

13. Multidisciplinary Approach to Romano-British Cattle Butchery

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It has been suggested, from observations of faunal remains, that Romano-British butchers employed crude and unskilled practices for carcass dismemberment. By adopting a multidisciplinary approach to the analysis of butchery marks from archaeological material, it has been shown that the cut marks are in fact representing specific techniques that were highly specialised and efficient for carcass dismemberment.

The research presented in this paper used modern butchery practices to replicate a number of the more distinctive marks to clarify what actions may have caused them, what implement may have been used and what actual function was evident. In addition, information from archaeometallurgic reports, and iconographic and literary sources were used to gain the clearest interpretation from an amalgamation of resources.

The results suggest that, far from a lack of skill, urban Romano-British butchery seems to point more to a need for speed. Furthermore, specific implements were in production and use, and unlike the modern British cleaver, the Romano-British cleaver was in fact a dual-purpose implement designed with the intention of facilitating and improving carcass dismemberment.

This paper demonstrates the value of taking on board a multidisciplinary approach to combine information from various strands of archaeology in order to make better use of archaeological material. With further research, butchery analysis should elucidate a range of information relating to diet, cuisine, trade, use of space, acculturation, meat production and implement specialisation.

Keywords: BUTCHERY, ROMAN BRITAIN, EXPERIMENTAL ARCHAEOLOGY.

Introduction

“Bones present zooarchaeologists with the ability to make direct observations of a fundamentally unchanged food residue, and assist in determining how past cultures exploited animals within their environment” (Zimmerman Holt 1996).

Of key importance, however, is how zooarchaeologists extract information from excavated remains, and subsequently how the information is used by other archaeologists to further theoretical and practical knowledge. What this paper will demonstrate is that both zooarchaeology and archaeology would benefit from an integrative approach being incorporated into new research.

Furthermore, while the various strands of archaeology can benefit from integrating methodologies to promulgate a deeper understanding of past activity, this should not be seen as the limit of what a ‘multidisciplinary approach’

can encompass. This paper will show that where butchery and bone fragmentation are concerned, modern knowledge can also contribute to our understanding of past cultures.

Butchery in the Romano-British period

The Romano-British period was chosen as the focus of this study for a number of reasons. Primarily, it has been extensively studied with significant animal bone reports having been published (e.g. Grant 1971; 1975; Maltby 1979; 1984; 1993a; 1993b; 1996; 1998; Thawley 1982; Aird 1985; Done 1986; Dobney *et al.* 1996; Noddle 2000). Secondly, this period has yielded an extensive array of cutting implements (Manning 1966; 1976; 1985), which provide information about the materials present and the technology developed at the time (Cleere 1976; Manning

1979). There is also a wealth of knowledge detailing the everyday lives of Romans available from iconographic and literary sources (Frere 1967, 295; White 1967; Strong and Brown 1976; Scullard 1994, 6). These can be used (with care as this information can be subjective) to assist in deciphering information arising from archaeological excavations.

Most important to this study of the aforementioned points is the information relating to actual butchery practice from the Romano-British period. To date, one of the clearest trends to come out of butchery analysis is that of a distinction between butchery practices noted on urban and rural sites (Maltby 1981; 1985; 1989; 1994; 1996; Thawley 1982, 217).

The level to which butchery in the Romano-British period can be termed a 'trade' cannot at present be ascertained. Some suggestions have implied that meat production at that time was of secondary importance to the maintenance of traction and dairy animals (Grant 1975, 384; Everton 1979, 37; O'Connor 1989, 15; Murphy *et al.* 2000; Noddle 2000, 219), rather than a clear trade in itself. However, it is just as likely that many animals of all three main domesticates (cattle, sheep and pigs) were bred specifically for their meat value (Leary 1998, 50–1).

Butchery

The general processes of modern butchery from live animal to table involve a series of events from stunning, 'sticking' for blood removal, evisceration for removal of soft internal organs, skinning, halving and quartering (Jones *et al.* 1985, 153; Thawley 1982, 219; FAO 1991, 23–40; Rixson 2000).

The above is a very simplified version of events; one need only walk into a meat market, butchers, restaurant or household to gain some appreciation of the complex variations in meat processing that can occur. These variations not only stem from location but also from the ultimate use of the meat, age of the animals, implements used and the skill of the practitioner.

The issue of variation is of particular importance to the present study. The differences in butchery techniques cannot be understated in terms of the potential for information that might be elucidated, provided accurate recognition of the variation can be determined. Indeed, the variation in butchery practice can be considered fundamental to the whole issue of carcass dismemberment and processing. It is this variation that can help establish the reasons behind the processes that resulted in the butchery marks. However, this can only be achieved with a more comprehensive amalgamation of quantitative methods (to identify the presence and proportions of waste to meat bearing bones in an assemblage) with replication studies to better understand what the marks and patterns of fragmentation represent (Maltby 1985, 19–21).

