# 6. Changing trends in the study of a Paleolithic site in India: *A century of research at Attirampakkam*

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To account for this immensely numerous collection of implements in a small space is a question more easily proposed than solved (Foote, 1869:234)

## Introduction

The above quote was made by the British geologist Robert Bruce Foote, while discussing his discovery of stone tools at the prehistoric site of Attirampakkam, Tamil Nadu, South India. Prior to this, Foote had identified the first stone tool in the subcontinent (Foote, 1866); a find which not only pushed back the known antiquity of human occupation in India, but which also generated awareness of what stone tools looked like. Thus, on 28th September 1863, when Foote and his colleague William King were investigating the 'Stri Permatoor' (Sriperumbudur) shale beds in the gully around 'Atrampakkam nullah' (Attirampakkam), King was able to recognize and pick up two "well-shaped oval implements" on a terrace of 'quartzite shingle' in the gully bed (Foote, 1866:3). Little did they realize that this discovery would initiate a century of research into the Paleolithic archaeology of Tamil Nadu; which was later, often referred to as constituting the 'Madras Paleolithic industries'. Subsequent sporadic research at Attirampakkam and neighboring sites in the basin of the river Kortallaiyar (a part of the Palar river basin), led to the emergence of concepts that came to influence much of later Indian prehistory. Reviews of the Indian Lower Paleolithic, and studies in various parts of the country, invariably included references to these industries, including the site of Attirampakkam; despite the fact that only two research papers and short notes on the early excavations constituted almost all what was known of this region. This paper briefly discusses these early studies, against which ongoing excavations at Attirampakkam may be situated.

The site of Attirampakkam is located around 47 km inland from the current shoreline



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(13° 13′ 50″ N and 79° 53′ 20″ E; 37.5 AMSL), around 1 km to the north of the river Kortallaiyar, Northern Tamil Nadu (Figure 1). To the west lie the NNE-SSW-trending Allikulli hills (200–380 m AMSL), which are cobble-to-boulder size fanglomerates or paleodeltas of early Cretaceous age (Muralidharan et al., 1993; Kumaraguru and Trivikrama Rao, 1994; see Pappu, 2001b). The lower-lying areas of the eastern Cuddapah piedmont in the vicinity of the Allikulli Hills, are underlain by a shaly marine formation (Avadi formation) which is coeval and inter-tonguing with the conglomerate beds (Kumaraguru and Trivikrama Rao, 1994). The region falls in an area of seasonally dry tropical conditions, receiving 105 to 125 cm of annual rainfall with a major peak occurring from September to November (National Commission on Agriculture, Rainfall and Cropping Patterns, 1976; Pappu, 2001b). In the Kortallaiyar basin as a whole, Acheulean to Middle Paleolithic sites occur in ferricretes (1.5–2 m thick) resting on shales. Younger ferricretes, which appear to represent eroded gravels sourced by the older outcrops during the Late Pleistocene, contain Middle Paleolithic artifacts; while microliths occur on the surface.

## The Discovery of Attirampakkam

The discovery of tools at Attirampakkam was not a matter of chance but of careful observation by King and Foote, in the course of their geological surveys. The area that they studied ranges from the point where the Attirampakkam gully discharges into the river Kortallaiyar, to around 2 km upstream to the village of Nambakkam. The fresh condition of artifacts lying in the gully, prompted Foote to trace their origin to nearby lateritic gravels seen in the gully sections; within which he was able to locate in-situ tools (Table 1). This was confirmed by a small test pit excavated in the lateritic gravels, which yielded further tools. Variability in the nature of these lateritic gravel beds in terms of the presence of ferruginous matter and pebbles, was considered to have affected the condition of the implements in terms of weathering and staining (Foote, 1869:233). The laterites rested on rolling shale beds, which he believed, were subjected to extreme erosion prior to the deposition of the laterite. Foote did however note the presence of a large implement on the surface of these 'plant shales' underlying the lateritic conglomerate, a fact that assumes importance in the light of our recent excavations.

