partly assigned to a specialized production (Fig. 3.3). These workshops were perennial and settled, as shown by the increasing number of hearth structures in the same spaces and the operational continuity in later times.⁹ Specialized areas between and even within these rooms existed, especially in room 3 where the space was well partitioned. The discovery of similar military artefacts in the course of manufacture in two of the three rooms promoted the hypothesis of a common functioning of the front rooms. Moreover, the close links between the shops and the portico, built with planted posts and not with posts on pebble supports as on the rest of the plot, should be highlighted. However, it remains very difficult to reconstruct the circulation within these spaces because of the incomplete data, the missing thresholds and the inability to recognize the access facilities between the rooms.

The architectural complex studied here referred to small-scale metal shops/workshops, where production and front selling activities coexisted. These were particularly widespread in the urban grid of the upper town.¹⁰ It did not involve activities gathered in peri-urban artisanal districts but rather craftsmen who settled as close as possible to the busy thoroughfares, the houses and the potential customers. These workshops had to ensure the production of specific metal items, but above all the maintenance and repair of daily life objects brought by the neighborhood's customers.

However, our case study is somewhat more specific because of the production purpose. On the one hand, the sales area can be imagined in a structure-free location among the three rooms studied: it could be the front of room 1 - but the lack of discovery in this area could be due to the levelling of the upper layers - or the front of room 2, considering the five stake-holes that lined the front wall and could indicate the location of a counter. On the other hand, assuming a concentration of sales activities in the adjacent shops in the corner complex of plot 1, which presented no evidence of local production and could therefore host this type of activity, did not seem relevant. It has been shown that the two units appear to operate independently.¹¹ It might also be assumed that the sale did not take place on this spot and that these premises were only intermediaries, without any access to customers but providing supplies to other local businesses or more directly to military establishments.

⁹The topographical permanence of smithy activities on the facade of a block, clearly visible and open to the street, was also attested in Olbia (Pagès, *Artisanat et économie du fer en France méditerranéenne*, 76).

¹⁰At the Augustan time, other attestations of metalworking activities could be observed on the front of the blocks at 'Clos du Verbe Incarné' (plot 4 nearby, plot 5 further north or block XXVI further south), on the neighboring site of the so-called 'sanctuary of Cybele' in front of a domestic block and at 'Rue des Farges' among commercial premises opening onto a square. This handicraft was more represented in the upper town from the Tiberian period and during the second half of the 1st c. AD.

¹¹Based on the continuous retaining wall that divided plots 1 and 3, their levels and their own construction strategies (Clément, "L'architecture domestique à *Lugdunum*").

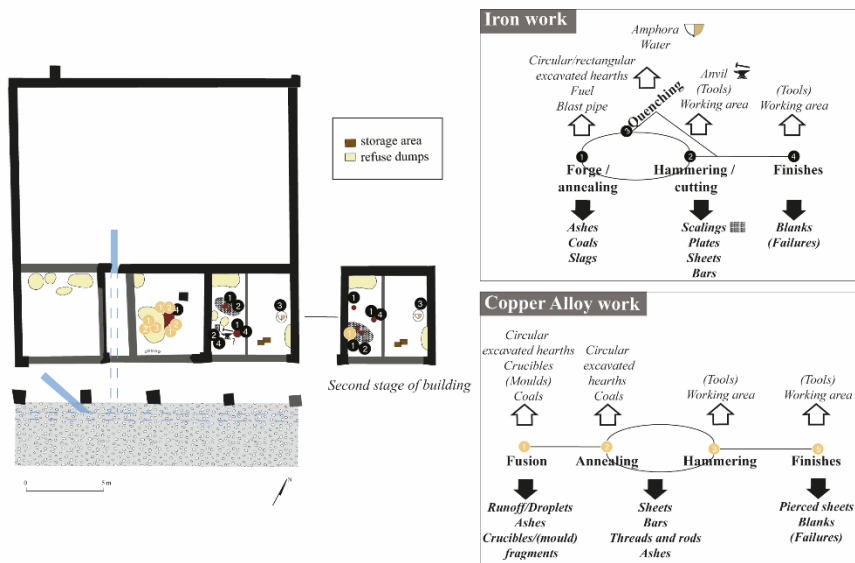


Fig. 3.3. Functional analysis of the shops/workshops and identified stages of the operative chain. The white arrows represent the necessary resources; the black ones the resulting waste (in brackets: not found in the workshop). (Base map by G. Bailly-Comte; CAD and graphs by M. Lépée, based on Monteix, Duvauchelle 2008)

The trilobate arrowheads

At 'Clos du Verbe Incarné', the working structures testified to the production of particular artefacts with a military purpose recognized as arrowheads. Although this production was not exclusive, it was the only one clearly identified within the workspace and storage areas of rooms 1 (10 arrowheads) and 3 (94 arrowheads). According to old excavation data, at least 104 arrowheads have been discovered. Unfortunately, only 45 of them have been found in the collections of the Museum *Lugdunum* and could therefore be studied (Fig. 3.4).¹²

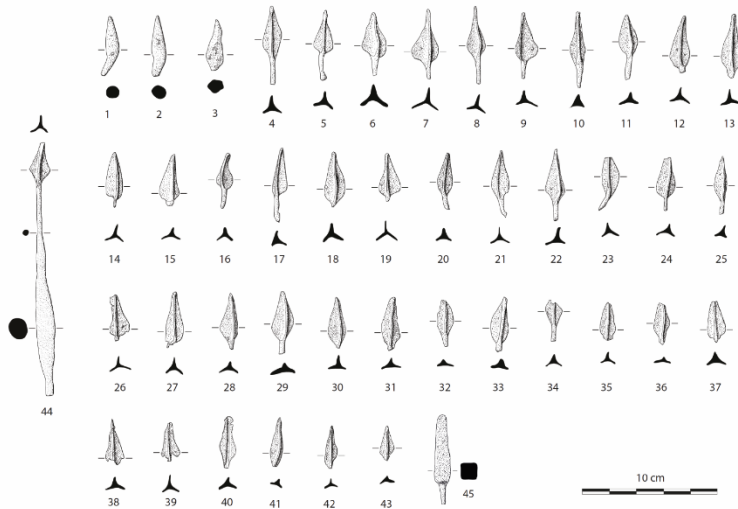


Fig. 3.4. The trilobate arrowheads found in the shops/workshops 1 and 3. (Design and CAD by L. Guillaud)

