

THE ORIGINS OF BONE TOOL TECHNOLOGIES: AN INTRODUCTION

Tool use is one of the hallmarks of what makes us human. This defining behaviour is fostered by our high fidelity social learning environment and unique process of cumulative cultural evolution. From the Stone Age to the Digital Revolution, the human narrative has been written in the technologies we developed to meet the challenges of everyday life. How our ancestors accomplished increasingly complex tasks reflected the skills and materials available at the time, and as technology developed in complexity, so too did their lives. For over two million years of the human lineage, stone and bone tools preserve the only record of our technological heritage and capacity for innovation. Studying the origins and development of these technologies plays a vital role in retracing our evolutionary footsteps toward becoming human.

The use of intentionally modified stone tools may extend back to more than three million years ago in East Africa (Harmand et al., 2015) and persisted in some parts of the world until historic times. These tools began as simple stone flakes and hammerstones used to butcher animal carcasses (Semaw et al., 1997, 2003; Semaw, 2000; McPherron et al., 2010), followed by the addition of stone handaxes, and later flourished into a wide array of technological and cultural traditions that serve as a record of humanity's cumulative process of behavioural evolution.

The use of bone tools followed a slightly different trajectory, first appearing during the Oldowan period as early as 2.1 million years ago in East Africa

(Backwell and d'Errico, 2004) and slightly later at two million years ago in southern Africa (Backwell and d'Errico, 2001, 2008). The East African tools consisted of large mammal long bone shaft fragments intentionally shaped by knapping and a few complete bones used as hammers. In contrast, the bone implements from southern Africa were not deliberately modified to aid in butchery activities, but rather used in termite foraging, digging for tubers, processing fruits and other tasks (d'Errico and Backwell, 2009). The use of these early bone tools appears to have been infrequent and expedient before largely disappearing from the archaeological record of the ensuing Acheulean and Middle Stone Age in Africa.

Rare examples of bifaces made from elephant bones are known from several locations scattered across Europe and the Levant (see Zutovski and Barkai, 2016), but these tools date to the end of the Lower Palaeolithic (500-250 ka) and are unlikely to be technologically descendent from similar, yet much earlier, bone tools from East Africa. At roughly the same time and in the same areas of Europe and the Levant, hominins began using antlers and limb bones of large mammals in the manufacture and maintenance of lithic tools (Roberts and Parfitt, 1999; Goren-Inbar, 2011; Blasco et al., 2013; Julien et al., 2015; van Kolfschoten et al., 2015; Moigne et al., 2016). Commonly known as retouchers (*retouchoirs* in French) or percussors (*percuteurs*), these bone tools display characteristic pits and scores



Figure 1 Participants of the “Retouching the Palaeolithic” conference at Schloss Herrenhausen in Hannover, Germany, October 2015.

indicative of use in shaping lithic tools (see Patou-Mathis, 2002); lithic fragments often embedded in the pits and scores attest to their various functions related to stone tool manufacture (Mallye et al., 2012; Tartar, 2012; Bello et al., 2013). The use of bone retouchers in various forms continued uninterrupted until stone was abandoned in favour of metal as a raw material for tools (see Taute, 1965; Schibler, 2013; Vitezović, 2013).

Bone retouchers and percussors are particularly intriguing, as they incorporate elements of both bone and stone tool technology. As stone is a more durable raw material that can withstand the effects of burial over the course of many millennia, our understanding of specific stone tool technologies and associated human behaviours is far advanced beyond that of tools made of bone and other osseous raw materials. The origin of bone tool use lagged behind that of stone tools; in a similar fashion, the initial recognition of and subsequent appreciation for Palaeolithic bone tool technology has been somewhat delayed (e.g., Dupont, 1871; Daleau, 1884; Henri-Martin,

1906, 1907). A renewed interest in bone tool technology has arisen over the past decades (e.g., Chase, 1990; Vincent, 1993; Patou-Mathis, 2002; Mallye et al., 2012; Mozota, 2012; Blasco et al., 2013; Jéquier et al. 2013; Abrams et al., 2014; Daujeard et al., 2014; van Kolfschoten et al., 2015), and we now recognize that the production of bone tools spans much of human prehistory, and their forms are as varied as their inferred functions.

It is the relatively abrupt appearance of bone retouchers and similar osseous tools coupled with their sustained use across a wide geographic area that justifies their position at the dawning of bone tool technology. The root of this technology lies in the circumstances under which prehistoric humans ceased to consider bone as a sterile by-product of the hunting and butchery process and began to recognize bone’s technological utility for the manufacture and maintenance of lithic tools. While the designation of a singular, oldest bone tool will be subject to periodic revision, the enduring significance of this origin story is one of technological

innovation and adaptation – the propensity and talent for creating tools to solve new and old problems in different ways. Bone retouchers emerged at a time of broad technological upheaval, when the bifaces that record the final stages of the Lower Palaeolithic gave way to a mosaic of prepared core, flake-based technologies across Africa and Eurasia. This rapid period of innovation was driven by the interplay between various biological, social, and environmental factors (see Elias, 2012), and identifying these internal and external forces through the archaeological record provides a framework to evaluate the adaptive significance of bone retouchers. These contexts are of immeasurable value for understanding how the emergence and development of bone tool technology influenced human subsistence and other socio-economic adaptations across space and time.

To explore these behavioural and cultural facets to the use of bone retouchers and similar tools, a scientific workshop was organized around the title, “Retouching the Palaeolithic: Becoming Human and

the Origins of Bone Tool Technology”. The event took place in October 2015 at Schloss Herrenhausen in Hannover, Germany (**Figure 1**), with generous financial support provided by the Volkswagen Foundation’s “Symposia and Summer Schools Initiative”. This volume is a product of the exchange of ideas at that workshop and brings together a diverse array of perspectives on bone tools use spanning across Europe and the Levant, from the Lower Palaeolithic to the Neolithic. In part, this work aims to build on the influential volume edited by Marylène Patou-Mathis in 2002, “*Retouchoirs, compresseurs, perceurs... Os à impressions et à éraillures*”, which has served as the reference manual for bone retouchers and other similar tools. The goal of this current volume is to reach a wider audience and move beyond the physical attributes of the bone tools themselves toward a deeper understanding of the behavioural implications behind the development of various bone tool technologies. With this synthesis, we add an important dimension to the ways in which tool use defines what it means to be human.

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Jarod M. Hutson ^{a,b,*}, Alejandro García-Moreno ^{a,c}, Elisabeth S. Noack ^a, Elaine Turner ^a, Aritza Villaluenga ^{a,d}, Sabine Gaudzinski-Windheuser ^{a,e}

^a MONREPOS Archaeological Research Centre and Museum for Human Behavioural Evolution, Römisch-Germanisches Zentralmuseum, Neuwied, Germany

^b Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

^c Prehistory and Archaeology Museum of Cantabria (MUPAC), Santander, Spain

^d University of the Basque Country (UPV-EHU), Prehistory Research Group, Vitoria-Gasteiz, Spain

^e Institute of Ancient Studies, Johannes Gutenberg-University Mainz, Germany

* Corresponding author. Email: hutson@rgzm.de