Stone Age Research in Siwalik Hills – A Critical Review

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Abstract

Indian subcontinent witnessed the hominoid evolution in the late Miocene sediments of Siwalik Hills of north¬ western sub¬ Himalayas. This area has been well known in palaeontological circles for over a hundred years, providing an abundance of fossils including some of the first evidence for extinct apes, going back to approximately 9 million years old. In this region, a prominent evidence of wide spread hominin occupation since the Middle Pleistocene has been reported which indicates varied patterns of land use and intra¬ regional mobility. North-western portion of Indian subcontinent is a very important zone for its paleoanthropological potential. The Paleolithic evidence in this sub¬ Himalayan foot hills is a perennial issue in the search for human origins. Hominin occupation of this area has been traditionally derived into two types: ¬ the Acheulian and the Soanian. Acheulean assemblages are less common than Soanian and are usually represented by small numbers of cleavers or handaxes. In this region most of the Acheulian localities are from surface contexts. In the Siwalik, the Soanian lithic industry occurs in two categories such as one dominated by flake production and representing the Middle Paleolithic and other dominated by shaping of choppers. Soanian industry represents some of the highest concentration of Paleolithic assemblages in the old world. The present paper critically reviews the archaeological studies in this region from the early part of 20th century to present time. It also highlights the Stone Age research trends of this region through chronological order. Methodological aspects of the researches also have taken into consideration during review. The paper also focuses on the important issues related to Paleolithic research of this region which are still continuing.

Key words: Siwalik Hills, Geology, Geomorphology, Earlier studies, Research trends, Archaeological remains, Stone Age Locality, Recent issues

Introduction

The Indian subcontinent occupies the major landmass of South Asia. It is a conditional scale landmass that contains a wide range of the physiographic zones and geographic features along with different topographic entities. This subcontinent plays a significant and unique role in any discussion of out of Africa dispersals given to its central geographic position between western and eastern Asia and its low land position. Its physical distribution of mountain ranges and arid zones have influenced hominin colonization and dispersal patterns through time. Moreover the basins of the subcontinent have particular spatial boundaries and this would have influenced Paleolithic occupation of the region. Considering the vast landmass of Indian subcontinent, varied physiographic and mosaic of ecological conditions suitable for adaptive radiation, the scores of early hominoid fossils are not very illuminating. The situation is an unimpressive one when compared to that of the other fossil bearing countries. But whatever hominoid primate fossil records are available in the subcontinent, the sole credit goes to Siwalik. The Siwalik Hills are known for their remains of fossil primates, which made them known worldwide as one of the most important evolutionary centers of the sub – Human primates. The fossil remains of anthropoid apes of Siwalik region are broadly distributed in the time span between middle Miocene to early Pleistocene.

The region also provides one of the most complete successions of mammalian fossil faunas in the world. The region offers scientists well preserved bodies of multidisciplinary evidence to understand human evolution and behavior in relation to changing environment. In this region there is a vast evidence of hominin occupation since at least the Middle Pleistocene period which is found from various eco – geographic regions of North –Western India as well as from Pakistan and Nepal. Paleolithic sites of these regions have been derived into two types which are found in the form of sites, site complexes, find spots and numerous surface scatters. In view of the wealth of the Pleistocene mammalian fossils and Pleistocene tools of different periods, the region has received attention of the archaeologist, geologist, prehistorians and anthropologists alike.

The Siwalik Hills and its Geological History

The Siwalik ranges are the southernmost hills of the Himalayan foothills of the mighty Himalayas. They mostly maintain a regular course from the river Yamuna to river Ravi on the south of the western Himalaya. On the north, the Siwalik descends gently to flat floored structural valley called 'Dun'. Dun is longitudinal depression filled up by recent gravels derived from the Antagiri (a Himalayan lake). Geologically the Siwalik represents clastic sediments of the nature of fresh water molasse which accumulated in a long narrow foredeep formed to the south of the rising Himalayas which had its inception in the third and most intense uplift during the middle Miocene to middle Pleistocene in age (Tripathi, 1986). All the sediments of the Siwaliks have come from Himalaya. During its emergence the land surface was flat and then later on due to the collision between Indian Plate and Asian Plates, the Himalayan sediments which come down into the basin are uplifted and due to this geological incident the Siwalik Hills has emerged. Structurally, the Siwaliks have been folded and over thrust to the south by the lower Tertiary formations which in terns are thrust over by the pre-Tertiary within the Siwalik basin itself, frequent reversals of the stratigraphic sequence has been brought about by thrusting. The intensity of thrusting decreases from north-east to the south-west, where the Siwaliks are characterized by broad open folds dissected by high angle reverse faults heading north (Tripathi, 1986). Lithologically, the Siwaliks represent a great thickness of the detrital rocks, such as coarsely bedded sandstones, sand rock, clays and conglomerates measuring between 5000-5500mt. in thickness. Primarily sediments observed in the Siwalik sediments include large scale fabular and through cross beds and cut and fill structures. Besides small scale cross beds, wavy and parallel lamination, lunate and linguoid ripple marks, flute and load casts, horizontal bedding and mud cracks are also common.

The Siwalik Hills or the Siwalik foreland basin consists of fluvial sediments. These hills were formed during the period from 14 million to nearly 500000 years ago. The Siwalik foreland basin is an active collisional foreland basin system that developed adjacent to the Himalayan mountain belt in response to the weight of crustal thickening when the Indian plate collided and subducted under the Eurasian plate. With a width of 450 kms.(280mi.) and 2000 kms.(1200mt.) long (DeCelles, 2012) the foreland basin span to five countries which include India, Nepal, Pakistan, Bhutan and Bangladesh. The importance of stratigraphy of the Siwalik foreland basin is unparalleled due to its significance on development of the basin throughout the geological time. The sediments of the Siwalik Hills are divided stratigraphically into lower, middle and upper sub groups which are further divided into individual formations that are all laterally and vertically exposed in varying linear and random patterns- Kamlial, Chinji, Nagri, Dhok Pathan, Tatrot, Pinjore and lower and upper Boulder conglomerate formation (BCF) (Randell et.al. 1989; Chauhan, 2003; Kumarvel et.al., 2005). The Lower Siwalik formation comprises an upward-coarsening mud rock succession of Miocene age. The Middle Siwalik formation (> 1600 m) is mainly composed of sandstones of Upper Miocene/Early Pliocene ages (Khan and Tewari, 2011; Kumar et al., 2003). Upper Siwalik formation consists of conglomerates, sandstones and mud rocks (Kumar et al., 2003), 2300 m thick (Karunakaran and Rao, 1976), of Pliocene to Lower Quaternary age (Delcaillau et al., 2006; Rao, 1993).

The Siwalik deposits are one of the important fluvial sequences in the world and comprised of mudstones, sandstones and coarsely bedded conglomerates laid down between approximately 18.5 Ma – 0.22 Ma (Valdiya, 2001). The sediments were deposited by rivers flowing southwards from the Greater Himalays, resulting in extensive multi – ordered drainage systems. Following their deposition, the sediments were uplifted through intense tectonic regimes between approximately 5.5 Ma – approximately 1.6 Ma (Valdiya, 2001) and subsequently resulting in a unique topographical entity – the Siwalik Hills. Establishing the timing, duration and frequency of this upliftment history has great implications on our understanding of hominid land use patterns and relative site chronologies (Chauhan and Gill, 2002). Often, Paleolithic sites that are located on Siwalik slopes are situated (in surface contexts) on or above hill sediments belonging to all formations. Ongoing erosion and techtonic activity has greatly affected the topography of the Siwaliks. The present day morphology of Siwalik is comprised of hogback ridges, consequent, subsequent, obsequent and resequent valleys of various orders, gullies, choes, earth – pillers, rilled earth buttresses of conglomerate formations, semi circular choe- divides, talus cones, colluvial cones, water gaps and choe terraces (Mukherji, 1976) and the associated badlands features include the lack of vegetation, steep slopes, high drainage density, shallow to non – existent regoliths and rapid erosion rates (Howard, 1994). The duns and flat-bottomed longitudinal structural valleys with their own drainage systems are intermittently located between the Siwaliks and the Lesser Himalayas (exclusively in India and Nepal) (Nakata, 1972). Asian monsoon plays a significant role for the geomorphology of the region. Siwalik Hills of India is a region where Asian monsoons were active since several million years. Highly seasonal rainfall leads to the mean annual precipitation rate to range between 1 m/yr to3 m/yr in the Siwalik Hills (Bookhagen and Burbank, 2010; Burbank et al., 2003). An average 50% of total rain in the Siwaliks ends in run-off (Singh, 2002) and seasonal stream occurred. The significant erosion occurring in the Siwalik is due to (i) uplift, (ii) significant rainfall during the monsoon, (iii) poor mechanical resistance to erosion. Upper Siwalik formation is more erodible than middle and lower Siwalik formations (Barnes et al., 2011). All known Paleolithic sites in the Siwalik Hills are found in varying geographical and geomorphic contexts (Fig. 2).