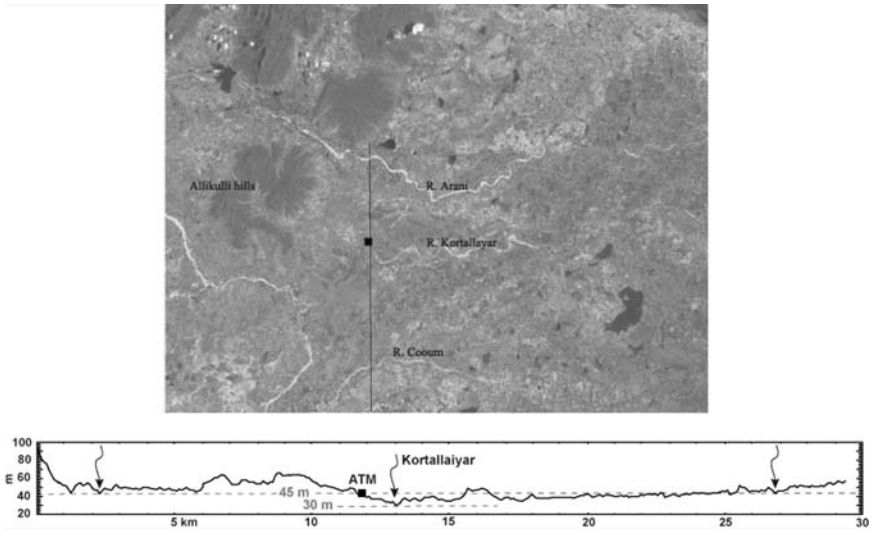


Figure 1. A part of the Kortallaiyar river basin showing location of Attirampakkam (ATM)

*Table 1. History of archaeological investigations at Attirampakkam*

| *Investigator* | *Stratigraphic Context* | *Lithics* |
|---|---|---|
| R.B. Foote (1866, 1869, 1870, 1916) | • Soil and made ground 6′<br>• Lateritic conglomerate with layers of quartzite pebbles 11/2–3′<br>• Sandy-clay with quartzite pebbles and kunkar in strings 51/2–6 ½′<br>• Lateritic conglomerate full of quartzite pebbles 3′<br>• Grey shales (plant shales) with ferruginous stains 1′8″<br>• Nearby in bed ‘c’ he found a hatchet shaped implement 10–11′ below the surface. In another section he notes a tool lying on the face of ‘e’ i.e. plant shale. | Class I: Implements with one blunt or truncated edge<br>a. Pointed weapons (spear heads);<br>b. wedge shaped weapons (axes-hatchets; etc.)<br>Class II: a) Implements with a cutting edge all around. Implements pointed at one or both ends; b. Oval or almond shapes implements; c. discoidal implements.<br>Class III: Flakes. |
| De Terra and Paterson (1939) | Tools occur in basal lateritic gravels of terrace T2. A few rolled specimens of earlier date were similar typologically to those from Vadamadurai tank. After deposition of the detrital laterite over a white boulder conglomerate it was dissected producing a set of three terraces, of which Terrace 2 at 20′ is aggradational and preserved at Attirampakkam. | Late Acheulean handaxes and cleavers some in situ in the basal lateritic gravel, and a few rolled specimens.<br>**Cleavers**: numerous cleavers, made on flakes with the flake surface untouched or partially flaked. Existence of Vaal River variant, with a parallelogramatic cross section. Cleaver shapes are rectangular, with straight or convex butt; or with sides converging slightly, and some are triangular in outline with pointed butts. The working end is usually straight and at right angles to the axis of the tool; but in some cases it is oblique and in a few cases convex or concave.<br>**Handaxes**: mostly on flakes though the flake surface is partly or wholly trimmed. The flaking is by the step technique with small, flat and neat steps with small step retouch at the edge. Mostly pear to tongue shaped, the latter having fairly straight and slightly convergent rather than convex sides. They range from 8–6 inches down to 2 × 2 inches and small |

*(Continued)*

*Table 1. (Continued)*

| *Investigator* | *Stratigraphic Context* | *Lithics* |
|---|---|---|
| | | and large forms are found in fairly equal numbers. Some S-twist examples are seen. **Cores**: discoidal type, with more or less alternate flaking some being retouched and used as tools. Some are more oval in shape with alternate flaking resemlbling unfinished crude handaxes. Some were retouched to form notched, steep or ordinary side scrapers. |
| V.D.Krishnaswami (1938a) | • Sandy loam<br>• Pellety loam<br>• White sandy-clay with kunkar<br>• Hard lateritic conglomerate (Lower to Middle Acheul and Late Acheul)<br>• Sriperumbudur shale | Industry V: It shows a stratigraphic evolution of the Acheulean culture from the lateritic basal gravels of this terrace to the loam on the top in exposed sections. He notes a derived series (both rolled Abbevillian coup-de-poings and the lateritised tools being early Acheul) and a contemporary series (fresh from the lateritic conglomerate upwards of T2), and fresh of lateritic patination. The coup de poings and cleavers predominate and compare well with Late Acheul forms of Europe and Africa. Victoria West handaxes, and those made on the double Vaal principle were also seen. Some handaxes simulate Micoquian types of the Somme valley. Towards the end of T2, levallois flakes appear. Handaxes and ovates: 61%, cleavers: 27%, cores: 12% |
| Zeuner (1949: 45) Attirampakkam gully section | • Orange soil<br>• Pink grey weathering<br>• Implimentiferous<br>• Shale<br>• Note: the stratigraphy diagram attached clearly indicates the presence of an implimentiferous gravel. | |
| K.D. Banerjee (1969:20–22) | • Top soil (microliths)<br>• Compact brownish soil with lateritic pellets (sterile) | He found that the detrital lateritic gravel had an industry which he termed post-Acheulean (comprising |

