Human origins studies in India: position, problems and prospects*

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Abstract

The Indian subcontinent contains one of the richest and continuous records of hominin behavior in the Old World. This evidence is found in diverse paleoecological settings and temporal contexts (particularly in India), reflecting the successful adaptive strategies of South Asian hominins during the Pleistocene. More importantly, this evidence geographically links similar records of behavior from both the western and eastern parts of the Old World. Despite this significance, however, the subcontinent has received only marginal academic attention and, until recently, its behavioral record was not considered in general human evolutionary syntheses. This is partly explained by the lack of early hominin fossils, a dearth of excavated sites and associated chronometric dates. These drawbacks are directly related to the lack of adequate funding and technical knowledge, complex bureaucracies, and a general lack of interest in paleoanthropology – all of which have hindered prehistoric research in South Asia, at varying levels. Although Indian and Western researchers have recently begun to confront such problems through multidisciplinary excavations and international collaborations, the quality and frequency of this level of research are minimal. Therefore, to foster the immense research and educational potential of South Asian paleoanthropology, greater emphasis needs to be placed (by both academic and government institutions) on the prioritization of research themes and the adoption of modern methodological techniques. This paper briefly reviews the salient features and academic status of the South Asian Paleolithic and its relevance in understanding human evolution in an Asian context. Associated problems (theoretical as well as practical) are discussed and broad solutions are introduced, to modernize and expand paleoanthropological studies in India.

Introduction

In recent decades, the study of human origins has become an intense scientific discipline at a global level, resulting in numerous discoveries as well as debates. One of the more popular issues being addressed is the nature and timing of various dispersal events from East Africa into other parts of the Old World (Tattersall, 1997), and subsequent inter-regional techno-cultural interactions. Related environmental adaptations and
technological innovations were fundamental aspects of regional hominin behavior throughout the Old World during the Pleistocene. Therefore, adaptive strategies probably differed vastly across the diverse eco-zones throughout Asia, including the Indian subcontinent. The geochronological evidence for archaeological and fossil evidence outside Africa points to a Lower Pleistocene age for the earliest dispersal and involves the genus *Homo* (Larick and Ciochon, 1986). However, most paleolithic evidence from South Asia, which lies between the two sources of the earliest *Homo* fossils outside of Africa (Gabunia and Vekua, 1995; Swisher et al., 1994), does not fit into this chronological framework. The South Asian landmass comprises a temperate/subtropical setting, dominated by a seasonal monsoon regime prevalent since the Miocene. Therefore, climatic fluctuations (e.g. such as intense but gradual cooling and drying periods) must have had major implications on patterns of faunal and floral distribution and associated hominin behavioral systems.

A large amount of prehistoric data has been accumulated over the last century and the evidence points to a rich and intense period of hominin occupation (particularly the Middle Pleistocene), encompassing a mosaic of landforms and ecological resources. However, our present knowledge does not yet provide a robust empirical and analytical base for understanding human environmental adaptability in a South Asian context. As a result, several important questions remain to be answered, such as the timing of colonization of peninsular India, the factors responsible for techno-cultural change, and identifying the hominin specie(s) that occupied prehistoric India. Therefore, a question can be posed: *Does the rise and maturation of South Asian lithic industries conform to African trajectories or were there geographically independent patterns of regional development?* Such a broad issue can only be addressed through longitudinal and meticulous multidisciplinary research, involving the collaboration of specialists from various scientific disciplines. Very few such investigations have taken place in South Asia, and therefore, the potential for such research is immense. In addition to research, paleoanthropology as a discipline needs to be introduced in academic syllabi at all levels, in order to replace outdated theories with new concepts and recent interpretations (e.g. the revised taxonomic status of *Sivapithecus*).

▲ The Indian Subcontinent and its eoco-geographical relevance

South Asia or the Indian subcontinent encompasses the political boundaries of Pakistan, India, Nepal, Sri Lanka, Bangladesh, and Bhutan. To the west of peninsular India is the Arabian Sea, to the east, the Bay of Bengal, and to the south is the Indian Ocean. The entire region comprises a diverse
spectrum of ecological and topographical zones (Figure 1) combined with a complex geological history (Siddhartha, 1999). The north is dominated by the Greater and Lesser Himalaya and the Siwalik hills, all ranges almost geographically parallel and temporally successive to each other. This mountainous terrain includes northern Pakistan, northern India, most parts of Nepal, and Bhutan. South of these mountain and hill ranges are the Indo-Gangetic plains located in all South Asian countries except Sri Lanka and Bhutan. The plains are followed (to the south) by the great Thar Desert (in eastern Pakistan and northwestern India), and the Vindhyan range of hills. This hills are located north of the Deccan Plateau, a prominent landscape of peninsular India, and includes the Western and Eastern Ghats (ranges of hills). Although most parts of India are recognized as being tropical or sub-tropical, such landscapes are especially prominent along the coasts of peninsular India, Kerala in southwestern India, and northeastern India or east of Bangladesh. The subcontinent is also interspersed with a large number of rivers and streams, and although agricultural land makes up over 65% of the region, numerous ecological and geographic features such as deciduous woodlands, tropical evergreen forests, savanna, semi-arid and arid scrub lands, arid sand deserts, and periglacial loessic landforms (Korisettar and Rajaguru, 2002), caves, canyons, rock-shelters, lakes, pools, and springs are also found in high numbers. Excepting the rivers of Narmada and Tapi, most rivers flow from west to east and exhibit unique fluvio-sedimentary regimes (see Gupta, 1995).

Most importantly however, the Indian subcontinent is well-known for its prominent monsoon regime, which has been in existence since Miocene times (Quade et al., 1989) and, no doubt, must have had major implications on the patterns of human evolution and behavior during the Pleistocene (see Joshi, 1985). The physiographic configuration of India induces the behavior of both the Southwest and Northeast monsoons, during summer and winter respectively (Korisettar and Rajaguru, 2002). The geographical significance of the Indian subcontinent in understanding Old World hominid dispersal patterns cannot be overstated, particularly since it has received less palaeoanthropological attention that most regions in the Old World (see Dennell, 2000-01). It lies directly between Africa to the west and Southeast Asia to the east from where the oldest Homo erectus specimens have been reported. Another significant fact is that it straddles the Movius Line and represents the easternmost domain of rich Acheulian localities (see Movius, 1948; Clark, 1994; Schick, 1994). Finally, this immensely rich source of prehistoric archaeological evidence plays a central role in understanding the evolution of the genus Homo in Asia, knowledge still evading Old World palaeoanthropology (see Dennell, 2000-01). The time-bracket of most prehistoric evidence and associated technological transitions within the subcontinent are perfectly synonymous with rapid encephalization in
hominids which basically took place during the Middle Pleistocene (Ruff et al., 1997). South Asia is highly regarded for its rich source of *H. sapiens* fossils dating from the Upper Pleistocene to the Holocene and holds tremendous potential in delineating patterns of modern human evolution within this region (Kennedy, 2000). In India, some examples of these Upper Pleistocene/Holocene hominin fossils come from Baghai Khor, Bagor, Pachmarhi, Mahara-Pahar, Tilwara, Valasna, Sarai Nahar Rai, Mahadaha, Damdama, and Lekkharia; in Sri Lanka, they come from Fa Hien, Batadomba Lena, Beli Lena Kitulgala, Bellanbandi Palassa, Hambantota, Alu Galge, Ravan Alle and Beli Lena Athula (Kennedy, 2001).