Earlier Studies – A Review

Quaternary investigations have been conducted for over nearly century now in the region of sub-Himalaya. The first evidence of the presence of early man in the western sub-Himalaya was recorded by Wadia (1928). Although these were the form of sporadic discoveries of occasional stone tools, they, viewed with the Quaternary glaciological studies in the Himalaya carried out by Dianelli (1922). The first truly comprehensive Quaternary study of the Himalaya and the adjoining foot-hills and plateau in association with artifactual evidence was carried out by De Terra and Patterson together with Teilhard de Chardin, a noted French paleontologist in the Jammu and Kashmir and Soan valley under the aegis of Yale-Cambridge expedition of 1935(De Terra et al., 1936; De Terra and Paterson, 1939). Their aims involved integrating the regional geology, chronology, and the associated palaeolithic material. Their efforts resulted in the location of a multitude of palaeolithic sites of varying ages and traditions, including the discovery of the Soanian tradition (named after the Soan River). This work is remarkable both in its interdisciplinary collaborative aspects as well as in the substantial results, there have become a standard work of reference against which all subsequent per-historic researches in the subcontinent have become measured. Even De Terra himself used this study as a standard reference for elaborating his observations regarding the lithic culture complex in the valleys of the Narmada and the Kortalayar (South India) during the course of the same expedition. In the Soan valley, Soanian artifacts occur in mixed surface contexts with Acheulian artifacts, as well as independently (De Terra and Paterson, 1939). Paterson divided the technological differences with the Soanian being based on flakes, and the Acheulian (then called the "Stellenbosch") predominantly consisting of handaxes (Rendell et al. 1989). His conclusions were based on his experience with the Clactonian tradition (a core-and-flake industry) of Britain, and the European palaeolithic research paradigms prevalent at the time. Due to the lack of stratified sites, the team chronologically grouped the artifacts based on their condition and the Soan terrace sequence. They also put forward the idea that the Acheulian was a younger cultural 'intrusion' into the Soanian-dominated region (De Terraand Paterson, 1939). However, in the ensuing decades their methodology and results were felt, by both geologists and archaeologists, to be erroneous and inapplicable in South Asia (Gill, 1951; Ray and Ghosh, 1981).This British-American team was also responsible for assigning cultural labels to some of these lithic assemblages as 'Soan' or 'Soanian' (Hawkes et al., 1934; Movius, 1948) and 'Soan Flake Tradition', and broadly placed their origin in the middle Pleistocene (Dennell and Hurcombe, 1993). Paterson's observations on the terrace sequences and associated surface assemblages in the Soan valley of Pakistan, led him to believe that several technological existed within the Soanian (Paterson and Drummond, 1962) and were thought to be a result of glacial and inter-glacial period. Much later, a detailed analysis of the lithic evidences obtained by this expedition from the Soan valley was brought out by T.T.Paterson and H.J.H. Drummond (1962). During 1954 the Indian National Council led an expedition to Karakoram. Under the aegis of this expedition Graziosi (1964) discovered and analyzed quite number of lithic artifacts and sites in north-western Punjab (Pakistan), which is another milestone in the research on early man in the western sub-Himalayan region and adjoining areas. The first serious attempt at the revision of De Terraand Paterson's work was initiated by the British Archaeological Mission to Pakistan (BAMP) in the late 1970s. Through a project spanning over two decades, the BAMP team established that the Soan river 'terraces' were actually erosional features rather than classic river terraces (Rendell et al., 1989). Therefore, Paterson's chronology assigned to the palaeolithic material (based on the 'terrace' sequence) could no longer be held as valid. The BAMP team also succeeded in locating and dating sites ranging from the Lower to the Upper Palaeolithic, including two Acheulian sites of Potwar area of Pakistan such as Dina and Jalalpur (Rendell and Dennell, 1987; Rendell et al., 1989). At Dina, a handaxe was found within and underlying a quartzite conglomerate, and at Jalalpur fourteen artifacts, including two handaxes, were recovered from a gritstone/conglomerate lens (Rendell and Dennell, 1985). The investigators correlated the artifact-bearing horizons with deposits that were previously dated to 700 to 400 kya through palaeomagnetism (Allchin, 1995). The age of these Acheulian occurrences broadly correlates with several early Acheulian sites further south in peninsular India. Interestingly, the investigators did not encounter Soanian artifacts as per De Terraand Paterson's description (Paterson and Drummond, 1962), and as such do not regard it as an independent lithic tradition (Dennell and Hurcombe, 1989). Following De Terraand Paterson's work, a number of lithic localities have been brought out to light in the Indian part of the sub-Himalaya after the partition of India in 1947. The first in this direction is the investigation carried out by Prufer (1956), who discovered a number of Stone Age sites in the valley of Sirsa within Pinjore- Nalagarh dun while searching for extension of the Harappan civilization in the Sutlej valley. Sen (1955) published a detailed account of his observations in the field regarding Prufer's sites and analyzed the lithic artifacts from this area, namely around Nalagarh. Although Sen equated the Nalagarh lithic industry with the early Soan of West Pakistan, Mohapatra(1966, 1974a, 1976) has argued in favor of Soan because of its developed characteristics both chronologically and typo-technologically. Sharma (IAR 1954-55) of the Archaeological Survey of India (ASI) picked up a few pebble tools from Daulatput area which incidentally happen to be the first conclusive proof of the presence of early man in the Soan dun towards Beas River. Almost simultaneously, Lal of the same organization led an expedition and explored valleys of the Beas and the Banganga in the Kangra valley of Himachal Pradesh. In his report Lal (1956) studied the terraces of the Banganga around Guler and tried to fix the horizons of the implement bearing deposits. Besides he also noticed the occurrence of paleoliths in Kangra, Dehra and Dhaliara situated upstream, to the north and west Guler. Others who have since then worked in this area including Khatri (1960), Krishnaswami (IAR, 1964), Archaeological Survey of India (IAR 1965-66; 1968-69; 1969-70), Mohapatra(1966; 1974a; 1976), Mohapatra and Saroj (1968), Joshi (1970), Sankalia (1971), Joshi et.al (1974) etc have made some important contribution towards the Paleolithic research in Indian Siwalik Hill region. Saroj (1974) had investigated the Jammu region between the Chenab and the Ravi which is in fact an extension of De Terraand Paterson's work in Potwar in the west and Lal's and Mahapatra's work in Kangra in the east. He discovered sixteen sites and designated various lithic industries as Jammu A, B, C and D which correspond to all the Soanian industries. In addition, he also recorded the find of some Neoliths from this area (Saroj, 1974). Joshi et al (1975) noted sub-triangular point on quartzite flake along with small choppers on pebbles from the Saketi area of Markanda valley of Himachal Pradesh. Joshi et al. (1978) have recommended evolution of the Paleolithic industries and their stratigraphy independently without tagging them with the successions as worked out by De Terraand Paterson (1939) in the Soan valley. The primary insitu position of the paleoliths recovered from Kangra valley terraces is yet uncertain, although large collections have been made during an excavation conducted on the third terrace of the Beas at Dehra Gopipur (Mohapatra, 1966). However the collections of the paleoliths made by different scholars at different times and places in the Beas- Banganga basin show choppers at the most dominant tool type, in which the unifacials occur in great strength than the bifaces. The presence of unifacial choppers in large number rather unique in the sub-Himalaya because in the Acheulean industries of India the choppers generally accompanying handaxes and cleavers are usually bifacialy worked. In view of the fact that most of the collections made at Guler on the Banganga chopper group should be distinguished as a separate entity and distinguished as Guler industry. Mohapatra(1974a), in a critical survey of the entire mass of prehistoric cultural evidences from Himachal Pradesh, distinguishes Nalagarh industry from that of the Beas- Banganga valley primarily on the basis of many advanced features inclined to consider Beas- Banganga and Sirsa Valley namely the Soan or the pebble –tool culture of the Indian early Stone Age. The Sirsa valley industry according to him is a developed manifestation of the Beas-Banganga industry which undoubtedly is earlier in age. Therefore he equates the Kangra valley industry with the early Soan and that of the Pinjore- Nalagarh dun with the late Soan. The lithic complex of the Chikni valley, adjacent to the Pinjore- Nalagarh dun, is exactly similar to that of the Sirsa valley and in view of their contiguity Mohapatra and Singh (1979) considered the former as part and parcel of the later. Sharma (1977) reported Acheulean bifaces from upper Siwalik deposits near Chandigarh however Mohapatra(1981) later challenged the stratigraphical position of the artifacts. Although Joshi (1967-68) also reported Acheulean artifacts in the adjacent Kangra region in Himachal Pradesh, these were later classified as being non-Acheulean in morphology from a re-analysis by Joshi himself (Karir, 1985). During 1981 Khanna recovered few stone implements from Saketi area of Himachal Pradesh. Though it was a sporadic finding but this study had given impetus to researchers to find out more sites in this area. During the mid of 1970, the first Acheulean site (Atbarapur) in Indian Siwalik has been discovered by Mohapatra (Mohapatra, 1981, 1990; Mohapatra and Singh, 1979). It is one of the important Acheulean sites in Siwalik zone (Indian) from where the largest collections of Acheulean artifacts have been reported (see Fig. 3). The artifacts from Atbarapur provide important information regarding the technological behavior of the Acheulean people of the Punjab plain. In the Ghumarwin area of Bilaspur district of Himachal Pradesh the Soanian occurrences were for the first time reported by Sankhyan (Sankhyan, 1983, 2017). During his study he has reported a number of choppers, scrapers along with flake tools. Chauhan (2007) reported a new Soanian locality Toka from Sirmaur district of Himachal

