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Bits and pieces: Lithic waste products as indicators of Acheulean behaviour at Attirampakkam, India

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ABSTRACT

Inferences on short or long term trends in Acheulean behaviour are primarily derived from studies of lithic *chaîne opératoires*. With a predominant focus on bifaces and cores, few studies discuss in depth, components of lithic waste products, significant in informing on aspects of technology, skills, transmission of knowledge, or behavioural organisation at site and landscape scales. Here, we present perspectives on Acheulean behaviour focusing on lithic waste arising from debitage and façonnage sequences. We draw on excavated assemblages from the Early Pleistocene site of Attirampakkam, India, currently the oldest Acheulean site in South Asia, supplemented by our experimental studies to replicate this technology. The assemblage reflects a fragmented reduction sequence, with transport of large flakes and partially shaped tools to Attirampakkam, from 'quarry sites' located in proximity to raw material sources, followed by later stages in the on-site façonnage of handaxes, primarily on large flake blanks. Acheulean behaviour at this site reflects geographic awareness, planning depths, and strategies adopted in anticipation of raw material scarcity at the site. Conservation of raw material and time is indicated by the utilisation and retouch of suitable waste flakes including biface shaping/thinning flakes into small flake tools, indicating multiple uses of handaxes as both tools and 'cores'. This behaviour occurs along with individual knapping errors denoting lack of adequate control or ability/intention to rectify problems, persisting through time. There is also sparse evidence for intentional platform faceting. Despite assemblage variability through time, we observe technological stasis over this thick Early Pleistocene sequence.

1. Introduction

The primary focus for debating Acheulean behaviour lies in the realm of the concept of lithic *chaîne opératoires* (Roche and Texier, 1991; Soressi and Geneste, 2011; Tostevin, 2011). The complexity of such debates is enhanced by variability arising from the immense duration of the Acheulean (Beyene et al., 2013; Lepre et al., 2011; Pappu et al., 2011) and its vast geographic distribution (Petraglia and Korisettar, 1998). Bifaces form the focus of most studies in addressing issues related to questions of Acheulean 'tradition', intelligence, skills, cultural transmission, learning and the individual, technology, and stasis and change (Belfer-Cohen and Goren-Inbar, 1994; de la Torre et al., 2008; Goren-Inbar, 2011; Goren-Inbar et al., 2008; Gowlett, 2006; Lycett and Gowlett, 2008; Madsen and Goren Inbar, 2004; McNabb et al., 2004; Newcomer, 1971; Petraglia, 2005; Pope, 2004; Stout et al., 2000, 2014; Shipton and Clarkson, 2015; Sharon et al., 2011; Wynn, 1979, 1995). However, a characteristic feature of the Acheulean lies in behavioural organisation on landscape scales, with assemblages predominantly reflecting aspects of fragmented reduction sequences, further influenced by site taphonomy. Thus, sites, or even levels within them, may reflect sparse or missing assemblage components, of which the most conspicuous are cores and/or bifaces (see Goren-Inbar and Sharon, 2006). In all situations, when present, waste products arising from varied Acheulean debitage and façonnage sequences, assume great significance as indicators of site taphonomy, technology, and behaviour (Stout et al., 2014).

Most of such research on the Acheulean, and in particular on reduction sequences, has a skewed perspective arising primarily from studies in Africa, Europe, and the Levant, with little information from the rich and diverse Acheulean of India, and from much debated assemblages in East or Southeast Asia (Brumm and Moore, 2012; Hou et al., 2000; Li et al., 2014). Addressing this severe geographic lacuna, would not only 'fill-up' gaps in our knowledge, but would potentially contribute towards new aspects of Acheulean behaviour in diverse geographic regions and environments, with a focus on raw materials often differing from flint, chert, or volcanic rocks commonly studied (but see Santonja, 1996). India assumes great importance in this scenario, with emerging chronological constraints on the Acheulean situating it between the Early Pleistocene (Pappu et al., 2011), and extending possibly till MIS 6-5e (Haslam et al., 2011). This along with its vast spatial distribution and assemblage variability in varied geographic and ecological contexts, renders this region important for exploring Acheulean

