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Are osseous artefacts a window to perishable material culture? Implications of an unusually complex bone tool from the Late Pleistocene of East Timor

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ABSTRACT

We report the discovery of an unusually complex and regionally unique bone artefact in a Late Pleistocene archaeological assemblage (c. 35 ka [thousands of years ago]) from the site of Matja Kuru 2 on the island of Timor, in Wallacea. The artefact is interpreted as the broken butt of a formerly hafted projectile point, and it preserves evidence of a complex hafting mechanism including insertion into a shaped or split shaft, a complex pattern of binding including lateral stabilization of the cordage within a bilateral series of notches, and the application of mastic at several stages in the hafting process. The artefact provides the earliest direct evidence for the use of this combination of hafting technologies in the wider region of Southeast Asia, Wallacea, Melanesia and Australasia, and is morphologically unparallelled in deposits of any age. By contrast, it bears a close morphological resemblance to certain bone artefacts from the Middle Stone Age of Africa and South Asia. Examination of ethnographic projectile technology from the region of Melanesia and Australasia shows that all of the technological elements observed in the Matja Kuru 2 artefact were in use historically in the region, including the unusual feature of bilateral notching to stabilize a hafted point. This artefact challenges the notion that complex bone-working and hafting technologies were a relatively late innovation in this part of the world. Moreover, its regional uniqueness encourages us to abandon the perception of bone artefacts as a discrete class of material culture, and to adopt a new interpretative framework in which they are treated as manifestations of a more general class of artefacts that more typically were produced on perishable raw materials including wood.

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Introduction

The analysis of artefacts made of bone and other osseous materials (e.g., antler, tusk) has lagged significantly behind the study of stone artefacts. A number of factors underlie this contrast, including the fact that osseous materials are less frequently preserved, especially in subtropical to tropical environments; that artefacts made on these materials are usually quite rare, even under favourable preservational circumstances; and that osseous artefacts often show minimal modification and thus present relatively few opportunities for classical typological analysis (for exceptions see Julien, 1982; Pétillon, 2008). Despite these limitations, recent studies of osseous materials, especially those from European Palaeolithic assemblages, have made significant progress in several key areas. In particular, the combined use of experimental replication studies and high powered microscopy has established the precise nature of manufacturing technologies (e.g., d'Errico et al., 1984, 2003a; Knecht, 1997; Pokines, 1998; Zhilin, 1998; Christensen and Valentin, 2004; Pétillon and Ducasse, 2012; Tejero et al., 2012; Tartar and White, 2013) and added a new certainty to the inference of function (e.g., Pokines and Krupa, 1997; Legrand and Sidéra, 2007; Buc, 2011; Tartar, 2012). Other significant developments are the documentation outside of Europe of regional trends in osseous manufacturing technology (e.g., for Africa: Henshilwood et al., 2001; d'Errico and Henshilwood, 2007; Backwell et al., 2008; for Southeast Asia: Barton et al., 2009; Rabett and Piper, 2012), and the application of typological and technological approaches to these previously neglected regional osseous artefact assemblages (Pasveer, 2004; Barton et al., 2009).

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A major theme of recent literature on osseous artefacts is the extent to which the manufacture and use of 'formal' osseous tools, including their incorporation into composite tools through hafting technologies (e.g., mastic, binding), is an exclusive characteristic of fully modern human behaviour (McBrearty and Brooks, 2000; Ambrose, 2001; Henshilwood and Marean, 2003; Klein, 2009). This purposeful and purportedly symbol-laden behaviour is contrasted with a much older pattern of 'casual' use of bones and antlers by earlier hominins. Occasional use of naturally splintered bone is documented even by the earliest hominins (Brain and Shipman, 1993; Backwell and d'Errico, 2001, 2003; d'Errico and Backwell, 2003), and both bone and ivory were occasionally worked using percussion methods by Middle Pleistocene European *Homo* populations (Cassoli and Tagliacozzo, 1994; Rosell et al., 2011). However, claims for the contemporaneous systematic fashioning of bone and ivory by cutting, shaving and polishing have been rejected (Villa and d'Errico, 2001), despite the fact that these techniques were clearly in use at that time to fashion wooden spears (Thieme, 1997).

The earliest replicated evidence for careful shaping of osseous artefacts dates from the Middle Stone Age (MSA) of Africa, dated to between 80 and 60 ka (thousands of years ago) (Henshilwood et al., 2001; Henshilwood and Marean, 2003; d'Errico and Henshilwood, 2007). While these early African assemblages typically contain small numbers of somewhat irregularly shaped bone artefacts, they nonetheless document formalized manufacturing processes as well as the occasional hafting of a bone point into a composite tool (Henshilwood and Sealy, 1997). Hafting of stone artefacts was widely practiced at this time, both in Africa (Barham, 2002; Lombard, 2005; Rots et al., 2011) and Europe (d'Errico et al., 2003b; Rots, 2012), and mastic hafting of stone artefacts is recorded from as early as the late Middle Pleistocene of Italy (c. 160 ka; Mazza et al., 2006), presumably accomplished by a pre-*sapiens* population. One still controversial assemblage, possibly dated to c. 80 ka, comes from the Semliki Valley of Zaire (Brooks et al., 1995; Yellen et al., 1995). This assemblage contains highly sophisticated harpoon-like forms that are not only morphologically complex but also imply elaborate hafting mechanisms. While the age of these artefacts is contested on account of the lack of comparable forms in the southern African context (e.g., Henshilwood and Sealy, 1997), the rare occurrence of similar artefacts from early Upper Palaeolithic sites in North Africa (Yellen, 1998) upholds the possibility that complex point manufacture and hafting was part of the technological repertoire of early modern humans.