Pradesh and the study signifies the typological diversity within the Soanian industry and its technological organization is known to be more complex than previous thought (see Fig. 4). When compared with other Soanian sites in the Siwalik region in general, Toka maintains more differences than similarities. For example, it is the richest known paleolithic site to date from a geographical perspective; Toka is more comparable to the sites on Siwalik frontal slopes in association with post Siwalik streams and terraces than elsewhere in the region. Since 2009, a group of archaeologists under 'Indo-French Prehistoric Mission' has surveyed the Siwalik frontal range near Chandigarh and highlighted a dozen of Stone Age localities on the outcrops where artifacts in quartzite occur with fossil bones, in which a few show butchering marks (Gaillard et al., 2016). Bain (2018) has reported some Soanian and Acheulean remains from the site Bam in Ghumarwin region of Bilaspur, Himachal Pradesh. The unique diversity of the Bam assemblage throws light on the various kinds of specialized occupations adopted by prehistoric man in the Siwalik Frontal range (See Fig. 5). In Nepal Paleolithic researches at Siwalik Hills conducted by some researches during the later part of 20th century. The earliest stratified evidence from Siwalik in the Nepal essentially comes from two sites in the Dang-Deokhuri (dun) valleys. The sites such as Gadari and Satpati yielded handaxes through erosion, indicating occupation on the banks of the ancient Babai River. These sites mark the north-easternmost extension of the Acheulian in the Indian subcontinent and are the first reports of the industry in this part of the sub-Himalayas (Corvinus, 1990). The Gadari handaxes were recovered from the basal gravels of the alluvium and thus, belong to the oldest period of the dun. The artifacts are made on quartzite cobbles or large flakes by primary flaking and step flaking. One is a small oval handaxe, with a jagged bifacial edge. Another specimen is a larger handaxe (manufactured on a flake) with a much straighter edge. An oval unfinished handaxe, a pick, a large cleaver, and a number of large cores and flakes were also recovered. The Satpati site was discovered in the early 1990s and is situated at the foot of the Siwalik Hills, west of the Narayani River where it merges with the Terai Plains. The site (consisting of 18 artifacts) is in the folded alluvial sandstones and gravels of the Gangetic alluvium, which were a part of the tectonic activities of the last phase of the Himalayan uplift, later becoming exposed by the folding of the geological beds (Corvinus, 1995). Although the assemblages at both sites are small, they reflect the diversity of tool-types utilised during the Lower Palaeolithic in the region. Corvinus states that the handaxes are made in the Indian Acheulian tradition, thus suggesting technological influence from India (Corvinus, 1996). As in Pakistan, the fact that only two Acheulian sites were encountered in over ten years of exploration signifies a marginal Acheulian presence in the region, when compared with the other Lower Palaeolithic industries of diverse typological resolution in Nepal. With the exception of De Terraand Paterson's finds in the early 1930s, all other Siwalik Acheulian sites from Pakistan, India, and Nepal were reported only within the last twenty-five years.

The close reviews of existing studies at Siwalik Hill region unfold few trends of researches. The researches during early phase of 20th century were mainly geological in nature and the findings of lithic remains during the field study were associated only. Such researches pertaining to the geological and environmental events revealed intimate relationship between the sub-Himalaya and the Himalayan regions. No focus was there to in-depth study of the archaeological artifacts. During this time most of the studies were focused on paleoclimates and depends on the characteristics of the lithological units and the associated faunal remains. During the time of Yale – Cambridge expedition launched by De Terraand Paterson, their primary goal was to seek evidence from Pleistocene glaciation phases in the sub-Himalayan region and to highlight its impact on early human cultures both in concordance with the European model. For the work, methodology and interpretative frameworks that were prominent in Europe (four – fold Alpine glacial sequence) were applied in Indian context (especially the glacial climatic cycles). This glacial –interglacial model became a standard for the subsequent prehistoric and Pleistocene research in Indian subcontinent and prevailed for more or less four decades, until revised by different workers. During the later part of 20th century there were some new research methodologies and theoretical applications in the earth sciences and archaeology were introduced and due to this impact Paleolithic research in this area have been strongly marked by multidisciplinary collaborations and new techniques were adopted for field study. Plate tectonic concept and to some extent, site formation process played an important role during this time. Specialized branches of earth science like- geomorphology, sedimentology etc. have been attached with archaeological researches in the Siwalik Hill region which make has made the research more interdisciplinary and holistic. A greater emphasis has been placed on laboratory procedures of Quaternary sediments. During this phase most works done by Indian and foreign scholars in prehistoric archaeology, paleoanthropology, paleoenvironment and geoarchaeological studies.

