Chapter 1
Combining Stones and Bones, Defining Form and Function, Inferring Lives and Roles

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How to cite this chapter:
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Introduction

Animal procurement and tool production form two of the most tightly connected components of human behaviour. They are tied to our emergence as a genus, were fundamental to the dispersal of our species, and underpin the development of our societies. The interaction between these fundamental activities has been a subject of archaeological inference from the earliest days of the discipline (e.g. Lartet 1862, 59–69), yet the pursuit of each has tended to encourage and entrench specialist study. As a result, our understanding of them has developed in full-view but in general isolation of one from the other. While, procurement methods are still used as the principal way of defining the economic development of human history (from hunting and gathering, to farming, to industrialization), it has been the production and diversification of tools that has traditionally received the closest scientific attention. Indeed, the materials used in hunting tool and weaponry production (Heizer 1962) still constitutes the way we partition our pre-modern history chrono-culturally: from stone, to bronze, to iron; with typological and technological classification systems underlying these divisions remaining the authority of archaeologists. It has only been in the latter part of the twentieth and into the twenty-first centuries, as research has become more directly focused on the points of material cross-over between technological and faunal studies (such as in use-wear and residue analyses, chaîne opératoire and ‘Organisation of Technology’ (Nelson 1991) approaches, and animal-butchery traces and techniques) that the depth of the relationship between these two fields has started to emerge. The research papers gathered together for this volume expose and explore this interaction from contexts spanning much of prehistory, from the Middle Pleistocene to the Late Holocene, drawing data from a wide range of environmental settings. The book is divided into three core sections: taphonomy and technology; raw materials, operational sequences and decision-making; and subsistence and cultural practice; each of which covers both sides of the complex inter-relationship between animals, the technologies used to procure them and those arising from them. Collectively the papers herein represent an essential investigation of the links that tie rather than the properties that have long separated the study of ‘bones or stones’.

Taphonomy and technology

From an early point in the nineteenth century there had been interest in determining the forces and agents that created marks on bones recovered from ancient contexts. In British Archaeology, the most well-known early example was William Buckland’s (1822) study of fossil fauna from a cave in Kirkdale, Yorkshire. He deduced that hyenas had been the primary accumulators of the assemblage based on observations of modern hyena behaviours (e.g. Buckland 1822, 187–8). This conclusion was reached some one hundred years before the development of Efremov’s ‘taphonomy’ (1940). Establishing a connection between extinct fauna and ‘human industrial remains’ (e.g. lithics) was also a primary interest of other nineteenth-century luminaries such as Lyell (1863), Pengelly et al. (1873) and Prestwich (1860) who sought to affirm the depth of human antiquity.

Outside of Britain, M. Edward Lartet, working at Aurignac in southwestern France, the type-site for the Aurignacian, would be among the first to directly consider human agency in bone modification; both through breakage for marrow extraction — for which he too made recourse to analogy — and to the appearance of linear surface striations — ‘scratches and shallow cuts, which appear to have been caused by the edge of some instrument employed to remove the flesh’ (Lartet 1862, 60). English archaeologist John...
Evans would write the same year, sensing the significance of this connection between bones and stones, that ‘this would prove not only the contemporaneity of these animals with man, but that they also formed his food’ (Evans 1862, 25). Although, as Lyman (1994) notes, the precocious analytical headway made in the nineteenth century in accounting for the various processes possibly affecting and conditioning archaeological assemblages appears to have come to somewhat of a standstill during the first half of the twentieth century. This was possibly due to a general shift away from the desire to demonstrate the ‘antiquity of Man’ and towards structuring the ‘developmental’ stages of humanity (see Chazan 1995); while palaeontological research continued to more directly concern itself with matters of site formation. These insights were synthesized in Efremov’s (1940) classic formulation that saw ‘taphonomy’ as the study of the laws of embedding — a field covering the processes acting on an animal between its death and its eventual incorporation into the lithosphere, the examination of local lithological conditions, the chemical and microscopic processes affecting this transition, and the quantitative estimation of the extent and composition of the local palaeontological community. Despite the fact that Efremov never actually envisaged taphonomy as inherently applicable to archaeology it has, nonetheless, become an important, even crucial, component in our discipline.

