

THE MILITARY FABRICA AND THE PRODUCTION OF ARMS IN THE EARLY PRINCIPATE

M.C. Bishop

"The main source of supply of arms in the earlier Empire was small shops and dealers. Fine armor beyond the call of duty could be ordered by the military swell from local artists, or was hawked about in the camp."

MACMULLEN, 1960, 25

"It is not known for certain whether the fabri, or specialist craftsmen, of a legion actually made armour or only repaired it. No doubt many of them were capable of making it in times of emergency, or when a legion was stationed in newly conquered territory far away from production centres, but had manufacture been their full-time occupation there surely could not have been any need for private firms to manufacture arms of any kind.

"I would suggest that maintenance of equipment and the production of javelin heads, arrows and the like were the main tasks assigned to the average military workshop."

ROBINSON, 1975, 8

These two opinions might be held to represent a school of thought that has gained considerable, but by no means universal, credence amongst students of the Roman army. The nature of production of military equipment in the early imperial period is an extremely complex problem and it must be stressed that there is no one easy answer. Nevertheless, there is sufficient evidence to allow us not only to study certain areas in a reasonable amount of detail (and it is the purpose of this paper to examine the role of the fabricae in this process with particular reference to metalworking, although other areas of manufacture will necessarily be brought into the discussion), but also to consider some of the wider implications of this matter.

Fabricae themselves have received detailed treatment on a number of occasions¹ and there have been attempts to study the personnel who worked within them,² but in order to understand their role in the production of military equipment, it is necessary to examine critically the archaeological, literary, and sub-literary source material. Moreover, it will prove necessary to be particular about the contemporaneity of this material, so

the evidence used, wherever possible, will be drawn from the 1st century A.D.

THE SOURCES

1) Literary

Our most important literary sources are the De Re Militari of Vegetius and a fragment of Taruttienus Paternus³ preserved in Justinian's Digest. Obviously, neither of these are, on the face of it, first century in date, but they will still prove to be admissible once we study their background in some detail.

The main passage of relevance in Vegetius is II,11 where he is describing the duties of the praefectus fabrum (Appendix No.1). He relates how each legion had a number of workshops producing a variety of weapons (*'omniaque armorum genera formabantur'*) and, most importantly from our point of view, stresses the self-sufficiency of the legion (*'haec enim erat cura praecipua, ut quicquid exercitui necessarium uidebatur numquam deesset in castris'*) and that they met their needs by manufacture.

It is generally accepted that Vegetius compiled his work during the 4th century A.D.,⁴ using authors from a variety of periods, ranging from the Republic up to his own day.⁵ There has been considerable debate as to which source Vegetius used for this particular section, the chief candidates being Taruttienus Paternus, Iulius Frontinus, and Cornelius Celsus (who was, in turn, using Cato, it is presumed).⁶ Now, whilst both Frontinus and Celsus were writing in the 1st century A.D.,⁷ Cato was quite clearly a Republican source and so of doubtful relevance to the changed circumstances of the imperial army.⁸ The office of praefectus fabrum certainly existed under the Republic, but it does not appear to have had anything to do with military workshops and was, in fact, largely an honorary title.⁹

What appears to have happened is that Vegetius has become confused over the posts of praefectus fabrum and praefectus castrorum, the latter first being attested at the end of the 1st century B.C.¹⁰ Many of the duties which he says are the responsibility of the former (II,11) are also to be found associated with the latter (II,10).¹¹ Therefore, if these duties of the 'praefectus fabrorum' belong in the imperial army, the description is unlikely to come from Cato. The most likely origin would seem to be either Celsus himself, writing in the Julio-Claudian period, or Paternus.¹²

P. Taruttienus Paternus, writing towards the end of the 2nd

century A.D.,¹³ included a list of immunes who, by the nature of their work, were exempted from ordinary fatigues (Appendix No.2).¹⁴ Whilst the post of immunis is not known before the 2nd century, it is strongly suspected that a similar system was in operation well before that.¹⁵ Paternus' list is more interesting than it may at first seem, for all of the posts included would have fallen within the area of responsibility of the praefectus castrorum; not surprisingly, men who could be considered to be fabrica staff are included.¹⁶

2) Sub-Literary

Our two fundamental literary sources for the activities of the military fabricae would both seem to belong within the period of the principate, but we can be more certain of the dating of our sub-literary evidence. Here we are dealing with three main texts, one an undated papyrus from Egypt, the other two being closely-dated writing tablets from one of the pre-Hadrianic forts at Vindolanda.¹⁷

The Berlin papyrus inv. 6765, which probably dates to the 2nd or 3rd centuries A.D., preserves a record of two days' activity within a legionary fabrica, probably that of legio II Traiana Fortis (Appendix No.3).¹⁸ The salient points include the facts that 100 men were employed in the workshop on one day, including immunes, cohortales, civilians, and a group - galliari - who may be slaves.¹⁹ Lists of items being produced are given and these include spathae, two sorts of shield, iron plates, bows, and catapult fittings.²⁰ An interesting distinction is also made between items made (fabricatus) and those completed (peractus).²¹ The value of this text in demonstrating the volume of production possible and the numbers of personnel involved is immediately obvious.²²

Two of the wooden writing tablets found at Vindolanda - Tab. Vind. 1 and 3 - provide us with evidence which demonstrates that a similar situation was pertaining in the early empire, the period that concerns us here. Tab. Vind. 1 (Appendix No.4) lists men being sent to work in the workshops on April 25th. The figure given is 343 men and this includes cobblers, and various assignments of a constructional nature, the precise details of which are lost to us.²³ Tab. Vind. 3 (Appendix No.5), on the other hand, is just a fragmentary list of names of men, identified by century, but it almost certainly includes gladiarii, fabri, and scutarii. The first tablet supports the idea that large contingents of troops could be assigned to the fabricae, whilst the second shows that weapons manufacture may have been one of the tasks in which they would be employed.

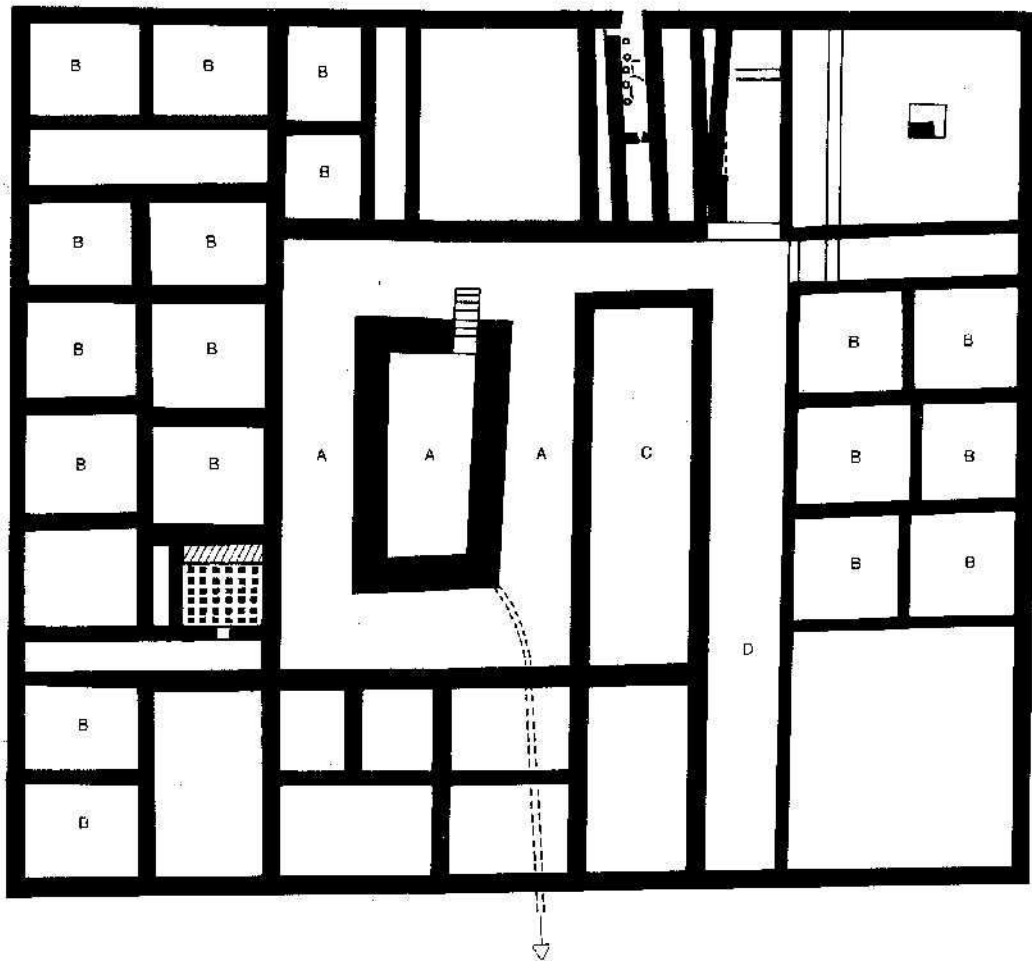


Fig.1: The stone fabrica building at Wiesbaden (after ORL Nr.31, Taf.V,1). There is a courtyard with a large watertank (A) at the centre of the complex. Around the periphery are pairs of rooms (B) that may be workshops with their associated storage space. The large, centrally located room (C) may be an assembly hall. Direct access to the courtyard of a fabrica is usually afforded by a corridor (D).