All of these objects correspond to the type of trilobate arrowheads. These projectiles were one of the most common type encountered in the Roman world, particularly in military context. It has been the subject of extensive

¹²Guillaud, *Militaria de Lugdunum*, 297-305.

typological and chronological studies for many years.¹³ Among the most significant of these, the contribution of W. Zanier has to be noticed. He has established four main types and clearly linked their presence to the military sphere. Originally manufactured in bronze, the trilobate arrowheads were almost exclusively made of iron during the Roman period.¹⁴ The specimens collected in Lyon were discarded in progress of manufacturing, but they seemed to correspond to Zanier's type 2 or 3,¹⁵ without any barbs.¹⁶ The occurrences of these arrowheads are numerous and show a very wide distribution both in a geographical and a chronological way.¹⁷ They can be found from Britain to the eastern provinces, through the Rhine and Danube borders. Among the most significant lots, more than twenty arrowheads of this type could be found in *Vindonissa*, while 127 objects were discovered in *Vetera/Xanten* and above all several hundred in Judea in Gamala and Masada.¹⁸

This collection has a major interest because it provides us an insight into the manufacturing process of these projectiles. The issues relating to the manufacture of Roman weapons have already aroused the researchers' interest.¹⁹ On the basis of experimental work W. Zanier was able to identify twelve stages in the manufacture of these archery projectiles. The tools needed to produce trilobate arrowheads are few and no specific craft installation is really necessary,²⁰ which is relevant regarding the structures discovered inside room 3 at 'Clos du Verbe Incarné'. Unfortunately, no associated tools have been discovered in the workshop area such as hammers, tongs, punches, files, etc. Only the hypothetical place of an anvil log associated with metal micro-waste could be notice.

Nevertheless, almost all stages of the manufacture of these archery projectiles are represented (Fig. 3.5). Among the semi-manufactured arrowheads, several blanks appear to correspond to the early stages of manufacture. More examples show an abandonment of work at stage 4 or 5 of the process. Most of the specimens appear to have been ditched at an advanced stage of completion. They are characterized by three well individualized and opposite wings (stage 8). Clues explaining why they were wasted are not obvious. In the case of fragmented objects, it is easy to consider the break of the point during hammering. On the other hand, the well-preserved specimens may have been left because the tang broke prematurely, and so were impossible to be assembled on its wooden shaft.

One of those artefacts is interesting because it allows us to depart a little from the theoretical scheme proposed by W. Zanier. This object consists of a long rod with a circular section, the lower part of which is enlarged. The upper end shows a trilobate head like the previously studied items (Fig. 3.4, n°44). This example shows that blacksmiths may have worked the iron from a longer bar or rod to form the point, allowing the object to be better gripped during manufacture using tongs. The final step would therefore be to cut the tang to the desired length.

Finally, it should be notice that among the arrowheads found in room 3 is a specimen of a different type. It is distinguished by a tang and a pyramidal head, which is quite massive (Fig. 3.4, n°45). Although these arrows were less well represented in the Roman world, there were also known from the *limes* camps. It can therefore be assumed that the blacksmiths at 'Clos du Verbe Incarné' produced not only trilobate arrowheads but also other types of

¹³Erdmann, "Dreiflügelige Pfeilspitzen aus Eisen von der Saalburg"; Davies, "Roman Arrowheads from Dinorben and the *Sagittarii* of the Roman army"; Coulston, "Roman Archery Equipment"; Zanier, "Römische dreiflügelige Pfeilspitzen"; Zanier, "Zur Herstellung römischer dreiflügeliger Pfeilspitzen".

¹⁴One particular example has been found in Moigrad/Porolissum, where nearly 200 foliated arrowheads made of bone were discovered (Zanier, "Römische dreiflügelige Pfeilspitzen", 17; Feugère, *Les armes des Romains*, 212).

¹⁵Zanier, "Römische dreiflügelige Pfeilspitzen", 6 fig.1.

¹⁶The fact that these elements were semi-finished products or production failures could nevertheless imply the production of barbs during the process of production.

¹⁷Guillaud, *Militaria de Lugdunum*, fig. 139.

¹⁸For an exhaustive list of artefacts, see Guillaud, *Militaria de Lugdunum*, 539-540, list 9.

¹⁹Sim, "Roman Chainmail"; Sim, *Beyond the Bloom*, 64-70; Sim, Ridge, *Iron for the Eagles*.

²⁰Zanier, "Zur Herstellung römischer dreiflügeliger Pfeilspitzen", 24 fig. 5.

projectiles related to archery. Moreover, from a technical point of view, this type of arrow is much easier to manufacture than trilobate arrowheads, because they correspond to stage 3 of the *modus operandi* established by W. Zanier.

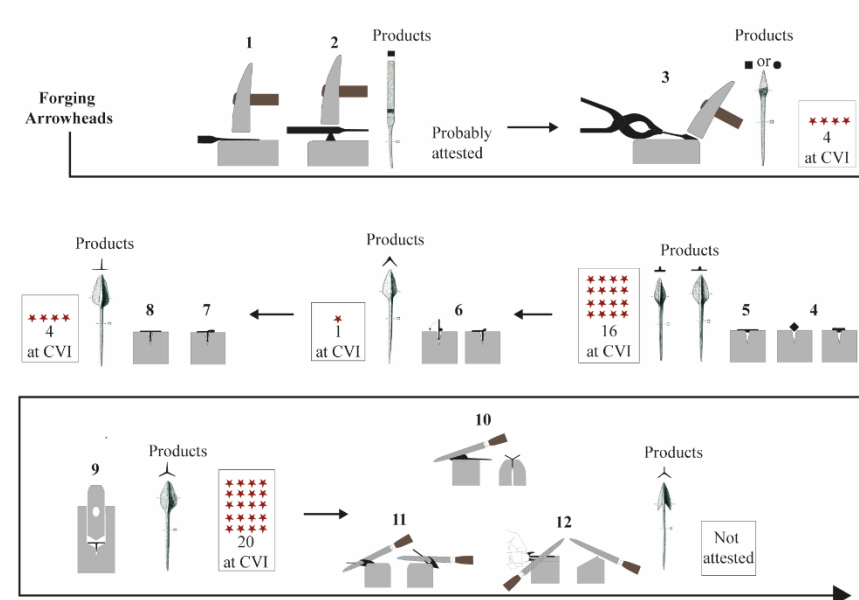


Fig. 3.5. Manufacturing steps for military trilobate arrowheads (CVI = ‘Clos du Verbe Incarné’). (Steps by W. Zanier 1988; CAD by L. Guillaud)

Craftsmen in *Lugdunum* and the Production of Military Equipment

Archaeological data

From an archaeological point of view, the production of arrowheads at ‘Clos du Verbe Incarné’ does not seem to represent an isolated case of the involvement of blacksmiths or metal craftsmen serving the army.