Implements

Cutting implements obviously play a paramount role in butchery practice. From the very basic stone cutting tools first employed by prehistoric hominines to the finely honed, specifically manufactured knives and cleavers of today, cutting implements can very much dictate and direct the techniques used to dismember a carcass.

In the modern setting the butcher generally employs the knife as the principal tool. However, the practice of splitting the carcass in half, then quartering it, employs either the electric or hand-held butcher's saw. This specific butcher's tool has small teeth for easy sawing of hard bone material, but not of meat or soft tissue. A saw is not employed to cut through soft tissue, as the teeth would become 'clogged'. Instead, a knife is used prior to any sawing to cleanly cut the meat, leaving the bone free to be sawed. The cleaver tends to have little use, especially where large beef carcasses are concerned, due to the potential splintering of bone this tool would cause.

Cutting implements from the Romano-British period came in a wide range of shapes and sizes. These ranged from small knives, thought to have had the dual purpose of knife and razor use, to medium-sized straight-bladed implements, which were usually tanged, to large knives/cleavers, which were either tanged or riveted (Manning 1976, 37).

Need for a multidisciplinary approach

It is unfortunate that to date very little work has combined the various archaeological disciplines in order to gain a more lucid picture of past activities. Butchery technique is very much linked to the types of implements used for dismemberment. Therefore, it is surprising that current research does not aim to link together expertise from these two disciplines (Coy and Maltby 1984, 96). To illustrate the value of a multidisciplinary approach, it is useful to employ an example that has already been mentioned.

Cleavers and large knives are often clustered together within an assemblage of metal artefacts found from a site. It has been stated "where the distinction is drawn between a large knife and a cleaver is largely a matter of opinion, although the latter is usually socketed" (Manning 1976, 37). This small point, made by an expert in metal artefacts, highlights a very important distinction for anyone interested in butchery. Within the modern butchery trade cleavers are invariably double- or triple-riveted to give a durable and strong handle able to withstand prolonged and sustained chopping of dense bone material onto a solid wooden block for a period of many years. A knife, however large, that is tanged and not riveted is unlikely to be able to withstand the heavy use that a riveted blade can endure.

Therefore, the cleaver is a tool specific to the butchery trade. For this reason, as well as the expense, size, and

skill required in using such an implement, the average modern household does not have a 12-inch (26.4 cm) chopper in everyday use. Relating this back to the Romano-British period, it is feasible to speculate that, if large riveted knives are found within the archaeological record, they were made specifically for, and used exclusively by, butchers.

Accordingly, if such finds are associated with bones showing butchery marks then it is possible – and highly likely – that these marks are either from large scale seasonal processing (possibly by itinerant butchers) or from established practitioners. This would indicate the presence of ‘butchery waste’ in the strictest sense and *not* household waste, or tertiary butchery/bone working marks (Rixson 1988). Such distinctions provide a better understanding and more precise appreciation of what the marks correspond to and what the site itself may represent.

Herein lies the value of a multidisciplinary approach; by adopting the view that different strands of archaeology can provide mutually beneficial information, and by creating a cohesive synthesis of this information, a clearer understanding of past cultures can be achieved.

Replication of butchery marks

The experimental aspect of this project involved the replication of various butchery marks observed on faunal material from the Romano-British period. The basic method was derived from other replication studies (Sadek-Kooros 1972; Jones 1980; Binford 1981; Stanford *et al* 1981; van Wijngaarden-Bakker 1990, 167–74; Armour-Chelu 1992) as well as personal experience.

The replications elicited a number of technical aspects that have led to some interesting and pertinent conclusions. These include the probability that carcasses were hung for processing (as noted from skinning of the foot), that the Romano-British butchers were processing carcasses quickly and that specific butchery implements were in production and use. These conclusions are discussed at greater length below.

Hung versus lying for meat processing

This is an important issue as it potentially has far-reaching implications relating to butchery techniques, building construction and trade (large scale trade would probably lead to hanging, if this was not already the chosen mode of storage and dismemberment, as it reduces the need for space).

Hanging requires vertical space (although it saves a great deal of ground space). This implies that specific buildings would have had to be created, or parts of premises converted, with tiered platforms, to accommodate the needs of the butcher/meat processor.

If an animal is slaughtered, gutted and skinned on the ground, it needs to be dismembered at the same time.