However, hominin fossils older than the Upper Pleistocene are not abundant and only a single specimen is known - from the sediments of the Narmada Valley in central India. In the early 1980s, a fossil hominid calvarium was recovered at Hathnora in a secondary basal gravel and is currently thought to be of Middle Pleistocene age (Sonakia and Biswas, 1998). It was originally classified as that of advanced *Homo erectus* (de Lumley and Sonakia, 1985), and later attributed an archaic or early form of *H. sapiens* (Kennedy and Chiment, 1991). Additional phylogenetic re-evaluation of the cranium reveals that it shares many key features with *H. heidelbergensis* (Cameron et al., 2004). The calvarium has been later supplemented by the discovery of possible clavicles and a rib fragment from the same deposit and general location (Sankhyan, 1997; 2005).

To re-emphasize, the geographical significance of India regarding its hominin behavioral record is multi-fold. Some of these unique attributes are: a) it represents the eastern-most concentration of Acheulian (Mode 2) technology in the Old World; b) it lies between East Africa/Eurasia and Southeast Asia, the oldest known sources of *Homo erectus* fossils; and c) the Middle and Upper Paleolithic assemblages exhibit potentially-indigenous trajectories of technological evolution from the Late Acheulian industries of the region.

### A brief history of paleolithic research in India

During his academic reign (1930s to 1980s) over Indian prehistory, H. D. Sankalia and his colleagues and students placed great emphasis on correlating palaeoenvironmental parameters and corresponding technological and behavioral adaptations of early hominids in the subcontinent (Paddayya, 1994). Each area under investigation was specifically selected on the basis of its geological nature and archaeological potential. It is important to note that many of the paleolithic studies in the subcontinent were also augmented by ethnoarchaeological studies. South Asia is one of the unique regions that offer the opportunity
to study many tribal communities, whose patterns of artifact production and land use are partly applicable to the paleolithic archaeological record. Owing to its large size and extensive Quaternary sediments, India has yielded the highest amount of Paleolithic evidence from South Asia. Transitional cultural sequences from the Lower Palaeolithic to the Mesolithic have been variably recovered from western Rajasthan, Belan and Son valleys and the Bhimbetka rock-shelters in Madhya Pradesh, and the Reningunta area in Andhra Pradesh (Misra, 2001). The majority of evidence in Sri Lanka belongs to the Upper Palaeolithic and some Middle Palaeolithic lithic assemblages have been reported (Deraniyagala, 1992), thus signifying a relatively late colonization of that region from southernmost peninsular India, when perhaps the sea-levels were significantly lower.

**The Three Phases of Development**

The development of Quaternary and Paleolithic research in India can be divided into three phases: 1) from 1863 to 1964, 2) from 1964 to the early 1980s (Korisetter and Rajaguru, 1998), and 3) from the 1980s to the present day[1]. During the first phase, inferences relating to palaeoclimates and palaeoenvironments depended on the characteristics of lithological units (such as coarse-grained and fine-grained clastic sediments) and the associated faunal material. Methodology and interpretative frameworks that were prominent in Europe were applied to the Indian context (most especially the glacial climatic sequence). Due to this massive influx of European influence between 1940 and 1960, many regional surveys were conducted to eradicate theoretical gaps, which included Pleistocene chronology and cultural successions. The 1960s formed a decade of important methodological and theoretical applications in the earth sciences and archaeology, all over the world. These new standpoints called for a reassessment of the old schemes and the use of new scientific methods. Numerous geographic zones of study were introduced and they included littoral, aeolian, lacustrine, and off-shore environments (Korisetter and Rajaguru, 1998). Therefore, since 1970, Quaternary research in India has continued to produce exceptional data that will eventually allow prehistorians to correlate it with the known global climatic and archaeological frameworks.

**The First Phase (1863-1964)**

The first discovery (in 1863) of Lower Paleolithic artifacts was made at Pallavaram near Madras (now Chennai) by Robert Bruce Foote (Pappu, 2001). He was probably the first investigator to attempt establishing their ages as well as reconstructing contemporary climatic conditions, and also the first to apply a geochronological perspective with an emphasis on site-formation. Although some prehistoric research was carried out following
Foote's efforts, similar attempts to reconstruct palaeoenvironments were not made until the 1920s and 1930s.

Cammiade and Burkitt (1930) followed up on Foote's work along the southeast coast of India and discovered a large amount of Paleolithic sites from various localities. Utilizing the encountered material and its geological contexts, they observed geological gaps in Foote's fourfold framework (borrowed from the Alpine sequence of Europe), and also provided a climatic background to the evolution of Stone Age cultures, resulting in an alternating succession of wet and dry periods (Korisetter and Rajaguru, 1998). More importantly, they also made a clear-cut comparison of the tool industries with the African material, and concluded that all industries of southeast India have exact counterparts in Africa, particularly in South Africa. This observation is now known to be partly inaccurate, in that many prehistoric assemblages in the subcontinent also exhibit distinct technological and typological features.

In addition, Krishnaswami (1938) conducted detailed stratigraphical surveys at Vadamadurai, Attirampakkam, and Manjankaranai in the Kortallayar Valley. The decade of the 1930's was also a time for the Yale-Cambridge expedition, launched by de Terra and Paterson (1939). Their primary goal was to seek evidence of Pleistocene glaciation phases in the Sub Himalayan region and to highlight its impact on early human cultures, both in concordance with the European model. Following their fieldwork in the Kashmir Valley (Jhelum), on the Potwar plateau (Soan Valley), in the central Narmada Valley (between the towns of Hoshangabad and Narsinghpur), and around Madras, they arrived at a fourfold glacial-interglacial model first established by Penck and Brückner in 1909 (Korisetter and Rajaguru, 1998). The basis for this model came from their observations of the terraces in the Soan Valley (now in Pakistan) and the Jhelum in Kashmir. This glacial-interglacial model became a standard for subsequent prehistoric and Pleistocene research in India and prevailed for four decades, until revised by various American, British, and Pakistani workers.

