People with Animals

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Front cover: Sheep shearing in Mongolia (Photo © Lee Broderick, 2012).

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MANURE: VALUED BY FARMERS, UNDERVALUED BY ZOOARCHAEOLOGISTS

Lee G. Broderick and Michael Wallace

Manure is a crucially important animal product in many mixed and sustainable agricultural production systems but, despite this, it is frequently overlooked by zooarchaeologists who instead tend to focus on more widely recognised contributions of domestic livestock to human subsistence. The case is made here for the consideration of this secondary product in zooarchaeological palaeoeconomic interpretations through the presentation of an ethnographic case-study from work carried out in Ethiopia in 2008. Discussion then focuses on a review of the ways in which manuring practices may be identified in the archaeological record and the importance of full integration of research through the collaboration of different specialists involved in a research project.

Introduction

Zooarchaeologists typically characterise domestic faunal assemblages as reflecting exploitation strategies which were designed by farmers to maximise yields of meat, dairy produce, traction or wool. Are these characterisations a result of the secondary products revolution paradigm? Alternatively, are they a consequence of familiarity with the modern Western world's industrialised farming system? An important resource from cattle and other livestock is manure, yet it is often overlooked by zooarchaeologists, who are frequently called upon to interpret past subsistence strategies and livestock exploitation schemes. Manure is clearly a secondary product of domestic animals, as defined by Andrew Sherratt, being a useable resource which does not result in the death of the animal; but it was never specifically mentioned in his paradigm generating paper (Sherratt, 1981) or in the debates that followed (cf. Greenfield, 2010).

Manure is a very effective fertiliser, used today wherever chemical fertilisers are either too expensive or less desirable (Morris, 2007, pp. 21–22). As such, manure plays a crucial role in any integrated agricultural system (Jones and Crane, 2009), forming a vital link between animal and plant husbandry. In order to determine the potential relative importance of manure in small-scale, self-sufficient agricultural (here used for its full definition, encompassing all food-producing activities including arable and pastoral elements) systems, such as those typical of pre-industrialised societies, an ethnographic study was carried out in Ethiopia. This study revealed a subsistence strategy in which manure was the single most important animal product.

The potential methods through which manuring can be discerned archaeologically are reviewed and discussed with a suggestion that full collaboration between various specialists involved in research projects is necessary if such practices are to be recognised for their full importance in the archaeological record.

Fieldwork methods

In July and August 2008, ethnographic work was undertaken in the Gurage and Sidama regions of Ethiopia (Fig. 4.1). These regions were chosen due to their mild, temperate climate, rendering them in certain ways comparable to parts of Europe. The regions also fall within the Ethiopian Highlands, a climatic island surrounded by desert, which until recently effectively isolated many cultural and subsistence behaviours from outside influence, or at least making such influence rarer. The largely pre-industrial way of life and

Figure 4.1. The administrative regions of Ethiopia (after UN Emergencies Unit for Ethiopia) with the research areas of Gurage and Sidama highlighted.

the environmental similarity to many parts of Europe make the ethnographic study of these regions highly relevant to European, as well as African, archaeology.

The Gurage and Sidama regions in the Ethiopian Highlands have an average annual rainfall of *c.*1300 mm (Barnett, 1999; Welde-Michael *et al.*, 2008), comparable to the Scottish Hebrides, particularly the southern islands such as Islay (Gregory *et al.*, 1991). Mean annual temperatures of 16–20°C (Barnett, 1999) also bear comparison with parts of Britain. These regions are characterised by small-scale farming, on highly productive volcanic soils (Broderick, field notes, 2008). Ethiopia contains some of the most fertile land in all of Africa and has long been acknowledged as a centre of indigenous agricultural development as well as the source of domestication of a variety of food species (Barnett, 1999), the southern highlands, in which Gurage and Sidama are included, are a part of this fertile block.