To these important documents we can add an address on a writing tablet found in the Schutthügel at Vindonissa and probably dating to the mid-first century (Appendix No.6), which mentions a scutarius called Valerius, of the eighth cohort.²⁴ Vindonissa was also the findplace of a bronze votive inscription (Appendix No.7) which, appropriately enough as it turns out, was set up to Mars by Tiberius Iulius Aquila, describing himself as a gladiatorius.²⁵

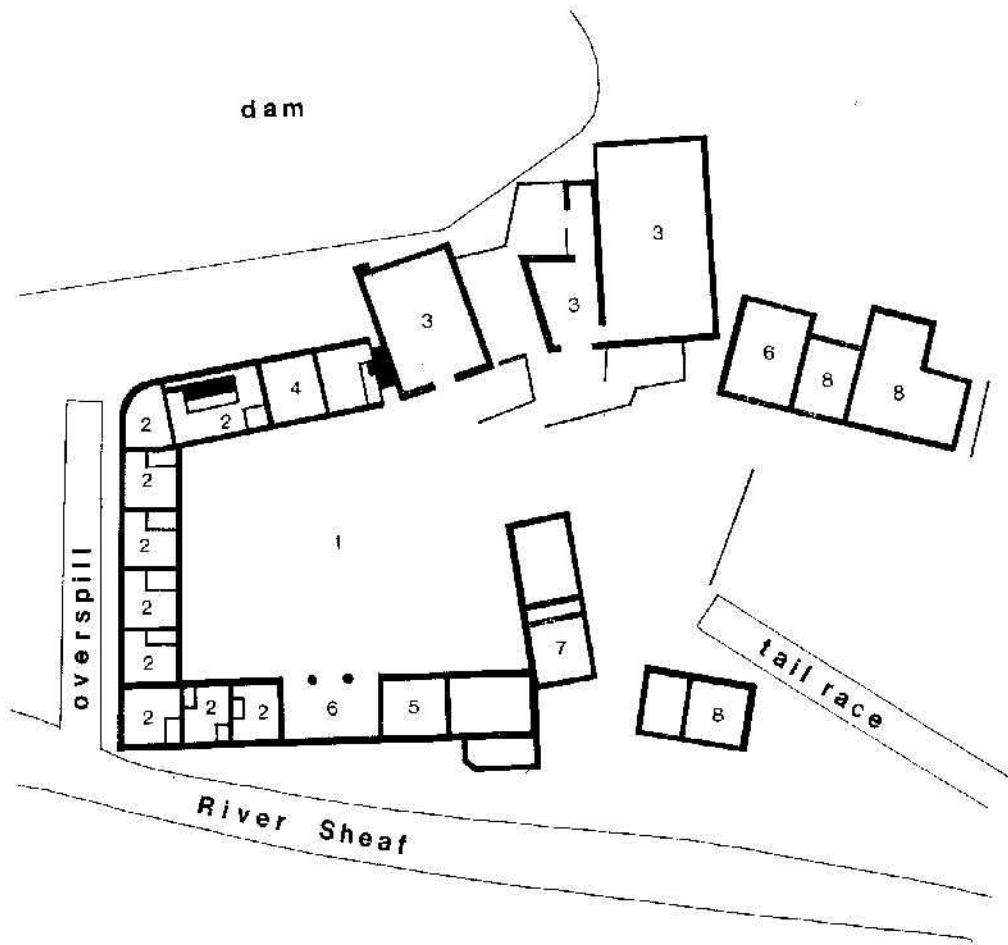
3) Archaeological

The literary and sub-literary sources would therefore appear to provide sufficient evidence for us to postulate direct participation by the army in the production of military equipment during the early principate, but we must now turn to the archaeological evidence to test this hypothesis.

Fabricae have been identified - with more or less certainty - at a number of sites of the 1st and early 2nd centuries A.D. Sites such as Haltern, Hofheim, Valkenburg, Oberstimm, Inchtuthil, Wiesbaden, and Vindolanda may be included amongst these, if only because they are the most familiar.²⁶ At these sites, the typical workshop building took the form of a courtyard structure, usually with a large central water tank fed by the establishment's water supply (Fig.1). It is interesting to compare the layout of these fabrica buildings with more recent parallels, such as the Abbeydale industrial hamlet in Sheffield (Fig.2).²⁷ Characteristically, the Roman buildings feature a comparatively large number of rooms, the purpose of which is not always clear.²⁸ By comparison with such sites, a number of other buildings have been suggested as fabricae, but the most interesting of these is building G at Vetera I. If this was indeed a workshop, then it is the largest building of this type known to us (it would have been designed to serve a double-legionary garrison).²⁹

It is worth noting in passing that no building has yet been conclusively identified as a fabrica - industrial evidence, although present, is seldom overwhelming - and that many structures which clearly had another primary function, could produce the sort of evidence associated with industrial processes.³⁰ That being said, a number of buildings which we are, for argument's sake, accepting as fabricae have produced evidence suggestive of the production of military equipment.

Here we may discern a number of classes of evidence that may be of some use. First there is direct evidence of metalworking (but equally wood-, bone-, and leatherworking) in the form of waste products, raw materials, or material intimately bound-up



(not to scale)

Fig.2: The Abbeydale Industrial Hamlet (after PEATMAN, 1981, 2 Fig.). The plan shows Abbeydale as it is today. Its main components are the courtyard (1), the rooms (2) associated with primary production processes (crucible furnace, forges), those (3) devoted to secondary processes (finishing), final assembly (4), where the products were painted to prevent corrosion (5). In addition there was storage space (6), an administrative area (7), and accommodation for the workers and the manager (8). The main products were two types of scythe and all processes necessary for their manufacture (with the exception of rolling the steel, done at a nearby mill) were performed on-site.

with the production process (such as crucibles). The waste products of iron and copper alloy working have been recorded from Hofheim,³¹ Oberstimm,³² Wiesbaden,³³ Rheingönheim,³⁴ and Exeter³⁵ to name but a few. Second, there is the indirect evidence of tools, particularly those of the smith or armourer in the case of metalworking. It is said that a number of tools were found on the site of the fabrica at Haltern when it was excavated.³⁶ Finally, there is the equipment itself; but this class, for reasons which will soon become apparent, is not as straightforward as it might at first seem.

Dr Jürgen Oldenstein has demonstrated that military equipment was produced on the 2nd and 3rd century limes in Germany and has pointed to the important role of scrap metal as a resource in this scheme.³⁷ Scrap is, by definition, a waste product that is recycled and the process of recycling has long been an important part of the production of metal goods.³⁸ There is every reason to suspect that it was equally, if not more, important to the Roman army.

Sir Ian Richmond suggested that the hoard of iron nails and wheel tyres found in a pit in the fabrica at Inchtuthil was deliberately placed there by the Romans when they abandoned the site, in order that this precious resource would not fall into the hands of their enemies.³⁹ Twelve tons of nails were, for whatever reason, deposited in a pit, but they were not all used nails from the demolition of the site.⁴⁰ Excavation of other military sites has not yet revealed a comparable hoard of nails, but other artefacts have been recovered in considerable quantities.

James Curle's excavations at Newstead produced a rich haul of military equipment of all kinds, but chiefly metalwork. Deposited in pits and wells, this was long thought to be the result of some sort of disaster;⁴¹ at the same time, a ritual motive was sometimes suggested as at least a partial cause.⁴² The 'disaster' theory has now been discounted on good archaeological grounds,⁴³ and, seen in the context of the Inchtuthil find, an alternative explanation has been offered for the Newstead material: namely that it was not the debris from a battle or the spoils of a triumphant foe, but rather (part, at least, of) the stock of scrap metal belonging to the fort's workshop.⁴⁴

In this instance, military equipment found in the archaeological record was scrap. It is understandable, if we imagine the considerable amount of organisation involved in the abandonment and systematic demolition of a Roman military site, that not all waste material could be moved with the army.⁴⁵ Thus the logical move for a praefectus castrorum would be to remove

all trace of its existence by burying it.⁴⁶ But it is at this point that we must ask how military equipment came to be in the archaeological record under 'normal' circumstances: the reason that has come to be tacitly accepted is what might be termed 'accidental loss',⁴⁷ but whilst this is acceptable for very small items, it becomes increasingly unlikely the larger the item involved.⁴⁸ Indeed examining military equipment more closely, a pattern is clearly discernible: even single finds are usually damaged in some way.⁴⁹ Examination of the finds from any military site will inevitably reveal a long list of defects. Confirmatory evidence comes in the form of the bent scraps of metal, particularly copper alloy, that are so common on these sites.⁵⁰

The evidence would seem to suggest, then, that most of the military equipment that is excavated on Roman military sites was discarded as scrap by the time it entered the archaeological record. If this supposition is linked together with the idea that a fabrica would keep a hoard of stock, taking with it as much as was practicable when it moved on, then we are beginning to uncover the basic framework of the system of military equipment production. Hoards of military metalwork, similar to those from Inchtuthil and Newstead, are known from other sites. A large quantity of material, both iron and copper alloy, was found at Augsburg-Oberhausen.⁵¹ Although mooted as the site of a major military base, this hoard, or something similar, might be seen as the sort of 'core hoard' a military unit would take with it when it moved.⁵²

Yet more information about military equipment can be derived from its location within a Roman fort or fortress.⁵³ The archaeological context of military equipment is usually pits and ditches, such finds far outweighing the 'casual' find of an item in a floor surface or such like.⁵⁴ The deposition of military equipment in the archaeological record was inextricably linked with the abandonment and demolition of a site.⁵⁵ The process of demolition can be reconstructed with some accuracy:⁵⁶ there would be an intensive search for anything re-usable that was transportable, but once the fabrica carts (or even boats) were full, everything else had to be discarded where it would no longer be accessible - throwing odd pieces of military equipment into pits and ditches along with the other rubbish would ensure their complete burial once the demolition process was completed.⁵⁷ Some pieces, such as small numbers of 'lorica segmentata' fittings, may simply not have seemed worth saving.⁵⁸

Virtually every military site of the 1st century A.D. has produced military equipment and this might be taken to imply widespread manufacture.⁵⁹ It also allows the thought that whenever a military site was abandoned, military equipment would

be deposited, an idea that is exemplified in the clearest possible fashion at Vindonissa.⁶⁰

The analysis of copper alloy artefacts has shown that several different forms of brass (or gilding metal) were in use in the army,⁶¹ but that these classes were extremely homogeneous within their groupings, something that, given the level of Roman military technology, was only possible with the recycling or large amounts of scrap metal and its segregation into the particular categories of metal, where appropriate.⁶²

THE FABRICA SYSTEM

Theory

Once it has been established that non-archaeological and archaeological sources both imply that production of equipment was undertaken by the army on a fairly large scale (indeed, to the point of self-sufficiency, if we are to believe Vegetius), then it is possible to begin to attempt a reconstruction of the system, based upon the fundamentals discussed above, and some models are presented here to demonstrate how the system could have operated.