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behavioural and cognitive evolution, strategies for adapting to local geomorphological and ecological changes, raw material variability, and for questions on hominin dispersals (Bar-Yosef and Belfer-Cohen, 2001; Corvinus, 1983; Dennell and Roebroeks, 2005; Gaillard and Mishra, 2001; Jacobsen, 1985; Jayaswal, 1978; Misra, 1987; Misra, 1989; Murty, 1966; Paddayya, 1982; Pant and Jayaswal, 1991; Pappu, 2001; Pappu and Kumar, 2006; Pappu et al., 2003, 2011; Petraglia, 2001; Rajaguru et al., 2009; Shipton, 2012).

In the South Asian Acheulean, as noted at many sites in Africa and parts of the Levant, bifaces and other large cutting tools (LCT's), were made primarily on large flake blanks (Sharon, 2007), using a variety of techniques (bifacial flaking, Victoria West, Levallois, Kombewa, and the Chirki technique), and were also fashioned on cobbles or from slabs (Corvinus, 1983; Petraglia, 2001), yielding complex waste products with a vast potential for informing on technology and behaviour. Despite this, waste products are much neglected in studies of the South Asian Acheulean, where they are overshadowed by bifaces, and are often relegated to brief mentions in artefact type-lists. Waste products in the Indian context have variously been termed as debitage, flakes, unmodified flakes, waste, debris, angular fragments, or isolated detachments. Lacking detailed descriptions, their significance has been primarily as indicators of the existence of 'factory sites' or on-site knapping. Exceptions include research at Chirki-on-Pravara (Corvinus, 1983), Singi Talav (Gaillard, 1993; Gaillard et al., 1985) and Aitbarpur (Gaillard et al., 2008, 2010), where waste products were described in some depth with attempts made to study Acheulean *chaînes opératoires*. Similarly, at Isampur, studies identified modes of both façonnage and debitage sequences as related to biface production from limestone slabs (Shipton, 2012; Shipton et al., 2009). A few experimental studies have been conducted to investigate technological and other aspects of the Acheulean, with greater attention paid to the finished products and cores (Shipton et al., 2009; Sinha, 1984, 1986).

Here, we seek to investigate aspects of Acheulean technology as reflected in the waste products, with a focus on the deeply stratified Early Pleistocene Acheulean horizons at the site of Attirampakkam (henceforth referred to as ATM), India. ATM is currently the oldest Acheulean site in South Asia, with the earliest Acheulean horizons (Layers 6 to 8) dated to between ~1.07 and 1.77 Ma (weighted mean average age of 1.51 ± 0.07 Ma) (Pappu et al., 2011). Early Pleistocene levels at ATM differ from many other sites, being marked by the complete absence of giant cores, and with sparse cores for small flake production. In addition to the numerous bifaces and other LCT's (Pappu and Kumar, 2006), sizeable numbers of small flake tools and waste products provide primary clues towards interpreting technology and activities at this site.

We examine the significance of waste products in informing on: 1. varied reduction sequences adopted here, 2. stages of handaxe reduction, 3. technological strategies, 4. knapping skills and errors, 5. hominin mobility and use of landscapes, and 6. behavioural stasis or change through the Early Pleistocene Acheulean. We situate this within the context of questions on spatial and geographic knowledge, hierarchical organisation of behaviour, decision making, and problem solving of Acheulean hominins. We draw on excavated data from the site, and on our experimental knapping programme to address these issues.