Leaving a carcass lying either on its side or back causes blood to accumulate in the parts that are in contact with the ground, making meat unfit for consumption. Furthermore, the carcass is more prone to infiltration by bacteria (FAO 1991, 32) as well as increasing the likelihood of insect or rodent infestation.

These practical considerations would have been just as pertinent during the Romano-British period. However, although the replications point to the carcass being hung, establishing this is not so straightforward. An important gauge of whether an animal was hung or lying during the initial stages of dismemberment can be found on the axial skeleton.

The ribs of cattle are one of the few areas of the carcass that are easier to chop through while hung. In other words, generally it is simpler to disarticulate a carcass at joints and *then* chop into the bone once the ‘joint of meat’ can be placed on a block.

However, the vertebrae, dorsal aspects of the ribs and sternum are all easier to chop, particularly if halving down or close to the midline is required, while the carcass is hung. Consequently, where butchery marks, particularly chop marks, are noted on the dorsal aspect of the ribs – especially on the *inferior* surface (indicating that the carcass was hung by the Achilles and chopped from the caudal/sacral vertebrae to the cervical vertebrae) – or the vertebrae are themselves chopped, this would be a strong indication of the carcass being hung during dismemberment. Sites such as Caerwent (Hambleton and Maltby, in prep.) and Winchester (Maltby 1989, 88) have abundant evidence of such butchery on cattle ribs and vertebrae and would consequently support the notion that carcasses were commonly hung on urban sites in the Romano-British period.

It is important to find supporting evidence for hanging, as this scenario is not as clear-cut as it might at first seem. The foot is likely to be removed prior to hanging. Furthermore, even with a small cow it is likely that once hung, the feet would be above the practitioner’s head, making skinning difficult. A possible explanation may involve the carcass being hung by the Achilles, hoisted part way up for ease of foot removal, then hoisted up the rest of the way for further skinning; a sequence of events that is favoured by smallholder butchers (Figure 13.1).

Romano-British butchers feel a need – a need for speed!

The urban Romano-British butchers were employing practices that sped up the carcass dismemberment process, thus resulting in a change in implement use and the appearance of deeper more pronounced cut marks, that some have erroneously interpreted as indicating unskilled practices.

The replications carried out have shown that practices were favoured that minimised the time spent on each

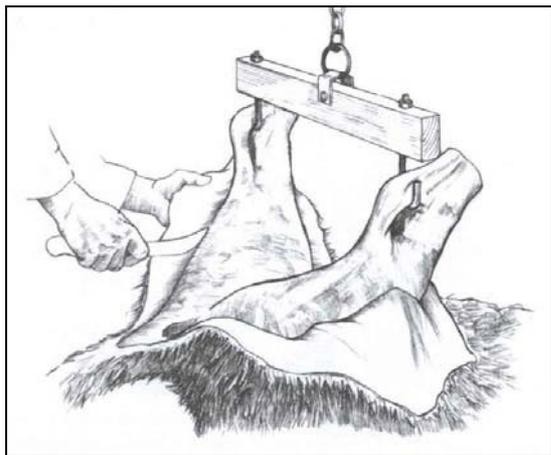


Figure 13.1. Skinning with carcass semi-hoisted.

carcass, particularly with regard to the scoop marks on upper limb bones resultant from meat removal, scapula butchery and the manner in which the femur was disarticulated from the pelvis.

Importantly, these techniques were being used instead of methods that require less effort physically, but require more actual cutting. To illustrate this point, to dismember the femur from the pelvis using the cleaver requires one slicing cut (or possibly two) into the gluteobicep muscle, then a single chopping cut to release the femur by disarticulating the femoral head. At most, two further slicing cuts are needed to completely separate the whole leg from the carcass. Using the knife as the principal disarticulation tool also requires one or two slicing cuts into the gluteobicep muscle. However, at least two to five further slicing cuts are required to deal with the tough ligaments and tendons surrounding the hip joint, then a further two or three slicing cuts to release the whole leg. Both of these methods have their technical merits and it should not be thought that one is rudimentary and the other sophisticated. Although the first method was apparently used during the Romano-British period, whereas the latter is more common in the present day, the latter also appears to have been used in previous periods such as the Iron Age when knife use dominated. It is apparent that the implements available played a vital role in how carcasses were dismembered.