Paleolithic remains from Siwalik Hills

In the Siwalik region, paleolithic sites are situated within a range of eco-geographic contexts and have been traditionally divided into two types – Acheulean and Soanian and are found in the form of site complex, find spots and numerous surface scatters (De Terraand Paterson, 1939; Stiles, 1978; Mohapatra, 1981; Chauhan, 2007, 2008a). The Siwalik paleolithic, in general, points to multiple phase of occupation since the early Pleistocene and lastly intermittently up to the upper Pleistocene (Chauhan, 2007). In contrast to the BCF (Boulder- Conglomerate Formation) period, there is abundant stratigraphic evidence accentuating the post- Boulder conglomerate (or post- Siwalik) geological context for most paleolithic sites in the Siwalik region and traditionally attributed to Soanian. The Soanian has been considered the Indian representative of the "Chopper Chopping" tool tradition, found in NW Indian subcontinent and contemporary with the Acheulian found in Peninsular India. It is based on fieldwork done in the 1930's by De Terraand Paterson along with some observations of Teillard de Chardin and is named after the Soan River in Pakistan. At the time when the concepts of the Soanian (De Terraand Paterson 1939) and the Movius line (Movius, 1944) were formulated no absolute dating methods were available and global correlations were made on the basis of correlation to "Ice Ages" of global extent. De Terraand Paterson divided the Soanian lithic remains into different stages such as Pre Soan, Early Soan (A, B and C), Late Soan (A and B) and Pindi Gheb & Dhok Pathan industries. During the 1980's Allchin and then Dennell and Rendell's re-investigation in the Soan area of Pakistan led to them totally rejecting the validity of Soanian as an archaeological entity (Dennell and Rendell, 1991). Detailed analyses of the Soanian lithic remains reported from various sites of Siwalik Hills have revealed few processing sequences which were associated during tool manufacture. The production of flakes from the cores is probably less commonly performed as the residual cores are rare. The another processing sequence consists of splitting cobbles along their grand plane of fracturing them obliquely; this provides blanks having rather shape edges that can be used as such or sharper into choppers. Sometimes, intentional fractures have been displayed on few tools. One of the major processes within the lithic reduction sequence is that of shaping cobble tools, either on whole cobble or on primarily split or fractured cobbles, which seems to have produced a good number of flakes. Besides the various types of choppers, there are some more elaborate and standardized specimens, rectangular in shape with a preferential transversal edge; they are made on split cobbles or large flakes. These similar type of tools are known further northwest in the Siwalik frontal Range (Gaillard et al, 2010a, 2011, 2012), in the context of Soanian sites, where they are provisionally called 'Square tools' and are comparable to the Hoabinhian tool types known in south-west Asia (Colani, 1927, 1929). The Soanian choppers shaped by only one flake removal represent one of the major features of the lithic assemblage from Siwalik. They are usually made on whole cobble, fractured cobbles on flakes and the shaping (if any) extends on the non-cortical face, which is usual for all the choppers. Soanian cores and core tools were dimensionally and morphologically constrained by the overall shape of the blanks (fluvially worn clasts); a trait also noted in certain Mode 1 techno- complex such as the Oldowan (Porr, 2000). But considering all these, our present understanding of the timing of Soanian industry's origin remains equivocal and this assemblage is currently known to have been most abundant during the late Middle Pleistocene to Upper Pleistocene times (Mishra, 1994; Misra, 2001; Chauhan, 2003). Despite some geographic and morphological similarities, the Soanian is not comparable to older Mode 1 assemblages as reported from North Pakistan (Randell and Dennell, 1985; Hurcombe, 2004). Likewise the Soanian is also not comparable to the relatively older non-biface assemblage from China (Yi and Clark, 1983; Yingsan, 1994; Hou et al, 2000). Since the Yale Cambridge expedition, a fierce controversy regarding the presence of the Acheulean in the sub-Himalayan tract, considered as Soan cultural area, continued till the Siwalik frontal range there is a place name Atbarapur in the Hoshiarpur district of Punjab was found to have a cluster of Surface scatter to the Acheulean implements (Mohapatra, 1981). Subsequently some more places yielded similar artifacts in identical context (Mohapatra& Singh, 1979a, 1979b). The Acheulean in the Siwalik is much less common than Soanian and is usually represented by small numbers of cleavers and handaxes (De Terra& Paterson, 1939; Mohapatra & Singh, 1979; Mohapatra, 1981; Rendell & Dennell, 1985; Chauhan, 2003). The Acheulean artifacts of Siwalik Hills are informative regarding the technological behavior of the Acheulean hominins having made and use them. The artifacts comprise of large flakes on the one hand and core and choppers on the other hand both having more or less same size. Apart from the cores and half of the choppers, a good percentage of Acheulean assemblage trimmed into cleavers, scrapers and few handaxes. The average length of those artifacts varies from region to region (see Table 3). In this region the availability of cobbles and boulders for the Acheulian people to make their tools implies that they were occupying the region in the later stages of the Pinjor deposition, as conglomeratic layers were becoming more frequent, especially around 1 Ma, due to active uplift in the Himalayas (Nanda, 2002).

The production of large flake seems to be an important character of Acheulean technological tradition or Mode 2, throughout the world. Such large flake scars may be obtained from various types of raw material, occurring in different ways. It must be quartzite quarried from the outcrops, close to the site, as in the shelter IIIF-23 at Bhimbetka (Misra, 1985) or silicified limestone quarried at the site itself, as in Isampur (Paddayya et al., 1997, 1998, 2006); it may be basalt flaked from boulder sized nodules, as in Morgaon (Mishra, et al., 2000) or in the Narmada valley or also in Attirampakkam (Pappu, 2001; Pappu & Akhilesh, 2006). The Acheulean in the Indian Siwalik Hills are located between the Beas and Ghaggar Rivers and a few sites in the Sutlej River terraces imply an age between 1 and 0.6 Ma (Gaillard and Singh, 2014). In the Siwaliks of north-western India, the Acheulean technological tradition is characterized by predominance of cleavers and handaxes. The Siwalik Acheulean is dispersed in varying geographical and ecological settings, demonstrating a highly varied settlement pattern and temporal record (Chauhan, 2003). Acheulean occurrences in Siwaliks although comparatively low in number, tend to be discovered from older geological scenarios than the Soanian. This understanding is broadly sustained by such evidence as young OSL dates (Suresh et al., 2002) for specific Soanian assemblages, geomorphic and landform contexts, raw material availability and artifact densities. Movius (1944, 1948) considered the presence of Acheulean artifacts insignificant in the Siwalik and emphasized the Soanian cobble tools in his theory of two cultural zones during the Lower Paleolithic in the old world, leading the concept of “ Movius Line”. This concept is still being debated (Keates, 2002; Cornivus, 2004), although in Eastern Asia there are now strong arguments against it with the presence of handaxes or cleavers in South China (Huang, 1989; Hou et al., 2000), in Korea (Norton et al., 2006); in Sumatra (Forestier et al., 2005) and in Java (Von Koeningswald, 1936; Lumley et al., 1993; Semah et al., 2003). In the Siwaliks also, the large number of Acheulean finds suggest that the Acheulean sites pre-date the Soanian though the concept of separate Lower Paleolithic traditions into doubt; given the only evidence of Soanian sites (Lal, 1956; Mohapatra, 1966; Pruffer, 1956; Sen, 1955). According to Mohapatra(1981, 1990), the Acheulean sites cannot be older than the Upper Pleistocene, since the Siwalik slopes were not tectonically stable prior to that time. However, recent workers such as Kumar et al. (2001) and Powers et al. (1998) have successfully demonstrated the certain Siwalik frontal slopes were uplifted during Late Upper Pleistocene and Holocene. Owing the shared geomorphological surface contexts of the Acheulean and Soanian sites in the Siwalik region, both lithic traditions have been perceived to be contemporaneously being previous workers (Mohapatra, 1990). Consequently, their techno- cultural relationship has been in contention due to their mutual association, and the issue remains unsolved (Misra & Mate, 1995). According to Gaillard and Misra (2001), Soanian Paleolithic evidence of Siwalik region should be viewed as being post Siwalik or post Boulder Conglomerate formation in relative age or younger than 600ka. Recent assessments of the South Asian Paleolithic record have suggested that most Soanian assemblages are younger than Acheulean evidence in Siwalik region.

Current issues in Stone Age research at Siwalik Hills

There are some of the current issues for archaeological researches in Siwalik Hills. These are as follows –

1. A good 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 Siwalik Hills. Therefore, there is a significant paucity in paleoecological and associated faunal data from the Siwaliks 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.

2. The major problem of the Siwalik is the lack of early Pleistocene evidence. Sediments of the Siwalik Hills are mainly based on washing away deposits. The early Pleistocene sediments are being washed away or deeply buried in this area.

3. It is not clear which factors were responsible for episodes of technological change and exactly when these behavioral transitions took place in the Siwalik Hills. Therefore, it is also unknown whether these changes represent technological influences of Pleistocene hominin.

4. While numerous paleolithic sites have been dated through absolute geochronological techniques, a systematic chronological control on Soanian as well as Acheulean assemblages is still lacking.

5. 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 in Siwalik Hills.

6. One of the most significant deficiencies in Siwalik Hills paleoanthropology is the virtual lack of hominin fossils.

7. There is also insufficient evidence of Acheulean hominin occupation in Siwalik Hills, prior to the Matuyama/Brunhes magnetic polarity transition.

8. Despite several attempts at interpreting the Acheulian-Soanian relationship(s), this techno-morphological dichotomy is still not well understood.

9. Very little is known about the technological transitions in the lithic industries in this region. It is not clear exactly which (ecological) factors were responsible for changes in technology and when these changes took place.

10. An additional challenging issue is a coherent typological framework for the chronological diversity of stone tools in this area.

This ongoing problem is not only restricted to the Soanian tradition and most lithic assemblages in South Asia, but transcends to Old World prehistory in general.

11. 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.

12. In the Paleolithic archaeology, where the material remains of early human behavior is often represented in insufficient quantities, geological method often play a major role in understanding the history of a site especially if it is situated in an area where high rates of erosion and intense upliftment episodes exist. Siwalik Hill region is one of the best examples for this type of geological episodes. So from that point of view there needs to study the Paleolithic sites of the Siwalik Hills through site formation processes to understand the paleoenvironmental parameters and associated human behavioral patterns within the site.