At Lyon itself, two other sites have provided waste from crafts or goods related to military manufacture or repair. In the upper town of Fourvière, not far from ‘Clos du Verbe Incarné’, the so-called ‘sanctuary of Cybele’²¹ has uncovered a refuse dump pit dating from AD 15. This structure contained the remains of copper alloy craftsmanship. It illustrated the mass production of buckles for military belts made of bronze sheet and cast decorative elements. Like at ‘Clos du Verbe Incarné’, the craft wastes from the pit showed a metal industry that combined iron and copper alloy working (slag, cut sheet metal, castings, pumicestones, etc.). At ‘Hôtel-Dieu’, close to the Rhône river, a series of objects made of copper alloys showed a probable repair activity or production of decorative elements for horse harnesses or belts. These artefacts were mainly excavated within backsoils associated with a lacunary settlement dated between 40 and 70 AD. They consisted of pendants and nails applied to the leather harness straps. Unfortunately, these two previous examples couldn’t be linked directly to working structures or a workshop context.

In the upper town, at ‘Rue des Farges’, the excavation of several commercial units opening onto a square with a portico revealed a fairly large number of objects related to horse harness and military belt fittings. These objects were concentrated on the ground and demolition levels of the shops, which were abandoned in the middle of the

²¹ Desbat, Savay-Guerraz “Feuille 9. Les Théâtres”, 368-371. Several hypotheses have been suggested concerning the function of this building; recently, L. Guillaud compared it to the *principia* of military camps (Guillaud, *Militaria de Lugdunum*, 401-406).

1st c. AD.²² The particularity of this sample lies in the presence of tinned or sometimes niello-decorated elements, well known in military context and produced for example in Alesia (cf. *infra*). Their concentration within the commercial area made it possible to consider with precaution a possible production or sale of these elements *in situ*. However, no structure or artisanal waste clearly confirmed this hypothesis.

Epigraphical data

Moreover, several inscribed items, found in *Lugdunum* itself and elsewhere in Gaul, seem to show the involvement of craftsmen from Lyon in the manufacture of offensive and defensive weapons.²³

Many Roman weapons discovered in the forts bear the mark either of the owner or of the craftsman at the origin of the object. Two marks observed on decorated scabbards of Mainz type were clearly attributed to craftsmen from Lyon. The first was found in *Vindonissa* in the barracks of the XIIIth legion camp. The plate fragments show several registers decorated in bas-reliefs depicting hunting scenes in a vegetal decoration. At the junction of the two upper registers there is a rectangular cartouche with the inscription *C. Coelius Venust(us) Lugud(uno)*. The name of the craftsman (a Roman citizen) is therefore clearly followed by the place where the object was produced, without any doubt the capital of Gaul in Lyon. Another fragment of scabbard, found in ‘Le Grand-Saint-Bernard’ in Switzerland, is stylistically strictly similar to the upper register of the Windisch example.²⁴ It was probably made from the same matrix, and therefore from the same workshop in Lyon.

At Strasbourg, a second inscription has been found on a well-preserved scabbard associated with a Mainz type sword. At the upper end, in a rectangular cartouche, the inscription ‘*Q. Pude(n)s ad Ara(m) f(ecit)*’ can be read. On this mark, the name of the craftsman is not followed by the city of the workshop but by a mention of an altar (*ara*). For E. Ettliger and M. Hartmann, this would have been the altar of Rome and Augustus associated with the sanctuary of the Three Gauls, which is traditionally placed on the hillside of the hill of ‘Croix-Rousse’.²⁵

Finally, an armament set discovered in the middle of the 19th century at ‘Montée de Balmont’ provided a bronze armour-piece named *ocrea* with two pierced marks on its edges. Unfortunately, the object has now disappeared from the collections of local museums. Only the notes and basic reproductions of the objects have survived through the efforts of A. Steyert, a historian from Lyon at the end of the 19th century. One of the marks is well preserved and allows us to restore the mention ‘*IMP. CAES. AVG.*’. The other inscription is more incomplete and several readings could be assumed. M. Poux suggested recently carefully that it could be read ‘*[AD] [A]R[A]M F(ecit)*’, following the example of Strasbourg.²⁶ The latter case remains however submitted to more caution because the weapons set has been dated more recently, probably from the end of the 2nd c. AD.

The Production of Military Equipment in Civilian Contexts: long-distance networks or local market?

²²Clément et al. “Feuille 12. Les Farges”, 429-441.

²³Ettliger, Hartmann, “Fragmente einer Schwertscheide aus Vindonissa”.

²⁴Ettliger, Hartmann, “Fragmente einer Schwertscheide aus Vindonissa”, 8-10; Deschler-Erb, “*Instrumentum et militaria* du Grand Saint-Bernard”, 267-268.

²⁵Ettliger, Hartmann, “Fragmente einer Schwertscheide aus Vindonissa”, 38; Feugère, *Les armes des Romains*, 141-142. While R. Mc Mullen proposed a local origin for this sword (McMullen, “Inscriptions on armor and the supply of arms in the Roman Empire”, 36-37), G. Ulbert saw in it the mention of the *ara ubiorum* of Cologne (Ulbert, “Römische Bronzекнопfe mit Reliefverzierung”, 44 and 48-49; Oldenstein, “Manufacture and supply of the Roman army”, 84).

²⁶Another restitution could be: ‘*[TU]RM(A) F(ecit)*’ (Poux, Guillaud, “La bataille de Lyon aux prismes des découvertes archéologiques”).

Customers and trade

The issue of the production and circulation of weapons and military equipment during the Early Principate has been the subject of constant questioning for many decades. The scale of distribution and the level of integration into existing commercial networks, particularly throughout Roman Gaul, need to be discussed.