Although the term is occasionally misused or misappropriated by archaeologists (see Lyman 2010 for a detailed discussion of the matter), from the later twentieth century onwards there has been a renewal of interest in site-formation and transformative processes (e.g. Schiffer 1983; 1988), continued development and refinement of a *taphonomie lithique* (e.g. Bordes 2000; 2002; 2003; Tixier 1978; Villa 1982; 2004), geoarchaeological contributions (Bertran & Lenoble 2002; Bertran et al. 2005; 2010; Lenoble 2003; Lenoble et al. 2003; Texier 2000) and even an archival taphonomy (Dibble et al. 2009). As research by archaeologists into these processes has progressed, distinguishing genuine associations from happenstance has become central to the interpretative process, and is a matter explored by three papers herein (Monchot et al., Smith and de la Torre et al.). The sifting of natural phenomena from different types of anthropogenic modification has been especially prevalent in butchery analysis. The development of criteria for distinguishing different agents and effectors has been considerably refined over the last thirty years (e.g. Binford 1981; Domínguez-Rodrigo & Yravedra 2009; Fisher 1995; Greenfield 2006; Greenfield & Horwitz this volume; Jin & Shipman 2010; Olsen & Shipman 1988; Potts & Shipman 1981; Seetah 2008; Shipman & Rose 1983), and has been extended to the study of variables affecting the occurrence of bone lesions related to hunting (e.g. Badenhorst this volume; Noe-Nygaard 1974; Pokines 1998). Much in the same vein, behavioural and cognitive issues linked to the emergence and elaboration of genuine osseous technologies and distinguishing them from naturally fractured specimens, particularly in early contexts, have recently received particular attention (see e.g. Choyke 1997; d’Errico & Backwell 2003; Johnson 1985; Lyman 1984; Myers et al. 1980; Rabett 2008). Discerning *bona fide* human intervention from taphonomic factors again plays a major, if not fundamental role in these discussions. The observable alteration of an artefact or collection of artefacts and their state of preservation are the inexorable consequence of their depositional and taphonomic histories — including how they were excavated and subsequently conserved. The manner in which a particular site is excavated — bearing in mind that all sites are ‘well, fairly-well or poorly destroyed’ (Tixier 1978, *our translation*) — and how the resulting material is labelled, documented, archived and reorganized must also play a part in our analysis.

Debate about whether, and to what extent, we should distinguish site-formation processes from taphonomic ones remains complicated by the fact that clear consensus still does not yet exist about what is meant by an ‘archaeological record’ and what it should contain. The point made by Patrik (1985, 28) that different archaeologists use it in different ways, is as pertinent today as it was twenty-eight years ago. However, there is growing consensus that the non-anthropogenic often has as much to tell us about the immediate context of past human activity as does the activity itself — something played out through the growth in multi-disciplinary research projects and application of multi-proxy analyses of the burial record. What we are learning is that uncovering the human past is not just about the stories that artefacts can tell us, it is about what multiple lines of associated evidence can contribute collectively to our understanding of the resource choices and decisions people made and the natural and cultural forces that influenced them.