As part of the study 13 villages, primarily located in the Gurage region, were visited. No particular criteria were used in the selection of these villages. At each village an interview was conducted, with the aid of a translator, at the first occupied house encountered. Interviewees were always the house-owner or their partner: no effort was made to distinguish gender roles since research was directed at the household and community levels. Occasionally a second interview at the next occupied house was conducted at particularly large villages. Questions were designed to be non-leading and were asked in an unstructured, informal way; as far as possible placed in the context of a normal conversation. This process allowed the subject to become an active participant in the discussion, suggesting topics and yielding information which may not otherwise have been considered by the interviewer. Nevertheless, key questions were designed before fieldwork commenced and were all included in the conversation at each location. These questions included identification of the relative importance of various animal products and the benefits derived from livestock ownership.

Fieldwork results

Villages in both regions typically contain between 20 and 50 houses, usually arranged in a linear fashion along a main thoroughfare but with ample space between individual homes for garden agriculture as well as the movement of people and animals (Fig. 4.2). Less structured settlements are also occasional features of the landscape.

Garden agriculture forms the mainstay of the traditional economy: villagers typically grow tomatoes (*Solanum lycopersicum*), maize (*Zea mays*), ensete (*Ensete ventricosum*), walla potatoes (*Plectranthus edulis*), yams (*Dioscorea* sp.), potatoes (*Solanum tuberosum*), sweet

Figure 4.2. Linear village in Gurage region.

potatoes (*Ipomoea batatas*), papaya (*Carica papaya*), oranges (*Citrus sinensis*), mangoes (*Mangifera indica*), sugarcane (*Saccharum* sp.) and guava (*Psidium* sp.) as well as some cash crops. In the Gurage region the most common cash crop is qhat (*Catha edulis*): this is often grown in quantities little more than what is used for personal consumption but can in some instances cover an area equivalent to the rest of the cultivated area of a household. Coffee (*Coffea* sp.) has now become the most common cash crop in the Sidama region however, a crop that has proven so profitable that many households have become specialist coffee producers and have ceased to be self-sufficient. On the outskirts of some villages in the region restricted areas are ploughed for the growing of teff (*Eragrostis tef*), these areas forming a relatively small part of the actively managed landscape. Teff and other cereals in fact form a minor component of the local diet, the principal starchy carbohydrate being ensete; Barnett notes that this form of agriculture can not only support a dense population but also that "there is less risk of soil exhaustion than with cereal agriculture [as practiced in other parts of Ethiopia] as the crop is manured frequently" (1999, p. 18).

Deforestation and over-exploitation of farmland have left the country with one of the largest soil erosion rates in the world (Dubale, 2001). The farmers themselves are not blind to this problem and have for a long time practiced a subsistence system which is geared towards the maintenance of these rich soils (Broderick, field notes, 2008). Cattle (*Bos primigenius*) are the most important animal resource in Ethiopia (Barnett, 1999; cf. Broderick, 2012). Most people in these regions, however, do not own their own cattle, but are loaned them by family and/or neighbours (Broderick, field notes, 2008). It is important to note that ownership of cattle confers rights not only to it and its meat and offspring, but also most secondary products, such as dairy produce; essentially almost the only benefit derived from tending and housing cattle loaned in this way is their manure, which is used to fertilise crops (Broderick, field notes, 2008).

In all of the villages visited, livestock are typically owned by only one, or at most two, families but are cared for by all of the inhabitants; each household taking responsibility for a few animals (for the sake of clarity hereafter these households are referred to as fosterers, to distinguish them from the livestock owners) (Table 4.1). Fosterers stall the cattle in their own homes (Fig. 4.3) and care for them during periods of ill health. In contrast, herding is a

Figure 4.3. Cattle in their stalls in a house in the Gurage region.