The most convincing evidence for speed, however, has come from the replications carried out for meat removal from the scapula. It is worth mentioning first that chopping into meat is not a use one might expect for a cleaver although this action has been speculated in reports from sites such as Dorchester (Maltby 1993a, 319). This is completely unlike the processes used in modern butchery and would in fact seem totally unfeasible. However, what these replications have shown is that the different shape of the Romano-British cleaver made this possible. Whilst the action is not precisely 'chopping', and the purpose not exactly 'filleting', as might be defined in modern butchery (the purpose is more accurately 'meat-removal'), it is

nonetheless a different use of the cleaver to how it would be used today. This outcome was very much unexpected and highlights the potential for this type of study. Where this replication demonstrates evidence for speed comes from the fact that when using the knife (modern scenario) some 34 slicing cuts were made to remove the meat from the scapula. Using the cleaver (Romano-British technique) required only two or three chops. The meat is quickly removed from the ventral surface, then the spine is chopped and the majority of the meat removed from the dorsal surface. With the spine removed, the remaining meat can again be quickly detached from the surface of the scapula blade.

Other issues such as the changing trend in favour of the cleaver over the knife (Maltby 1989) also support the conclusion that urban Romano-British butchers were trying to reduce the amount of time spent processing each carcass.

What is evident in the modern setting is that there is an increasing trend towards the use of the electric band-saw for quick dismemberment of carcasses, and this is reinforced as more meat arrives frozen for convenience. It is possible that we are seeing a shift in trends very similar to those seen in the early Romano-British period, only in the modern setting butchers are moving away from knives and cleavers towards hand and electric band-saws.

Other factors also play an important role in how meat is butchered. Perhaps most important but least recognised is the change in cattle size. Modern cattle are considerably larger than their Romano-British counterparts, as evidenced by the comparisons made during the replication process. Modern cleavers are rarely used to chop into cattle bones, the saw being seen as a more appropriate tool. An increase in the size of cattle was also noted during the Romano-British period (Dobney *et al.* 1996, 31) and it is possible that this was one of the catalysts that caused a shift in the techniques seen, as well as the implements used.

Specific butchery implements and butchery practice

Studying the implements available to Romano-British meat processors, it is clear that specialist implements were being created specifically for the purpose of butchering animals. A number of factors support this conclusion.

Primarily, the archaeological bones that have been butchered by these implements show a consistency that must surely indicate that specific butchery tools were being created. Chop, slice and skinning marks are recorded with a regularity that must point to specific implement manufacture and use. Although humans have been creating tools to deal with carcass dismemberment for millennia, what is most impressive about the Romano-British period is that new tools seem to have been created to meet changes either in demand or techniques associated with meat dispersal.

The key point is that the Romano-British cleaver is essentially a dual-purpose tool, one that has apparently been *designed* to slice as well as chop. The modern cleaver

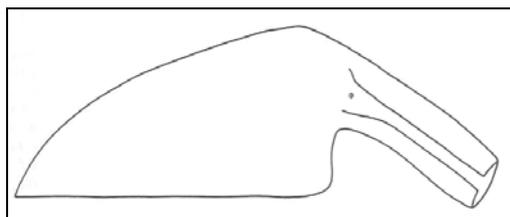


Figure 13.2. Cleaver found in London and Baldock.

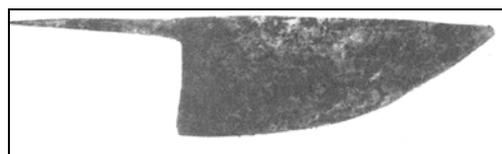


Figure 13.3. Tanged 'cleaver' excavated in London.

is very much a chopping tool and has been designed for this function, with a fully tanged and riveted handle allowing for maximum durability as a *chopping* implement.

The replications executed for this study point towards the use of the Romano-British cleaver as a dual-purpose butchery implement; a tool that allows chopping without compromising the ability to slice.

What is important from all the methods highlighted above is that these techniques were being used in favour of methods that required less specialised implements. In other words, the cleaver was changing the techniques that might be expected if only knives were present. This raises the question of what the catalyst might have been for this change in implement use and development. The Romano-British cleaver would need to be compared to Iron Age tools to assist in answering this question, but it is likely that this implement is very specific to this period. Otherwise it is probable that the characteristic marks seen on Roman bone assemblages would be seen in earlier periods.

To support this further, certain implements do appear to be unique to the Romano-British period. Highlighted above (Figure 13.2) is one cleaver in particular that does not appear to be present in any other period and which has no modern counterpart.

The shape of this cleaver appears to have been specifically designed to be used with a hung carcass. The positioning of the handle would prevent its use on a chopping block, as the practitioners would constantly be crushing their hand with each blow applied; it would also compromise any power into the blow due to the angle imposed on the wrist. It also highlights the use of specific tools that could find little use elsewhere in everyday life. The shape of this blade and the design of its handle make it highly likely that it was a specific butchery tool.