**Raw materials, operational sequences and decision-making**

The study of raw material use, availability and provenance has become an integral aspect of technological research and has been shown to affect and condition hunter-gatherer mobility strategies and patterns of tool production and use (e.g. Andrefsky 1994; 2009; Binford 1979; Geneste 1985; Torrence 1983). While
significant progress has been made in deciphering the ways siliceous raw materials articulate with techno-economy, attempts at attaining the same level of model building and theoretical application for bone tools have rarely ventured beyond the self-evident (namely, that such pieces are derived from faunal remains, probably during butchery). The inherent assumption remains that bone was derivative, a second-choice material. Of course, isolated cases exist where bone was the only suitable alternative in the absence of stone; however a growing body of evidence has shown that bone- or antler-working was a fundamental and complementary aspect of hunter-gatherer technologies from at least the beginning of the Upper Palaeolithic in Europe (d’Errico et al. 2003; Knecht 1997; Liolios 2006) and even earlier in Africa (Backwell et al. 2008; d’Errico & Henshilwood 2007; Yellen et al. 1995). Bone tools have the advantage of ‘indirectly reflect[ing] on both the environment and the way humans perceive and interact with that environment’ (Choyke 2003, 139). They convey a practical understanding of the articulation between the physical properties and constraints of organic resources. The social circumstances of their manufacture and use provide a far more realistic starting point for investigating this aspect of hunter-gatherer technology (e.g. Knecht 1997; Muñoz this volume; Plug this volume; Rabett 2011). In fact, given that bone implements can be directly dated, they may present a more reliable means for tracing technological trends and social reconfigurations across time and space than do lithic technologies (recent examples include: Langlais et al. 2012; Pétillon & Ducasse 2012).

As with stone resources, certain skeletal elements (including sections of shed antler) may be collected opportunistically, as part of an ‘embedded procurement strategy’ (Binford 1979), probably with foreknowledge of where and when to look for them in the landscape. Much more probable is that particular osseous raw materials either entered into the production sequence immediately following the initial dismemberment of the carcass or were singled out during its subsequent processing and then transformed into tools. Bone-tool blanks may begin life as cortical flakes ‘quarried’ from large dense sections of bone (Johnson 1985; Johnson et al. this volume), or they may begin as a fortuitously shaped split section of long-bone that has been broken to extract marrow (the point in the butchery sequence from which many pseudo bone tools derive).

Just as attention was often invested in the technical preparation of a lithic core before flakes or blades were removed, it was equally the case that osseous materials might also receive pre-treatment ahead of manufacturing. Heating is one method that affects the mechanical properties and working potential of bone. Stiner and colleagues (1995), for example, have observed that roasted bones react to loading in a similar manner to weathered bone when fractured. Overall, variables such as the extent of the bone surface area exposed to fire (versus how much was still encased within meat), the intensity of the heat source and the duration of exposure, each has its effect on bone structure. Ethnographic and experimental studies have also shown that bone and antler may be pre-soaked to improve workability (see e.g. Clark & Thompson 1953; Guthrie 1983; Newcomer 1974; Semenov 1964). Substantial parallels exist between selection procedures for stone and osseous raw materials in terms of mechanical properties, the methods in which they are transformed and the contexts of use. Acquiring raw materials for bone and antler artefacts also involves some noticeably different considerations to those involved in acquiring lithic raw materials.

A great disparity exists between the temporal nature of stone compared to bone formation. Bone is a much more dynamic material, constantly being reformed and replaced in the living animal, changing in composition as the animal ages and even after death, in that it becomes increasingly mineralized and will eventually lose structural integrity when subjected to weathering and other post-depositional processes. Whereas access to usable or favoured stone resources may be affected by local geology, distance, transportation and even weather conditions, the material itself is generally much less mobile. On the other hand, sources of bone in the living animal have their own patterns of mobility which need to be taken into account. As a result, game migration and the effects of changes or diversions in a migration cycle will have an impact on the timing and reliability of access to osseous raw materials and other animal products. At the same time, the acquisition of animal bone embodies a different kind of reliability: bone raw materials are guaranteed at the end of every successful hunt (see Knecht 1997). Such raw materials consistently occur in packages of generally comparable ‘quality’ and near-identical form (allowing for taxonomic and, to some extent, age-related variation); something that cannot be said of stone sources, wherein quality between and even within sources may vary considerably. Such reliability (or rigidity), however, also entails restrictions as well as guarantees on the kinds of tool manufacturing that can be realistically applied to bone (e.g. the long axis of a tool generally needs to follow the long axis of the bone in order to maximize resilience); something that is less of an issue when fabricating tools out of stone. As a further consequence of its status, as one
might expect, osseous raw material is bound up tightly with prevailing social attitudes towards animals, how they are procured, processed and consumed and what products and artefacts are made from them and when (e.g. Rasmussen 1931; Renouf 2000) — though it has to be said, ethnographic examples demonstrate that stone may also be perceived as animate (e.g. see Hallowell 1960, 24–5). It has been theoretical developments in the study of European Palaeolithic lithic technology that have brought technical actions and choices to the forefront of archaeological investigation, this is particularly true for early prehistory.