Table 4.1. Livestock stalled in each house surveyed in 2008; all households were livestock fosterers except for house G8i which was held by livestock owners

Village	*Av. livestock per house*	*House*	*Livestock*
Gurage Region			
G1 – Gelever Debere		i	2 heifers, 2 ox
G2 – Anka		i	2 goats
G3 – Waket Watera	5–18 cattle + some caprines	i	4 heifers, 5 ox
G3 – Waket Watera	5–18 cattle + some caprines	ii	4 cattle + 1 calf
G4 – Lumbe		i	4 cattle
G5 – Gajaba		i	3 cattle
G6 – Yarbay Taleg		i	6 cattle, 2 sheep
G7 – Amba Genet	2–6 head livestock	i	4 cattle, 1 goat
G8 – Sante		i*	35 cattle, 1 horse
G8 – Sante		ii	5 cattle, 2 sheep
G9 – Mengesha	7–8 cattle	i**	2 cows, 2 goats
G10 – Abela Mareka	5–6 cattle, 5 goats	i	
G11 – Abele		i	5 cattle
Sidama Region			
S1 – Colindo	2–3 (max. 5) head livestock	i	2 cows
S2 – Shela	1 head livestock	i	1 cow

communal activity with all of the cattle from one village (or sometimes two neighbouring villages) being allowed to graze together under the watch of several village boys. Livestock are fostered in this way until such time as they are chosen for sale or slaughter by the owner or else they calve. At the point of any of these events the fosterers return the cow (or goat (*Capra hircus*)) to the owner who then exercises their right as owner to the money/meat/milk and calf. Such a system might at first appear to unfairly favour the owner with the fosterer being exploited – deriving none of the benefits typically discussed in zooarchaeological literature after all of the time, care and attention that they have invested in the animal.

The demographics of livestock ownership follow no clear pattern. In some villages it was explained that the owners were older and therefore wealthier. In these circumstances it was suggested that sending cattle for fostering among younger families in the village was a way to help them get started in life. In other villages the livestock owners were young and loaning of livestock to fosterers was explained as a way of looking after the elderly in their old age (Broderick, field notes, 2008). Most probably, since only one or two households in any village own livestock, ownership is in fact maintained within a family: this would explain the inconsistent age-class. In either case, however, there is a consistency of sentiment that the owners are caring for the fosterers by letting them house their cattle.

Cattle are stalled in the houses of their owners or fosterers, so as to more easily collect their excrement (manure) which is then spread onto their fields and garden plots as fertiliser

(Broderick, field notes, 2008). The more level ground is occasionally ploughed to grow teff, whilst steep or rocky ground unsuitable for ploughing is used as pasture. Such careful management is necessary in the rich, but fragile, African montane environments (Mahaney, 1986). Although the soil in the Gurage and Sidama regions is highly fertile, owing to its high mineral and organic content, indigenous farmers believe that it will rapidly deteriorate and become unproductive without regular manuring (Broderick, field notes, 2008). Ploughed fields make up a minor component of the farming system and it is garden agriculture that is the most important component of the villagers' diet. Thus traction is only a minor benefit derived from the keeping of cattle. The primary benefit derived from fostering cattle, indeed the only benefit ever mentioned by villagers in ethnographic interviews, is their manure which is used to fertilise the intensively managed garden plots. Stalling cattle in their houses not only helps to protect the animals from inclement weather and predators but also enables the fosterers to easily collect their manure for this purpose.

Discussion

The importance of manure in non-mechanised agricultural systems has recently been emphasised again (Jones and Crane, 2009). The stalling of cattle, partly in order to gain easier access to their manure, in prehistoric Britain and Northern Europe has been suggested elsewhere (Bakels, 1997, p. 444; Reynolds, 1987, p. 41) and will be discussed further in relation to this project in a separate publication. The possible links with manuring and protracted use of fields in this area and period has also been suggested (Bakels, 1997, p. 444). Upland areas of Britain, in particular, are characterised by the same qualities of soil deterioration and climate change in the Bronze Age (Harding, 2000, p. 19) that today characterise the Ethiopian Highlands.