It is well-known that military equipment could pass into the hands of a number of owners, a fact most eloquently attested by items with several owner-inscriptions.⁶³ Moreover, the means by which this took place have already been studied and it is now generally accepted that, with a few exceptions,⁶⁴ equipment passed back to the army upon the retirement or death of the former owner in exchange for a (nominal?) sum of money.⁶⁵ This process of recycling items, along with the inevitable repair of damaged equipment, would have meant that the army's actual production needs at any given time would have been comparatively low and the life of an object could reasonably be expected to be above the notional 20 man-years period (but only, note, in times of peace; it is impossible to estimate loss-rates under campaign conditions).⁶⁶ Keeping a legion (and, presumably, its associated auxiliaries⁶⁷) equipped was thus not as difficult as might first appear. The use of scrap metal would further ensure that the demand for raw materials was very low, so a campaigning army did not need rapidly to locate sources or constantly replenish its stocks from the rear.⁶⁸ The picture presented by P. Berlin inv.6765 and the levels of production that were clearly attainable (although it must be remembered that we do not know the circumstances in which the document was written) are therefore not implausible.

That document, along with the two writing tablets from

Vindolanda, shows us how the fabrica system must have worked. Accurate modern reconstructions of Roman military equipment have usually been undertaken by an individual craftsman, responsible for all phases of the work, from the simplest to the most skilled.⁶⁹ This is not, of course, the most efficient way of doing things: it is far better to apportion menial tasks to unskilled labourers, who are in turn supervised by skilled craftsmen who can finish a job where necessary.⁷⁰ If this sort of system operated in the Roman army, then the legionaries could clearly provide the labour-force, and the immunes (as they were later to be called) the skill and supervision.⁷¹ In its way, this goes some way to explaining the status and the function of the immunis in the army.⁷² The principle of close supervision of technically difficult tasks was well-established, particularly in the construction of fortifications.⁷³ The use of ordinary soldiers in the workshops might also help to explain the widely varying quality of military equipment - the 'lorica segmentata' fitting produced by the hasty or inexperienced man cannot help but be inferior to one produced by a diligent or experienced worker.⁷⁴

We can, perhaps, see this system in operation to its best advantage if we submit an item of military equipment to an analysis of the personnel needed to produce its component parts. First, a simple object, like a spear:

- 1) A woodman, to supervise gathering of wood of the required shape and quality; unskilled porters
- 2) A smith (semi-skilled?⁷⁵) to forge the blade, rivets, and butt; unskilled men as porters (raw material, fuel, water, finished object), bellows-operator.
- 3) A carpenter to shape and finish the wood; unskilled porters
- 4) An expert to perform or supervise assembly and to check standard of work; unskilled porters to store finished items

All of these four principal jobs could be performed by one experienced spear-maker, but it would be more efficient to divide the work in this way.

In many ways, a simple object is not a true test of the system, so an examination of a complex object, such as a 'lorica segmentata' is called for:

- 1) One or more smiths to prepare the iron plates from ingots; unskilled men as porters (raw material, fuel, water, finished object), bellows-operator.
- 2) One or more copper smiths to prepare copper-alloy sheet and rivets from ingots; unskilled men as porters (raw material, fuel, water, finished object), bellows-operator.
- 3) Leatherworker(s) to produce (tan, cut, stitch) strapping for the armour; unskilled (or semi-skilled) workers for tanning, cutting, stitching, and as porters
- 4) Unskilled men to cut out sheet copper-alloy components,

assemble and rivet them together where necessary; porters to transfer components for final assembly

5) An expert to perform or supervise assembly and to check standard of work; unskilled porters to store finished items

There is no reason why the same porters could not be used at every stage of production, providing there were enough of them.

Hierarchy

Vegetius tells us, in a garbled fashion, that the officer with ultimate responsibility for the fabrica was the praefectus castrorum.⁷⁶ Each such praefectus would appear to have had his own officium,⁷⁷ who no doubt dealt with the administrative side of the workshops, doubtless producing documents like P. Berlin inv. 6765 or Tab. Vind. 1 and 3. The praefectus castrorum seems to have taken on these duties from the quaestor in a Republican army.⁷⁸

Beneath the praefectus were the staff of the workshops, the most senior of whom may well have been the optio fabricae, a post which is only definitely recorded in the Digest passage.⁷⁹ His precise status is ambiguous,⁸⁰ but it seems likely that he was the de facto head of the fabrica, whether an administrator or a professional.⁸¹

The main body of the staff was provided by the men we have already seen referred to as immunes. There has been a tendency to view these specialists as a separate entity within their unit,⁸² perhaps even living near the workshops⁸³ or in the accommodation of the first cohort of a legion,⁸⁴ but the available evidence seems to suggest that they were held on century strength⁸⁵ - a fact apparently confirmed by Tab. Vind. 3. The range of skills embodied amongst these men is hinted at, but surely not exhaustively listed, in the surviving fragment of Taruttienus Paternus.⁸⁶ Taking the singular and plural nouns in the list seriously, we might expect at least 56 staff attached to the praefectus castrorum (and, possibly, to the fabrica) and more likely over 60.

The bulk of the workforce was provided from the ranks, with men being assigned, probably on a daily basis,⁸⁷ according to the needs of the workshop at any given time. Over 340 men were working at Vindolanda on one particular day,⁸⁸ whilst the fabrica described in P. Berlin inv. 6765 could easily have had over 200 men working in it, which explains the productivity attested by that document.

Versatility was clearly the key to the successful operation of the fabrica and it would have been a system that was well

adapted to the unpredictable demands that alternating periods of campaigning and rest would have placed upon it.

Modus operandi

Many military sites of the early principate were, on the basis of the archaeological evidence, engaged in the production of military equipment.⁸⁹ Scrap material was collected, stored, and recycled; an important aspect of this process is obviously the collection - how was it organised? If we discard the accidental loss hypothesis as largely irrelevant,⁹⁰ then we may suppose that soldiers were fully aware of damage to their equipment and would seek to remedy it. A broken 'lorica segmentata' fitting would not be casually left where it fell,⁹¹ but would be retrieved in case it could be repaired - we must bear in mind that the cost of replacement would have to be born by the soldier,⁹² so there was a strong incentive to retain even the most insignificant scrap of material. Given a certain length of time spent around barracks, such odds and ends were bound to accumulate to the point where it would be worth the soldier's while to trade them in to help defray the cost of his deductions for new kit.⁹³

This hypothesis may well be behind the pattern of distribution of finds within military sites,⁹⁴ since when it was time for a fort to be abandoned, the fabrica would surely take its central stock of scrap with it, rather than gather odd pieces remaining in the barracks and awaiting delivery to it. These would then be tidied away by the demolition parties as close to the point where they were found as was possible - hence the distribution pattern.⁹⁵ However, the organization of the scrap cycle may well have been more organised than we have so far suggested: building VI at Carnuntum was found to have various items of equipment within its rooms and these were separated according to their type.⁹⁶ Segregation of scrap is, of course, of fundamental importance to its re-use for the production of military equipment.⁹⁷ We may well have, in such a building, an example of the enigmatic armamentarium;⁹⁸ if this were indeed so, we might go even further and suggest a link with the custos armorum, an immunis found on the strength of every centuria or turma.⁹⁹ The custos armorum would then become a convenient agent for the collection, storage, and general administration of the flow of scrap metal within his company,¹⁰⁰ but this must, for the time being, remain pure speculation.¹⁰¹

The main workshops were most likely to be found in those sites termed hibernae or winter quarters.¹⁰² The ideal conditions would then prevail - a semi-permanent site with the pick of local resources, available manpower, the ability to work

on long-term projects¹⁰³ - whereas on campaign, when the army was presumably normally working from what we call 'temporary' or 'marching' camps,¹⁰⁴ a permanent workshop would be far too cumbersome, and the troops would be needed for combat, rather than making equipment.¹⁰⁵ Here we must envisage the use of a field-forge, largely concerned with the repair of damaged equipment and manufacture of simple weapons.¹⁰⁶ The archaeological remains of such field-forges would almost certainly be negligible.¹⁰⁷ Such a system is briefly mentioned by Josephus¹⁰⁸ and is supported, albeit in a very negative sense, by the rarity of military equipment from temporary military sites.

Analysis of the fabrica-system of the 1st and early 2nd centuries A.D. would therefore suggest that it operated much the same as in later periods.¹⁰⁹ The main production was by the army, although there may have been room for specialist craftsmen working outside the army (possibly ex-fabrica workers), but they would necessarily be geared to a much lower level of production, since such a person had to perform all stages of the job himself,¹¹⁰ so that private production must have been responsible for a very small proportion of the equipment made at any given time.¹¹¹ Moreover, that sort of production was better geared to catering for the luxury end of the market and there is a little evidence that suggests this is indeed what it did - producing items which only the senatorial or equestrian officers (or perhaps some of the top centurions) of a legion could have afforded.¹¹² In short, there was no large-scale private industry in the west.

The model suggested by the various strands of evidence (Fig.3) shows just how little raw material the army needed at any given time. When it was necessary to issue new equipment, then it could rely partly on recycled intact items, and partly on new artefacts manufactured from scrap. Since manufacture is kept on the legionary level, supply and demand could be monitored closely by the fabrica and the production programme regulated accordingly. The two great virtues of the system are, therefore, efficiency and flexibility.

EFFECTS OF FABRICA PRODUCTION

The craftsmen working in the fabricae of the frontier legions in the west were almost certainly free of any central control.¹¹³ This meant they could pursue their own particular tastes, and those of the market they served, and this in turn meant that there was great scope for variety and individuality in Roman military equipment of the early imperial period.