With the stabilization of the Rhine and Britain frontiers, the military camps, which were more or less permanently settled, were equipped with handcraft buildings, regarding the evidence of metal craftsmanship.²⁷ These *fabricae* are now well identified, for example in Dangstetten, Mainz or Birdoswald. These buildings did not correspond to a precise architectural pattern. They could also be located in all areas of the camp and were often identified by the craft structures and the metal waste they provided. To the best of our knowledge, the metal handcrafts inside the roman forts were probably not mass production but were perhaps intended more for the repair and manufacture of replacement items toward the units in garrison. We could assume that the army was therefore not fully self-sufficient in terms of equipment²⁸ and was probably dependant on pre-existing supply networks in order to meet the demand.²⁹

Thus, in the civilian context, we may distinguish on one hand the *canabae*, *vici* and urban centres close to the military camps. They were linked in this way by local networks of exchange which seem obvious. This is the case in *Vindolanda canabae* for example³⁰ or also in Augst (Switzerland).³¹ In the latter case, evidence of production/repair and recycling of military artefacts (belt buckle drafts, manufacture of bone sword grips) was identified in *insulae* 22 and 50, associated with the attested military presence in the lower town.

On the other hand, several civilian sites located far from the military fixation lines on the *limes* also seemed to be the actors of this supply. It is well-known that during the Augustan period the production of military equipment was already carried out by private workshops in the regions concerned by the conquest of the provinces. However, the archaeological evidences of this production in a civilian context are scarcely recognised and the relationship between private craftsmen and the army is still under-explored. Nevertheless, some examples of shops/workshops dating from the 1st c. AD inserted in the urban centres in close connection with domestic settlement can be recognized. Thus, the research carried out by H. Dolenz in Magdalensberg³² (Austria) showed that local craftsmen were probably involved in the production of horse harness and military equipment (decorative pendants, *phalerae*, scabbard fittings...). These clues were particularly concentrated in the shop/workshop OR 17 between BC 20/10 and the beginning of the 1st c. AD in the artisanal district next to the *forum*. The manufacture of copper alloys was attested here on the basis of the structures, the numerous production waste and the semi-finished military artefacts found *in situ*. The surrounding infrastructures linked to retail trade also contained some evidence that military equipment was sold (burnt shop SH5 from the Tiberian period). In Gaul, in Alesia (France, Côte d'Or), several workshops of bronze-workers and blacksmiths were documented in the neighbourhoods to the south-east of the *forum*. They were associated with refuse dumps which revealed the production of horse gear elements from the Neronian period.³³ The discovery of moulds and misfits indicated the production of *phalerae*, junction loops, fasteners and strap fittings. Silver foil and inlaid with niello was applied to these harness elements. This speciality

²⁷ Bishop, "The military fabrica and the production of arms", 7; Hanel, "Fabricae, Werkstätten und handwerkliche Tätigkeiten", 22-25; Reddé et al., *L'architecture de la Gaule romaine. I. Les fortifications militaires*, 116-117.

²⁸ Nicolay, *Armed Batavians*, 131-132; Cosme, "Les fournitures d'armes aux soldats romains", 137.

²⁹ Oldenstein, "Manufacture and supply of the Roman army", 89.

³⁰ Kolbeck, "A Foot in Both Camps", 4-5.

³¹ Deschler-Erb, *Ad arma!*; Deschler-Erb, "Der Anteil des Militärs an der frühen Entwicklungsgeschichte von Augusta Raurica".

³² Dolenz, Flügel, Öllerer, "Militaria aus einer Fabrica auf dem Magdalensberg (Kärnten)".

³³ Rabeisen, "Fourniture aux armées?"; as well as recent discoveries from the workshops at "Champs de l'Eglise" (Depierre et al., "Alésia : un nouvel atelier de bronzier").

is well documented by textual sources about Alesia's metalworkers.³⁴ Furthermore, in Autun (France, Saône et Loire), at '11 avenue du deuxième Dragon', excavations revealed several shops opening onto a street in the Tiberian period.³⁵ Among them, a shop attested copper alloy craftsmanship dedicated to the repair of various objects, including horse gear elements (moulds for harness or belt fittings). Moreover, in Javols (France, Lozère),³⁶ a production of horse harness components was also attested by fragments of crucibles and moulds used for manufacturing junction loops, *phalerae* and decorative strap fittings. This production was associated with wheelwright and locksmith activities during the 1st c. AD. These testimonies were found in a shop and its adjoining portico.

However, the above examples all illustrate a production devoted to items of equipment rather than weapons. It shows even more the specificity of the case of *Lugdunum* and its economic role linked to the military sphere. We should mention here another example, although later, which constitutes a scarcer indication of an offensive weapons production in a civilian context. In Poitiers (France, Vienne), the excavations of 'Ilot des Cordeliers' attested to the presence of bronze craftsmanship since Tiberian times.³⁷ Several rooms on the frontage of a monumental *domus* (perhaps interpreted as a *schola*), revealed a polymetallic handcraft associated with hard animal material and leather industry dedicated to the production of military artefacts in the 2nd c. AD. Both finished objects and semi-products illustrated the manufacturing and sale of sword pommels and blades, scabbard chapes, shield bindings, loop fasteners, as well as decorative mounts for horse harness. This specialised craft could be linked to the presence of military equipment in a domestic context (adjoining backrooms) which suggests the settlement of veterans. We may also mention the more specific case of road stations, such as *Ambrussum* (France, Hérault), where a weapons production took place in the 2nd c. AD, in connection with the army and administrative agents (*stationarii*) who passed through there.³⁸

Following these additional examples besides the case of Lyon, several hypotheses regarding the distribution networks can be suggested. According to the scheme proposed by J. Oldenstein,³⁹ Rome was able to rely on the major river axes and the roads consolidated by Agrippa and Augustus to transport its supplies to the *limes*: the Rhone valley thus made it possible to reach, in a relatively short period of time, the upper Rhine and Danube rivers via the Saone and the Doubs (extended by the roads of the Swiss plateau) and also to lead to the Lower Rhine through the Moselle and the Meuse (Fig. 3.6). As a result, *Lugdunum* was able to be one of the civilian sites with skilled craftsmen contributing to the army's punctual supply, using long-distance exchange networks. Its preferred location as a major hub, at once a center for the arrival, production and redistribution of goods, certainly contributed greatly to this strategic choice. Lyon's role in the production and wholesale trade of other goods towards the *limes* as early as the end of the 1st c. AD is well known, regarding food supplies (wine and oil transported in amphoras produced in Lyon or transiting through Lyon for redistribution; cereals based on the distribution of *granaria*), ceramic tableware (like the vessel manufactured in Arezzo branches settled in Lyon, in

³⁴ Plin. Nat. 34.48.162.