The archaeological record of osseous artefact use in Southeast Asia, Melanesia and Australia shows interesting parallels with the African record. In particular, there appears to be a similar temporal progression from early 'casual' assemblages comprising low numbers of non-standardized forms to more recent 'industries' characterized by more frequent production of more 'formalized' artefacts (Barton et al., 2009; Rabett and Piper, 2012). In the Southeast Asian context, this transition appears to begin around 15 ka and the formal artefact types are interpreted as spear barbs that increased the effectiveness of either fishing or the hunting of arboreal mammals, especially monkeys (Barton et al., 2009). By contrast, in Melanesia and Australia the more formalized osseous assemblages generally date to the mid- to Late Holocene and appear to be functionally diverse, some comprising armature for fishing spears or arrows (Lampert, 1966, 1971; Brockwell and Akerman, 2007), but others showing evidence of use in composite artefacts used for woodworking or sewing/threading (Pasveer, 2004). An exception is found in the high latitude region of Tasmania where bone artefacts of a standardized spatulate form are common in deposits dating from the Last Glacial Maximum (LGM) (c. 30–18 ka; Webb and Allen, 1990; Cosgrove, 1999). These artefacts lack evidence for hafting and were most likely used for piercing animal skins to make garments, a local adaptation to conditions of extreme cold (Cosgrove, 1999; Gilligan, 2010).

Bone artefact assemblages from the islands of Wallacea, situated between the continental landmasses of the Sunda shelf and greater Australasia (Fig. 1), conform in most respects with the regional pattern (Glover, 1986; Pasveer and Bellwood, 2004). Here we report a remarkable exception from Timor Leste, a regionally unique bone artefact of strikingly complex form from an early context (c. 35 ka). This artefact challenges the notion that complex bone-working and hafting technologies were a relatively late innovation in this part of the world. Moreover, its regional uniqueness encourages us to abandon the perception of bone artefacts as a discrete class of material culture, and to entertain a new paradigm in which they are treated as manifestations of a more general class of artefacts that more typically were produced on perishable raw materials including wood.

Theory

Every human artefact is a manifestation of one or more mental constructs, and many are the product of remarkably complex internal computations involving numerous symbolic elements, some based on 'learned' social values and others based on personal experience (Mithen, 1996; Read and van der Leeuw, 2008). Even in the case of the 'casual' use of an object of pre-existing form (e.g., a naturally shaped stone, a bone fragment that resulted from marrow extraction), the act of selection is influenced by a mental construct of intended function, though it may also be influenced by far more complex sets of constructs that exclude certain materials for particular tasks (e.g., a fragment of dog or pig bone would not be appropriate for many tasks within an Islamic context). An artefact that is modified in some way prior to use, by contrast, owes its ultimate form to the intersection of numerous constructs related to appropriate raw materials and manufacturing techniques, intended functions and longevity of use, various 'stylistic' considerations of colour, shape and texture, as well as the acquired knowledge and skill base of the practitioner. In addition, the form of manufactured artefacts will be likely constrained by the physical properties of the raw material.

Bone has attracted much less attention as a raw material for artefact manufacture than either stone or wood (see Johnson, 1985 for a useful review). Our purpose here is not to explore recent developments in this topic from a technical point of view (although this needs to be done) but merely to point out that bone, as a raw material, shares key properties with stone and wood. Cortical bone in particular can be shaped in a variety of ways. Like stone, it can be ground, or if it is thick enough, it can be flaked. Pieces of any size can also be cut, shaved, or scraped, all of which actions can also be performed on wood. In common with both stone and wood, the properties of bone can be altered by drying and/or heating. Drying makes bone less flexible and more likely to shatter under bending stresses (Evans, 1973). Heating results in oxidation of the organic components of bone and when taken to extremes, causes the inorganic components to shrink and become highly brittle (Thompson et al., 2011).

Bone and stone are only partially interchangeable as raw materials. While a bone of sufficient size can be flaked, its internal structure prohibits highly controlled flaking of the kind that can be achieved with a high quality lithic material. Moreover, while bone flakes may perform better for some butchering tasks than stone flakes (Johnson, 1985), bone is undeniably softer than the majority of stone types that might be selected for flaking and will yield a less durable edge. At best, bone represents a second-rate material for flaking although its quality may be offset by factors of availability in

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