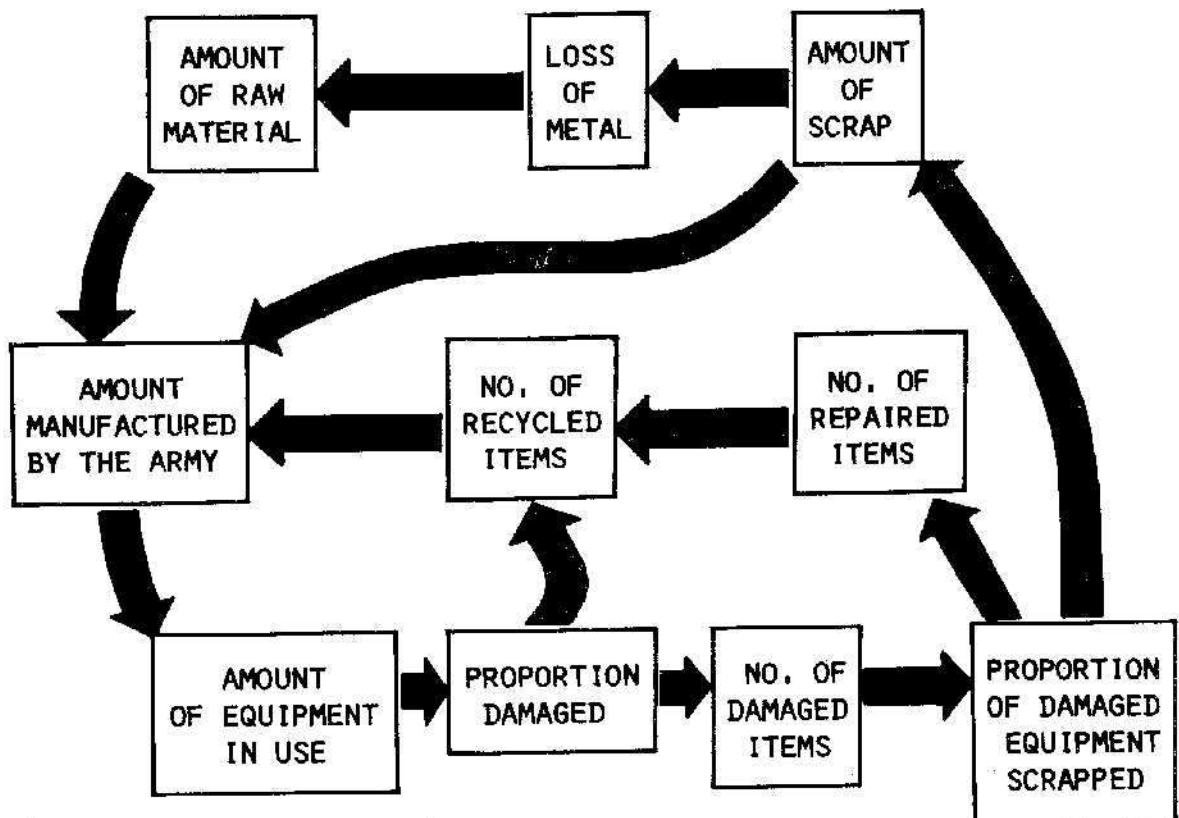


Fig.3: Model for the production of military equipment in military fabricae.

Craftsmen working within a legionary fabrica would have a set repertoire of designs for items like belt-plates or pendants. They would have learnt elements of this when they were first introduced to the job, but would have added to it from their own experience, both by what they saw during their career, and what the soldiers wanted: this made for a very eclectic system.¹¹⁴ Thus, in conditions of isolation, a legion's equipment would become very noticeably distinct from that of other legions - however, the fact that army groups campaigned together most summers¹¹⁵ meant that craftsmen would have the opportunity to meet and exchange ideas, so the common pool of ideas would belong to the army-group, rather than the legion (although peculiarities may still have been apparent).¹¹⁶

The movement of units between army-groups meant that the influences on any given legion's craftsmen were rendered even more diverse and could in turn be passed on further through the Roman army as a whole, as and when the opportunity presented itself.¹¹⁷ The craftsman thus had a rich profusion of sources of inspiration upon which he could draw.

Examples of these craft traditions are obviously going to be very difficult to isolate in the archaeological record, given this diversity of influences, but it may nevertheless be possible to indicate some likely candidates. Prime amongst these is what might be termed the Upper German tradition, a style of equipment decoration and design manifested in the region of that province in the Tiberio-Claudian period and then dispersed in the decades that followed.¹¹⁸

Some examples that may be cited include a certain type of belt-plate, made of beaten copper alloy and depicting a range of mythological scenes and devices.¹¹⁹ The most common motifs include the wolf and twins, lotus blossoms, and a human bust with cornucopiae.¹²⁰ The distribution of these objects, many of them reasonably securely dated to the Tiberio-Claudian period, show a bias towards Upper Germany, with a few from areas where legions from that army group were subsequently transferred (such as Britain and Pannonia).¹²¹ Likewise, belt-plates inlaid with niello show a similar, but more widespread distribution - the finds of these items in Britain are particularly interesting and again suggest an Upper German connection.¹²²

One particular style of scabbard fitting, associated with the legio XIII Gemina by its presence in the Schutthügel at Vindonissa,¹²³ is also found at Carnuntum, Magdalensberg, and Mainz.¹²⁴ These cases are exceptional in the comparative ease with which army-groups, or even legions, can be traced, but it becomes much more difficult once units are shifted round to accommodate the invasion of Britain.¹²⁵ Usually, only broad

trends can be suggested, such as the use of lobate decoration on Danubian 'lorica segmentata' fittings,¹²⁶ the prevalence of lunate pendants in Lower Germany,¹²⁷ or the concentration of Imperial-Gallic helmets in the Rhineland.¹²⁸

THE CITY-STATE

The fabrica-system is here proposed as the means of producing military equipment in certain parts of the Roman world, but it was by no means the only way. The archaeological evidence, which would seem to be a reliable indicator of military production in the west, is largely absent in the eastern half of the empire, a fact usually ascribed to the state of archaeological knowledge in the respective areas.¹²⁹ A few items are known, but the large amounts of damaged pieces are lacking, despite the fact that the Middle East, at least, was the scene of some of the most intense campaigning by the Roman army in the early principate.¹³⁰

The solution to this state of affairs lies, it might be suggested, in two well-known and often-cited references to the production of equipment in the East: both Tacitus and Cassius Dio mention equipment being produced for the army in eastern cities, both implying an element of quality control on the part of the Romans.¹³¹ The tradition of cities (or, more properly, city-states) producing equipment to demand had a respectable pedigree: in 399 B.C., Dionysius I converted Syracuse into one large workshop in order to equip his army.¹³² Scipio turned New Carthage into a vast munitions factory in 210 B.C.,¹³³ and during the third Punic war, the city of Carthage itself went into mass-production of equipment after having surrendered all its arms to the Romans and then changing its mind.¹³⁴ Many more examples can be found from late Hellenistic and Republican times to confirm this picture.¹³⁵

The characteristics of such enterprises were their makeshift nature, the speed with which they were set up, and the volume of production of which they were capable.¹³⁶ This system was obviously ideally suited to equipping large armies quickly.¹³⁷ The most important common factor was, however, the classical city - wherever such settlements were found, it seems to have been possible to use this peculiar facet of their nature.¹³⁸ This gives us our first hint that the difference lay not between east and west, but between city-state and military fabrica. So long as the Roman army was operating within the sphere of influence of the classical city, then it was possible to organise its supplies as and when they were needed. Expansion outside of this essentially Mediterranean zone (most notably into 'Celtic' areas), however, meant the army was forced to choose between

establishing long lines of communication with its centres of production, or meeting its own needs: it chose the latter course.¹³⁹

This use of the polis to provide large amounts of equipment quickly may be one reason why most new legions were recruited within the Mediterranean zone, rather than in 'frontier' areas.¹⁴⁰ We may even see a manifestation of this system in the Imperial-Italic class of helmets,¹⁴¹ generally thought to be of a lower standard of manufacture than those of Imperial-Gallic manufacture.

CONCLUSIONS

Vegetius certainly seems to have been right when he described the legion as self-sufficient in its needs. There is, however, a more important side to this than purely the logistical aspect: army-groups in the north and west of the empire, restricted by the weather outside the campaigning season, needed to maintain their morale.¹⁴² The everyday routine of sentry-go or patrols could not occupy any more than a small proportion of a force,¹⁴³ so employing troops in the workshops or on production-related tasks was a valuable source of variety in what must have been an extremely monotonous existence at times. Our evidence seems to suggest that it was the legionaries who undertook various manual tasks, in the early empire at least, and that the bulk of patrolling and police-work would have been left to the auxiliary forces.¹⁴⁴ Manufacture could therefore be left to the legions and their troops (but we cannot totally exclude auxiliary involvement).¹⁴⁵ It is clear, however, that the production of equipment was not so much a necessary chore as an important factor in the continued efficiency of the army.

The strength of the mechanism of arms-supply in the early empire was undoubtedly its flexibility. Adopting the Greek polis-system of production and then supplementing it with the fabrica-system meant that the Romans were capable of adapting to the prevailing local conditions. Changes in the nature and structure of the empire under Diocletian meant that it was necessary to evolve the chain of arms factories attested in the Notitia Dignitatum and elsewhere, but there can be no doubting that they looked back, at least in part, to military fabricae of the earlier period, rather than any wholly contractual civilian scheme.¹⁴⁶

Finally, this study would also seem to suggest that we can apply a number of rules relating to the presence of Roman military equipment in the archaeological record.

1. Military equipment discovered on land is most likely to have

been deliberately discarded by the Roman army and - by implication - that a military presence of more than temporary duration can be deduced.¹⁴⁷

2. Such discarded material is inherently characteristic of a particular unit or army group.
3. This material is normally only discarded when a site is abandoned and is thus linked to the demolition process.
4. Areas where the military situation was complex and sites were frequently abandoned will tend to produce more finds of military material than those with a stable situation and long periods of occupation.
5. The relative distributions of military equipment in the west and east of the empire is not simply a result of differing levels of archaeological investigation.

ACKNOWLEDGEMENTS

I should like to thank my wife Martha Andrews, Mr P.W.M. Freeman, and Dr D.L. Kennedy for reading this paper in draft form and discussing it with me. Whilst I have benefitted greatly from their advice, they are in no way responsible for any mistakes contained within it.

NOTES

1. VON PETRIKOVITS, 1970; 1974a; 1974b; 1975, 88-98; cf. JOHNSON, 1983, 183-8.
2. SANDER, 1962. Cf. VON PETRIKOVITS, 1970, 246-7.
3. Taruttienus is to be preferred over Tarruntenus - cf. AE 1971, 534; I am grateful to Dr D.L. Kennedy for this reference.
4. For a discussion of Vegetius' work in its contemporary setting, see GOFFART, 1977 and BARNES, 1979.
5. On the sources for Vegetius work, see SCHENK, 1930; PARKER, 1932; SANDER, 1929; 1932; 1939.
6. These sources are named by Vegetius I,8. Paternus: SCHENK, 1930, 8-26; Frontinus: ibid., 39-83; Celsus: ibid., 26-39; Cato: SANDER, 1932, 374.
7. Celsus: SCHENK, 1930, 28 with further refs.; Frontinus: ibid., 39-41.
8. A fragment of Cato's military writings is preserved in Fronto, Ad Verum Imp., II,1,20.
9. DOBSON, 1965, 62-3.
10. KEPPIE, 1984, 176 with n.5.
11. II,9-11 seems to be the result of confusion over the posts of praefectus castrorum, praefectus fabrum, and praefectus legionis. All of the duties listed in this section fell within the sphere of the praefectus castrorum.
12. SCHENK, 1930, 29 discusses originality in Celsus' works.
13. Paternus' contribution to military writing is considered in SCHENK, 1930, 23-4; cf. RE 'Tarruntenus Paternus'.
14. Digest L,6,7.
15. WATSON, 1969, 75-7.
16. These are: artifices qui fossam faciunt, architectus, nauegi, specularii, fabri, sagittarii, aerarii, bucularum structores, carpentarii, scandularii, gladiatores, aquilices, tubarii, cornuarii, arcuarii, plumbarii,

ferrarii, lapidarii, 'qui calcem cocunt', 'qui siluam infindunt', 'qui carbonem caedunt', optio fabricae. This assumes that tubarii and cornuarii are horn-makers, rather than musicians.