³⁵ Dubreucq, Silvino, "Un nouveau témoignage sur l'artisanat des métaux à Autun".

³⁶ Rabeisen, Saint-Didier, Gratuze, "L'artisanat des alliages cuivreux à l'époque romaine : témoignages d'une production métallurgique à Javols-Anderitum (Lozère)".

³⁷ Jouquand, Wittmann, "Des ateliers et des boutiques en bordure d'un complexe monumental"; Jouquand-Thomas, Larcelet, Miks, "Römische Helme".

³⁸ Pagès, *Artisanat et économie du fer en France méditerranéenne*, 109; Fiches, "A propos de la politique routière de l'Etat romain".

³⁹ Oldenstein, "Manufacture and supply of the Roman army".

the workshop of ‘La Mulette’), coins...⁴⁰ The long-distance distribution of these goods was managed by the corporations of river transporters well attested by the epigraphy.⁴¹

It seems interesting to note that the chronology of these different activities had some historical relevance. We know, as a matter of fact, that the end of the Augustan period was marked by large-scale military operations on the *limes*, first the ‘reprisal campaigns’ led by Tiberius following the defeat of Varus from AD 10, then the offensives led on the right bank of the Rhine by Germanicus between AD 14 and 16. During these different operations, it is likely that the army's demand for military equipment must have been more than significant and that the troops in the field could not satisfy it on their own. This need for a quickly renewed arsenal during a military campaign applies specially to light artillery projectiles such as arrowheads, which, unlike hand-held weapons, are most often left on the battlefield after use. The specialized production of the workshop at ‘Clos du Verbe Incarné’ could therefore fit into these long-distance networks dedicated to the military camps.



Fig. 3.6. Lyon and the commercial networks towards the *limes* at the Augustan period: squares = main Augustan camps on the *limes*; red dashes = main roads to German *limes*; stars = inscribed weapons attributed to craftsmen from Lyon. (Base map artefacts.mom.fr, © Artefacts; CAD by L. Guillaud and M. Lépée)

Nevertheless, the assumption that these weapons could have been produced for a local clientele must be discussed because *Lugdunum* has maintained a close link with the army since its foundation. The capital of the Gauls is one of the few colonies under Roman law to have disposed of a permanent garrison during the Principate, commonly known as the urban cohort. The presence of this specialized unit, which assumed military, administrative and police functions at the same time, is very well attested by epigraphy.⁴² Several units succeeded one another in Lyon in the 1st and 2nd c. AD, probably in the tradition of the *urbaniciani* of the *Urbs*, before being replaced by legionary contingents from the Germanies following the Battle of Lyon in AD 197. Recently, excavations carried out in the upper city, on ‘Clos de la Visitation’, led to the discovery of buildings with a military purpose and several dozen weapons and military equipment that seem to confirm the close cantonment of the unit in Lyon at least as early as the reign of Tiberius.⁴³ Among this furniture, three trilobate arrowheads have been uncovered. The idea that the

⁴⁰ Desbat, Genin, “Les ateliers précoces et leurs productions”; Desbat, Martin-Kilcher, “Les amphores sur l'axe Rhône-Rhin”; Poux, “Le granarium des ‘Buissières’ à Panossas”.

⁴¹ Bérard, “Les corporations de transport fluvial à Lyon à l’époque romaine”.

⁴² Bérard, *L’armée romaine à Lyon*.

⁴³ Ongoing digging campaigns under the direction of B. Clément, S. Carrara and L. Guillaud (Univ. Franche-Comté, SAVL, Archeodunum). See Clément, Guillaud, Carrara, “Témoignage d’une lutte de pouvoir à la fin du II^e siècle : les fouilles du Clos de la Visitation (Lyon 5^e)”.

arrows of ‘Clos du Verbe Incarné’ were intended for the urban cohort, and thus for a local clientele, is consequently not excluded. However, it encounters currently a chronological issue. Until now, no epigraphical document or undeniable archaeological evidence confirms the existence of the Roman garrison in the Augustan period, although some tenuous clues tend to point in that direction.⁴⁴

The actors of the production process

Let us return to the case of ‘Clos du Verbe Incarné’: here the quantity of metal objects and waste, as well as their spread over at least two of the shops on the plot, made it possible to consider a significant production and suggested the involvement of several craftsmen for this specific activity. The location of the workshop, in the heart of a residential area, seemed to indicate that the craftsmen in charge of production must have belonged to the civil and private sphere. The type of the contracts binding the army to the civilian craftsmen, however, remains difficult to define.

On the one hand, the collaboration between civilian metalworkers and the army is well attested by literary and epigraphic sources. The support of the Gallic peoples seemed to continue in later times, as Tacitus attested concerning the Lingons during the wars of Vitellius.⁴⁵ Among the *Aedui*, an inscription found in Monceaux-le-Comte and dated to the end of the 2nd c. AD⁴⁶ mentions craftsmen specialized in the manufacture of armour (*opifices loricatorii*). The inscriptions on the weapons mentioned above are a further example of that phenomenon. In the camps themselves, archaeological documentation also mentioned collaboration with civilian craftsmen, as witnessed, for example, by the *Vindolanda* tablets.⁴⁷

In *Lugdunum*, funerary inscriptions from the 2nd and 3rd centuries underline the presence of very diverse craftsmen who worked here, including a few metalworkers. Most of them showed a high degree of specialization in their type of production, but none of them revealed a link with the military world.⁴⁸ In addition, the contracts signed between the Roman power and the craftsmen/traders of Lyon could be based on the *collegiati*, well identified in the city: a potential link between some of these corporations⁴⁹ and a military market can be assumed, especially concerning the corporations of transporters. However, in the present case, no professional association of metal craftsmen were attested in Lyon.

Furthermore, the diversity of the terms and conditions of this collaboration must be highlighted. Beyond the issue of massive orders of goods and supplies, the possibility of orders from particular individuals to specialized craftsmen for the manufacture and/or repair of prestige goods should be taken into account. The Roman army did not have a completely uniform equipment: the legionaries, with the help of their personal pay, could complete and improve their equipment, especially their sword and belt, symbols of the soldier's military and personal identity.⁵⁰ The swords of *Vindonissa* and Strasbourg, previously mentioned, could fulfill such orders. Juridical sources also confirm the existence of contracts for special orders, responding to a request for the manufacture of a specific

⁴⁴The earliest evidence was provided by Tacitus, who mentioned the presence of a cohort in Lyon in AD 21 at the time of the revolt of Sacrovir (Tac. Ann. 3.40-41). See Guillaud, *Militaria de Lugdunum*, 353-408.