2. Early Pleistocene Acheulean horizons at Attirampakkam

The open-air stratified multicultural site of ATM (13°13′50″N, 79°53′20″E, 37.5 m a.s.l.) is situated near a meandering tributary stream of the river Kortallaiyar, northwest of Chennai, southeast India (Fig. 1). Our research and excavation programme (1999–ongoing), revealed a continuous stratigraphic sequence of around ~9 m, with eight major sedimentary units (Layers 1 to 8), bearing a sequence of stratified Acheulean and Middle Palaeolithic assemblages (Fig. 2) (Pappu, 2007; Pappu and Kumar, 2006; Pappu et al., 2003, 2004, 2010, 2011). Early Pleistocene Acheulean artefacts were repeatedly buried within stratified argillaceous floodplain deposits (Layers 6 and 8) comprising alternating sand and silty clay beds lacking palaeosols, suggesting periodic cycles of sediment deposition without lengthy interruptions and derived from eroding Cretaceous shale and sandstone outcrops in the catchment (Gunnell et al., 2006). The suspended silt particles settled out under conditions of low-velocity, laminar overbank streamflow, burying the artefacts without considerable displacement. An intervening horizon (Layer 7) with Acheulean artefacts comprises a cobbly–pebbly bed-load gravel in a silty ferruginous matrix (Pappu et al., 2011). Palaeoclimate reconstructions based on clay mineralogy and rock magnetics indicate that Layers 6 and 8 represent a humid environment such as an intermittent floodplain pool that is conducive to the production of fine-grained magnetite, interspersed with intensely arid events. Layer 7 indicates the onset of localized micro-anaerobic environments due to flooding (Blackwell et al., 2007; Sreedhar et al., 2008; Warrier et al., 2011). The lithic assemblage comprises LCT's with bifaces and other large flake tools, a small flake tool component, few artefacts on cobbles and pebbles, unretouched waste flakes, flake fragments and other angular/chunky products, and sparse cores suitable for production of small flakes (Pappu and Kumar, 2006; Pappu et al., 2011). It is interesting to note that in 1863, the discoverers of ATM, R.B. Foote and W. King, were struck by the presence of numerous 'rude', 'half-finished', and 'perfect' tools at this and other sites in the region (Foote, 1866). While King boldly suggested on-site knapping in specific areas/sites and even proposed long-distance barter of tools, Foote discussed issues of fluvial reworking amongst other factors, and believed that '.more evidence is wanted on the subject' (Foote, 1866:17). This classic debate is possibly one of the earliest in prehistoric archaeology, where waste flakes played a crucial role in interpreting behaviour and formation processes (Pappu, 1991).

3. Archaeological and experimental studies: material and methods

Test pits, horizontal excavations, and geological step trenches were excavated at ATM, over the 50,000 m^2 area of the site. Early Pleistocene Acheulean deposits were exposed in several trenches, step-trenches, and test-pits. This study focuses on the assemblage from Trench T8 (Trench Code Number E10.928 N29.635, 32.85 m.a.s.l.). This trench (30 m^2, 90.63 m^3) was excavated to a maximum depth of around 9 m, with artefacts found till a depth of 7.8 m. In situ artefacts (generally those >2–4 cm) were plotted recording three dimensional coordinates, pitch, orientation, position of rest in the sediment, associated features, etc. Sediments were sieved, with the blocky clay often further gently crumbled by hand, for recovery of artefacts ≤20 mm and microdebitage; wet sieving was implemented for selected quadrants. Waste products are defined as artefacts that lack visible modification or retouch, including complete and broken flakes, flakes, and flake fragments ≤20 mm, and angular and blocky debris which lack diagnostic attributes of flakes (Table 1). We include flakes with macroscopic evidence of edge damage, often termed 'utilised' pieces (Isaac, 1977). Field surveys along with studies of satellite remote sensing data, over an area of 8000 km^2, led to identification of varied raw material sources and creation of a database of Palaeolithic sites in the region (Pappu et al., 2010). In this paper, we focus solely on the waste products in Trench T8. An experimental knapping programme on quartzites and quartzitic sandstones to investigate the ATM technology is being undertaken by the first author, aspects of which are discussed here. We focus on handaxe shaping, wherein during experiments each 'cognitive' flake (intended flake product) detached was documented (Madsen and Goren Inbar, 2004:18), along with waste products of ≤20 mm and dust, spatial aspects of rotation/flaking of the biface, angle of flaking, nature of hammer stones/abraders before and during knapping, decisions made by the knapper at every stage, as also the spatial patterning of the distribution of the waste products arising from knapping, and the entire flaking strategy.