*(Continued)*

*Table 1. (Continued)*

| *Investigator* | *Stratigraphic Context* | *Lithics* |
|---|---|---|
| | • Redeposited detrital laterite (post-Acheulean)<br>• Redeposited Shaly-clay (sterile)<br>• Detrital laterite (post-Acheulean)<br>• Weathered shale (Acheulean)<br>• Shale | points, scrapers and longish flake-blades). He contradicted the work of previous scholars that the lateritic gravel was the Acheulean horizon. No further analysis was done. |

These observations not only established the context of artifacts, but also inspired a debate between Foote and King, which is possibly amongst the earliest discussions on 'site formation processes' at prehistoric sites (Foote, 1866:27; Pappu, 1991–1992). A significant feature of the site, observed through the years, is the high density of artifacts per unit area as compared to any other site in the region or elsewhere in India. This struck Foote and King who suggested various explanations for the same. King attempted to explain the presence of the vast number of artifacts by suggesting that these were localities of manufacture of tools for purposes of barter, as inferred from the presence of unfinished artifacts and flakes along with complete tools. He further argued that there was no visible system of distribution of tools across the ground, in lines or groups, which could imply long-distance fluvial transport, although some local drifting might have been possible (King in Foote, 1866: Appendix:ix). Thus the site was thought to be primary in nature. Writing in 1866, Foote believed that this matter, though not improbable, required further study. He however differed from King and other geologists who believed that the lateritic conglomerate at this site was derived from higher lateritic beds located elsewhere (Foote, 1866:9). In Foote's opinion, the laterites of the valley and upland, belonged to the same formation and were structured by the slope of the underlying plant-bearing shales (Foote, 1866:9). This could also be judged by the perfect state of preservation of tools, which did not correspond with the theory of their long-distance transportation. By 1869, Foote however disagreed with King, and argued that the site could not have been a manufacturing centre owing to the paucity of chips and flakes, and also wondered why so many perfect implements were left behind (Foote, 1869:234). He argued that for 'savage people', such foresight in preparing tools long before their use was improbable and that improvidence was rather to be argued for. He further argued against in situ manufacture, arguing that the size ranges of the gravel clasts available were not sufficient for tool manufacture for even the middle-sized implements. Rather, he believed that the area when submerged under the sea, was used for fishing by people in rafts and catamarans and that their weapons were washed off during sudden squalls, and lost along the surf line, to be finally embedded by tidal action. Foote was also the first to observe the fact that tools were vertically embedded; possibly stuck in the mud on sinking under water (Foote, 1869:234–235). Subsequently, many of his views changed; and he declared himself wrong as regards the marine origin of laterites. Instead, he invoked powerful pluvials that corresponded with the Pleistocene Ice ages. Tools were now believed to be transported to greater or lesser degrees, along with lateritic deposits, within which they were finally embedded (Foote, 1916:181).

Classification of implements followed that of John Evans (Foote, 1866:17), with the addition of forms that he believed were not found in Europe as per the books available to him in India (see Table 1). In particular, the class termed as the 'Madras Type', was thought to be unique to this region. Following classification, Foote also put forward hypotheses on the use of some of these tools, as also the effect that varied uses would have on the edge. He was perhaps one of the earliest scholars to suggest that flakes were not only waste products, but could also be utilized as effective tools.

Foote's monumental study of the prehistoric archaeology of southern India (Pappu, 2001b), enabled him to place Attirampakkam within the context of other sites in the region. His insightful observations on stratigraphy and tool contexts; the presence of tools on the surface of the shales, vertically embedded artifacts; and thoughts on the causes for the high density of tools at this site; are as relevant today as they were in the 19th century. Following his death, interest in prehistory in this region lapsed, save for a sole publication by P.T. Srinivasa Ayyanger (1988 reprint) who wrote on the Stone Age of India, summarizing and interpreting data available at the time.

## Linking 'Cultures': Attirampakkam as part of the 'Grand Sequence'

This phase characterized principally by the work of T.T. Paterson and V.D. Krishnaswami, is one where the foundations of modern Indian prehistory were laid, and where discoveries made during the 19th century were critically re-examined. The age of the 'Amateur' archaeologist yielded to that of the 'Professional'; (Levine, 1986) and while much was gained in terms of new information, the breadth of vision in interpreting data so characteristic of the work of Foote, was often sacrificed in the search for hard facts.