Working from the premise that ‘material culture has a relevant history’ (Schlanger 1994), the notion of chaîne opératoire describes the process by which a raw material is transformed into a cultural artefact, including its use, repair and eventual discard. Ultimately, this constitutes a ‘chronological segmentation of actions and mental processes’ (Sellet 1993) embedded within individual and collective cultural understandings (e.g. Dobres 2000). In an innovative analysis of Magdalenian bone and antler technology, Dobres (2000) chose not to look at particular chaîne opératoires underlying particular tool classes, but at what she calls ‘composite assemblages’ implicating several formal (traditional and imposed) tool categories. She argued that ‘the conceptual framework of the chaîne opératoire can link together the tangible and intangible dimensions of technological practice. At the same time, the analytic methods of chaîne opératoire research make it possible to link the archaeological record … to the dynamic social milieu in which they were practised’ (Dobres 1999, 129). Dobres’s general thesis was that technologies are not merely the sum of their ‘hardware’ but also embody cultural attitudes about how tools should be made and used (see also Ridington 1983). Such agency-based approaches represent a productive theoretical corollary for more techno-economic perspectives on the relationship between bone and stone tools; but one in which we must guard against importing and imposing levels of inference and cultural meaning from one regional and, more importantly, temporal setting to another (see e.g. Gravina 2004).

During the European Upper Palaeolithic and Mesolithic, tool blanks were produced by a variety of different techniques (i.e. splitting, cleaving, groove and splinter, knapping, percussion: Clark & Thompson 1953; Elliott & Milner 2010; Goutas 2009; Knecht 1997; Liolios 2006; Pétillon & Ducasse 2012; Tartar 2012) and to varying intensities. Apart from the obvious interest these technologies present for investigating the social transmission of skill and knowledge, alterations in manufacturing techniques and production intensities have important knock-on effects for the composition (both domestic and hunting) of associated stone tool assemblages, raw material economies and overall socio-technical systems. The progressive amplification of the role and importance of osseous raw materials and tool types inevitably entwined bone- and stone-working chaîne opératoires into an inseparable and cogent technological, economic and cultural system.

**Subsistence and cultural practice**

Post-processual and interpretative archaeologists have advocated for some time (e.g. Hodder 1991) the importance of material culture in creating identity and in mediating human social relations. To date, there has been little debate concerning the role played by material culture and, more specifically, hunting and gathering technology in mediating and articulating relationships between humans and the environment. This is an area that has considerable bearing not only for understanding prehistoric subsistence practices, but also for how archaeologists attempt to model them. Until comparatively recently the notion of ‘technology’ had received limited attention in social anthropology (Lemmonier 1986; Pfaffenberger 1999). In fact, the importance, and scholarly study, of material culture was not deemed consistent with an anthropology that, in the early part of the twentieth century, was trying to establish itself as a credible discipline. As a result its study was marginalized and has tended to be neglected ever since (Pfaffenberger 1992). This is in contrast to the centrality of material culture in archaeology where it has long been used to infer cultural affiliations, function and change. Though, as Dobres and Hoffman (1994) point out, even the very concept of ‘technology’ has rarely been subjected to any kind of sustained scrutiny. ‘Tools’ have tended to be accepted first and foremost as objects wielded by societies in response to certain circumstances and judged according to how well they meet those needs.