On the west coast of India, K.R.U. Todd initiated prehistoric as well as Pleistocene research (primarily expanding on the east coast model) and described the cultural stratigraphy and climatic succession on the basis of a depositional sequence in the Bombay (now Mumbai) region (Sankalia, 1974). During the 1950s, both Zeuner and Wainwright showed that evidence for more than four cycles of wet and dry phases existed, at least in the peninsular riverine environments. During this time, the notion was adopted of the pluvial phase being a period of heavy rainfall in tropical areas, compatible with cool and dry conditions of the temperate zone. Zeuner's fieldwork in the late 1940s and 1950s resulted in the publication

Other regional studies on the Pleistocene climatic and cultural succession in India followed and included the work of Bose and Sen in Mayurbhanj; Krishnaswami and Soundara Rajan in the Singrauli Basin, Uttar Pradesh; Soundara Rajan in the Gundlakama Valley, Andhra Pradesh; Subbarao in the Mahi, Orsang, and Karjan Valleys, central Gujarat; Joshi in the Malaprabha Valley, Karnataka; Sankalia in the Godavari and Pravara River valleys in the upland Deccan, Maharashtra; and Mohapatra in the Brahmani Valley, Orissa (see Korisetter and Rajaguru, 1998). An interesting point to be noted is the emphasis placed (at that time) on river valleys and basins for the investigation of paleolithic sites. Later efforts were directed at sites between river valleys or away from river valleys (Sankalia, 1969) and expanded the potential of these sites in peninsular India. Nevertheless, specific regional interpretations of the evidence gained valuable ground and inter-regional correlations were also produced. Such terms as *Soanian*, *Madrasian*, *Mahadevian*, *Abbevillian*, *Clactonian*, *Chellian*, and *Acheulian* were applied to non-systematic collections of paleolithic artifacts from riverine sections, without considering their typo-technological and chronological implications.

**The Second Phase (from 1964 to the early 1980s)**

Although regional studies continued in the 1960s, interdisciplinary approaches were beginning to be valued and began to be utilized extensively by various workers. As a result, Sankalia (1963) produced *Prehistory and Protohistory in India and Pakistan*, where he covered the regional alluvial and cultural sequences from all investigated regions of India and correlated them with appropriate wet and dry climatic cycles. In 1974, he updated it by including new data produced during the intervening decade (Korisetter and Rajaguru, 1998). The plate tectonic concept played a major role and resulted in oceanographic expeditions and palaeomagnetic anomaly studies of rocks and sediments. Deep-sea oxygen isotope stratigraphy and the continental loess-palaeosol stratigraphy have been increasingly utilized for Quaternary correlation in South Asia.

**The Third Phase (from the early 1980s to the present day)**

In recent decades, a third phase can be formally recognized, and is strongly marked by a) absolute-dating efforts, b) international multidisciplinary collaborations, and c) an implementation of genetic studies on modern populations. Over the last two to three decades, a greater emphasis has been placed on laboratory procedures and radiometric dating of Quaternary sediments. The multidisciplinary collaborative efforts between South Asian and Western scholars are represented by the work of Sharma and Clark...
The most prominent and long-term work by Indian and foreign workers in prehistoric archaeology, palaeoenvironmental studies, and geochronology in association with the archaeological studies in various parts of India, has been carried out extensively by faculty of Deccan College Postgraduate and Research Institute (Pune), Department of Archaeology, Allahabad University (Allahabad), M.S. University (Baroda), Physical Research Laboratory (Ahmedabad), Cambridge University (Cambridge), University of California (Berkeley), some of which is mentioned in slightly more detail below. An example of one of the most important non-archaeological projects is the multidisciplinary work of D.P. Agrawal and his team on the environmental history of the Kashmir valley (e.g. Agrawal et al. 1989). This work not only established a strong foundation for additional work but also provides a palaeoenvironmental and palaeoclimatic background to human dispersal into the subcontinent during the Lower Pleistocene. Another classic example of integrating the archaeological evidence with associated chronologic and palaeoenvironmental data is the work done by Deccan College and others on hominin adaptations in the Thar Desert of Rajasthan, northwest India (e.g. Raghavan et al. 1989; Misra, 1995; Misra et al. 1982)

Finally, genetic studies (e.g. Bamshad et al., 2001) and comparisons of the prehistoric, linguistic, and biological evidence (Kumar and Reddy, 2003) are also being undertaken, and can reveal valuable information concerning the origin of the diverse South Asian population. Combined, these studies have resulted in a better understanding of hominid adaptive strategies in changing environments (over varying periods of time) at intra-regional levels.

The Chronology of the Indian Lower and Middle Paleolithic

The Lower Paleolithic evidence in South Asia is essentially divided into two facies or types of lithic assemblages: Mode 1 (Soanian and non- or pre-Acheulian) and Mode 2 (Acheulian) industries (Gaillard and Mishra, 2001), both often occurring independently as well in shared geographical, geomorphological, and stratigraphical contexts. However, most of the Mode 1 evidence post-dates the evidence representing Mode 2 assemblages. An intriguing related query that has remained unresolved, is the initial timing of the colonization of the Indian subcontinent. Traditionally, archaeologists working in India have always relied on relative dating methods (e.g., terrace sequences, biochronology, typology, regional stratigraphy, etc.). In recent years, the application of absolute
dating methods have become increasingly useful for identifying the ages of Lower Paleolithic sites and site clusters (Singhvi et al., 1998), and has contributed in extending the lower age limit for the earliest evidence to the early Middle Pleistocene and possibly beyond (Table 1). Most of the localities have been dated through the Thorium-Uranium method and include a predominance of Acheulian sites (Mishra, 1992; Korisetter and Rajaguru, 1998; Chauhan, 2004b).

The youngest reliable dates for the Acheulian occurs at two localities: Umrethi (Gujarat), which was dated to >190 kyr, and in the Hunsgi Valley (Karnataka), where the terminus of the Kaldevanhalli travertines dates between 166 kyr and 174 kyr. Middle Pleistocene ages were obtained from vertebrate fossils (teeth) in stratigraphic association with Acheulian tools in the Hunsgi-Baichbal Valley, where they were dated to 287 to 290 kyr (at Tegghalli and Sadab) (Szabo et al., 1990). At Tegghalli, Nevasa, and Yedurwadi, the dates exceed 350 kyr from three different geographic contexts, demonstrating that the Acheulian extends beyond the maximum dating limit of the uranium series method (Pappu, 2001). Although chronological sequences through stratigraphical profiles are rare occurrences, the Didwana assemblage was an exception and the resultant date was between a bracket of >150 and < 390 kyr through a 19m column in a sand dune (Raghavan et al., 1989; Mishra, 1995a).