⁴⁵Tac. Hist. 1.57

⁴⁶CIL XIII, 2828.

⁴⁷Kolbeck, “A Foot in Both Camps”.

⁴⁸CIL XIII 1948 (negotiator argentarius vascularius); CIL XIII 2024 (arti(fici) arge[nt(ario) excludor(i)); CIL XIII 2036 (incompa/rabilis ingeni(i) artis fabricae / ferrariae).

⁴⁹These are notably the *nautae* and the *negotiatores vinarii* (Hasegawa, “L’union de collègues professionnels de Lyon”). The other corporations attested are those of *centonarii*, *fabri* and *utricularii*.

⁵⁰Bishop, Coulston, *Roman military equipment from the Punic Wars to the fall of Rome*, 253-261; Hoss, “The Roman Military Belt”.

object and/or supplying the craftsman with the raw material, particularly in the case of goldsmith's art.⁵¹ Here, the case of 'Clos du Verbe Incarné' rather gives evidence of a production limited to a short-time period, which appears to respond to large-scale contracts linked to a massive and prompt demand.

Finally, wondering about the identity of the actors of such a production, given the specific customers for whom they worked, also means looking at the architectural framework of the rooms where the production is located and asking the question of their ownership. At 'Clos du Verbe Incarné', they were inserted in the facade of a dwelling place, which will later become a *domus* with an inner courtyard and elaborate fittings. Could we assume that the owner of the Augustan times had placed *instructores* at the head of his shops and had himself strong links with the army? Should we on the contrary suppose that the owner of the house at the back was not involved in the management of this retail trade and rented his shops to independent craftsmen? The lack of recognized access between the premises and the house, as well as the construction of upstairs apartments that could be reached from the staircases in the shops from the middle of the 1st c. AD onwards, insisted on the autonomy of this complex. No conclusion can be drawn, though, because the Augustan aspect of the rear of the plot remained very poorly known and gave only an incomplete view of the relationship between the economic facade and the domestic settlement.⁵²

The hypothesis of veterans involved in the local economy and assuming the role of craftsmen/merchants seems particularly appropriate in Lyon, which is a veteran colony established in BC 43. Veterans as *negotiatores* were documented by epigraphic sources, particularly in Lyon itself, where Vitalinius Felix of the *Legio I Minervae* worked as a pottery merchant in the 3rd c. AD.⁵³ It is known that they could enjoy a preferential customer network among their former fellow soldiers and that they had certain legal and economic benefits (such as tax exemptions) that helped them start their wholesale business.⁵⁴ Some of them were specialized in the production/sale of weapons and military equipment, which is particularly relevant to our discussion. In Mainz, a veteran sword dealer is mentioned.⁵⁵ In Pompeii, archaeological findings meet epigraphic sources: a blacksmith's shop on the Via Stabiana (VIII 7, 8, 3) was apparently the place of work of Surus Garasenus, a veteran from Syria - based on his military diploma found in the store - who produced and sold here horse gear fittings in a civilian context, from the furniture discovered.⁵⁶ At 'Clos du Verbe Incarné' a veteran could therefore be the main actor of this industry.

The different scenarios evoked regarding the identity of the actors and customers of this production of arrowheads point in all cases towards the idea of a production controlled by the representatives of the army, most likely aimed at a long-distance distribution.

References

Anderson, Timothy J., Clara Augustoni, Anika Duvauchelle, Vincent Serneels and Daniel Castella. *Des artisans à la campagne. Carrières de meules, forge et voies gallo-romaines à Châbles (F)*. Fribourg: Service archéologique de l'État de Fribourg, 2003.

⁵¹Tran, *Dominus tabernae*, 312.

⁵²The case of *tabernae publicae*, which we are tempted to evoke if we assume a link between the local authorities and a craft production for the army, does not seem relevant here, given the location of the workshops in private dwellings, unrelated to public buildings (Tran, "Tabernae publicae: ateliers et boutiques dans le patrimoine des cités de l'Occident romain").

⁵³CIL XIII 1906.

⁵⁴Hasegawa, *Les commerçants et les transporteurs*, 193-199; Verboven, "Good for business", 309-312.

⁵⁵CIL XIII 6677 (C. Gentilius Victor).

⁵⁶Simon Ortisi, *Studien zum römischen Pferdegeschirr*, 149-152.