The efficiency of a technical system has tended to be defined in energetic terms, as a function of output, divided by the amount of input or cost (e.g. Bleed 1986). Comparing tool efficiencies in a predictive sense has been the objective of many researchers studying the relationship between traditional technologies and subsistence behaviours (e.g. Churchill 1993; Hames 1979; Hill & Hawkes 1983; Hurtado & Hill 1989; Rambo 1978; Roscoe 1990; Yost & Kelley 1983). Recourse to this overriding principle bridges the millennial gap between modern and prehistoric technical systems. For many it remains the most secure and universal way to establish a link between
the tools themselves and the choices faced by those who made and used them. The constraints of resource availability, and the risks of going without, require efficient technical solutions (Torrence 1983). Bleed (1986, 739) contends that a tool may be required to ‘meet with social expectations, or convey social or symbolic meaning, but beyond these considerations, the lesson of evolutionary selection is that a design must be efficient’. Thus, the demands of a particular type of resource shape the most efficient means of procuring it, i.e. the most suitable choice of tool. It has been argued, therefore, that the role of an implement (its intended purpose) can become the defining criteria in the way it is designed, manufactured, used and ultimately discarded (Binford 1979). The fact that this approach can be universally applied has been a boon to investigation, permitting wide-ranging comparisons. Technology is considered in terms of how well it follows the law of efficiency. Thus, archaeological studies of technology have tended to privilege the dimensions of its hardware over the social relations of which it was originally part (see though Dobres 1995; 2000; Dobres & Hoffman 1994; Hallowell 1926; Ridington 1982).

The perceived material qualities of a tool (such as its precision and material reliability) unarguably remain a significant part of a hunting event. Although Ridington has suggested that they ‘are not essential to its successful operation … Success in hunting and other activities depends more on the possession of knowledge and reciprocities with other persons than on the possession of particular material goods’ (Ridington 1999, 178–81; also see Bodenhorn 1993; Hallowell 1926). Ethnography places significance not only on tools, but also on the knowledge/relations of subsistence that are enacted through them. As already stated these interpretations emerged from a discipline that had long been somewhat biased against the ‘materiality’ of technology. Allowing for the fact that both approaches have been somewhat over-stated, the nature of subsistence technology probably lies somewhere in-between. Potentially, a chaîne opératoire approach (a method advocated by several papers in this volume) that wedds the ethnographic nuances of social behaviours towards the natural environment with robust artefactual and taphonomic methodologies would be well-equipped to integrate the materiality of the hardware with networks of social relations. Work in the mid-1990s by Laura Rival, although not specifically geared to identifying the kinds of details required in archaeological approaches to technology, nonetheless made very pertinent observations regarding this kind of integrated approach to subsistence and subsistence technology. In her ethnographic study of the Huaorani people of the Amazonian rainforest, Rival described how attitudes towards peccaries, the only hunted terrestrial animal, were markedly different to those held for monkeys. ‘Whereas monkeys are recognised as individuals, peccaries form an anonymous crowd … Never sought after in a hunt, but killed [in collective drives] whenever detected near a settlement, they are seen as aggressive invaders. Huaorani knowledge of peccary social organisation is limited to the least’ (Rival 1996, 150–51). Although the two are not synonymous for the Huaorani, a sharp distinction can be made between ‘hunting’ on the one hand and ‘killing’ on the other. One hunts monkeys, yet the death of the animal is not considered the result of the blowpipe dart that hit it, but rather the poison on the dart. Thus, death — since it may come some minutes after — is separated from human action. Killing on the other hand literally means ‘causing someone to die by spearing’ (Rival 1996, 155) and the death of the animal (the peccary) is much more immediately tied to the hunter’s action. In other words, the greater social distance entails less knowledge of, and interest in, the species and therefore less concern in dispatching it. This relationship between social distance and concern is reflected in the technology. She explains that although producing blowpipes is difficult, time-consuming work, it is carried out in a social setting amidst other activities shared with friends and relatives. Blowpipes are freely loaned between kin and carry few distinguishing features. Spears, on the other hand, are usually made whilst secluded. Although simpler and less time-consuming to manufacture, they can only be carved from old non-producing palms. ‘Felling young palms — a common occurrence in time of war — is seen as a threat to social order’ (Rival 1996, 153). Spears are ‘individualized’ and may carry distinctive carvings that clearly identify their owner. The proximity of social relatedness to an animal affects how and when a tool is made and its mode of use.