Although this corpus of dated Acheulian sites in India indicates a late Middle Pleistocene age for these assemblages, an earlier occupation is suggested by recently examined sites. They include Dina and Jalalpur in northern Pakistan, Moregaon and Bori in the Deccan region of western India, and Attirampakkam and Hunsgi in southern India (Rendell and Dennell, 1985; Gaillard and Mishra, 2001; Paddayya et al., 2002), which are among the better-studied sites. The first radiometric age was extracted from the Bori tephra from the Kukdi Valley in the Deccan Plateau, and yielding an average age of 1.38 myr by K/Ar method (Mishra et al., 1995). However, in due time, this age was rejected by several geologists, who argued that it was probably correlated with the younger Toba ash eruption, dated to c. 74 kyr from deep-sea cores and this was also supported through ample geochemical sampling from various localities (Shane et al., 1995; Westgate et al., 1998). Furthermore, three Ar/Ar dates were also recently obtained, with two samples resulting in ages of 680 kyr and 660 kyr (Mishra et al., 1995). Most recently, preliminary ESR dates from the Acheulian site at Isampur in Karnataka (Paddayya et al., 2002) compliment the dates proposed by investigators (Rendell et al., 1987) for an early hominid colonization of the Indian subcontinent. However, these assemblages in the Potwar Plateau, dated to between ca. 2 and 1 myr by Rendell et al. (1987; 1989), do not necessarily suggest a subsequent dispersal southwards into peninsular India.
Biostratigraphic chronology and research has been conducted extensively in India and shows clear evidence of constant taxonomic change throughout the Plio-Pleistocene, although no index fossils have been identified for subdividing the Pleistocene (Badam, 1979). Fluorine-phosphate ratios on bone and fossils have been applied to numerous archaeological circumstances, in an attempt to supplement stratigraphic evidence and to distinguish between Middle and Late Pleistocene localities (Kshirsagar, 1993). While there may be merit in supplementing stratigraphic evidence through chemical ratios, the accuracy of these measures is undetermined and thus unreliable, since little is known about palaeoenvironments and depositional conditions, and further, few correlations have been made with these absolute dates (Korisetty and Rajaguru, 1998).

The Character and Distribution of the Acheulian (Mode 2) in South Asia

India straddles the Movius Line (Schick, 1994) and marks the easternmost domain of the Acheulian Industrial Complex, where it disappears abruptly in the tropical evergreen forests of eastern India (Clark, 1998). The Indian peninsula south of the Kaveri river, some northeastern zones of the subcontinent (e.g. Meghalaya, Assam, Manipur), and the Ganga Plains have not yielded abundant Palaeolithic or Acheulian evidence. Nonetheless, most of the Acheulian and non-Acheulian assemblages are found throughout the rest of the Indian subcontinent in a variety of ecological contexts, including montane regions, hill slopes, alluvial settings, coastal plains, and in rockshelters (Misra, 1989). Well-studied examples of the Acheulian come from the Thar desert (Misra, 1995), the Son and Belan Valley assemblages (Sharma, 1973; Sharma and Clark, 1983; Clark and Williams, 1990), the Bhimbhetka area or Raisen District of Madhya Pradesh near the Narmada Valley (Misra, 1985; Jacobson, 1985), Maharashtra (Corvinus, 1981), and southern India (Paddayya et al., 2002; Pappu et al., 2003). The northernmost Mode 2 assemblages in India are found in Kashmir, where Sankalia (1971) and Joshi et al. (1974) discovered a handaxe, choppers, scrapers, and flakes from an interface between a boulder conglomerate and overlying fine-grained sediments. Lower Palaeolithic tools have also been reported from the nearby region of Ladakh (Sharma, 1995).

In the 1960s, Khatri (1966) argued for an indigenous origin for the South Asian Acheulian from Oldowan tools at Mahadeo Piparia, Narmada Valley in Central India. (He was later disproved by Supekar (1968) and criticized by subsequent workers). A similar conclusion was also reached by Armand (1985) from his work at the non-biface site of Durkadi, also in the Narmada Basin. Wakankar (1973) also proposed that the Acheulian horizon at an excavated Bhimbhetka rock-shelter was underlain by a
‘pebble-tool’ horizon. However, additional excavations by Misra (1985) at Shelter III F-23 did not support Wakankar's claims for a pre-Acheulian industry. Today, it is a generally-accepted fact that the South Asian Acheulian is a result of early migrations of Homo from Africa sometime in the Lower Pleistocene (Petraglia, 2003). The Early Acheulian from the Indian subcontinent appears to share a suite of technological attributes with other similar assemblages from the Old World (McPherron, 2000). Comparison of classic biface assemblages from India and East Africa illustrate that they are both a result of specific ecological preferences and represent unique modes of transport behaviors across a range of diverse landscapes (Noll and Petraglia, 2003). Additional shared attributes include a systematic production of certain tool-types and the application of various reduction techniques.

However, while Acheulian assemblages of South Asia broadly resemble those from Africa and Europe, there are differences in size, shapes, and specialized forms (Pappu, 2001). The Acheulian (Mode 2) assemblages in South Asia are generally divided into either Early or Late developmental phases, depending on their typo-technological features and associated metrical analyses (Pappu, 2001; 2002). While the term ‘Middle Acheulian' has been occasionally applied to ‘transitional' assemblages (e.g., Jayaswal, 1978), the term is not as common today in the South Asian context. Early Acheulian assemblages are generally “characterized by such core tools as handaxes, choppers, polyhedrons, and spheroids, a low number of cleavers and flake tools, the predominant use of the stone-hammer technique, and the absence of the Levallois technique” (Misra, 1987: 117). Early Acheulian bifaces in South Asia are often asymmetrical, large with thick butts or mid-sections and possess large and bold flake scars (albeit irregular), indicative of hard-hammer percussion (Chauhan, 2004b). In contrast, Late Acheulian assemblages are represented “by the low proportion of bifaces, the high ratio of cleavers to hand axes, the very high ratio of flake tools like scrapers, the extensive use of the soft-hammer technique, and the knowledge of the Levallois and discoid-core techniques” (Misra, 1987:117). The Late Acheulian assemblages are generally smaller, thinner, and more refined, with a significant increase in the degree of retouching and controlled bifacial thinning/flaking. Assemblages from Acheulian sites show differences in the proportions of choppers, handaxes, and cleavers, probably depending on the ecology, function, and raw material (Pappu, 2002) [6]. Although only a small percentage of important Lower Paleolithic sites have been studied in detail, Mishra (1994) and Pappu (2001) observe that Late Acheulian sites are found predominantly in surface contexts, whereas the known Early Acheulian sites (albeit sparse) are usually in buried contexts.

While the large number of Late Acheulian sites in peninsular India reflects an intensification of hominid activity during the Middle Pleistocene in
South Asia, the low profile of the Early Acheulian facies is noteworthy. Currently, several sites are known to possess associated attributes, but until recently, very few of these sites have been studied in detail and through multidisciplinary approaches. In fact, most of the Mode 2 evidence is represented by Late Acheulian sites, highlighted by a visible increase in artifact density as well as overall distributional patterns throughout the subcontinent.