The point raised earlier concerning the difference between a large knife and a true cleaver is best illustrated with the following example (Figure 13.3), which although classed as a cleaver is more accurately a 'large knife'. The tang is thin and has no evidence of socketting (rivets to attach the handle). This knife would clearly be less adept at chopping when compared to the previous example and it can be speculated that these implements would have very different uses.

In terms of the implement itself, another branch of archaeology seems to support the extensive use of the cleaver in the Romano-British period. One problem with iron cutting implements is that they do not maintain their

cutting edge as well as steel. From personal experience of using iron blades to chop bone, it is apparent that while they are adept at carrying out the process, they do require more maintenance than steel blades. Furthermore, iron blades will actually 'knick' if they are allowed to blunt in any one area and the area is not 're-edged'. Consequently, they require frequent sharpening, especially when chopping bone. Supporting this is the fact that a large number of whetstones are consistently found on Romano-British sites, although it must be remembered that these would also have been used to sharpen agricultural as well as household implements.

Evidence for large scale butchery

In terms of the way our view of meat has changed, perhaps the most important consideration is the change in demand. As demand for meat increases, production increases, and consequently a specific *trade* is created. The disassociation of some individuals from producing food means that others will gain employment from doing just that. Subsequently, specialists appear and butchers are one of these.

The scale of specialist butchery practices during the Romano-British period is difficult to ascertain. However, some clues are available. Firstly, it is clear that 'patterns' of butchery existed, at least for some urban regions. This would suggest a certain degree of interchange in terms of technique and that there was in fact a need for specific techniques. It is possible that this need arose due to an increase in meat demand, and was met by individuals who had knowledge of mass meat processing, prime candidates being military personnel. Unlike smallholders or even farmers on rural sites, military caterers would have had to provide a steady and regular supply of meat to large numbers of individuals over a prolonged period of time. Consequently, they would be the most likely individuals to develop the knowledge concerning quick carcass dismemberment. Furthermore, military sites would also have weapon-making and repair facilities, which could easily be employed and adapted to assist in designing, creating and repairing tools best suited for the task of carcass dismemberment.

This is highly speculative, but provides a possible scenario whereby the potential catalysts for the progression of quick dismembering techniques are developed, as well as the availability of raw materials and knowledge for technological advances in tool design. In support of this

notion is the archaeological material from military sites such as Cirencester (Thawley 1982, 217–9), which shows a pattern of butchery similar to urban trends.

There was also a need for the knowledge to be perpetuated, and this would come from an increase in meat demand, which would mean that individuals coming out of the military (or whatever arena the techniques for quick dismemberment originated) would find a niche for their skills.

One aspect of this advancement in the meat trade that is not speculative is the fact that community size (towns, cities etc) increased during the Romano-British period. Consequent to this would be an increase in the demand for meat to feed a growing population. Following the invasion of Britain, it might be expected that in the ensuing periods of peace many soldiers would have needed to find work in areas aside from the military. With the skills and possibly even the tools for carcass dismemberment, it could be speculated that ex-military personnel found work as butchers and formed the basis of a meat trade based on the increase in demand for meat that would have been seen at the time.

What is perhaps more important than the evidence from Rome and the possible means of development/perpetuation of dismemberment practices is the actual evidence from archaeological sources. Romano-British towns such as Caerwent have produced over 20,000 bone fragments, with over 3,000 having butchery marks on them (Hambleton and Maltby, in prep). Further to this is the fact that the replications for this study have shown some very important butchery techniques leave no marks at all; possibly most important of these being some methods of marrow extraction.

What is also important is the type of material being deposited. Large numbers of split meat bearing limb bones, as well as deposits that are composed almost exclusively of head and foot bones, have been found on Romano-British sites such as Silchester (Maltby 1984, 202) and Lincoln (Dobney *et al.* 1996, 23). This can only be taken to indicate that these are substantial assemblages of butchery and bone-working waste (Maltby 1989, 75).

While the above indicates evidence for large-scale butchery practice, and other sections have highlighted the notion that this practice was likely to be specialised, none of this actually elucidates what 'large-scale' means in terms of numbers of animals being processed. How this might be estimated is a difficult process and requires information coming from a variety of sources. It has been suggested that the average day's work for a tradesman during the Roman period was in the region of six hours. This however is calculated on the premise that the Roman day was divided into 'twelve increments' that depended on the amount of daylight; therefore there was a difference in an increment depending on time of year (Harris 2000, 98).

It has also been speculated that the majority of trade actually took place at the individual's home, with an opening in the 'front room' to allow buyers to view and



Figure 13.4. Relief from Ostia showing butcher premises.

purchase wares. Butchers may require special consideration due to the need to dispose of waste that could potentially attract vermin, as well as the fact that abattoirs and meat markets were known to exist in the Roman era (Gerrard 1955, 2). Iconographic representations from some parts of the Roman Empire also clearly indicate actual butchery premises (Figure 13.4). Nevertheless, it must be assumed that the majority of butchers practised as other tradesmen did, namely from their own home.