Vegetius summarises the responsibilities of the praefectus castrorum in II,10.

17. Naturally, these documents also benefit from being original and not transmitted.
18. See the brief discussion in BRUCKNER & MARICHAL, 1979, 6-7. The two days are the 18th and 19th of April.
19. But note that these were almost certainly personal slaves, calones, and not any sort of organised slave labour (loc. cit.). Cf. MACMULLEN, 1984, 44 & nn.27-8.
20. Spathae: Col.I,11; scuta planata: II,13; scuta talaria: II,9; lamnae levisatae: I,10; II,10; arcus: II,14; capitula ballistaria: II,15.
21. Fabricatus: Col.I,11; I,12; peractus: I,14; II,14.
22. It is not clear whether the figure of 100 refers to all workers, or just to legionaries - i.e. milites legion]ari n(umero) C (Col.I,4-5) - although we may suspect the latter to be the case.
23. It is noteworthy that the list is not dealing exclusively with staff carrying out building work, but includes sedentary workers (i.e. the cobblers), so is likely to be reasonably representative of the sort of list normally drawn up.
24. The form IIX, instead of the more usual VIII, may be early, although SANDYS, 1927, 55-6 disagrees.
25. Almost certainly not a civilian as MACMULLEN, 1960, 25-6 implies; his name suggests (but does not demand) a Julio-Claudian date.
26. Haltern: VON SCHNURBEIN, 1974, 65 - cf. id., 1982, 59; Hofheim: RITTERLING, 1904, 8-14 and 1913, 59-65; Valkenburg: SCHÖNBERGER, 1979; Oberstimm: SCHÖNBERGER, 1978, 30ff; Inchtuthil: TAYLOR & WILSON, 1961, 160; Wiesbaden: ORL Nr.31, 32-6; Vindolanda: BIRLEY, 1977, 111-5.
27. The groundplan of the fabrica was certainly ergonomically efficient, since it provided each part with easy access to any other and to the main water tank. At the same time, the

open yard could be used for temporary storage or open-air processes.

For a convenient discussion of the Abbeydale industrial hamlet, see PEATMAN, 1981.

28. Many of these smaller rooms have been identified as accommodation for men associated with the respective buildings (VON PETRIKOVITS, 1975, 49; cf. below, n.29).
29. LEHNER, 1928, 20-1 with Abb.2.
30. Such as the tribunes' houses at Colchester - FRERE, 1983, 309 with Fig.15.
31. RITTERLING, 1904, 9.
32. SCHÖNBERGER, 1978, 304.
33. ORL Nr.31, 34.
34. ULBERT, 1969, 113.
35. BIDWELL, 1980, 31-5.
36. VON SCHNURBEIN, 1974, 65.
37. OLDENSTEIN, 1977a; 1977b.
38. Hoards of scrap from the prehistoric period are well-known - cf. MEGAW & SIMPSON, 1979, 297-8.
39. TAYLOR & WILSON, 1961, 160.
40. ANGUS et al., 1962.
41. CURLE, 1911, 113-5; FRERE, 1978, 143-4.
42. ROSS & FEACHEM, 1976.
43. MANNING, 1972, 243-6.
44. Ibid., 246.
45. The maximum capacity of a wagon is open to debate; Diocletian's edict on prices includes a 1200lb wagon load (De pretiis. XVII), whilst the Theodosian Code sets a limit of 1075lb (WHITE, 1984, 129). Even in the case of the former, at least 20 wagons would have been needed to haul the nails deposited at Inchtuthil.

46. Since he was in charge of logistical matters, such a decision must have been his responsibility.
47. Cf. The report by Dr G. Webster on the Chichester gladius in DOWN, 1981, 173; LEAHY, 1980, 84 draws a similar conclusion about a pendant from Normanby.
48. The accidental loss of very small fittings may seem acceptable, but larger objects like swords are not just 'lost' in this way and certainly not in the quantities that the archaeological record would seem to suggest.
49. The military equipment from any early imperial site will show convincing evidence of this phenomenon, but a few examples will suffice: FRERE & ST.JOSEPH, 1974, Fig.30,58 & 59 (damaged harness junction-loops); 60 (fragment of a box latch); CRUMMY, 1983, Fig.151,4211 (bent belt-plate); NIBLETT, 1985, Fig.64,37 (broken helmet browguard - I follow FITZPATRICK, forthcoming in identifying Sheepen with a large pre-Flavian military base).
50. As at Rheingönheim (ULBERT, 1969, Taf.59), but most sites where military equipment is found produce such scrap material - cf. Oberstimm (SCHÖNBERGER, 1978, Tafn.38-41).
51. HUBENER, 1973.
52. Similar such core hoards may include the Künzing (HERRMANN, 1969), Straubing (KEIM & KLUMBACH, 1951), and Corbridge (DANIELS, 1968) examples.
53. On this subject, see BISHOP, forthcoming.
54. Longthorpe: FRERE & ST.JOSEPH, 1974, 46-78 & Fig.22 (pits & ditches); Newstead: CURLE, 1911, 116-39 & 419 (for full references to ditch-finds; pits & ditches); Sheepen: NIBLETT, 1985, 112 (pits); Nijmegen: BOGAERS & YPEY, 1963 (pit)
55. Hence its frequent association with destruction debris - one of the original reasons for the 'disaster hypothesis' at Newstead: CURLE, 1911, 113-4 reasoned that intact quernstones were unlikely to be discarded normally, but their weight may have precluded their being taken with the departing army. In connection with the Antonine abandonment, he notes the association of military equipment and building debris in Pit I (ibid., 115).
56. The order in which things were done may have varied to some extent, but the basic principle of the recovery of re-usable

items, discarding of unwanted material, and demolition of structures is common sense.

57. It was, of course, standard practice for the abandoning force to cast the ramparts into the ditches - cf. Longthorpe (FRERE & ST.JOSEPH, 1974, 11), Strageath (WILSON, 1974, Fig.3), or Colchester (CRUMMY, 1984, 93 & Sheet 6b, Sx65).
58. Such items were probably kept in ones or twos in barracks by the troops against the time when they would be collected.
59. There are notable exceptions to this: temporary camps seldom produce anything of this nature, whilst the fort of Pen Llystyn was comparatively poor in finds of this nature - HOGG, 1969, 181-5.
60. Where the 'Schutthügel' was added to each time a legion left (cf. RE 'Vindonissa' 103-4). It is unlikely that it was used for dumping military equipment when the site was in occupation.
61. This is demonstrated by the work of a number of researchers over the past few years - Gowland in FOX & ST.JOHN HOPE, 1901, 245-6; CRADDOCK et al., 1973, 15; reports by Justine Bayley in HURST, 1985, 30 and NIBLETT, 1985, 115; BISHOP, unpublished.
62. On scrap segregation: BAYLEY & BUTCHER, 1981. For a practical example of this, see RLO II, 41-2.
63. MACMULLEN, 1960, 33-6.
64. See BREEZE et al., 1976, 77-81.
65. Ibid., 93-5; GILLIAM, 1967, 237-8.
66. There are too many unknown factors, such as the complete loss of equipment (implied in Tacitus, Ann., II,5) or the capture of enemy material (thus supplementing the scrap stock).
67. Assuming that legionary workshops supplied a legion's associated auxiliaries; on the attachment of auxiliary units to a legion, see SADDINGTON, 1982, 183-4.
68. In his calculations of the Roman demand for iron, WHITE, 1984, App.4 completely disregards the role played by the recycling of scrap, as well as the value of coppiced wood as a fuel source (RACKHAM, 1976, 23 & 51).

69. See, for example, GARLICK, 1980.
70. As suggested by ANSTEE, 1953, 202.
71. Immunes are mentioned in P. Berlin inv.6765 (Appendix No.3) and men who fall within this class are mentioned in Tab. Vind. 3 (Appendix No.5).
72. Paternus says these men achieved their status 'by the conditions of their service' (Appendix No.2) - in other words responsibility by virtue of their expertise. Cf. WATSON, 1969, 76.
73. The construction of camps was supervised and checked by the centurions (Vegetius, III,8; Polybius, VI,34).
74. ROBINSON, 1975, 181-2 with Fig.182 thought that the variety in lobate lorica hinges was due to evolution, but it is easily explained by varying degrees of competence in execution.
75. Whilst skill at blacksmithing takes a long time to achieve, functional objects could be produced with only a minimum amount of practice (particularly under supervision); the basic beating out of ingots could have been undertaken by ordinary legionaries (who might, if they showed a talent, have been upgraded to immunes).
76. On the praefectus castrorum: DOBSON, 1978, 68-74; WEBSTER, 1979, 117; KEPPIE, 1984, 176-7; MAXFIELD, 1981, 204-5.
77. WATSON, 1969, 85; cf. VON DOMASZEWSKI, 1908, 48.
78. For the duties of the quaestor in the Republican army see Polybius VI,39; cf. HARMAND, 1967, 172-9 and 366-8.
79. There are a few suggested references - MACMULLEN, 1960, 28 n.49; cf. BREEZE, 1976, 128 who only cites the Digest.
80. Loc. cit., using the optio valetudinarium to say that "the duties of the post were not medical but administrative".
81. Ibid., 132.
82. VON PETRIKOVITS, 1975, 122-3; SANDER, 1962, 147.
83. VON PETRIKOVITS, 1975, 49.
84. BREEZE, 1969, discounts this idea, pointing out that the laterculi from Lambaesis illustrate the fact that immunes

could come from any of the cohorts of a legion.