L.A. Cammiade and M.C. Burkitt's (1930) classic study linking sequences of pluvials and interpluvials with evolving archaeological 'cultures' along the southeast coast of India; closely followed by the search for hominins in the subcontinent, culminating in the Yale-Cambridge expedition under De Terra and Paterson (1939), stimulated research in the Kortallaiyar basin. This expedition aimed at understanding "the Ice Age cycle in the Himalaya and to unravel the Pleistocene history of Stone Age man in other parts of India" (De Terra and Paterson, 1939:1). Influenced by concepts of 'Evolution progressive' as exemplified in the work of Brueil and popularized by de Terra and Paterson (Dennell, 1990:553), the Kortallaiyar basin was chosen as an ideal example of a coastal river system where prevalent ideas on stratigraphy, chronology, climate and industries could be tested; and form another link in the attempt to build up a 'Grand Sequence' (Dennell, 1990). A geological approach involving construction of river terraces and cultural sequences across the country, linking of these sequences; and correlating them with Pleistocene pluvials and interpluvials, formed the foundation of this work. The work of V.D. Krishnaswami (1938a, 1938b, 1947), who participated in this research may also be viewed within the context of the growing nationalist movement in the subcontinent, and reflected his desire to establish the cultural heritage of India on a firm basis, to place it in the perspective of changes occurring all over the world, to establish the great antiquity of man in India, and to draw together the Soan and the Acheulean into a pan-Indian sequence. The major issues characterizing this phase of research are discussed elsewhere (see Pappu, 2001b).

The basis of these studies lay in the identification of four terraces of the river Kortallaiyar; TD to T3 at elevations of 100′ (30 m), 60′ (18 m), 20′ (6 m) and 8′ (2 m); which were a logical extension of the terrace sequences built up in the Soan and

Narmada regions (De Terra and Paterson, 1939). Terraces were either aggradational or erosional and were associated with a definite stratigraphic sequence, climatic phase and with an 'evolving culture sequence' ranging from the 'Abbevillio-Acheulean' to the 'Upper Paleolithic' (Krishnaswami, 1938a; De Terra and Paterson, 1939). Of the four terraces identified, Attirampakkam fell on Terrace T2 (20′). This was described as an aggradational terrace with thicker gravels and covered by silts and sands. The interval between T1 and T2 was interpreted as a period of erosion and aridity followed by deposition of coarse gravel on T2 pointing to a definite resumption of increased pluvial conditions. Terrace formation was further linked to eustatic sea level changes and phases in the migration of the river Palar along the present course of the river Kortallaiyar.

Krishnaswami (1938a) noted the presence of a lateritic conglomerate overlying the Sripe-rumbudur shales and capped by loams separated by lenses of pellety laterites. The industry within this terrace was classified as Industry V, defined as having Late Acheulean, Micoquian and Levallois elements. No difference in assemblage composition was noted throughout the terrace, either in gully sections or in excavations. This fact was confirmed by a study of collections from different levels made by his colleague Drummond, also a member of the Yale-Cambridge expedition. Despite these preliminary observations, Krishnaswami was careful to note that further sub-division on "grounds of stratigraphy though it has not been yet made and this may bring forth minor differences in the industry as to how the handaxes and cleavers have developed here" (Krishnaswami, 1938:71). In describing this industry he noted two series of tools: a) a derived series of tools, comprising rolled Abbevillian 'coups-de-poing' and early Acheul lateritized types; and, b) a contemporary series, above the lateritic conglomerate and devoid of patination. 'Coups-de-poing' and cleavers were predominant and had a variety of forms comparable with that of Africa and Europe. He stated that some handaxes were flat with such a thinly elongated point that they simulated Micoque types from the Somme valley. He noted the presence of Victoria West type handaxes, in addition to handaxes and cleavers made on the single and double Vaal principle. Towards the top of the terrace, Levallois flakes were noted (Krishnaswami, 1938a:75).

Paterson chose to term industries in this region as the 'Madras Paleolithic industries', a term that seems to have been applied in a general way to collections from this area distributed in various parts of the world (Petraglia and Noll, 2001). In his sequence of four-fold terraces, Paterson joined Krishnaswami in placing 'Attrampakkam', on terrace T2 (20′), of the river Kortallaiyar. Tools occurred within the basal laterites and were largely late Acheulean handaxes and cleavers. He also noted the presence of a few rolled tools, similar to those of the first two groups at the site of Vadamadurai (i.e., 'Abbevillian, earliest Acheulean, and Middle Acheulean). Like Foote, he remarked on the extreme freshness of most tools. The presence of flake cleavers, and occurrence of the Vaal river variant of South Africa were documented by Paterson (Table 1). The industry also contained pear to tongue shaped handaxes, and discoidal cores (some retouched into tools) (Paterson, 1939:329). He also noted the presence of a small group of cores and flakes, which were entirely fresh and unpatinated, and some of which were found in the overlying silt, while others were on the surface.