Drawing from personal experience it must be stated that skinning, evisceration and meat dismemberment is both physically demanding and time consuming. Therefore with approximately six to eight hours work per day, limitations on space, and the physically demanding nature of the work involved, it might be speculated that a butcher may deal with between three and five cattle carcasses per day. It is obvious that other animals would also have to be processed, and the figure of three to five is probably the most a single butcher (assuming the carcass is hung and with assistance to do so) could physically process in any one day. It is likely that this figure actually was considerably less, maybe as low as one cow carcass per week, depending more on the demand for beef than what might be processed by an individual.

Conclusions and recommendations

Roman butchery has characteristics that could almost be considered unique. This study has hopefully clarified some of the mystery behind the ways these practices were carried out. What seems evident is that a specific set of circumstances was in place that not only catalysed the practices seen, but also allowed for their perpetuation. Most prominent amongst these is the increase in demand for meat, coupled with innovation of tools to allow for the quick processing of carcasses and individuals to take up and develop the burgeoning 'trade' possibly coming from the military. One area that has been overlooked but is also imperative to the changes seen is the fact that cattle were considerably smaller in the Romano-British period than they are today, facilitating dismemberment using the cleaver. This is significant because part of the reason that

modern cattle carcasses are not processed heavily with a cleaver (aside from the issue of splintering) is that the bones themselves are very dense, and chopping therefore becomes a laborious and repetitive process. As already mentioned, this heavily influences the modern preference for the use of the hand and electric saws.

This study has shown the benefit of incorporating different lines of evidence in order to make better use of the available data. Certainly, the incorporation of metal-lurgic and lithic evidence to support osteological findings is paramount. However, this should not be the limit to this amalgamation. For example, a review of a few literary sources containing translations from Roman cookery make no references to specific 'cuts' or 'joints' to be used when preparing beef dishes (Vehling 1977, 30–32, 188–9; Flower and Rosenbaum 1978, 187–8; Edwards 1984, 285). While caution must be used when using these sources, they do provide important data and in this case actually reinforce the findings from the current study.

Leading on from this and focusing specifically on the Romano-British period, what is certainly needed is further investigation into the comparative differences between urban and rural/villa sites, employing this amalgamative approach. Therefore, while strong evidence comes from the osseous material, not only in terms of numbers of bones found, but also in the marks evident on them; differences in the types and number of implements noted would be useful, as would information relating to whetstones. This last point is particularly useful as whetstones link directly to the implements themselves, but are more likely (as with the bones) to be discarded and left at a site if a group moves from one area to another.

Perhaps one of the most useful methodological issues to be raised is the benefit of experimentation through replication. Clearly it can be seen that replication can provide a new perspective to the topic in question and that this certainly merits more use of this type of research.

From an archaeological perspective this study certainly seems to have dispelled the notion that urban Romano-British butchers were crude or unskilled. What seems very apparent from the replications is that speed seems to be of the essence, and this must reinforce the notion that 'trade' and high demand were important factors. However, speed cannot explain everything and it is almost certain that with further development of this research area, techniques will be apparent that have more to do with a desire for specific 'cuts and joints' as much as for speed. This may be more important when looking at other periods where demand may not have been so high, but which nonetheless provide an exciting area into which to further this type of research.