- Bailly-Comte, Géraldine. *Etude d'ateliers de forgerons et de bronziers à Lugdunum (Lyon) à travers l'étude des déchets métallurgiques et des structures artisanales, découverts sur le site du Clos du Verbe Incarné (colline de Fourvière), îlots VII et VIII*. Univ. Lumière Lyon 2, Unpublished academic work, 2001.
- Bérard, François. "Les corporations de transport fluvial à Lyon à l'époque romaine." In *Collegia. Le phénomène associatif dans l'Occident romain*, edited by Monique Dondin-Payre and Nicolas Tran, 135-154. Bordeaux: Ausonius Editions, 2012.
- Bérard, François. *L'armée romaine à Lyon*. Rome: Ecole Française de Rome, 2015.
- Bishop, M.C. "The military *fabrica* and the production of arms in the Early Principate." In *The production and distribution of Roman military equipment. Proceedings of the Second Roman Military Equipment Research Seminar*, edited by M.C. Bishop, 1-30. Oxford: BAR Publishing, 1985.
- Bishop, M.C. and J.C.N. Coulston. *Roman military equipment from the Punic Wars to the fall of Rome*. Oxford: Oxbow Books, 2006.
- Chardon-Picault, Pascale and Michel Pernot *Un quartier antique d'artisanat métallurgique à Autun, Saône-et-Loire: le site du Lycée militaire*. Paris: Editions de la Maison des sciences de l'Homme, 1999.
- Clément, Benjamin. "L'architecture domestique à Lugdunum." In *Atlas Topographique de Lugdunum. Vol. I Lyon-Fourvière*, edited by Michel Lenoble, 495-514. Dijon: Société Archéologique de l'Est, 2018.
- Clément, Benjamin, Armand Desbat, Capucine Sartre and Hugues Savay-Guerraz. "Feuille 12. Les Farges." In *Atlas Topographique de Lugdunum. Vol. I Lyon-Fourvière*, edited by Michel Lenoble, 427-462. Dijon: Société Archéologique de l'Est, 2018.
- Clément, Benjamin, Lucas Guillaud and Stéphane Carrara. "Témoignage d'une lutte de pouvoir à la fin du II^e siècle: les fouilles du Clos de la Visitation (Lyon 5^e)." In *Enquête de pouvoir de Rome à Lugdunum*, edited by Patrice Faure and Frédéric Hurlet, 159-173. Gand: Snoeck, 2021.
- Cosme, Pierre. "Les fournitures d'armes aux soldats romains." In *The Impact of The Roman Army (200 BC –AD 476). Economic, Social, Political, Religious and Cultural Aspects*, edited by Lukas De Blois and Elio Lo Cascio, 239-260. Boston: Brill, 2007.
- Coulston, Jonathan C. "Roman Archery Equipment." In *The production and distribution of Roman military equipment. Proceedings of the Second Roman Military Equipment Research Seminar*, edited by M.C. Bishop, 220-336. Oxford: BAR Publishing, 1985.
- Davies, Jeffrey L. "Roman Arrowheads from Dinorben and the *Sagittarii* of the Roman army." *Britannia* 8 (1977): 257-270.
- Delaval, Eric. *L'habitat privé de deux insulae de la ville haute de Lugdunum sous le Haut-Empire romain : contribution à la connaissance de l'architecture domestique en Gaule romaine*. Univ. Provence Aix-Marseille, Unpublished PhD thesis, 1995.
- Depierre, Germaine, Antoine Mamie, Romuald Pinguet and Arnaud Coutelas. "Alésia : un nouvel atelier de bronzier dans le quartier des Champs de l'Église." *Revue Archéologique de l'Est* 55 (2006): 151-172.
- Desbat, Armand and Stéphanie Martin-Kilcher. "Les amphores sur l'axe Rhône-Rhin à l'époque d'Auguste." In *Amphores romaines et histoire économique. Dix ans de recherche. Actes du colloque de Sienne (22-24 mai 1986)*, 339-365. Rome : Ecole Française de Rome, 1989.
- Desbat, Armand and Martine Genin. "Les ateliers précoces et leurs productions." *Gallia* 53 (1996): 219-241.
- Desbat, Armand and Hugues Savay-Guerraz. "Feuille 9. Les Théâtres." In *Atlas Topographique de Lugdunum. Vol. I Lyon-Fourvière*, edited by Michel Lenoble, 339-392. Dijon: Société Archéologique de l'Est, 2018.

Deschler-Erb, Eckhard. *Ad arma! Römisches Militär des 1. Jahrhunderts n. Chr. in Augusta Raurica*. Augst: Römermuseum Augst, 1999.

Deschler-Erb, Eckhard. "Der Anteil des Militärs an der frühen Entwicklungsgeschichte von *Augusta Raurica*." In *Genese, Struktur und Entwicklung römischer Städte im 1. Jahrhundert n. Chr. in Nieder- und Obergermanien: Kolloquium vom 17. bis 19. Februar 1998 im Regionalmuseum Xanten*, edited by Gundolf Precht and Norbert Zieling, 203-216. Mainz: Ph. Von Zabern, 2001.

Deschler-Erb, Eckhard. "*Instrumentum et militaria* du Grand Saint-Bernard." In *Alpis Poenina, Grand Saint-Bernard, Une voie à travers l'Europe, Séminaire de clôture, 11|12 avril 2008, Fort de Bard (Vallée d'Aoste)*, edited by Lorenzo Appolonia, François Wibl  and Patrizia Framarin, 257-310. Aoste, 2008.

Dolenz, Helmo, Christof Fl gel and Christoph  llerer. "*Militaria* aus einer *Fabrica* auf dem Magdalensberg (K rnten)." In *Provinzialr mische Forschungen. Festschrift f r G nter Ulbert zum 65. Geburtstag*, edited by Wolfgang Czysz, Claus M. H ssen, Hans P. Kuhnen, C. Sebastian Sommer, Gerhard Weber, 51-80. Espelkamp: Vlg Marie Leidorf, 1995.

Dubreucq, Emilie and Tony Silvino. "Un nouveau t moignage sur l'artisanat des m taux   Autun (Sa ne-et-Loire) au 1er s. ap. J.-C.: du 11 av. du deuxi me Dragon." In *Actualit  de la recherche sur les mobiliers non c ramiques de l'Antiquit  et du haut Moyen  ge, Oct 2012, Lyon, France*, edited by St phanie Raux, Isabelle Bertrand and Michel Feug re, 377-398. Montagnac: Editions Mergoil, 2015.

Erdmann, Elisabeth. "Dreifl gelige Pfeilspitzen aus Eisen von der Saalburg." *Saalburg Jahrbuch* 33 (1976): 5-10.

Ettlinger, Elisabeth and Martin Hartmann. "Fragmente einer Schwertscheide aus *Vindonissa* und ihre Gegenst cke vom Grossen St. Bernhard." *Jahresbericht der Gesellschaft pro Vindonissa* 1984 (1985): 5-46.

Feug re, Michel. *Les armes des Romains, de la R publique   l'Antiquit  tardive*. Paris: Editions Errance, 1993.

Guillaud, Lucas. *Militaria de Lugdunum. Etude de l'armement romain et de l' quipement militaire   Lyon (1er s. av. - 4ve s. ap. J.-C.)*. Montagnac: Editions Mergoil, 2019.

Fiches, Jean-Luc. "A propos de la politique routi re de l'Etat romain : l'apport des fouilles d'*Ambrussum* (Villetelle, H rault)." *Gallia* 73/1 (2016): 13-27.

Hanel, Norbert. "*Fabricae*, Werkst tten und handwerkliche T tigkeiten des Milit rs in den Nordprovinzen des r mischen Reichs." In *Arqueolog a militar romana en Hispania II: producci n y abastecimiento en el  mbito military*, edited by  ngel Morillo Cerd n, 19-32. Le n: Universidad de Le n y Ayuntamiento de Le n, 2006.

Hasegawa, Takashi. "L'union de coll ges professionnels de Lyon par le biais de patrons communs : le moyen le plus prompt de r soudre des affaires?" *Pallas* 99 (2015): 227-243.