Nature as a distant, impersonal and semantically neutral ‘object’ — central to scientific interpretations of the environment — does not appear among many small-scale societies (see e.g. Bird-David 1993; Howell 1996; Ingold 1992a; Ridington 1982; 1983). Ingold remarks that ‘[h]unter-gatherers [in general] do not, as Westerners are inclined to do, draw a Rubicon separating human beings from all non-human agencies’ (Ingold 1992b, 42). Socialization, and with it social expectations and obligations, bridges what to Westerners has been historically a fundamental divide. Indigenous ideologies attribute ‘cause’ (e.g. chance, misfortune, success in the hunt, weather patterns, etc.) to ‘personalistic’ rather than impersonal ‘natural’ forces (Hallowell 1960). One socializes with the envi-
The physical attributes of a tool contribute to, but are worked bone into standard faunal analysis as a way with the forest, their sociality is directly engaged in parts of the forest which are not envisaged as personages. [Their] social world consists only superficially of the 350-odd individual human beings’. While evolutionary ecology permits relatedness between species, even expends great effort tracing the origins of social behaviour, at no point are agents of the natural world considered as social entities; they have no voice and no say (see Evernden 1993). Examination of indigenous attitudes towards the environment highlights that a scientific approach is one of a range of possible perceptions. What many of these ideas have in common is the acceptance that social relations extend into the natural environment. This realization has important ramifications for our understandings of prehistoric subsistence strategies and associated technologies. The physical attributes of a tool contribute to, but are not necessarily the defining elements, of subsistence technologies. The act of hunting is not only about procuring game; it is about conducting a social interaction — a ritualized transaction — between the hunter and the animal. Among the technological studies in the current volume, Loponte & Buc and Rabett & Piper make reference to the importance of incorporating worked bone into standard faunal analysis as a way to further both quantitative and socio-cultural aspects of interpretation; while in their study of changes in lithic technology during the European Late Glacial, Sternke & Costa advocate a choice-based model of tool production that more closely links the spheres of environmental, technological and social constraints than do traditional approaches.

Although, arguably, more philosophically-informed and critical than previous archaeological attempts to integrate social theory, recent approaches are predominantly geared towards reading contextual meaning and social interaction through an archaeological record relieved of the effects of natural transformation processes. There is little interpretative interest in these or human–environment relations; primary interest lies with accessing human–human relations because only these are assumed to be social. Consequently, while striving to access past perceptions, many recent interpretative efforts (particularly in relation to hunting and gathering economies) run the risk of perpetuating the exclusivity of traditional approaches to material culture. In order to move this aspect of archaeological interpretation forward, what will perhaps be required are approaches that bridge natural- and social-science perspectives.

Conclusion

In the nineteenth century, pioneers in the field of archaeology looked to prove the antiquity of humanity through associations between extinct fauna and stone tools. Following acceptance of an early human prehistory, a great deal of effort has since been expended on distinguishing human action from other natural processes affecting assemblage and site formation; identifying what is human and what is not. Towards the end of the century data began to be based through a further analytic filter, this time to demonstrate the existence, accessibility and importance of contextual meaning in that human record — how social relations can be read from material culture. Although each phase has introduced valuable contributions to the way we interpret archaeological sites, they have also tended to introduce increasing exclusivity; divisions between material categories of artefact, the processes affecting them and even what constitutes sociality read through them. The papers gathered for this volume begin the process of bridging these divides, of integrating what have all too often become isolated archaeological and interpretative domains. In taking a more inclusive approach to the material, technological and social dynamics of early human subsistence we have returned to the earliest of those archaeological associations: that between stone tools and animal bones. In revealing the inter-dependence of their relationship, this volume takes what we hope will be a first step towards a revitalized understanding of the scope of past interactions between humans and the world around them.

References


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