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References

- Aird, P.M. 1985. On distinguishing butchery from other post-mortem destruction: a methodological experiment applied to a faunal sample from Roman Lincoln, pp. 5–35 in Fieller, N.R., Gilbertson, D.D. and Ralph, N.G. (eds.), *Palaebiological Investigations* (BAR International Series 266). Oxford: British Archaeological Reports.
- Armour-Chelu, M.J. 1992. Vertebrate Resource Exploitation, Ecology and Taphonomy in Neolithic Britain, with special Reference to the Sites of Noltland, Etton and Maiden Castle (Unpublished PhD thesis). London: Institute of Archaeology and British Museum.
- Binford, L.R. 1981. *Bones: Ancient Men and Modern Myths*. New York: Academic Press.
- Cleere, H. 1976. Iron making, pp. 127–53 in Strong, D. and Brown, D. (eds.), *Roman Crafts*. London: Duckworth.
- Collingwood, R.G. and Richmond, I. 1969. *The Archaeology of Roman Britain*. London: Methuen.
- Coy, J. and Maltby, M. 1984. Archaeozoology in Wessex, pp. 204–51 in Keeley, H.C.M. (ed.), *Environmental Archaeology: a Regional Review. Volume 2. Wessex* (Historic Buildings and Monuments Commission for England Monograph 1). London: English Heritage.
- Dobney, K., Jaques, D. and Irving, B. 1996. *Of Butchers and Breeds. Report on Vertebrate Remains from Various Sites in the City of Lincoln* (Lincoln Archaeological Studies 5). Lincoln: City of Lincoln Archaeology Unit.
- Done, G. 1986. The animal bones from areas A & B, pp. 141–7 in Millet, M. and Graham, D., *Excavations on the Romano-British Small Town at Neatham, Hampshire, 1969–79*. (HFCAS Monograph 3). Winchester: Hampshire Field Club and Archaeological Society.
- Edwards, J. 1984. *The Roman Cookery of Apicius*. London: Rider.
- Everton, R.F. 1979. The animal bones, pp. 36–7 in Ellis, P., *Catsgore 1977 – Further Excavations of the Romano-British Village* (Western Archaeology Trust Monograph 7). Gloucester: Alan Sutton.
- FAO. 1991. *Guidelines for Slaughter, Meat Cutting and further Processing* (FAO Publications 91). Rome: Food and Agriculture Organization.
- Flower, B. and Rosenbaum, E. 1978. *The Roman Cookery Book*. London: Harrap.
- Frere, S.S. 1967. *Britannia: a History of Roman Britain*. London: Routledge and Kegan Paul.
- Gerrard, F. 1955. The craft of the butcher, pp. 1–3 in Gerrard, F. (ed.), *The Book of the Meat Trade, Vol 1*. London: Caxton Publishing Company.
- Grant, A. 1971. The animal bones, pp. 377–88 in Cunliffe, B., *Excavations at Fishbourne 1961–1969* (Society of Antiquaries Reports of the Research Committee 27). London: Society of Antiquaries of London.
- Grant, A. 1975. The animal bones, pp. 378–408 in Cunliffe, B., *Excavations at Portchester Castle: Volume I Roman* (Society of Antiquaries Reports of the Research Committee 32). London: Society of Antiquaries of London.