The Character and Distribution of Mode 1 Evidence in South Asia

Since the beginning of paleolithic studies in the Indian subcontinent, most research has focused on the easily-recognized Mode 2 assemblages. As a result, an equally-robust understanding for the Mode 1 evidence is currently lacking. Furthermore, the chronological framework for Mode 2 assemblages from South Asia does not necessarily imply a similar framework for Mode 1 assemblages in the region, although considerable temporal overlap is evident in all parts of the subcontinent (Jayaswal, 1978). A situation similar to that of Europe, where most Mode 1 assemblages (pre-Acheulian) are slightly older than the Mode 2 assemblages, may also exist for South Asia (Dennell, 2000-01). Although Mode 1 assemblages of Lower Pleistocene age have been reported from northern Pakistan, similar evidence has not yet been convincingly reported from peninsular India. Most of the geological, geomorphological, and archaeological evidence for Mode 1 assemblages in South Asia points to a Middle to Upper Pleistocene age range. Furthermore, most of these Mode 1 assemblages appear to be contemporaneous to (but separate), younger than, or a part of Mode 2 assemblages in the region. The latest review of these Mode 1 assemblages in India was carried out by Jayaswal (1978; 1982). As mentioned earlier, Mode 1 tool-types occur in independent contexts as well as parts of Mode 2 assemblages[7]. These assemblages are found in a variety of geomorphological contexts and ecological settings throughout the entire subcontinent and some reported examples include: de Terra and Paterson (1939), Khatri (1966), Armand (1985), and Reddy et al. (1995) (for a more detailed review, see Chauhan, 2004a). While some assemblages represent Lower Pleistocene occupation (e.g. Dennell, 2004), most of the evidence (particularly in peninsular India) is restricted to Middle and Upper Pleistocene contexts. De Terra and Paterson first proposed the name ‘Soanian' for the paleolithic industry found in the Soan valley in northern Pakistan, and reported evidence of techno-cultural change for this evidence. However, recent studies on site-formation (Chauhan, 2004a) shows that the techno-chronological divisions for the Soanian are not valid.

It is important to note that Mode 1 assemblages in South Asia have always been reported to be made from rounded river-worn clasts (usually quartzite), and angular or tabular raw material has never been
employed (unlike in the Oldowan where both types have been exploited). This suggests that most Mode 1 assemblages are a result of environmental adaptations by Pleistocene hominids in the region. This is supported by recent studies that show the functional versatility of Mode 1 tool-types, particularly choppers. The evidence from the Indian subcontinent demonstrates that most Mode 1 assemblages are either contemporary with or younger than Mode 2 assemblages. Considering the presence of Oldowan-type assemblages in the Arabian Peninsula and Southeast Asia, the absence of the same in the Indian subcontinent is particularly noteworthy. This may be due to one or more of the following reasons:

a. that the hominid groups that produced early Mode 1 assemblages in the periphery regions (e.g., northern Pakistan, Tadjikistan, the Arabian peninsula, Southeast Asia) did not disperse into peninsular India (or did so, albeit much later) (e.g. Dennell, 2003);
b. that Mode 1 assemblages of Lower Pleistocene age have not been properly recognized/identified to be as such (in peninsular India);
or
c. that Lower Pleistocene Mode 1 assemblages occur in a relatively low profile in peninsular India and/or have not been well-preserved.

The Middle Paleolithic Evidence from South Asia

In South Asia, separating the Middle Paleolithic horizons from the Late Acheulian ones has proved to be a major problem (Mishra, 1995a). The emergence of Middle Paleolithic technology, marked by the prepared-core or Levallois technique, signifies a dramatic change in hominid cognition and subsistence strategies. Most Middle Paleolithic assemblages, in global context, are produced on smaller clasts or nodules of raw material, rather than extracting blanks from large blocks or clasts of raw material (as in the Lower Paleolithic). One main feature is an increase in the intensity of tool-use as well as formal tool-preparation (i.e. retouch, rejuvenation). This transition in raw material exploitation and a corresponding decrease in tool-size are generally regarded as parts of a distinct shift in human behavioral patterns, marked by changes in land-use, technology, demography, and mobility. In recent decades, some of these Middle Stone Age features are viewed as representing the emergence of modern human behavior (Stringer, 2002).

Despite detailed inter-regional metrical and typological comparisons (Jayaswal, 1974; 1978), the timing and character of the South Asian Middle Paleolithic phase remain poorly-understood in comparison with similar evidence from Africa, Europe, and West Asia. Although a large number of sites are now known (see Sankalia, 1974), the concept of the Middle Paleolithic as an independent technological system was acknowledged by Indian prehistorians only in the mide-1950's (Athreya,
1996; Dennell, 2000-01). Today it is considered to be an easily-recognizable flake-based lithic tradition found throughout the Indian subcontinent (Misra, 1989), and similar to those from other parts of the Old World. Some well-studied stratified examples are Nevasa (Mishra, 1995b) in Maharashtra, Samnapur (Misra et al., 1990) in Madhya Pradesh, and the evidence from the Kortallayar Basin (Pappu et al., 2003) in Tamil Nadu.

In comparison with the Lower Paleolithic types, the four features that distinguish Middle Paleolithic assemblages are: i) a decrease in size of the artifacts, ii) a noticeable shift from large Acheulian bifaces to more smaller, specialized tools iii) an increase in the prepared-core technique, and iv) a preference for fine-grained raw material (such as chert, jasper, chalcedony, flint, crypto-crystalline silica, and so forth). Some of the new types within Middle Paleolithic tool-kits are cores, discoids, flakes, flake-scrapers, borers, awls, blades, and points. Although these features are shared with other Middle Paleolithic assemblages in the Old World, the South Asian evidence is typo-morphologically and technologically distinct. In fact, this uniqueness once compelled workers to attribute a formal name to some distinct assemblages from the type-site of Nevasa, Maharashtra: the ‘Nevasian’ industry (later found to be a part of the Late Acheulian assemblages in the region) (Mishra, 1995b; also see Athreya, 1996).

Although this term has been abandoned, the presence of certain features such as the Levallois technique and formal Middle Palaeolithic finished tools, such as scrapers, points, and flake types found in Africa, Europe, and the Levant, is notable.

A consistent geological feature of Middle Paleolithic sites in South Asia is that they are often found near sources of raw material, such as gravel or conglomerate beds. The cultural horizons are found within sandy-pebbly gravel horizons, generally overlying the basal boulder gravels comprising Lower Paleolithic artifacts (Guzder, 1980). In fact, Korisettar and Rajaguru (2002:332) have observed: “In general the Middle Palaeolithic sites are rarely buried with Quaternary sequences in the peninsular region; this possible indicates the dominantly erosive mode of the streams in the Deccan. They are common on the surface with rubble and fan gravels and generally lie away from the streams but close to quarries or sources of raw material.” However, certain Middle Palaeolithic assemblages have also been recovered from within sandy gravels overlying silts, which often cap cobbly-pebbly horizons, such as at Samnapur in the Narmada Basin (Misra et al., 1990). While most assemblages are made on fine-grained raw material, in some regions such as Rajasthan, parts of Andhra Pradesh, parts of coastal Maharashtra, and the Narmada Valley, quartzite continues to be used. Since c hoppens and diminutive handaxes are often found in certain Middle Paleolithic contexts (Guzder, 1980; Tewari et al., 2002; Corvinus, 2002), it may be suitable to divide Middle Paleolithic assemblages into two
separate groups: light-duty assemblages and heavy-duty assemblages. The factors for such variation in assemblage composition may include function, raw material variability, ecology, culture, style, and/or natural post-depositional formation processes.