These studies established a standard against which other industries were compared. Analysis of other lithic assemblages were invariably within a framework of how they could be situated within the Madras biface or pebble tool family, and until a re-examination of this region in the 1990's (Pappu, 1997, 2001), cultures were compared with the Kortallaiyar basin terrace sequences.

## The Archaeological Survey of India and Excavations at Attirampakkam

From 1957 to 1979, excavations were conducted by K.D. Banerjee of the Archaeological Survey of India at Gudiyam, Attirampakkam, Vadamadurai, Poondi and Neyvelli. Barring brief notes (I.A.R., 1962–63, 1963–64, 1964–65, 1966–67), this work was never published. Banerjee denied the existence of fluvial terraces and put forward a hypothesis of marine terraces at elevations of 73 m, 45 m, 30 m, and 17 m AMSL (Agrawal, 1982:53) (Table 1). Like Foote, Banerjee also observed Acheulean artifacts on the surface of, and slightly within the weathered shale. He was unclear as to whether the horizon of this industry was on the surface of the shale or in an overlying deposit, which was subsequently washed away (Banerjee, 1969:20–22). Unlike previous scholars, he associated the laterite with a post-Acheulean industry (comprising points, scrapers and longish flake-blades). He also confirmed the presence of a redeposited laterite higher in sequence with a post-Acheulean industry capped by a sterile brownish soil.

## Excavations at Attirampakkam (1999–2004)

A re-examination of the archaeology of the Kortallaiyar river basin was initiated in 1991 (Pappu, 1996, 1999, 2001a, 2001b). In this study, the ferricretes or ferruginous gravels (corresponding to the laterites of previous scholars), bearing Acheulean tools were noted resting disconformably on Sriperumbudur shales (also classified as the Avadi formation), and were capped by silty-clays. A study of the gully sections did not reveal any artifacts in the shales or clays. Preliminary observations indicated that the principle geomorphic processes include weathering of the bedrock clasts, winnowing of the siliceous and ferruginous matrix of the Sriperumbudur and Satyavedu formations, and erosion of Tertiary ferricretes, which contributed source material in the form of gravels, silts, sands and clays constituting Pleistocene deposits in this region. Subsequently, transport and redeposition took place due to colluvial processes, stream and sheet floods and stream channel processes; this was followed by weathering of the profiles and ferricritization. Further, deposits in the low-lying areas on either side of the Kortallaiyar, formed part of the flood plain of the Old Palar/Kortallaiyar, while the northern areas were under the influence of the river Arani. While terraces were noted, they did not correspond with the 'four-fold' terrace sequence put forward by previous scholars. The surface assemblages were predominantly Middle Paleolithic. Only three possible Acheulean tools were collected from the surface. These were stained white owing to contact with the bedrock (shale) and were rolled and abraded, which hinted at the possibility of a pre-lateritic archaeological horizon. Studies of site formation processes and lithic technology were conducted, and the site was situated with the broader context of the regional archaeological record (Pappu, 2001b).

These preliminary studies of the site were based only on surface collections and the study of gully sections. It was subsequently decided to expand this preliminary study into a project for examining the Pleistocene archaeology and paleoenvironments of the region. Excavations (1999–2004) were initiated at Attirampakkam by the author, with geochronological and geomorphological studies under the direction of M. Taieb and Y. Gunnell (Pappu et al., 2003a, 2003b, 2004; Pappu and Kumar, 2005). The ongoing research project aims at investigating questions related to hominin behavior in the context of changing Pleistocene environments, to situate the site within the broader geomorphic context; to obtain a series of dates; to study lithic technology and the nature of cultural transitions through time; and to situate these studies within the regional archeological

landscape, and within the context of South Asian prehistory.

Artifacts were mapped eroding over an area of around 50,000 $m^2$. A contour map of the site and surface deposits was prepared at 1 m intervals. Following this, an area of 220 $m^2$ was excavated in the form of test-pits, geological step trenches and horizontal trenches, the methodology of which is discussed elsewhere (Pappu et al., 2004). Emphasis was laid on meticulous recording of all artifacts and features (e.g.,, three-dimensional measurements, orientation, inclination, nature in which the tool was embedded in the sediment); sieving all excavated sediments, digital photography, drawing and videography; and collection of samples for sedimentological, paleobotanical and micropaleontological and rock magnetic studies; and for obtaining paleomagnetic measurements, ESR, cosmogenic Be and OSL dates (Figure 2).