85. We find an armorum custos, carrarius, librarius, and a cerarius in P. Gen. Lat. I iv b verso being recorded as exempt from duty in the century ('opera vacantes'); cf. WATSON, 1969, 73-4. P. Gen. Lat. I verso v and verso iv I indicate that only 31 (with an additional 5) remain available for fatigues from a theoretical century strength of 80 - FINK, 1971, 210.
86. The passage makes no claim to be an exhaustive list, only listing a sample of such posts (see Appendix No.2).
87. This is clearly indicated by Tab. Vind. 3 and P. Berlin inv. 6765, which record specific dates - two consecutive days in the last case.
88. The fact that this, may have been an unusually large work detail is irrelevant, but it clearly demonstrates the principle of using the troop body as labour for the workshop.
89. As we have seen, finds of military equipment from nearly all first century A.D. sites would seem to support this assertion.
90. That is to say that items were accidentally lost, but such material forms an insignificant proportion of military equipment recovered from the archaeological record.
91. 'Lorica segmentata' fittings that failed would in fact be more likely to break and remain in situ, rather than detach themselves completely from the cuirass.
92. Since soldiers were expected to purchase their equipment, they must also have been responsible for lost or damaged material. It is possible, but not likely, that a regular deduction, such as 'caligas fascias' in P. Gen. Lat. I recto i, could cover such an eventuality.
93. This is suggested by the concentration of equipment in the barrack area at Oberstimm (BISHOP, forthcoming); cf. KLUMBACH & BAATZ, 1970. For equipment in pits in the barracks at Longthorpe, see FRERE & ST.JOSEPH, 1974, 32.
94. It is a pattern also observed by the excavators of Dangstetten - FINGERLIN, 1981, 422.
95. Ditch terminals and pits being the favoured repositories for such material - BISHOP, forthcoming.

96. RLD II, 41-2.
97. On segregation of scrap, see BAYLEY & BUTCHER, 1981.
98. The assumption that because weapons were found in the principia of a fort then this was the location of the armamentarium does not necessarily follow (cf. JOHNSON, 1983, 108-9).
99. On the custos armorum, see VON DOMASZWESKI, 1908, 44 (legionary) and 55 (ala).
100. The post seems to have been on a par with the tesserarius (BREEZE, 1974, 267), in being the next stage up from the librarius (ibid., 268; the situation was different in the auxilia - ibid., 281), so we should perhaps envisage responsibility of the sort enjoyed by the tesserarius (Vegetius II,7).
101. It has been shown that the custos armorum could not have been the guardian of a company's weapons whilst they were locked away (ROBINSON, 1975, 9). It would seem logical to have one man in each company whose specific task was to monitor the state of his men's weapons.
102. Vegetius tells us (II,11 - Appendix No.1) that the fabrica staff included men who constructed buildings for hibernae, permanent structures obviously being one of the main differences between the hiberna and aestiva. A workshop of the kind envisaged here would be a difficult thing to move about under normal circumstances, quite apart from the fact that the labour force would be on active duty in the summer months.
103. The fabrica presumably strove to build up a surplus of equipment during the winter months and may have embarked upon new ventures (as with the introduction of the 'lorica segmentata'?).
104. The relationship between modern and ancient terminology is difficult here; whether the castra aestiva (e.g. Tacitus Ann.I,37) was capable of supporting a full fabrica is unknown, although Hyginus 35 gives us an idea of the size and location of the fabrica within it.
105. This would imply that the field workshop was staffed largely by the immunes when on campaign.
106. Such forges have been used by many armies through the ages;

I am grateful to Mr J. Turner for identifying a number of similarities between the proposed operation of the fabrica outlined in this paper and REME workshops during the second world war.

107. Traces of any sort of occupation within temporary sites are ephemeral - RICHMOND, 1933, 58-69 could identify ovens/hearths, 'dugouts', and low turf mounds in camp B at Cawthorn. Even in permanent sites, the evidence for their original purpose from fabricae is surprisingly minimal once they have been cleared by the army, but then it is extremely difficult to prove the original purpose of any Roman military building purely by using the archaeological record.
108. Josephus, Bell. Iud., III,83; cf. Hyginus, 4 & 35.
109. The finds from the first, second, and early third centuries consistently seem to indicate that this was so: the range of finds from Antonine Newstead matches that from the Trajanic abandonment (CURLÉ, 1911, esp. 113 with 116-39). The Künzing (HERRMANN, 1969) and Straubing (KEIM & KLUMBACH, 1951) hoards are both apparently third-century, as is the cavalry sports helmet from one of the pits in the barracks at Echzell (KLUMBACH & BAATZ, 1970).
110. Even with a few slaves to help him, he could not achieve volume production.
111. Evidence for private production is slight, but is summarised in MACMULLEN, 1960, 25-6, which is largely followed by OLDENSTEIN, 1977a, 79-83.
112. See, for example, the description of luxury weapons contained in P. Giss. 47 where the Greek terms used are for officers arms, rather than the more usual graecisized Latin terms normally found (e.g. balteum in P. Mich. VIII 474,8-9).
113. Apart from the fact that such control was impractical in the Roman world (MILLAR, 1982, 7-11 for difficulties of communication), the variety of equipment design confirms this.
114. Vegetius 1,8 stresses the importance of tradition in the early imperial legion.
115. Tacitus Ann. I,16 for 3 legions of the Pannonian army in an aestiva together; I,31 for 4 legions of the Lower German army in a similar camp.

116. Such peculiarities would probably depend upon the whim of individual craftsmen.
117. Empire-wide army movements, such as major campaigns, were a good opportunity (e.g. RE 'legio', 1250-1), whilst the civil wars of A.D.68-70 brought many legions into contact for the first time in years (ibid., 1265-6).
118. By 'Upper Germany', the Upper German army-group is meant: the province, as such, did not exist before A.D.82 (RAEPSAET-CHARLIER, 1973, 161).
119. VON GONZENBACH, 1966, 184-9.
120. Cf. SCHÖNBERGER, 1978, Abb.76.
121. Britain: Chichester, Hod Hill; Pannonia: Magdalensburg (see n.120).
122. Although not many sites of the Pannonian legion (VIII Hispana) have been investigated as thoroughly as those of legio II Augusta.
123. VON GONZENBACH, 1965, 6.
124. Carnuntum: RLO XXXII, Taf.66,13; Magdalensburg: VON GONZENBACH, 1965, 20; Mainz: loc. cit.
125. See above n.117.
126. For lobate hinged-strap and -buckle fittings from the 'lorica segmentata', see RLO II, Taf.XVIII & XIX.
127. ZADOKS-JOSEPHUS JITTA & WITTEVEEN, 1977 includes many examples from the Netherlands.
128. ROBINSON, 1977, 557-9 saw Imperial-Gallic helmets as being the work of Gallic smiths supplying the German armies, but the evidence for them is weak.
129. This imbalance is shown up clearly in the proportions of helmets surviving from the west and east respectively - ROBINSON, 1975, 13-139.
130. Such as the campaigns of Corbulo in Armenia and Vespasian in Judaea.
131. Tacitus Hist. II,82; Dio LXIX,12,2.
132. Diodorus Siculus, XIV,41-3.

133. Livy XXVI,47.
134. Appian VIII,93.
135. In 68 B.C., Mithridates manufacturing weapons in his towns in preparation for war against Lucullus (Appian XII,87); inhabitants of Massillia set up officina for production of arms after they have shut their gates against Caesar (Caesar Bell. Civ. I,34).
136. Characteristically utilising all available space within a city (Diodorus Siculus XIV,41,6; Appian VIII,93), all available personnel (specialised and non-specialised - Diodorus Siculus XIV,43,1; Appian VIII,93), and working very fast (loc. cit.).
137. Dionysius was evidently thinking in terms of an army of 140,000 men (Diodorus Siculus XIV,43,2).
138. Presumably because they possessed a) expert craftsmen who could turn their hand to weapons production; b) a large, able, (and usually) willing workforce; and c) the organizational ability to harness all of this potential. Note that Dionysius (Diodorus Siculus XIV,41,3) and Sertorius (SCHLESINGER & GEER, 1959, 191) had to import specialist craftsmen to their production centres.
139. Long-distance transport (both land and sea) was difficult and not something to which sensitive bulk shipments of arms would be entrusted.
140. On new legions being raised in Italy, see MANN, 1963. Caesar raised legio V Alaudae in Transalpine Gaul, where there were classical cities (Suetonius Div. Iul. 24).
141. Cf. ROBINSON, 1975, 62.
142. It may be no coincidence that eastern armies, largely freed of the need to manufacture their equipment, had a reputation for slovenliness (Tacitus, Ann. XIII,35; Fronto, Ad Verum Imp., II,1,9).
143. P. Gen. Lat. I verso v is the best known record of such duties and relates to only 36 men from a century (WATSON, 1969, 73-4) available for fatigues. Of these, never more than half-a-dozen are occupied in guard duties on any one day.
144. Rightly or wrongly, this is certainly the impression given

by Trajan's Column.

145. On the face of it, the troops in Tab. Vind. 1 and 3 (Appendix Nos.4 & 5) are auxiliary, but it must be remembered that these documents do not specifically state this fact. Otherwise, references to cohortales in P. Berlin inv.6765 (Appendix No.3 Col.ii,5) may be taken to indicate the use of auxiliaries (BRUCKNER & MARICHAL, 1979, 7).
146. Late fabricae are discussed in detail in JAMES, forthcoming.
147. Finds of equipment from water are a different matter. I hope to discuss this subject in greater detail elsewhere.

APPENDIX: SUBLITERARY AND LITERARY SOURCE MATERIAL

No.1: Vegetius II,11

habet praeterea legio fabros tignarios structores carpentarios ferrarios, pictores reliquosque artifices ad hibernorum aedificia fabricanda, ad machinas turres ligneas ceteraque, quibus uel expugnantur aduersariorum ciuitates uel defenduntur propriae, praeparatos, qui arma uehicula ceteraque genera tormentorum uel noua facerunt uel quaeuata repararent. habebant etiam fabricas scutarias loricarias arcuarias, in quibus sagittae missibilia cassides amiaque armorum genera formabantur. haec enim erat cura praecipua, ut quicquid exercitui necessarium uidebatur numquam deesset in castris.

"A legion had workmen, joiners, masons, wagon-makers, smiths, painters, and other craftsmen for the construction of buildings in the winter-quarters and for the preparation of machines, wooden towers (which are either for assaulting enemy cities or defending their own) and so forth, who will either make from scratch or repair wagons, vehicles, and other sorts of engines. They even had workshops for shields, cuirasses, and bows, in which they fashioned arrows, missiles, helmets, and all sorts of weapons. For this was a principal concern: that whatever they saw was necessary for the army was never missing from the camp."