From radiocarbon dating efforts on shell, wood, etc. from different sites in peninsular India over two decades ago, revealed that the Indian Middle Paleolithic is younger than 100 kyr (Guzder, 1980). Later work has revealed that this technological phase may extend back to at least 140 kyr (Korisettar and Rajaguru, 2002) or to be 150 - 250 kyr old (see Dennell, 2000-01). Other localities in the subcontinent have been bracketed to be between 125 and ?40 kyr old (see Mishra, 1995a), although some dates may be too young (see Kusumgar and Yadava, 2002). Recent efforts were made by Tewari et al ., (2002) in the Ganga Plains at the site of Kalpi, which yielded vertebrate fossil remains as well as core-tools such as choppers, which are uniquely small in relative size. Using TL methods, the investigators estimated this site to be about 45 kyr in age. However, an early Upper Paleolithic assemblage from Site 55 in northern Pakistan was also dated to 45 kyr (Rendell and Dennell, 1987). These convergent ages for vastly different assemblage compositions pose a problem in understanding regional techno-functional development during the Upper Pleistocene in the Indian subcontinent. Interestingly, choppers apparently form a prominent feature in a flake-blade industry from the Singhbhum region of Bihar (Ghosh, 1970), thus perhaps validating the congruency of the dates from Kalpi and Site 55.

Current problems in Indian paleoanthropology and potential solutions

Despite the abundance of cultural evidence (described above), numerous important issues and problems currently need to be addressed. To begin with, a large amount of sites have been reported but has not been compiled with related paleoenvironmental data – information usually obtained independently by geologists and paleontologists. However, much of the past work (in the last century) has focused on the archaeological record (stone tools) in secondary context and little work has been done to compare and correlate information (in primary context) at an inter-regional level. Virtually no information exists regarding hominid subsistence, as known from other well-preserved localities in the Old World (e.g. Olduvai Gorge in East Africa ). Comprehensive and multidisciplinary approaches have been applied only in the last two decades and at very few paleolithic sites in India . Therefore, there is a significant paucity in paleoecological and associated faunal data from the Indian subcontinent from the Middle Pleistocene, a major time of hominin activity throughout the Old World . As a result, very little is currently known regarding the ecological
relationships of Pleistocene hominins and their associated adaptive strategies in this part of the Old World. It is not clear which factors were responsible for episodes of technological change and exactly when these behavioral transitions took place. Therefore, it is also unknown whether these changes represent technological influences of incoming populations (dispersal of *Homo sapiens* from Africa) or represent indigenous biocultural continuities (independent of external influence). In other words: *What are the factors for the poor resolution of Middle Paleolithic sites in comparison with the Acheulian evidence?*

**A. The lack of a sound chronological framework:** Although a large amount of this type of data has been generated from Africa, the Levant, Europe, and East Asia, similar levels of high-resolution data and interpretations are currently lacking from South Asia. Indeed, the paleoanthropological significance of South Asia has not been appreciated or acknowledged by most Indian departments and archaeologists, a fact indirectly reflected by the lack of a prominent prehistoric exhibit in the National Museum. Furthermore, while numerous paleolithic sites have been dated through absolute geochronological techniques (such as Th/U, ESR, and TL methods), a systematic chronological control on many significant assemblages is still lacking (e.g. Soanian). In the past, sites have often been excavated without the employment of a robust dating agenda. At other times, suitable material has not been easily available or well-preserved. While we are aware of complex spatial patterns of lithic scatters and the techniques used to produce them, we know very little about when crucial cognitive horizons were reached and when associated technological transitions took place. Without an established chronological framework, it is difficult or almost impossible to correlate data at an inter-regional level or make comparisons with similar sets of evidence from other parts of the Old World.

**B. The lack of hominin fossils older than the Upper Pleistocene:** One of the most significant deficiencies in South Asian paleoanthropology is the virtual lack of hominin fossils older than the Upper Pleistocene. Excepting the Mid-Pleistocene hominin fossils from the Narmada Valley (mentioned earlier), no additional material has been forthcoming from the subcontinent. Despite the presence of numerous intact cave deposits and the high preservation rates of fossil vertebrates in the major river valleys of the region, hominin fossils have evaded archaeologists, geologists, and physical anthropologists. This insufficiency appears to be related to a number of possible factors:

1. Geological factors such as low rates of preservation and high rates of erosion.
2. The fossils are exposed or preserved in very rare contexts and have not been recovered as of yet.
3. The fossils, especially fragmentary or weathered specimens, have not been recognized as being *hominin* by non-specialists, since most investigators in the field are archaeologists, prehistorians, and geologists, and NOT trained physical anthropologists.

The Narmada Basin and other river valleys with similarly-extensive floodplain and paleosol deposits hold great potential for additional fossil material, and should be explored more systematically by qualified specialists (i.e. well-trained physical anthropologists). In addition to such fluvial contexts, additional locations for fossil material include fine-grained sediments away from river valleys as well as fossiliferous sediments in the Siwalik region of northern India and cave deposits in various parts of the subcontinent.

**C. Current issues in South Asian paleoanthropology:**

*a) The lack of Lower Pleistocene behavioral evidence in peninsular India*: There is also insufficient evidence of hominin occupation of peninsular India, prior to the Matuyama/Brunhes magnetic polarity transition. Despite recent reports of early Acheulian evidence from various parts of India (Chauhan, 2004b), such old age estimates have not been found consistently and in high frequency. If such early dates are valid, the associated evidence signifies Lower Pleistocene occupation of peninsular India, evidence for which is missing in other parts of India. Either hominids did not colonize most parts of India until after the Lower Pleistocene or the evidence is rare and very difficult to identify in well-stratified contexts. A part of the problem may lie in the fact that late Pliocene-Lower Pleistocene aged sediments are extremely rare south of the Siwalik hills or peninsular India. Therefore, much of the evidence, if it did exist, may be either deeply buried under Quaternary alluvium or geologically transposed from tectonic and erosional processes.

*b) The Acheulian-Soanian dichotomy*: Despite several attempts at interpreting the Acheulian-Soanian relationship(s) (Mohapatra, 1990), this techno-morphological dichotomy is still not well-understood (Chauhan, 2003). The lack of absolute dates for prehistoric sites (both Acheulian and Soanian) in the Siwalik region of northern India has contributed to this gap of knowledge in South Asian prehistory.