Manure is clearly a very important resource and a crucial component in small-scale mixed farming systems (Bogaard *et al.*, 2013; van der Veen, 2005). In our Ethiopian example here, manure is deemed important enough in and of itself to warrant engagement in animal husbandry. The level of engagement differentiates it from examples of agriculturalists renting livestock at certain seasons and folding them on fields for their manure (Blench, 1999, p. 57; Halstead, 2013, p. 229). Although the net result may be similar the underlying mechanism is sufficiently different in our example to emphasise the importance of manure as a product, as well as embodying a rather different social relationship (service as opposed to financial/goods transaction). Livestock remains form the single greatest body of material studied by zooarchaeologists and the interpretation of subsistence strategies based on these remains is one of the most common tasks undertaken by them (Davis, 1987; O'Connor, 2004; Reitz and Wing, 2008). Despite this close familiarity with both subsistence and livestock, however, manure is a resource frequently overlooked by zooarchaeologists (but see Moreno-García and Pimenta, 2011). This, perhaps, is because of the fact that the remains of animals, that is their bones, cannot provide direct evidence of manuring. Zooarchaeologists, thus, must refer to other fields of research to understand this important use of animals.

Evidence for the identification of manuring in the archaeological record can come from various lines of investigation, some of which date back decades, whereas others are more recent innovations. Ceramics scatters as evidence for the spreading of midden waste over fields have long been considered a means of identifying manuring practices (Bintliff and Snodgrass, 1988; Wilkinson, 1989). Usually, but not always (Buckland *et al.*, 2009), the organic component decomposes, leaving the material-culture component scattered across manured areas. Although manuring is probably the most accepted explanation for such off-site ceramics scatters, it has been noted that farmers may take pains to avoid ceramic inclusions when manuring their fields (Halstead, 2013, p. 214). Alternative explanations for such scatters include accidental breakages along trade routes and periods of demographic growth (Bintliff and Snodgrass, 1988; Wilkinson, 1989). Scatters of material culture are somewhat problematic for the identification of manuring because it is unclear what proportion of the originally deposited material was animal waste or what impact the spreading had on crop yields.

Another off-site approach is the analysis of preserved soils. The earliest approach was phosphate analysis (Prøsch-Danielsen and Simonsen, 1988). High phosphate levels are indicative of high soil fertility, which in turn is suggestive of manuring. The presence of spherulites, on the other hand, provides specific evidence for faecal matter, as they are formed in the gut of animals, particularly ruminant herbivores (Canti, 1999). The level of spherulite production is dependent on the animal species and the animal's diet, and the technique is most effective when identifying concentrations of dung, such as at animal stables or in middens. Coprostanols and bile acids also provide evidence for faecal deposits (Bull *et al.*, 1999). They can survive in detectable amounts in preserved ancient soils, and not only identify the presence of faecal matter, but can sometimes be used to identify the genus of the dung producer. Further still, compound specific stable isotope analysis of amino acids and *n*-alkanoic acids extracted from soils has been shown to indicate the intensity of manuring (Bull and Evershed, 2012; Simpson *et al.*, 1999). These lines of geo-archaeological/geo-chemical investigation can be useful in identifying the parts of the landscape that were manured if soils are preserved, but evidence can also be lost to sedimentation or missed by limited landscape surveys. Different off-site methods often benefit from operating in tandem, such

as using ceramic scatters as a guide to identifying areas subjected to soil analysis (e.g. Bull *et al.*, 2001).