No.2: Digest 50,6,7

quibusdam aliquam uacationem munerum grauiorum condicia tribuit, ut sunt mensores, optio ualetudinarii, medici, capsarii, et artifices qui fossam faciunt, ueterinarii, architectus, gubernatores, naupegi, ballistarii, specularii, fabri, sagittarii, aerarii, bucularum structores, carpentarii, scandularii, gladiatores, aquilices, tubarii, cornuarii, arcuarii, plumbarii, ferrarii, lapidarii, et qui calcem cocunt, et qui siluam infindunt, qui carbonem caedunt ac torrent. in eodem numero haberi solent lani, uenatores, uictimarii, et optio fabricae, et qui aegris praesto sunt, librarii quoque qui docere possint, et horreorum librarii, et librarii depositorum, et librarii caducorum et adiutores corniculariorum, et stratores, et polliones, et custodes armorum, et praeco, et bucinator. hi igitur omnes inter immunes habentur.

"Certain soldiers are granted by their conditions of service some exemption from the heavier fatigues. These are men such as surveyors, the medical sergeant, medical orderlies and dressers, ditchers, farriers, the architect, pilots, shipwrights, artillerymen, glaziers, workmen, arrowsmiths, coppersmiths, helmet-makers, wagon-makers, roof-tile-cutters, swordcutlers, water engineers, trumpet-makers, horn-makers, bow-makers, lead-workers, blacksmiths, stonecutters, lime-burners, woodmen, and charcoal burners. In the same category there are usually

included butchers, huntsmen, keepers of sacrificial animals, the workshop sergeant... armoury sergeants, the herald, and the trumpeter. These are all included amongst the immunes." Based on WATSON, 1969, 76.

No.3: P. Berlin inv. 6765 (ChLA 409)

XIIII] Kal(endas) Ma[ias]		XIII Kal(lendas) Ma[ias
[op]erati]sunt in f.		[op]erati sun[t in fabricam legionis
milit]es legion abricam legionis		milites leg[ionari
immun]es		immunes [
[]ari n(umero) C		cohortales [
cohorta]les		galliar]ii fic[
galliar]ii fic[pagani [
]....es		custodiae [
] VIII		scuta talari]a
] IIII		leuesatae la[
]lamnae leuisatares X		item breues[
]spathar[u]m fabricatae X	[
]. fabricatae VI		[s]cuta planat]a
]elaria V		arcus peracti[
]peractae CXXV		capitula ball[istaria
].....		seruo in p[
c]lavis eamm ..		.[

Published in BRUCKNER & MARICHAL, 1979, 6-7

No.4: Tab. Vind. 1

VII K(alendas) Maias fabricis h(omines) CCCXXXIII
ex eis sutores vacat XII
s[tr]uctores ad balneum XVIII
ad plumbum [
ad ar [
[] a[] ualitudinar[
ad furnaces [
ad lutum [
tectores [
m. pil [
ad cae[
] b[
ad p [
cum[

Published in BOWMAN & THOMAS, 1983, 77-9

No.5: Tab. Vind. 3

Side A

[[] em[]]
[[] riu []]
[[] itarius[]]
]arium [
]us adiu []
[[]]arium []]
]s faber[
] s 7 ul
] im gladi []
]ueas.7 frui
[[]] ralem []]
[[]]is faber []]
[[]]rman[]]
]t q̄ e []

Side B

[[]] eni a[]]
[[]]ius ? []]
[[]]us ma ri []]
[[]]ius faber []]
] am []
]s . rufini []
] a eon []

traces

] .faber []
[[]atorium []]
[[]framen[]]
]a .am[]
] ?frum[]
]m []

trace

Published in BOWMAN & THOMAS, 1983, 81-3

No.6: **AE 1926, No.3**

*u*alerio scu[ta]rio
IIX

No.7: **CIL XIII 11504**

*m*arti uotum
*t*ib(erius) *i*ul(ius) *a*quil(a)
*g*ladia[ri]us
s(oluit) *l*(aetus) *l*(ibens) *m*(erito)

ABBREVIATIONS

AE	<u>L'Année Epigraphique</u>
ChLA	<u>Chartae Latinae Antiquiores</u>
CIL	<u>Corpus Inscriptionum Latinarum</u>
ORL	<u>Der obergermanisch-raetische Limes</u>
RE	<u>Paulys Realencyclopädie der classischen Altertums-</u> <u>wissenschaft</u>
RLO	<u>Der römische Limes in Österreich</u>

BIBLIOGRAPHY

- ANGUS et al. 1962: N.S. Angus, G.T. Brown, H.F. Cleere, 'The iron nails from the Roman legionary fortress at Inchtuthil, Perthshire', Journal of the Iron and Steel Institute, 200, 1962, 956-68
- ANSTEE 1953: J.W. Anstee, 'Fragments of Roman "bronze" scale armour from Corbridge', Museums Journal, 53, 1953, 200-2
- BARNES 1979: T.D. Barnes, 'The date of Vegetius', Phoenix, 33, 1979, 254-7
- BAYLEY & BUTCHER 1981: J. Bayley & S. Butcher, 'Variations in alloy composition of Roman brooches', Revue d'Archéométrie, suppl.29, 1981, 29-36
- BIDWELL 1980: P.T. Bidwell, Roman Exeter: Fortress and Town, (Exeter 1980)
- BIRLEY 1977: R. Birley, Vindolanda: a Roman Frontier Post on Hadrian's Wall, (London 1977)
- BISHOP forthcoming: M.C. Bishop, 'The distribution of military equipment within Roman forts of the first century A.D.' in PLANCK & UNZ, forthcoming
- BISHOP unpublished: M.C. Bishop, Report on the Analysis of Some Military Equipment from the Roman Fortress at Longthorpe Using Atomic Absorption Spectroscopy, unpublished report prepared for Peterborough City Museum and Art Gallery, (Sheffield 1984)
- BOGAERS & YPEY 1963: J.E. Bogaers & J. Ypey, 'Ein neuer römischer

- Dolch mit silbertauschierte und emailverzierter Scheide aus dem Legionslager Nijmegen', Berichten van de Rijksdienst voor het oudheidkundig bodemondezoek in Nederland, 12-13, 1962-3, 87-98
- BOWMAN & THOMAS 1983: A.K. Bowman & J.D. Thomas, Vindolanda: The Latin Writing Tablets, Britannia Monograph Series No.4, (London 1983)
- BREEZE 1969: D.J. Breeze, 'The organization of the legion: the first cohort and the equites legionis', Journal of Roman Studies, 59, 1969, 50-55
- BREEZE 1974: D.J. Breeze, 'The organisation of the career structure of the immunes and principales of the Roman army', Bonner Jahrbücher, 174, 1974, 245-92
- BREEZE 1976: D.J. Breeze, 'A note on the use of the titles optio and magister below the centurionate during the principate', Britannia, 7, 1976, 127-33
- BREEZE et al. 1976: D.J. Breeze, J. Close-Brooks, J.N.G. Ritchie, 'Soldiers' burials at Camelon, Stirlingshire, 1922 and 1975', Britannia, 7, 1976, 73-95
- BRUCKNER & MARICHAL 1979: A. Bruckner & R. Marichal (eds.), Chartae Latinae Antiquiores, Part X, Germany I, (Zürich 1979)
- CRADDOCK et al. 1973: P.T. Craddock, J. Lang, K.S. Painter, 'Roman horse-trappings from Fremington Hagg, Reeth, Yorkshire, N.R.', British Museum Quarterly, 37, 1973, 9-17
- CRUMMY 1983: N. Crummy, Colchester Archaeological Report 2: The Roman Small Finds from Excavations in Colchester 1971-9, (Colchester 1983)
- CRUMMY 1984: P. Crummy, Colchester Archaeological Report 3: Excavations at Lion Walk, Balkerne Lane, and Middleborough, Colchester, Essex, (Colchester 1984)
- CURLE 1911: J. Curle, A Roman Frontier Post and its People. the Fort of Newstead in the Parish of Melrose, (Glasgow 1911)
- DANIELS 1968: C.M. Daniels, 'A hoard of iron and other materials from Corbridge', Archaeologia Aeliana, ser.4, XLVI, 1968, 115-26
- DOBSON 1965: B. Dobson, 'The praefectus fabrum in the early principate' in JARRETT & DOBSON, 1965, 61-84

- DOBSON 1978: B. Dobson, Die Primipilares, (Köln-Bonn 1978)
- VON DOMASZEWSKI 1908: A. von Domaszewski, 'Die Rangordnung des römischen Heeres', Bonner Jahrbücher, 97, 1908, 1-278
- DOWN 1981: A. Down, Chichester Excavations Vol.5, (Chichester 1981)
- FINGERLIN 1981: G. Fingerlin, 'Eberzahnanhänger aus Dangstetten', Fundberichte aus Baden-Württemberg, 6, 1981, 417-32
- FINK 1971: R.O. Fink, Roman Military Records on Papyrus, American Philological Association Monograph 26, (Cleveland 1971)
- FITZPATRICK forthcoming: A. Fitzpatrick, 'Camulodunum: a reassessment' in PLANCK & UNZ, forthcoming
- FOX & ST.JOHN HOPE 1901: G.E. Fox & W.H. St.John Hope, 'Excavations on the site of the Roman city at Silchester, Hants., in 1900', Archaeologia, 57, 1901, 229-56
- FREERE 1978: S.S. Frere, Britannia. A History of Roman Britain, ed.2, (London 1978)
- FREERE 1983: S.S. Frere, 'Roman Britain in 1982. I Sites explored', Britannia, 14, 1983, 280-335
- FREERE & ST.JOSEPH 1974: S.S. Frere & J.K. St.Joseph, 'The Roman fortress at Longthorpe', Britannia, 5, 1974, 1-129
- GARLICK 1980: M. Garlick, 'The reconstruction and use of a lorica hamata', Exercitus, 1:1, Summer 1980, 6-8
- GILLIAM 1967: J.F. Gilliam, 'The deposita of an auxiliary soldier (P. Columbia inv.325)', Bonner Jahrbücher, 167, 1967, 233-43
- GOFFART 1977: W. Goffart, 'The date and purpose of Vegetius' "De Re Militari"', Traditio, 33, 1977, 65-100
- VON GONZENBACH 1965: V. von Gonzenbach, 'Schwertscheidenbleche von Vindonissa aus der Zeit der 13. Legion', Jahresbericht der Gesellschaft Pro Vindonissa, 1965, 5-35
- VON GONZENBACH 1966: V. von Gonzenbach, 'Tiberische Gürtel- und Schwertscheidenbeschläge mit figürlichen Reliefs', Helvetia Antiqua. Festschrift Emil Vogt, Beitr. z. Prähist. u. Arch. der Schweiz, (Zürich 1966), 183-208
- HARMAND 1967: J. Harmand, L'armée et le soldat à Rome de 107 à 50 avant notre ère, (Paris 1967)