- Hambleton, E. and Maltby, M. in prep. Archaeozoological Interpretations from the Animal Bone Assemblages from Excavations at Caerwent. National Museum of Wales.
- Harris, N. 2000. *History of Ancient Rome*. London: Hamlyn.
- Jones, P.R. 1980. Experimental butchery with modern stone tools and its relevance for Palaeolithic archaeology. *World Archaeology* 12, 153–65.
- Jones, R.T., Langley, P. and Wall, S. 1985. The animal bones from the 1977 excavations, pp. 129–174 in Hinchcliffe, J. and Green, C.S., *Excavations at Brancaster 1974 and 1977* (East Anglian Archaeological Report 23). Dereham: Norfolk Archaeological Unit.
- Leary, R.S. 1998. *Excavations at the Romano-British settlement at Pasture Lodge Farm, Long Bennington, Lincolnshire, 1975–77* by H.M. Wheeler. Lincoln: Trent and Peak Archaeology Trust.
- Maltby, M. 1979. *Faunal Studies on Urban Sites: the Animal Bones from Exeter 1971–1975* (Exeter Archaeological Reports 2). Sheffield: University of Sheffield, Department of Prehistory and Archaeology.
- Maltby, M. 1981. Iron Age, Romano-British and Anglo-Saxon animal husbandry: a review of the faunal evidence, pp. 95–127 in Jones, M. and Dimbleby, G. (eds.), *The Environment of Man: the Iron Age to the Anglo-Saxon Period* (BAR British Series 87). Oxford: British Archaeological Reports.
- Maltby, M. 1984. Animal bones and the Romano-British economy, pp. 125–37 in Grigson, C. and Clutton-Brock, J. (eds.), *Animals and Archaeology Volume 4: Husbandry in Europe* (BAR International Series 227). Oxford: British Archaeological Reports.
- Maltby, M. 1985. Assessing variations in Iron Age and Roman butchery practices: the need for quantification, pp. 19–31 in Fieller, N.R., Gilbertson, D.D. and Ralph, N.G. (eds.), *Palaeobiological Investigations* (BAR International Series 266). Oxford: British Archaeological Reports.
- Maltby, M. 1989. Urban-rural variations in the butchering of cattle in Romano-British Hampshire, pp. 75–106 in Serjeantson, D. and Waldron, T. (eds.), *Diets and Crafts in Towns* (BAR British Series 199). Oxford: British Archaeological Reports.
- Maltby, M. 1993a. Animal bones, pp. 315–40 in Woodward, P., Davies, S.M. and Graham, A., *Excavations at the Old Methodist Chapel and Greyhound Yard, Dorchester, 1981–84* (DNHAS Monograph 12). Dorchester: Dorset Natural History and Archaeological Society.
- Maltby, M. 1993b. The animal bones from a Romano-British well at Oakridge II, Basingstoke. *Proceedings of the Hampshire Field Club and Archaeological Society* 49, 47–76.
- Maltby, M. 1994. The meat supply in Roman Dorchester and Winchester, pp. 85–102 in Hall, A.R. and Kenward, H.K. (eds.), *Urban-Rural Connexions: Perspectives from Environmental Archaeology* (Symposia of the Association for Environmental Archaeology 12/Oxbow Monograph 47). Oxford: Oxbow.
- Maltby, M. 1996. Animal bones, in Holbrook, N. and Thomas, A., *The Roman and Early Anglo-Saxon settlement at Wantage, Oxfordshire: excavations at Mill Street 1993–4*. *Oxoniensia* 61, 158–160.
- Maltby, M. 1998. Animal bones, pp. 69–72 in Barnes, I., Butterworth, C.A., Hawkes, J. and Smith, L., *Excavations at Thames Valley Park, Reading, 1986–88*. *Prehistoric and Romano-British Occupation of the Floodplain and Terrace of the River Thames*. Salisbury: Trust for Wessex Archaeology.
- Manning, W.H. 1966. A hoard of Romano-British ironworks from Brampton, Cumberland. *Transactions of the Cumberland and Westmoreland Antiquarian Society* 66, 1–36.
- Manning, W.H. 1976. *Catalogue of Romano-British Ironwork in the Museum of Antiquities, Newcastle upon Tyne*. Newcastle: University of Newcastle upon Tyne, Department of Archaeology.
- Manning, W.H. 1979. The native and Roman contribution to the development of metal industries in Britain, pp. 111–21 in Burnham, B.C. and Johnson, H.B. (eds.), *Invasion and Response* (BAR British Series 73). Oxford: British Archaeological Reports.
- Manning, W.H. 1985. *Catalogue of the Romano-British Iron Tools, Fittings and Weapons in the British Museum*. London: British Museum.
- Mettler, J. 1987. *Basic Butchering of Livestock and Game*. Massachusetts: Storey Books.
- Moore, R.W. 1943. *The Roman Commonwealth*. London: English Universities Press.
- Murphy, P., Albarella, U., Germany, M. and Locker, A. 2000. Production, imports and status: biological remains from a late Roman farm at Great Hols Farm, Boreham, Essex, UK. *Environmental Archaeology* 5, 35–48.
- Noddle, A. 2000. Large vertebrate remains, pp. 217–43 in Price, E., *Frocester: a Romano-British Settlement, its Antecedents and Successors*. Gloucester: Gloucester and District Archaeology Research Group.
- O'Connor, T.P. 1989. What shall we have for dinner? Food remains from urban sites, pp. 13–23 in Serjeantson, D. and Waldron, T. (eds.), *Diets and Crafts in Towns* (BAR British Series 199). Oxford: British Archaeological Reports.
- Rixson, D. 1988. Butchery evidence on animal bones. *Circaea* 6, 49–62.
- Rixson, D. 2000. *The History of Meat Trading*. Nottingham: Nottingham University Press.
- Sadek-Koors, H. 1972. Primitive bone fracturing: a method of research. *American Antiquity* 37, 369–82.
- Scullard, H.H. 1994. *Roman Britain – Outpost of the Empire*. London: Thames and Hudson.
- Stanford, D., Bonnichsen, R. and Morlan, R. 1981. The Ginsberg experiment: modern and prehistoric evidence of bone flaking technology. *Science* 212, 434–40.
- Strong, D. and Brown, D. 1976. *Roman Crafts*. London: Duckworth.
- Thawley, C.R. 1982. The animal remains, pp. 211–27 in Wacher, J.S. and McWhirr, A.D., *Early Roman Occupation at Cirencester* (CEC Monograph 1). Cirencester: Cirencester Excavation Committee.
- van Wijngaarden-Bakker, L.H. 1990. Replication of butchery marks on pig mandibles, pp. 167–74 in Robinson, D.E. (ed.), *Experiment and Reconstruction in Environmental Archaeology*. Oxford: Oxbow Books.
- Vehling, J.D. 1977. *Apicius Cookery and Dining in Imperial Rome*. New York: Dover Publications.
- White, K.D. 1967. *Agricultural Implements of the Roman World*. Cambridge: Cambridge University Press.
- Zimmerman Holt, J. 1996. Beyond optimisation: alternative ways of examining animal exploitation. *World Archaeology* 28, 89–109.

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