The site has yielded a stratified cultural sequence (maximum depth of 9 m) comprising Lower, Middle and possible Upper Paleolithic deposits with a microlithic component in the upper layers and on the surface. Six sedimentary units were recognized, comprising laminated clays (Layer 6), disconformably overlain by a thick sequence of ferruginous gravels (Layer 5) capped by clayey-silts (Layers 3, 4), which were in turn overlain by fine ferruginous gravels (Layer 2) and clayey-silts (Layer 1). Acheulean industries were noted in Layers 5 and 6 with industries possibly transitional to the Middle Paleolithic in Layers 3 and 4. Middle Paleolithic assemblages were noted in Layer 2, with a possible component of an early Upper Paleolithic. Microliths were noted eroding out of an overlying ferruginous gravel, which is capped by sands. Three significant aspects of this stratigraphic sequence included: a) discovery of Acheulean artifacts within clays (previously assigned to Lower Cretaceous shales); b) occurrence of Acheulean levels within the lateritic gravels (contradicting Banerjee, who assigned these to the post-Acheulean industries); and, c) occurrence of assemblages within the clayey-silts of Layers 3, 4 (previously thought to be archaeologically sterile) (Figure 3).

The most significant discovery was that of the occurrence of Acheulean assemblages within a sequence of laminated clay deposits previously classified as a Lower Cretaceous shale of the Avadi or Sriperumbudur series (Foote, 1870; Krishnaswami, 1938a; Banerjee, 1969). An important question that arose was whether Acheulean tools were or have been sinking into the 'Cretaceous shales of the Avadi series'

Figure 2. General view of the excavations (Trenches T7A, B,C)

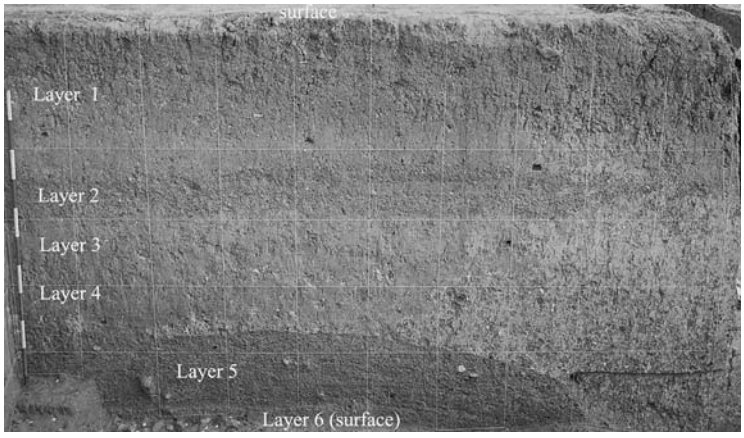


Figure 3. Stratigraphic sequence (Trench T7A)

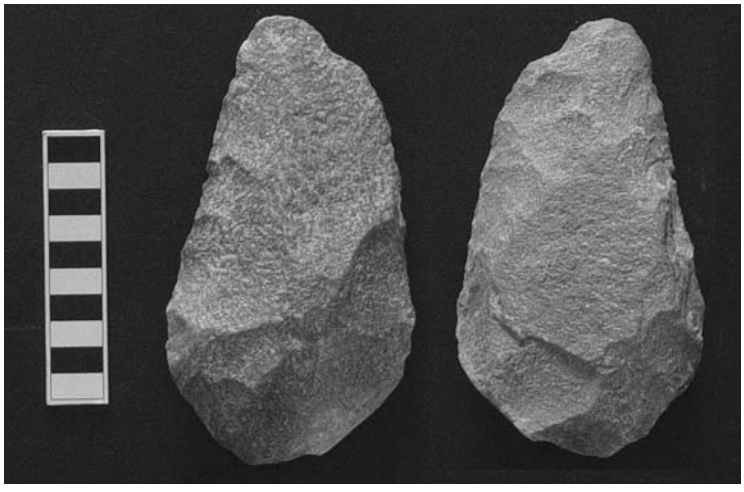

Figure 4. A handaxe within the clays of Layer 6 (Trench T8)