- HERRMANN 1969: F.-R. Herrmann, 'Der Eisenhortfund aus dem Kastell Künzing', Saalburg Jahrbuch, 26, 1969, 129-41
- HOGG 1969: A.H.A. Hogg, 'Pen Llystyn: a Roman fort and other remains', Archaeological Journal, 125, 1969, 101-92
- HUBENER 1973: W. Hübener, Die römischen Metallfunde von Augsburg-Oberhausen, Materialhefte zur bayerischen Vorgeschichte 28, (Kallmünz 1973)
- HURST 1985: H.R. Hurst, Kingsholm. Excavations at Kingsholm Close and Other Sites with a Discussion of the Archaeology of the Area, Gloucester Archaeological Reports 1, (Cambridge 1985)
- JACKSON & STONE forthcoming: R. Jackson & M.J. Stone (eds.), Roman Military Studies I, (forthcoming)
- JAMES forthcoming: S.T. James, 'The fabricae, state arms factories of the later Roman Empire' in JACKSON & STONE, forthcoming
- JARRETT & DOBSON, 1965: M.G. Jarrett & B. Dobson (eds.), Britain and Rome, (Kendal 1965)
- JOHNSON 1983: A. Johnson, Roman Forts of the 1st and 2nd Centuries A.D. in Britain and the German Provinces, (London 1983)
- KEIM & KLUMBACH 1951: J. Keim & H. Klumbach, Der römische Schatzfund von Straubing, Münchener Beiträge zur Vor- und Frühgeschichte Bd.3, (München 1951)
- KEPPIE 1984: L.J.F. Keppie, The Making of the Roman Army from Republic to Empire, (London 1984)
- KLUMBACH & BAATZ 1970: H. Klumbach & D. Baatz, 'Eine römische Parade-Gesichtsmaske aus dem Kastell Echzell Kr. Büdingen (Hessen)', Saalburg Jahrbuch, 27, 1970, 73-83
- LEAHY 1980: K. Leahy, 'A first century military pendant from Normanby, South Humberside', Lincolnshire History and Archaeology, 15, 1980, 83-4
- LEHNER 1928: H. Lehner, 'Ausgrabungen in Vetera 1927', Germania, 12, 1928, 20-5
- MACMULLEN 1960: R. MacMullen, 'Inscriptions on armor and the supply of arms in the Roman Empire', American Journal of Archaeology, 64, 1960, 23-40

- MACMULLEN 1984: R. MacMullen, 'The legion as a society', Historia, 33, 1984, 440-56
- MANN 1963: J.C. Mann, 'The raising of new legions during the principate', Hermes, 91, 1963, 483-9
- MANNING 1972: W.H. Manning, 'Ironwork hoards in Iron Age and Roman Britain', Britannia, 3, 1972, 224-50
- MAXFIELD 1981: V.A. Maxfield, The Military Decorations of the Roman Army, (London 1981)
- MEGAW & SIMPSON 1979: J.V.S. Megaw & D.D.A. Simpson, Introduction to British Prehistory from the Arrival of Homo Sapiens to the Claudian Invasion, (Leicester 1979)
- MILLAR 1982: F. Millar, 'Emperors, frontiers and foreign relations, 31 B.C. to A.D.378', Britannia, 13, 1982, 1-23
- NIBLETT 1985: R. Niblett, Sheepen: an Early Roman Industrial Site at Camulodunum, CBA Research Report 57, (London 1985)
- OLDENSTEIN 1977a: J. Oldenstein, 'Zur Ausrüstung römischer Auxiliareinheiten. Studien zu Beschlägen und Zierat an der Ausrüstung der römischen Auxiliareinheiten des obergermanische-raetischen Limesgebietes aus dem zweiten und dritten Jahrhundert n. Chr.', Bericht der römisch-germanischen Kommission, 57, 1976 (1977), 49-366
- OLDENSTEIN 1977b: J. Oldenstein, 'Zur Buntmetallverarbeitung in den Kastellen am obergermanischen und rätischen Limes', Bulletin des Musées Royaux d'Art et d'Histoire, 46, 1974 (1977), 185-96
- PARKER 1932: H.M.D. Parker, 'The antiqua legio of Vegetius', Classical Quarterly, 26, 1932, 137-49
- PEATMAN 1981: J. Peatman, Abbeydale Industrial Hamlet, (Sheffield 1981)
- VON PETRIKOVITS 1970: H. von Petrikovits, 'Die Spezialgebäude römischer Legionslager', Legio VII Gemina, (Léon 1970)
- VON PETRIKOVITS 1974a: H. von Petrikovits, 'Römisches Militärhandwerk. Archäologische Forschungen der letzten Jahre', Anzeiger der österreichischen Akademie der Wissenschaften, philosophisch-historische Klasse, 111, 1-23
- VON PETRIKOVITS 1974b: H. von Petrikovits, 'Militärische Fabricae der Römer' in D.M. Pippidi (ed.), Actes du IXe congrès

- international d'etudes sur les frontières romaines,
(Bucharest 1974), 399-407
- VON PETRIKOVITS 1975: H. von Petrikovits, Die Innenbauten römischer Legionslager während der Prinzipatszeit, Abhandlungen der Rheinischer Westfälischen Akademie der Wissenschaften Bd.56, (Opladen 1975)
- PLANCK & UNZ forthcoming: D. Planck & C. Unz (eds.), Kongress-Akten der Beiträge am Limes-Kongress in Aalen 1983, Sonderbd. Forschungen und Berichten zur Vor- u. Frühgeschichte. Baden-Württemberg, (Stuttgart forthcoming)
- RACKHAM 1976: O. Rackham, Trees and Woodland in the British Landscape, (London 1976)
- RAEPSAET-CHARLIER 1973: M.-T. Raepset-Charlier, 'Germania inferior et Germania superior', Latomus, 32, 1973, 158-61
- RICHMOND 1933: I.A. Richmond, 'The four Roman camps at Cawthorn in the North Riding of Yorkshire', Archaeological Journal, 89, 1932 (1933), 17-78
- RITTERLING 1904: E. Ritterling, 'Das frühromische Lager bei Hofheim i.T. Ausgrabungs- und Fundbericht', Annalen des Vereins für nassauische Altertumskunde und Geschichtsforschung, 34, 1904, 1-110, 397-423
- ROBINSON 1975: H.R. Robinson, The Armour of Imperial Rome, (London 1975)
- ROBINSON 1977: H.R. Robinson, 'The origins of some first century legionary helmets' in J.E. Bogaers (ed.), Studien zu den Militärgrenzen Roms II: Vorträge des 10. internationalen Limeskongresses in der Germania Inferior, (Köln 1977), 553-9
- ROSS & FEACHEM 1976: A. Ross & R. Feachem, 'Ritual rubbish? - the Newstead pits' in J.V.S. Megaw (ed.), To Illustrate the Monuments. Essays Presented to Stuart Piggott, (London 1976), 230-7
- SADDINGTON 1982: D.B. Saddington, The Development of the Roman Auxiliary Forces from Caesar to Vespasian (49 B.C.-A.D.79), (Harare 1982)
- SANDER 1929: E. Sander, 'Frontin als Quelle für Vegetius', Philologische Wochenschrift, 49, 1929, 1230-31
- SANDER 1932: E. Sander, 'Die Hauptquellen der Bücher I-III der epitoma rei militaris des Vegetius', Philologus, 87, 1932,

- SANDER 1939: E. Sander, 'Die antiqua ordinatio legionis des Vegetius', Klio, 32, 1939, 382-91
- SANDER 1962: E. Sander, 'Der praefectus fabrum und die Legionsfabriken', Bonner Jahrbücher, 162, 1962, 139-61
- SANDYS 1927: J.E. Sandys, Latin Epigraphy. An Introduction to the Study of Latin Inscriptions, ed.2, revised by S.G. Campbell, (London 1927)
- SCHENK 1930: D. Schenk, 'Flavius Vegetius Renatus: die Quellen der Epit. rei militaris', Klio, Beiheft 22, 1930
- SCHLESINGER & GEER 1959: A.C. Schlesinger & R.M. Geer, Livy with an English Translation in Fourteen Volumes. XIV Summaries, Fragments, and Obsequens, Loeb Classical Library, (London 1959)
- VON SCHNURBEIN 1974: S. von Schnurbein, 'Der römischen Militärlager bei Haltern, Bericht über die Forschungen seit 1899', Bodenaltertümer Westfalens, 14, 1974
- SCHÖNBERGER 1978: H. Schönberger, Kastell Oberstimm: die Grabungen von 1968 bis 1971, Limesforschungen 18, (Berlin 1978)
- SCHÖNBERGER 1979: H. Schönberger, 'Valkenburg Z.H.: Praetorium oder Fabrica', Germania, 57, 1979, 135-41
- TAYLOR & WILSON 1961: M.V. Taylor & D.R. Wilson, 'Roman Britain in 1960. I Sites explored', Journal of Roman Studies, 51, 1961, 157-91
- ULBERT 1969: G. Ulbert, Das frühromische Kastell Rheingönheim, Limesforschungen 9, (Berlin 1969)
- WATSON 1969: G.R. Watson, The Roman Soldier, (London 1969)
- WEBSTER 1979: G. Webster, The Roman Imperial Army of the First and Second Centuries A.D., ed.2, (London 1979)
- WHITE 1984: K.D. White, Greek and Roman Technology, (London 1984)
- WILSON 1974: D.R. Wilson, 'Roman Britain in 1973. I Sites explored', Britannia, 5, 1974, 397-460
- ZADOKS-JOSEPHUS JITTA & WITTEVEEN 1977: A.N. Zadoks-Josephus Jitta & A.M. Witteveen, 'Roman bronze lunulae from the

Netherlands', Oudheidkundige Mededelingen uit het Rijksmuseum
van oudheden te Leiden, 58, 1977, 167-95