Discussion

From the studies so far conducted in this region it is well accepted that the cognitive level of the Siwalik Hominids is reflected in numerous technological and typological features of the lithic assemblages. These features are in the form of prepared cores, large flakes, diverse range of bifaces, choppers, discoids, flakes as well as sequential and step – flaking pattern and varying degree of retouch. The abundance of the Paleolithic artifacts within a broad temporal scale in the Siwalik indicates that the region was ecologically favorable for Pleistocene hominid groups for a considerable length of time. These hominid groups settled in multiform geographical settings such as on Siwalik slopes, large river terraces, small stream terraces and in intermontane dun valleys. In this region the Soanian lithic tradition continues to owe its recognition simply made exclusively on river – laid rounded quartzite conglomerates. The dominant rocky materials of Siwalik Hills such as quartzite pebbles and cobbles are rounded in nature because of fluvial activity of this region. It can be mentioned that the Soanian industry appears to be a direct result of hominid adaptation to a unique ecozone, where rolled quartzite clasts were the only available raw material. It is evident that early Pleistocene archaeological materials of the Siwalik Hills have been reported from Pakistan in better context but in India most of the archaeological evidences have been reported from post-Siwalik deposits. It may be said that evidence of human occupation is there after the development of Siwalik Hills. However it is important to note that all such assemblages or Paleolithic materials in the Siwalik region may not be easily attributed to the Soanian, as done by earlier researchers. In other words there may be other lithic techno industries (which may or may not be contemporary with the Soanian) not yet documented or not archaeologically visible. It is true that Acheulean bifaces occur in a lower density than Soanian artifacts in the Siwaliks. This may primarily be due to the increasing availability of quartzite pebbles and cobbles of restricted sizes and scarcity of large boulders. Soanian artifacts were most certainly, manufactured when the raw material was in abundance. According to Chauhan (2003), Acheulean bifaces were most probably made in or transported into and abandoned in the Siwalik region where large quartzite clasts were generally absent or available in minimal quantities. From the neo-tectonic history of the Siwalik region, it can be said that quartzite clasts in rounded form only became available (where BCF was not generally present) during the late Middle Pleistocene and onwards. Therefore Soanian sites cannot be older than initial availability of the associated raw material, notably when considering the large density of artifacts at such sites. Siwalik Acheulean's technological and temporal attributes can be conjectural at this stage and more intensive investigations are needed to support or challenge it. Without the recovery of primary stratified sites, larger numbers of artifacts, suitable material for absolute dating and associated hominid fossils, our knowledge pertaining to hominid ecological adaptations, behavioral and technical changes in the Siwaliks will continue to be fragmentary. The archaeological record of the Siwalik does not offer a unilinear model of cultural evolution (Yi and Clark, 1983) during the prehistoric occupation in this region. Rather the evidence points to multiple phases of occupation since the lower Pleistocene and lasting intermittently up to the upper Pleistocene. The record of technological and cultural discontinuity and the conspicuous absence of typical middle Paleolithic and younger lithic assemblages is noteworthy. The geological context of the associated artifacts at nearly all these occurrences is invariably of secondary surface type. The Siwalik lithofacies, combined with slope gradients of the Siwalik Hills, has prevented consistent sedimentary accumulation during the hominid occupation. As a result, Paleolithic sites located on the Siwalik slopes have seldom been buried or preserved. Moreover numerous post-depositional formation processes have disturbed most known Paleolithic sites to varying degrees. For this, primary and stratified sites need to be recorded, excavated and dated on a longitudinal scale. It is important to mention that talking into perspective, the agents involved in preserving, altering and destroying a landform; archaeologists need to apply great caution when hypothesizing about hominid behavior from the Paleolithic sites in this part of South Asia. There is also an observation on the continuous application of the traditional terms to designate the lithic industries. It will be wise to omit those terminologies because till date we don't have any consistent stratigraphical evidence and associated chronometric dates of the lithic industries in Siwaliks (mainly Soanian). From the Siwalik Hills till now we don't have any lithic artifacts of upper Paleolithic phase and onward cultural stages probably because of raw material constrain. Due to lack of large clasts also we have limited numbers of Acheulean remains. The absence of exclusive flake assemblages like upper Paleolithic and Mesolithic in the Siwalik Hills in general, may be in part explained through site formation processes rather than a single settlement pattern or cultural phenomenon. There need to hypothesize the typology and classification of Siwalik lithic remains from behavioral change, environmental adaptation, and technological advancement point of view within a given period of time. Most of the studies so far conducted in the Siwalik region, are associated greatly with terrace sequences but now there is an urgent need to rethink those with fresh data along with new methodological framework. Paleolithic investigations should focus on reinvestigating the known sites through meticulous and long-term excavations, involving specialists in different disciplines rather than simply reporting new localities. In this region the tremendous research scope lies in studying various aspects such as general settlement patterns of the hominids, site and artifact densities, raw material exploitation, site taphonomy and so on until primary sites or in-situ artifacts are consistently recovered and excavated. 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 Paleolithic data along with fossil fauna and flora datasets and associated ecological variables in Siwalik Hills can result in a crucial and comprehensive source or reference for comparisons with other Paleolithic and faunal assemblages in the Old World. At last we can say though the dominance of the secondary surface sites in the Siwalik region limits our understanding of such aspects as site function, absolute chronology, typo-technological orientation through times and different issues related with it, they form an integral part of the story of Prehistoric colonization and mobility in the South Asia.

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Table -1: Chrono-stratigraphical division of Siwalik sediments (Chauhan, 2003)

SUB-GROUP	**FORMAION**	**Corvinus & Raimal, 2001 (Ma ago)**	**Prasad, 2001 (Ma ago)**
Upper Siwalik	Upper Boulder Conglomerate	5.9 - ?	0.9 – 0.2
	Lower Boulder Conglomerate		
	Pinjore		2.4 – 0.9
	Tatrot		5.1 – 2.4
Middle Siwalik	Dhok Pathan	7.9 – 5.2	10.8 – 5.1
	Nagri	10.1 – 7.9	
	Chinji	13.1 – 10.1	
Lower Siwalik	Kamlial	-	18.3 – 10.8

Table-2: Reported Soanian sites in Siwalik Hills of India, Pakistan and Nepal

SL. NO.	SITE/AREA	STATE/REGION	ARTIFACT TYPES	RAW MATERIAL	REFERENCE
1	Western Sub Himalaya	Kashmir, India	Flake, Split Pebbles, Chopper	Quartzite	Wadia, 1928
2	Potwar	Pakistan	Flake, Chopper, Utilized Flake, Scraper	Quartzite	De Terraand Paterson, 1939
3	Chauntra	Pakistan	Flake, Various types of core, Chopper, Sharp flake, Flake of Various types, Scraping tools	Quartzite	De Terra& Paterson, 1939
4	Ghariala				
5	Balawal				
6	MS 163				
7	Chak Sighll				
8	Rawalpindi				
9	Chakri, Section 16				
10	Adiala				
11	Khushalgarh	Pakistan	Pebble chopping tool and scrapping tool, Massive flake with retouch, Hand axe, Flake tool (Clactonian like)	Quartzite	De Terra& Paterson, 1939
12	Markhad				
13	Injra				
14	Dher	Sirsa Valley, Himachal Pradesh, India	Core, Various types of flake, Choppers, Scrapers, small retouched flakes	Quartzite	IAR, 1954-55
15	Majra				
16	Dhang				
17	Dadhi				
18	Merhanwala				
18	Daulatpur	Punjab	Different types of core, Various types of Flake, Chopper, Scraper	Quartzite	IAR, 1954-55
19	Nalagarh	Himachal Pradesh, India	Chopper, Scraper, Point, Borer, Core, Knife	Quartzite	Sen, 1955
20	Dhang				
21	Dabhur				
22	Churru				
23	Dangoh				
24	Pirthan	Himachal Pradesh, India	Unifacial Chopper, Flake, Utilized flake, Core	Quartzite	IAR, 1955-56
25	Khokra-Ka-Choa				
26	Rampur				
26	Panjasaran	Beas and Banganga Valley, Himachal Pradesh, India	Flaked pebble tools, Unifacial choppers, bifacial chopping tools	Quartzite	Lal, 1956