(Figure 4). This issue is under investigation and is being examined using geochemical, geochronological and micropaleontological studies. Geomorphological studies under the direction of Y. Gunnell (Pappu et al., 2003a, 2004) indicate that the laminated clay of Layer 6 is a Pleistocene floodplain deposit of fluvial origin, sourced by an Avadi shale outcrop, and aggraded during site occupation. Sedimentological studies (Pappu et al., 2003a, 2004), indicate a fluvial context, with the site located $< 1$ km from a large meander in the Kortallaiyar river cutting into its former floodplain. The negligible content in organic matter ($< 0.2\%$) of Layer 6 suggests episodic flooding rather than a perennial swamp with high biological productivity. Sedimentation was never interrupted for sufficiently long periods of time for paleosols to develop in the profile. This is also supported by the geochemical homogeneity of the sediment, which suggests stable paleoenvironmental conditions throughout the history corresponding to Layer 6. These studies are supported by those comparing artifacts and natural clast sizes between Layers 5 (ferricrete gravel) and Layer 6 (clay) in terms of their percentages, size ranges, and patterns of abrasion. The absence of pebbles and ferricrete

pisoliths predominating in Layer 5 and in Layer 6, and the absence of evidence of ferruginous staining or patination on tools in Layer 6 (Pappu et al., 2003a), tend to eliminate the possibility that tools are sinking into the clays of Layer 6 from Layer 5. This does not imply that vertical movement of tools did not occur, as a conjoinable pieces were noted in Trench T3, over 60 cm, which represents around ~ 10-12% of the total thickness of Layer 6. This does not seem to imply a large scale downward movement of artifacts. A total of 16 oriented samples of sediments from Layer 6, was collected in the trench T3 at 50 cm intervals from the surface to −7 m. Although no Pleistocene magnetic reversals could be identified due to insufficiently clear patterns in magnetic declination, the consistently low inclination values exclude a Cretaceous age for Layer 6. No major difference between magnetic directions from Layers 1–5 and Layer 6 further suggests that these formations are all of Pleistocene age (Pappu et al., 2003a).

It is inferred that Acheulean tools were periodically used at the site and left lying until buried by overwash. The overwash was generated by laminar flow overtopping the paleo-Kortallaiyar alluvial levees at a time when the river bed was 10–15 m higher than today, and the critical shear stress of such flow depths was insufficient to entrain or disturb the discarded artifacts. As episodic sedimentation proceeded, new tools continued to be discarded onto the fresh depositional surfaces. The laminations are typical of sediment settled by low-energy sheet flow in crevasse splays, floodplain ponds or abandoned channels. As per studies (Pappu et al., 2003a), the ferricrete colluvium of Layer 5 may coincide with a time of meander incision and erosional response of the hillslopes in the left bank of the meander bend. Ongoing studies will help to address this issue.

In the earliest phases of occupation (Layer 6, laminated clays), Acheulean hominins occupying the site utilized the area for specific tasks principally associated with the use of Large Cutting Tools (Figure 5). The deposit is devoid of cobble-sized clasts, nor are there any cores in these layers suitable for the detachment of large flakes. Preliminary manufacture of large flake blanks or trimming of cobbles was carried out off-site, possibly within a radius of 3–4 km of the site, where outcrops of quartzite cobble-boulder sized fanglomerates and gravel beds of the Allikulli hills and their outliers occur. Secondary trimming and retouch was carried out at the site, as is seen from the high percentage of debitage. In addition to finished tools, large flakes were also transported here, and were either shaped into other tools or utilized with minimum retouch or without retouching (Pappu and Kumar, 2005).

Acheulean assemblages noted in Layer 5 (ferruginous gravels) have evidence of extensive manufacturing activities, with cores, hammerstones, debitage and tools in all stages of manufacture, as also refitting artifacts (Figure 6). Raw material in the form of cobbles and pebbles in channel gravels were utilized. Assemblages in Layers 3 and 4 once again do not point to any intensive manufacture but represent largely a finished tool component, indicating use of the site for specific tasks. A complete sequence of manufacture including a few cores, debitage, tools and refitting artifacts are seen in Layer 2 (ferruginous gravels). A significant fact is the presence of more than 50% vertically embedded tools in certain levels of Layers 2, 3, 4 and 6, reasons for which are as yet unclear. The high resolution data recovered from the trenches is being analyzed to this end using Geomatics and GIS packages to investigate questions related to the spatial clustering of artifacts, and natural and cultural factors structuring their horizontal and vertical distribution. In addition to artifacts, three fossil faunal teeth, a set of impressions, possibly representing animal hoof-impressions, and fragmentary shells were also recovered (Pappu et al., 2004).