Hasegawa, Takashi. *Les commer ants et les transporteurs dans la soci t  des provinces gauloises et germaniques de l'Empire Romain (1er si cle avant n.  . - 3ve si cle de n.  .)*. Univ. Michel de Montaigne-Bordeaux III, Unpublished PhD thesis, 2015.

Hoss, Stefanie. "The Roman Military Belt." In *Wearing the Cloak. Dressing the Soldier in Roman Times*, edited by Marie-Louise Nosch and Henriette Koefoed, 29-44. Oxford: Oxbow Books, 2011.

Jouquand, Anne-Marie and Alain Wittmann. "Des ateliers et des boutiques en bordure d'un complexe monumental (thermes, forum?)   Poitiers   la fin du 3ve s. ap. J.-C." In *Aspects de l'artisanat en milieu urbain : Gaule et Occident romain*, edited by Pascale Chardron-Picault, 75-83. Dijon: ARTEHIS Editions, 2010.

Jouquand-Thomas, Anne-Marie, Anne Larcelet and Christian Miks. "R mische Helme aus einem mittelkaiserzeitlichen Siedlungskontext in Poitiers/Lemonum (D p. Vienne /F)." *Jahrbuch des R misch-Germanischen Zentralmuseums* 58 (2011): 591-660.

Kolbeck, Ben. "A Foot in Both Camps: The Civilian Suppliers of the Army in Roman Britain." *Theoretical Roman Archaeology Journal* 1 (2018): 1-19.

- Lépée, Marine. *Le commerce urbain de détail dans la Vallée du Rhône entre le Ier s. av. J.-C. et la fin du IIIe s. apr. J.-C.: cadre architectural, caractéristiques topographiques et faciès mobiliers*, Univ. Lumière Lyon 2-Univ. Lausanne, ongoing PhD thesis.
- Mangin, Michel. *Le Fer*. Paris: Editions Errance, 2004.
- McMullen, Ramsay. "Inscriptions on armor and the supply of arms in the Roman Empire." *American Journal of Archaeology* 64 (1960): 23-40.
- Nicolay, Johan. *Armed Batavians. Use and significance of weaponry and horse gear from non-military contexts in the Rhine delta (50 BC to AD 450)*. Amsterdam: Amsterdam University Press, 2007.
- Oldenstein, Jürgen. "Manufacture and supply of the Roman army with bronze fittings." In *The production and distribution of Roman military equipment. Proceedings of the Second Roman Military Equipment Research Seminar*, edited by M.C. Bishop, 82-94. Oxford: BAR Publishing, 1985.
- Pagès, Gaspard. *Artisanat et économie du fer en France méditerranéenne de l'Antiquité au début du Moyen-Âge: une approche interdisciplinaire*. Montagnac: Editions Mergoïl, 2010.
- Poux, Matthieu. "Le granarium des 'Buisnières' à Panossas : contribution à l'étude des réseaux d'entrepôts de grande capacité dans les Gaules et les Germanies (I^{er}-III^e s. p.C.)." In *Produire, transformer, stocker dans les campagnes des Gaules romaines, Actes du XIe Colloque de l'Association d'étude du monde rural gallo-romain*, edited by Frédéric Trément, 407-437. Bordeaux: Editions de la Fédération Aquitania, 2017.
- Poux, Matthieu and Lucas Guillaud. "La bataille de Lyon aux prismes des découvertes archéologiques." In *La bataille de Lyon en 197 apr. J.-C.*, edited by Pascal Faure and Matthieu Poux. Lyon, forthcoming.
- Rabeisen, Elisabeth. "Fourniture aux armées? Caractères et débouchés de la production d'équipements de cavalerie à Alésia au Ier siècle après J.-C." In *Militaires romains en Gaule civile. Actes de la Table-ronde de mai 1991 organisée au Centre d'Etudes Romaines et Gallo-romaines de l'Université Lyon III.*, edited by Yann Le Bohec, 51-72. Lyon: De Boccard, 1993.
- Rabeisen, Elisabeth, Guillaume Saint-Didier and Bernard Gratuze. "L'artisanat des alliages cuivreux à l'époque romaine : témoignages d'une production métallurgique à Javols-Anderitum (Lozère)." *Revue archéologique de Narbonnaise* 43/1 (2010): 339-368.
- Reddé, Michel, Raymond Brulet, Rudolph Fellmann, Jan Kees Haalebos and Siegmund von Schnurbein. *L'architecture de la Gaule romaine. I. Les fortifications militaires*. Bordeaux: Editions Ausonius, 2006.
- Sim, David. "Roman Chainmail: Experiments to Reproduce the Techniques of Manufacture." *Britannia* 28 (1997): 359-371.
- Sim, David. *Beyond the Bloom. Bloom refining and iron artifact production in the Roman world*. Oxford: BAR Publishing, 1998.
- Sim, David and Isabel Ridge. *Iron for the Eagles. The Iron Industry of Roman Britain*. Stroud: Tempus Publishing, 2002.
- Simon Ortisi, Christina. *Studien zum römischen Pferdegeschirr aus Pompeji, Herculaneum und den Vesuvillen. Metallzäume, Trensen und Kandaren*. Univ. Munich, Unpublished PhD thesis, 2003.
- Tran, Nicolas. "Tabernae publicae : ateliers et boutiques dans le patrimoine des cités de l'Occident romain." *Cahiers du Centre Gustave-Glotz* 20 (2009): 327-350.
- Tran, Nicolas. *Dominus tabernae : le statut de travail des artisans et des commerçants de l'Occident romain (Ier siècle av. J.-C. - IIIe siècle ap. J.-C.)*. Rome: Ecole Française de Rome, 2013.
- Ulbert, Günter. "Römische Bronzeknöpfe mit Reliefverzierung." *Fundberichte aus Schwaben* 19 (1971): 278-297.

Verboven, Konrad. "Good for business. The roman army and the emergence of a 'business class' in the northwestern provinces of the roman empire (1st century BCE–3rd century CE)." In *The Impact of The Roman Army (200 BC –AD 476). Economic, Social, Political, Religious and Cultural Aspects*, edited by Lukas De Blois and Elio Lo Cascio, 295-313. Boston: Brill, 2007.

Zanier, Werner. "Römische dreiflügelige Pfeilspitzen." *Saalburg Jahrbuch* 44 (1988): 5-25.

Zanier, Werner. "Zur Herstellung römischer dreiflügeliger Pfeilspitzen." *Saalburg Jahrbuch* 48 (1995): 19-25