27	Dhaliara				
28	Dhawala				
29	Guler				
30	Haripur				
31	Jammal				
32	Kotla				
33	Rampur	Himachal Pradesh, India	Chopper and Chopping tool	Quartzite	Prufer, 1956
34	Rampura		Chopping tool		
35	Manakpura		Chopper, Chopping tool, Discoid, Core of different types		
36	Chohlowal		Pebble chopper, Different types of flake, core		
37	Kiratpur		Chopper, Chopping tool, Flake, Core, Scraping tool		
38	Khokra-Ka-Choa I &II	Punjab	Chopper and Chopping tool	Quartzite	Prufer, 1956
39	Harraipur		Chopper, Flake		
40	Bhud		Chopper, Different types of flake, Split pebble and cobble		
41	Malpur – da – Choa		Chopping tool		
42	Mehrarwala I & II		Chopper, Chopping tool, Discoid core, Blade like flake		
43	Bilaspur	Himachal Pradesh, India	Core, Various flakes of different size, Chopper, Scraper	Quartzite	IAR, 1958-59
44	Jalalpur	Pakistan	Cobble tool, Flake tool	Quartzite	Marks,1961
45	Soan Valley	Pakistan	Flake, Chopper, Scraper, Utilized core, Waste flakes	Quartzite	Patterson & Drummond, 1962
46	Morgah	Pakistan	Handaxe, Cleaver	Quartzite	Graziosi, 1964
47	Dera Kharauni	Punjab, India	Chopper, Flake, Different types of scraper, Various types of core	Quartzite	Mahapatra, 1966

48	Manasha Devi				
49	Tera Sujanpur				
50	Alampur				
51	Nadan				
52	Dehra – Gopipur				
53	Sunnet				
54	Phera				
55	Chamba Ghat				
56	Bari				
57	Matela				
58	Baughta				
59	Sirsa				
60	Talwara				
61	Dadasiba				
62	Baroli				
63	Saketi	Himachal Pradesh, India	Pebble Flake, Chopper, Scraper	Quartzite	IAR, 1973-74
64	Dagah	Jammu, India	Large flake, Chopper, Medium and small flake, Retouched flake, Core, Scraper	Quartzite, Chert, Flint, Cherty Flint, Siliceous quartzite	Saroj, 1974
65	Ambran				
66	Nagrota				
67	Gudapatan-Ranjan				
68	Thalori				
69	Bariy an				
70	Drui				
71	Kuta				
72	Khatriyan-dic Hhan				
73	Dy alachak-Banuchak				
74	Dali-Salan				
75	Rajbagh				
76	Kurro				
77	Mah				
78	Jagatpur				
79	Mujahad	Pakistan	Scraper of various size, Core, Scraper, Large size flake	Quartzite, Quartz	Stiles, 1975
80	Markanda Valley	Himachal Pradesh, India	Chopper, Flake, Scrapers	Quartzite	Joshi et al, 1975
81	Guler	Himachal Pradesh, India	Chopper of different types, Flake, Core	Quartzite	Joshi et al, 1978
82	Haritalayangar	Himachal Pradesh, India	Bifacial Chopper, Unifacial Chopper, Chipped Pebbles, Flake, Core	Quartzite	Sankhyan, 1983

83	Baron				
84	Bhapral				
85	Kashol				
86	Tarauntola				
87	Lehri Sarail				
88	Katmandu Valley	Nepal	Various types of flake, Different types of core, Core scraper, Chopper	Quartzite	Corvinus, 1985
89	Chitwan Area				
90	Gidhniya				
91	Basantapur west				
92	Pandhanpur				
93	Khoiwala	Haryana, India	Chopper, Chopping Tool, Scraper, Cores of various type, Denticulates, Flake of different types, Point	Quartzite of different shades	Karir, 1985
94	Marhanwala				
95	Baddi				
96	Sandholi				
97	Bhud				
98	Dhang				
99	Riwat locality	Pakistan	Flake tool	Quartzite	Dennell et al, 1988
100	Uttarbaini	Jammu & Kashmir	Bifacial Chopper, Scraper, Core, Light duty flake tool	Quartzite	Bharma, 1989
101	Occurrence 360	Pabbi Hills, Pakistan	Different types of core, Flake of different types and size, Hammerstone, Different types of scraper, Split pebble and cobble, Discoid, Proto biface,	Quartzite	Dennell & Hurcombe,2004
102	218 Area				
103	Locality 387				
104	Locality 722				
105	Locality 625				
106	Locality 269				
107	Locality 730				
108	Nadah	Himachal Pradesh, India	Various types of Flake, Different types of core, Core fragment, Chopper, Hammerstone,	Quartzite	Chauhan, 2006
109	Masumpura				
110	Ganoli				
111	Bhud				
112	Bhud – ii				
113	Bhud – iii				
114	Madlar				
115	Kundla				
116	Churan				
117	Bhandariwale – Mirpur				
118	Johran				
119	Bhudra				
120	Andheri				
121	Moginand				
122	Moginand – ii				
123	Dewni				
124	Dewni – Khadri				

125	Dewni – Khadri – ii				
126	Jainti – Majri				
127	Karor Uparli				
128	Tandi Bara				
129	Gurha				
130	Kuri				
131	Saketi Fossil Park				
132	Toka	Himachal Pradesh, India	Flake, core, Core fragments/chunks ,Hammer stones, Utilized clasts, Various types of discoids, Various types of chopper, Debitage	Quartzite	Chauhan, 2007
133	Bara	Punjab	Chopper, Scraper, Point	Quartzite	Soni & Soni, 2013
134	Dher - Majra		Chopping tool, core, Blade like flake, Scraper		
135	Masol – 1	Punjab	Various types of flake, split cobble, ammerstone, Various types of chopper, Core, Chopping tool, Denticulate, Utilized flake	Quartzite	Gaillard et al, 2016
136	Masol – 2				
137	Masol – 3				
138	Masol – 4				
139	Masol – 5				
140	Masol – 6				
141	Masol – 7				
142	Masol – 8				
143	Masol – 9				
144	Masol – 10				
145	Masol – 11				
146	Masol – 12				
147	Masol - 13				
148	NGT – 1	Punjab, India	Chopper of various sizes, Large flake, Pitted cobble, Scraper, Retouched flake	Quartzite	Soni et al, 2017
149	NGT – 2				
150	NGT - 3				
151	Bara	Punjab, India	Chopper, Scraper, Point	Quartzit	Soni & Soni, 2017

Table-3: Reported Acheulean sites in Siwalik Hills of India, Pakistan and Nepal

SL. NO.	SITE/AREA	STATE/REGION	ARTIFACT TYPES	RAW MATERIAL	REFERENCE
1	Aitbarapur	Hoshiarpur district, Punjab, India	Cleavers, bifaces, flakes, flake scrapers, and flake chopper	Quartzite	M. Kumar, personal communication; Tribune 1977; Mohapatra and Singh 1978; Mohapatra 1980a,; Mohapatra, G. C., 1981;
2	Chandikotla		flakes, flake scrapers, core	Quartzite	
3	Jat- war		Cleavers, flake chopper	Quartzite	
4	Sabaur		Large flake and boulder core	Quartzite	
5	Jhangrian		Flake scraper and angular flakes	Quartzite	
6	Karura		Flake	Quartzite	
7	Garhi		Flake and core	Quartzite	
8	Supalwan		flakes, flake scrapers, and flake chopper	Quartzite	
9	Suna		flake	Quartzite	
10	Kangar		Angular flakes	Quartzite	
11	Kot		Cleaver, flake	Quartzite	
12	Lalwan		Large flake	Quartzite	
13	Palata		Different types of flake	Quartzite	
14	Samundri		flakes, flake scrapers	Quartzite	
15	Ghanaura		flakes, flake scrapers	Quartzite	
16	Kahnpur Khuhi		flakes, flake scrapers	Quartzite	
17	Tikhni		Large flake and boulder core	Quartzite	
18	Babahar		Flake	Quartzite	
19	Rahmanpur		Fkale scraper. flake	Quartzite	
20	Daulatpur		Flake	Quartzite	
21	Marwar		Large flake, scraper, core	Quartzite	
22	Chauntra	Pakistan	Flake, Various types of core, Chopper, Sharp flake, Flake of Various types, Scraping tools	Quartzite	De Terra& Paterson, 1939
23	Ghariala				
24	Balawal				
25	MS 163				
26	Chak Sighll				
27	Rawalpindi				
27	Chakri, Section 16				
28	Adiala				
29	Dina	Pakistan	Rolled hand axe	Quartzite	Rendell, H and Dennell, R. W., 1985
30	Jalalpur		Hand axe , flake artifacts		
31	Gadari	Dang-Deokhuri (*dun*) valleys , Nepal	Hand axe, Peak	Quartzite	Corvinus, 1990