*c) Nature and timing of technological transitions*: Very little is known about the technological transitions in the lithic industries (e.g. from Lower to Middle Paleolithic, Middle to Upper Paleolithic, etc). It is not clear exactly which (ecological) factors were responsible for changes in technology and when these changes took place. *Were technological transitions contemporary throughout the subcontinent or was there independent regional progression of certain assemblages?* The three examples described above are not exhaustive and numerous other aspects have yet to be addressed at both inter- and intra-regional perspectives (e.g. ecology, technology, chronology, geographical density, regional style, limited symbolic
behavior, cultural affinities and continuities).

**D. The lack of a consistent typological framework for stone tool assemblages:** An additional challenging issue is a coherent typological framework for the regional and chronological diversity of stone tools. This on-going problem is not only restricted to the Soanian tradition and most lithic assemblages in South Asia, but transcends to Old World prehistory in general. Typology and classification of any type of artifact (not just lithic) is the foundation needed to hypothesize about behavioral change, environmental adaptation, and technological advancement within a given period of time. In the past, most of the descriptive terminology for lithics has often been borrowed from other Old World localities without regard to differences in space, time, culture, raw material, and technique. Although attempts at establishing classificatory schemes and inter-regional technological relationships have been made (e.g. for the Soanian), none of these schemes is standardized and each fails to accommodate new tool-types. Moreover, some of the interpretations concerning hominin tool use may be a result of selective, biased, or non-systematic surface collections rather than from comprehensive collections or systematic random sampling. With exception of a few studies, literature on Indian prehistoric studies rarely include discussions on sampling strategies and early attempts at systematic sampling were made in the 1970s (Joglekar, 2002). In fact, the non-systematic collection of lithic artifacts from secondary surface contexts is a meaningless endeavor and results in the destruction of important sites. Excepting the work of some archaeologists, basic concepts such as the processing sequence of cores or the technological differences in finished-tool morphology, have also been generally neglected. Cammidae and Burkitt (1930) were the first workers to assign Indian lithic assemblages to different technological ‘Series’, without emphasizing cultural terms. However, this trend and a similar concept of ‘Modes’ (Clark, 1977) were adopted by South Asian prehistorians only recently. Researchers in South Asia have traditionally ‘borrowed' broad technological terms from evidence in other regions, and have hesitated to go beyond the uses of such terms as Lower Paleolithic, Middle Paleolithic, Upper Paleolithic, Early Acheulian, Late Acheulian, Soanian, and so on. While some cultural terms have been adopted to demarcate regional differences in lithic assemblages (e.g. Soanian, Mahadevian, Nevasian, and Madrasian), they are either typologically inadequate or are found to be completely inapplicable. Moreover, such broad terms are relatively vague and fail to elucidate technological adaptations and cognitive capabilities. The use of basic functional terms to describe typologically diverse artifacts is also inadequate and ambiguous. Rather, such broad terms as core, chopper, chopping-tool, scraper, and numerous flake types (among others) need to be revised from a morphological perspective to reveal and understand the diversity of sub-types within these groups. Most
of the workers in India relied heavily on the initial interpretations made in the 1930s by de Terra and Paterson, ultimately resulting in oversimplified and confusing cultural interpretations (see Misra and Mate, 1995). However, the Soanian “terraces” observed by de Terra and Paterson were later proven to be erosional features, rather than true river terraces (Rendell et al., 1989; Dennell and Rendell, 1991). Nevertheless, investigators over the decades have not hesitated in establishing relative inter-regional chronologies, technological sequences, and cultural dichotomies.

E. Problems at the professional level: It should be noted that some, if not all, of the problems discussed above are directly related to problems at a professional level. In other words, such factors as i) the lack of interest in paleoanthropology - this is partly due to the fact that the archaeological records for the protohistoric and historic periods are quantitatively richer and more dynamic, ii) the lack of a suitable infrastructure for prehistoric research; and iii) the lack of adequate funding and funding bodies specifically for paleoanthropological research, are clearly responsible. Currently, internal funding for most archaeological research is provided by the Archaeological Survey of India, Indian Council of Historical Research, and the Department of Science and Technology, in addition to university departments and research institutes. However, most excavation and interpretative methods have not changed (with some exceptions) in the last several decades, and new methods and techniques have not been adopted or introduced. Such concepts as site-formation studies (e.g. Paddayya, 1987), multidisciplinary excavations, experimental or actualistic studies, and the use of advanced software and technology (all considered standard approaches by Western scientists) have yet to be adopted consistently. Most work still involves the exploration for and reporting of surface sites, general typological descriptions, and the lack of specific goal-oriented research projects. For example, from an analysis of published data, Joglekar (2002:418) concludes: “Even after 1991, prehistoric research reporting is descriptive and confined to the limits of typological and nominal scale of measurement.” Surface collections are often made un-systematically and key features such as associated topography, geology, and paleontology go virtually unmentioned or are understudied. Longitudinal and comprehensive investigations in one region or at single-site contexts have rarely been undertaken. The lack of interest in paleoanthropology is also directly reflected by the amount and quality of prehistoric excavations and publications in the subcontinent. Most Indian researchers have hardly applied to foreign granting agencies (although they are clearly eligible) such as The Leakey Foundation, The Wenner-Gren Foundation, Earthwatch, and The National Geographic Society, probably due to the cumbersome administrative/bureaucratic procedures and also because the government generally does not encourage it. Nonetheless, several departments and institutes have been actively engaged in
palaeoanthropological research at varying levels, the results of which have been published in Indian as well as international peer-reviewed journals. As a result, Western scientists are becoming more aware of the importance of the South Asian human record, which until now had been largely ignored in general human evolutionary syntheses. It would be fair to state that the lack of interest in paleoanthropology is also partly related to the lack of job opportunities.

In spite of the large number of paleolithic sites in South Asia, definitive colonization and settlement patterns during the Early and Middle Pleistocene are not clear and very few Lower Paleolithic sites have been excavated in South Asia (Chattopadhyaya et al., 2002; Pappu, 2002). However, recent research efforts by numerous investigators have resulted in a better understanding of ecological adaptations, technological innovations, and associated broad temporal frameworks. Despite the paucity of older hominid fossils, the Indian record (along with evidence from neighboring regions) has significant implications for interpretations of the Multi-regional vs. Out-of-Africa models concerning the origins of modern humans. While the general archaeological evidence reflects the broad evolutionary trends known from other Old World regions, Indian assemblages show considerable evidence of indigenous development of stone-tool techniques, function, and patterns of land-use. It is relatively clear that the Early Acheulian of South Asia most certainly goes beyond the Brunhes-Matayuma boundary and represents the earliest evidence for bifacial technologies in this region of the Old World. Although reports on Lower Pleistocene archaeological occurrences have been made (Dennell, 2004), such discoveries are in need of more frequent and consistent supporting evidence—particularly from peninsular India. In that respect, there is ample scope for future multidisciplinary research in Indian paleoanthropology.