The focus of most archaeological investigations is the site, making the identification of the off-site activity of manuring problematic. Dung itself, if preserved in a charred state, is probably indicative of dung used as fuel rather than as manure, at least in dry regions (Charles, 1998; Wallace and Charles, 2013). Waterlogged deposits have preserved dung accumulations in barns and pens (Akaret *et al.*, 1999; Rasmussen, 1993), which provide an indication of the quantity of dung that could have been available for manuring, but does not capture the act of manuring. Likewise, several detailed attempts have been made to identify 'stable manure' via multiple lines of evidence, including insect and plant remains (Hall and Kenward, 1998; Kenward and Hall, 2012). Finally, Lancelotti and Madella (2012), suggest that high proportions of grass leaf and culm phytoliths are indicative of a herbivore diet, and thus archaeological deposits rich in these may have had a dung component. It is the case for all of these lines of evidence, though, that the accumulation of animal waste is not necessarily evidence for manuring. Dung has a wide range of applications, not least including as a slow-burning fuel (Anderson and Ertug-Yaras, 1996), as plaster or pottery temper (Lancelotti and Madella, 2012), or even to protect grain during Ethiopian teff processing (Refera, 2001).

Two effective approaches to the identification of manuring from on-site evidence are the study of crop remains, the intended recipient of the manure, and their associated weed seeds. The application of manure to arable land causes major alterations to plant growing conditions. Manuring, thus, can change the ecological characteristics of fields and therefore the composition of wild species that are unintentionally brought back to a site with the harvest (Bogaard, 2004; Jones, 2005; Jones *et al.*, 2010). Evidence for manuring can also be gleaned from the isotopic analysis of crop remains. Bogaard *et al.* (2013, 2007; Fraser *et al.*, 2011) have conducted stable nitrogen isotope analysis on modern and ancient crops, and have shown that manuring has a consistent and detectable effect on the stable nitrogen signal preserved in charred crop remains.

One recent example of an archaeology project with good communications between various specialists, including a zooarchaeologist, a geoarchaeologist and a phytolith expert, has provided opportunities for some of the integration proposed here. Spherulite and phytolith analysis at Althiburos, in Tunisia, showed extensive evidence for the collection of animal dung whilst faunal remains recovered demonstrated the keeping of domestic livestock (Portillo and Albert, 2011; Portillo *et al.*, 2012). Chemical analysis of the plant remains, as described above, has not been carried out at the site, though, and so direct evidence for manuring has not been identified. Interpretation of the faunal remains was based on Payne's mortality profiles (Payne, 1973) and indicated a meat optimisation strategy; although the specialist concerned concedes that other secondary products (including manure) were probably utilised as well (Valenzuela, pers. comm.). The underlying problem here is that the model explicitly identifies dairying or wool/traction maximisation strategies: most mixed strategies will tend to shift the mortality profile toward the median (meat) model, furthermore, a strategy for maximising manure does not rely on young animals and may appear more similar to the wool/traction model.

Conclusion

It has been suggested here that manure represents an important secondary product of animals which is underappreciated by many archaeologists. The ethnographic case-study presented here has demonstrated that there is at least one example of a society in which the manure produced by livestock is of sufficient importance in and of itself to justify their keeping as an integral part of a distinct economic system. Rarely are examples so black and white in the world today or, we presume, in the past; a mixed subsistence system involving the use of a variety of animal products should be considered the norm. Other primary and secondary products have long been recognised as being of possible principal importance but manure has long been denied this kind of recognition. Clearly, as we have shown here, the importance of manure to arable production means it may well have been an important, if not the most important, product derived from animals in past economies.

The interpretation of livestock being kept to maximise yields of dairy products, meat or wool/traction has been shown to be a product of models designed in a specific research framework related to the secondary products revolution paradigm. That zooarchaeologists are primarily concerned with information that they can derive directly from the material they study is understandable. On an interpretive level, however, when zooarchaeologists wish to engage with the wider discipline in debating human-animal relations they should not ignore the role of manuring simply because evidence of its practice cannot be derived from faunal remains. There is a clear need to work closely with other specialists when making interpretations so that the full range of animal uses can be considered. The weaving together of these multiple lines of evidence is crucial to the accurate and effective interpretation of the role of domestic livestock in past human societies.

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