Table 3: Average length dimensions for some bifaces from select Acheulian sites in the Siwalik region (Chauhan, 2003)

Country	Site	Artifact	Length (in cm)	Average (in cm)
Pakistan	MS 163	1 Handaxe	13.1	13.1
	Morgah	12 Handaxes	9.3 – 17.5	13.9
	Morgah	3 Cleavers	15 – 15.3	15.2
	Chak Sighu	7 Handaxes 1 cleaver	6.6 - 18	12.1
	Jalalpur	2 Handaxes	12 – 13.6	12.8
India	Dina	1 Handaxe	13	13
	Hoshiarpur	Bifaces (676%)	Largest – 19.4	14.8
		Cleavers (21 %)	Largest – 19.8	13.4
Nepal	Gadari	2 Handaxes	8.3 & 11.6	9.9

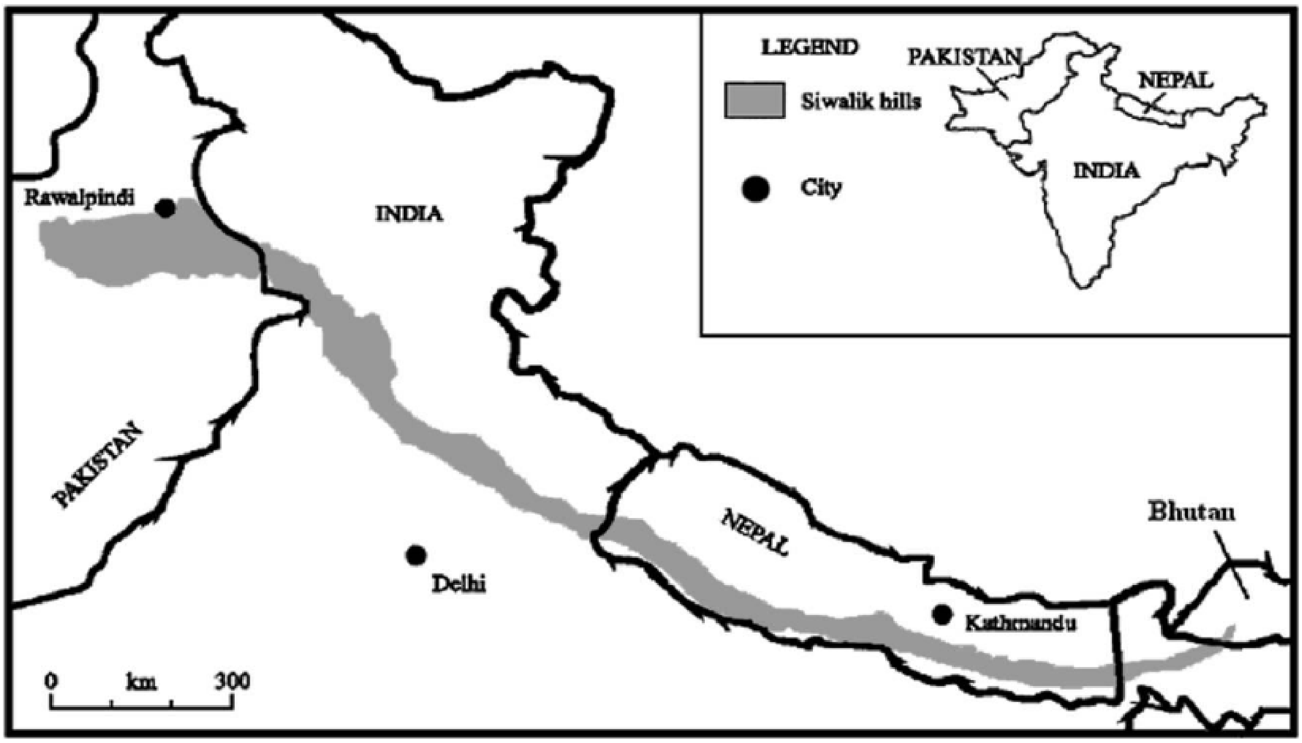

Fig. 1: The map showing Siwalik Hills and its geographical distribution (Source: Khan, A.M., Aktar, M. and Ikram, T., 2012)

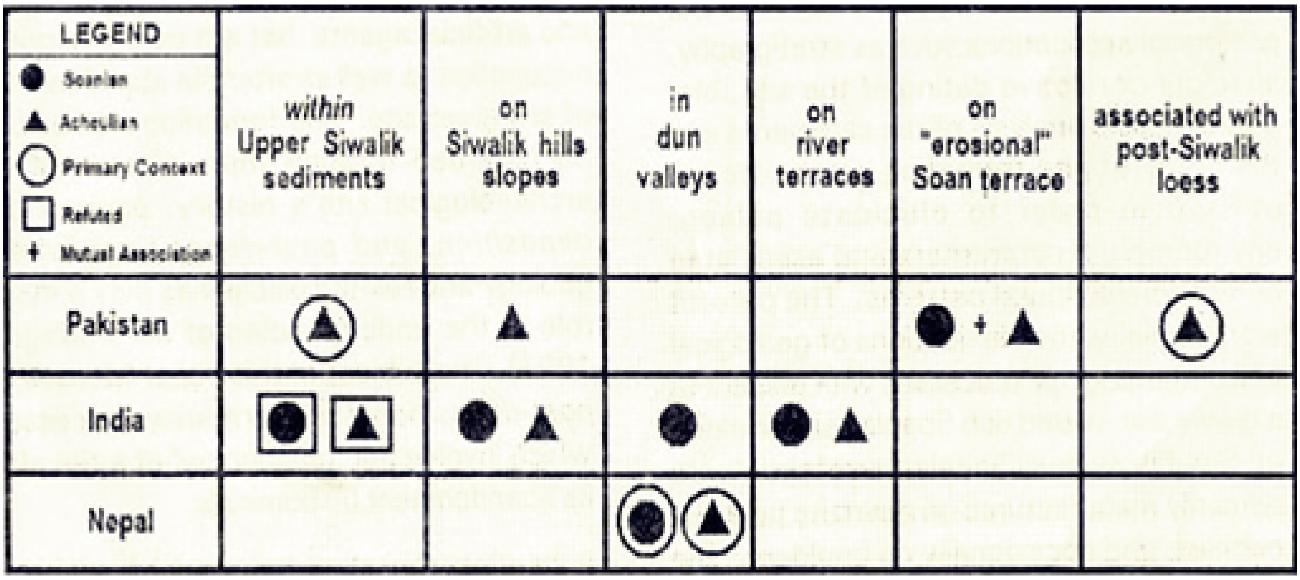

Fig. 2: Geographical, Geological an Geomorphic contexts of Paleolithic sites in Siwalik Hills (Chauhan and Gill, 2002)