A large amount of paleoanthropological data has been reported over the last century and numerous sites are known from throughout South Asia. Considering the availability of modern techniques, shifting research trends, and the growing importance of the South Asian record (Petraglia, 1998; 2001), the next step should involve comprehensive analyses of this data through the implementation of levels of action plans (Figure 2). For example, rather than simply reporting new localities, future investigations should focus on re-investigating the known sites through meticulous and long-term excavations, involving various specialists in different disciplines. Paleolithic sites need to be studied within their paleoenvironmental context and respective sources of diverse behavioral evidence need to be compared with each other (e.g. sites in lacustrine context, tectonic/erosional context, semi-arid context, coastal context, and floodplain context, for example). A long-term dating agenda should be carried out to ascertain the circumstances in which crucial behavioral
characteristics developed and/or evolved. This should be done by integrating biostratigraphy, geochronology, emphasis on both marine and terrestrial records, and inter-regional stratigraphical correlations. Composite stratigraphic section should be generated in relation to local geology, fossils, lithic artifacts, and the configuration of sediment exposures. This will reveal important behavioral changes with respect to key environmental events including climatic change, faunal/floral turnovers, and localized landscape transformations.

The archaeological research should be supplemented with the creation of online and interactive databases, containing individual stratigraphic sections (electronically) linked with stratigraphically-associated information on vertebrate fossils, archaeological evidence, patterns of hominin behavior, and multiform paleoenvironmental records (e.g. stable isotopes, sea-level oscillations, pollen records, regional climatic sequences, tectonic phases, faunal composition, and related deep-sea proxies). Future research should focus on the environmental factors that shaped hominin behavior, rather than just the archaeological aspects of these localities. The compilation of all known fauna and flora datasets and associated ecological variables in South Asia can result in a crucial and comprehensive source or reference for comparisons with other faunal assemblages in the Old World – particularly regarding taxonomic diversity and faunal migrations from Africa and East Asia. Such relationships can contribute significantly in understanding whether Asian hominins followed ‘biogeographic routes’ and the degree of their dependence on certain large mammalian taxa for subsistence purposes. Predictive modeling of behavioral and ecological patterns can be a critical factor in recovering primary sites in otherwise geologically disturbed regions. The use of Geographical Information Systems (GIS) can benefit greatly in understanding and linking the cultural and ecological changes that have taken place during the Quaternary in India.

Archaeological field schools generally focus on protohistoric and historic sites, and the discipline of prehistory is largely ignored or minimally studied. A well-structured prehistoric field school should be a vital feature at all academic levels, and should involve the introduction of basic concepts in paleoanthropology, geology, and paleontology. An additional avenue of focused research that can help answer paleoanthropological questions is genetic studies on Indian populations, of which the results are extremely interesting and valuable. Some important steps include (but are not limited to): i) establishing a source of funding for prehistoric studies; ii) gaining knowledge/experience of modern excavation and analytical techniques; iii) the chronometric dating of key paleolithic sites; iv) a focused search for hominin fossils in appropriate sediments; v) multidisciplinary collaborative efforts; and vi) the establishment of comprehensive electronic databases. This can only be done through the
collaboration and cooperation of students, scientists, academic institutions, government organizations, and private organizations (Figure 3). In fact, focused collaborations between the Archaeological Survey of India, the Anthropological Survey of India, and the Geological of India is recommended to address the larger issues (geological, chronological, and cultural) in Indian paleoanthropology. These institutions should also focus on and encourage international scientific collaboration between Indian and Western scientists and also enhance scientific access to paleoanthropological and related Quaternary data from India to the Western academic community through publication of research results in international journals, reference monographs, and international conferences.

Ultimately, the results from such endeavors should enable the rigorous testing of the environmental hypotheses regarding human evolution (Potts, 1998) and explore the possibilities of ecologically-isolated behavior and independent technological innovations. This will serve as a step in revealing the eco-geographical role that South Asia played in the origins of modern human behavior in Asia. Some answers to these questions are embedded in the rich and diverse faunal record of the subcontinent, as well as in the paleobotanical and sedimentary records. Since climatic oscillations became more intense (globally) following the Brunhes/Matuyama boundary, direct evidence of this should be visible in the Middle and Upper Pleistocene sediments of the subcontinent. Considering the significant role that South Asia has to play in Old World prehistory, paleoanthropological studies in India need to be pursued at greater levels of academic and non-academic participation, thus establishing its contribution in the evolution of modern human behavior in Asia. In light of globally changing research paradigms in human evolutionary studies, the time has come to bring South Asian paleoanthropology to an international platform.

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**Footnotes**

[*] This paper was presented at the *National Conference on Human Origins, Genome, and Peoples of India*, organized by The Anthropological Survey of India on March 22-24, 2004 at the India International Centre in New Delhi.


[2] Dennell (2000-01) highlights the historical differences of foreign
involvement in Indian paleolithic studies before and after Independence from British rule, mostly owing to infrastructure, the availability of funding, and the changing interests of scholars.

[3] Over the decades, most South Asian prehistorians have found it difficult to keep abreast of updated research techniques and theoretical approaches (Athreya, 1996). This was/is due principally to the lack of sufficient research funds, rapidly changing trends in global and South Asian archaeology, and even partially due to the apathy of some archaeologists. As a result, South Asian palaeoanthropology has declined in recent years (e.g. Bhattacharya, 1993) and today, only a small number of researchers are actively involved. Recently, some scholars in the Indian subcontinent have realized the need for change, and are applying the necessary multidisciplinary methods to their respective research agendas.

[4] Additional syntheses on (and the significance of) the South Asian prehistoric record are provided by Sali (1990), Varma (1997), Korisettar and Rajaguru (1998), Misra (1989; 2001), Petraglia (1998; 2001), and Dennell (2000-01). The primary focus of this paper is the Lower and Middle Palaeolithic records of India; therefore a discussion on younger assemblages, such as the Upper Palaeolithic and Mesolithic, is not provided.

[5] A recent review of the Acheulian of peninsular India is offered by Pappu (2001) and Chauhan (2004b) and the most recent review of non-bifacial assemblages of India was done by Jayaswal (1982) (also see Leng, 1992).

[6] Although Pappu (2002) only mentions the three main large tools found at Acheulian sites, an immense amount of differences also probably exist within small-tool assemblages as well, at both intra- and inter-site levels.

[7] Mode 1 artifacts that are a part of Mode 2 assemblages, are also found throughout the subcontinent. In that respect, Mohapatra (1985) had wrongly argued that Acheulian localities in the river valleys of peninsular India contain more choppers and the localities in upland regions contain more cleavers, a concept heavily criticized by most workers at the end of his paper (for geomorphic settings of Acheulian sites in India, see Pappu, 1985; 2001).

Table and figures

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