Figure 5. Handaxe from Layer 6

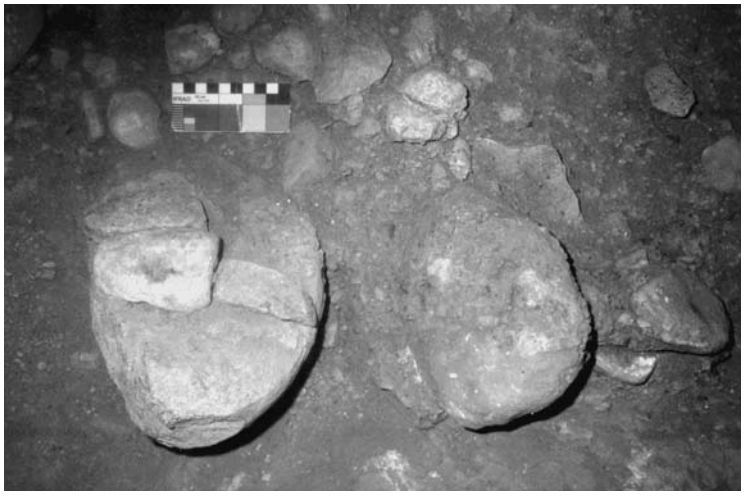

Figure 6. Cores, debitage and tools from Layer 5 (ferruginous gravels)

## Discussion

In the last 142 years since Foote's studies, research into the Indian Paleolithic has led to the discovery of sites, shed new light on Pleistocene environments, led to developments in chronology, and provided new perspectives in the study of lithics and in concepts regarding prehistoric behavior. Periodic reviews of these studies (Sankalia, 1974; Jayaswal, 1978; Jacobsen, 1979; Paddayya, 1984; Misra, 1989; Mishra, 1994, 1995; Korisettar and Rajaguru, 1998; Petraglia, 1998; Pappu R.S., 2001; Corvinus, 2004), and efforts to situate the Indian Paleolithic in a global perspective are however hampered by several factors. Much of what is written on the Indian Paleolithic is based on research conducted on surface occurrences in a few regions. Few large scale excavations of sites have been undertaken, and these are reported often briefly only in the official journal of the Archaeological Survey

of India (*Indian Archaeology: A Review*), or published in the form of brief articles in journals (see Mishra, 1994, Pappu R.S., 2001; Petraglia, 1998). Doctoral dissertations often deal with selected aspects of the excavation (Alam, 1990). Comprehensive excavation reports are even fewer (Joshi, 1978; Armand, 1983; Corvinus, 1983; Sharma and Clark, 1983; Pant and Jayaswal, 1991). This is compounded by problems associated with the study of surface scatters (questions related to site contexts, occurrence of palimpsets and lack of stratigraphic or chronological control); while the study of older collections in institutes or museums, is often marred by a lack of contextual information. There has also been an excess emphasis on the study of gully sections which requires to be treated with caution. In this context, valuable lessons can be learnt from our research at Attirampakkam, where the study of gully sections do not reveal artifacts within the clays of Layer 6 or the silty-clays of Layers 3 and 4, as seen in the excavations; thus leading to a stratigraphy which prevailed untested for almost a century. Further, excavations across the site also indicate that the surface assemblages are a result of the differential erosion of artifacts from varying layers, and thus need to be studied with caution. In this context, systematic excavations at Attirampakkam, have yielded high-resolution data which is being used to answer a wide range of questions on hominin behavior and paleoenvironmental change over the Pleistocene. With the exception of the 16R dune profile at Didwana, Rajasthan (Misra and Rajaguru, 1989), few open-air excavated Paleolithic sites in India have revealed similar thick sequences of Lower and Middle Paleolithic industries. In particular, the thick sequence of stratified deposits at Attirampakkam provides a unique opportunity for examining long-term changes during the Lower, Middle and Upper Paleolithic. Although dates are still awaited, this stratified sequence of Acheulean industries at the site assumes significance when examining early dates for the Acheulean elsewhere in India (Mishra, 1995). Further, few studies in the Indian Paleolithic have specifically addressed questions related to hominin behavior. In South India, the classic study of the Hungsi-Baichbal complex (Paddayya, 1982), followed by recent excavations at Isampur (Petraglia et al., 1999), revealed patterns of hominin movement across the landscape, variability and choices exercised in raw material usage, caching behavior, and well-planned quarrying activities. At Attirampakkam, analysis is still in process and thus at present brief observations can only be made at present. Changing patterns of raw material exploitation are noted with import of finished tools to the site in the lowest levels of the Acheulean (Layer 6), followed by on-site manufacture in the upper levels (Layer 5) with import of boulders for use as giant cores; in accordance with changing depositional environments and raw material accessibility over the Pleistocene. The site was occupied for over much of the Middle to Late Pleistocene, with evidence of abandonment only seen in Layer 1. Situating this site in a global perspective, may as yet be premature as results of various studies are still awaited; but our studies will certainly add important information to existing knowledge on change and continuity in the South Asian Paleolithic.

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