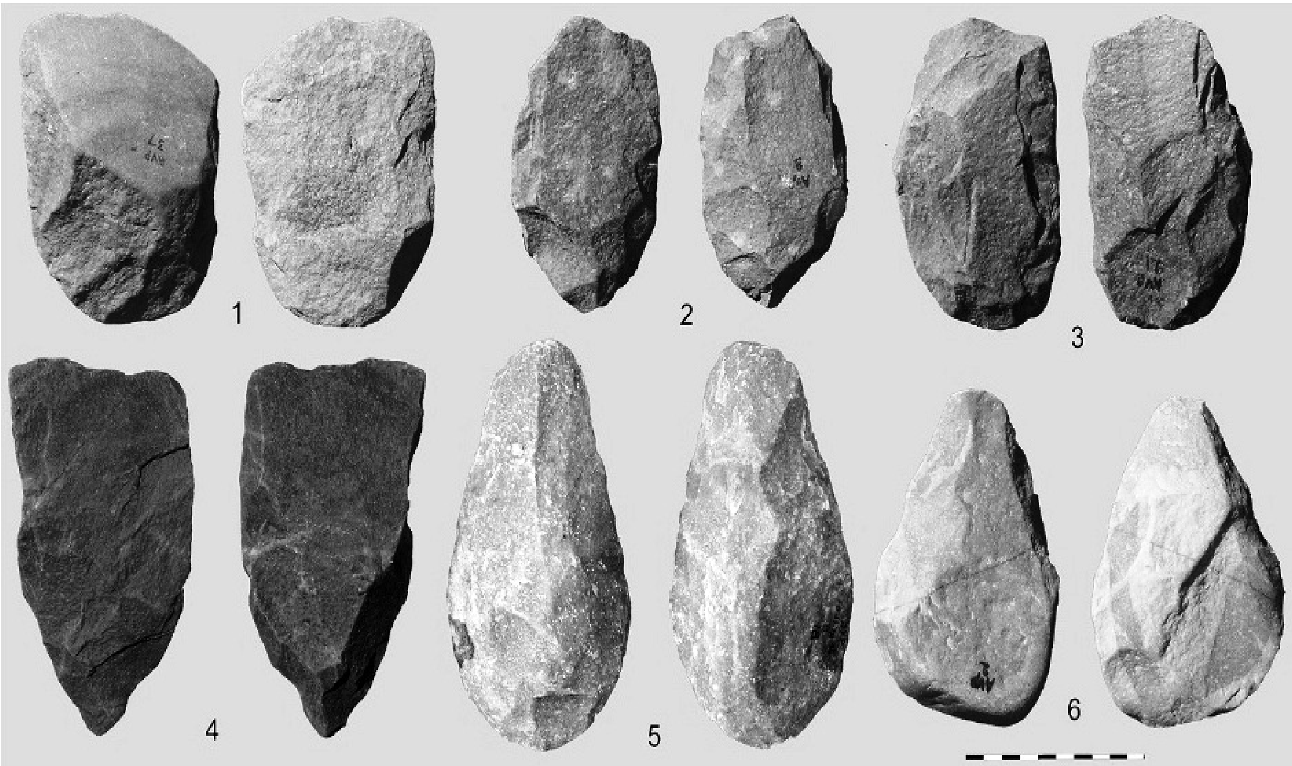

Fig. 3: Acheulean artifacts from Atbarapur

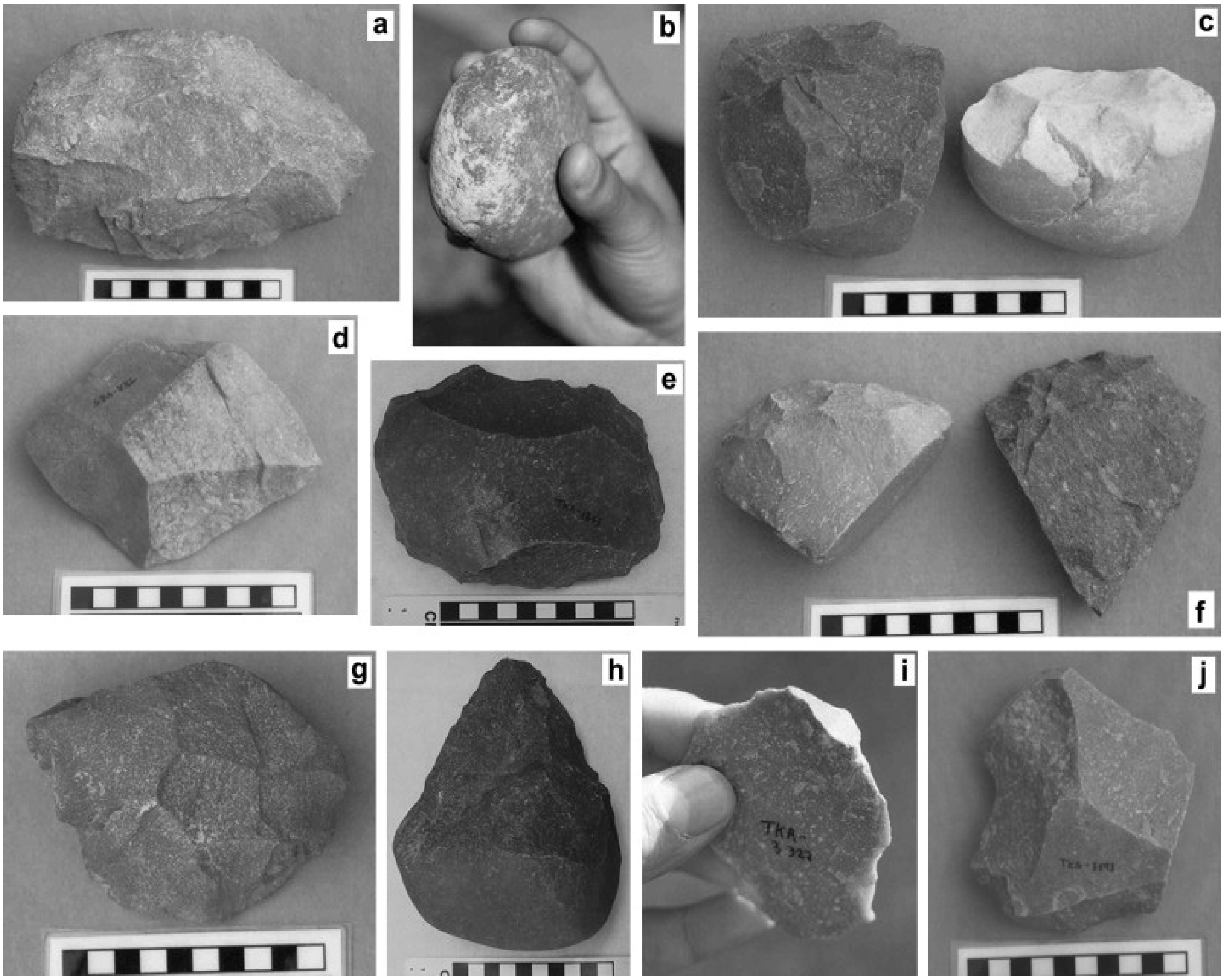

Fig. 4: Soanian lithic remains from Toka (source – Chauhan, 2007)

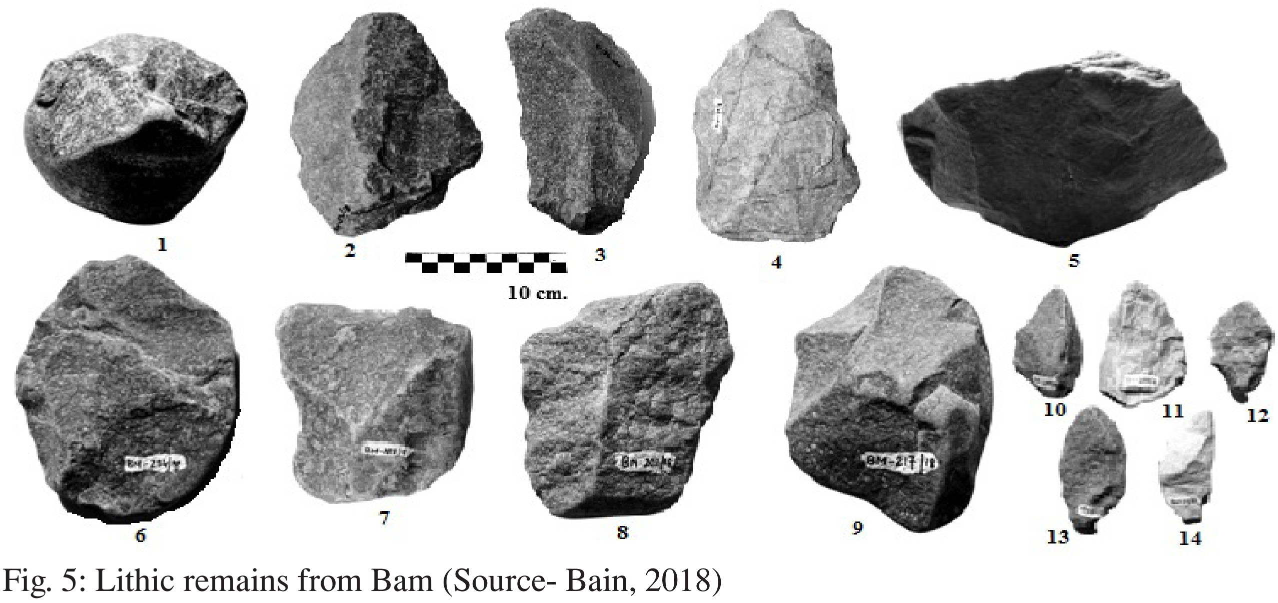

Fig. 5: Lithic remains from Bam (Source- Bain, 2018)