Indian Chalcolithic Culture: Aspects of Craft and Technology

Amrita Sarkar[1] **and Vasant Shinde**[1]

[1]. Department of Archaeology, Deccan College Postgraduate and Research Institute, Pune - 411006, Maharashtra, India (*Email: amritjoy@gmail.com*)

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Abstract*: Technology forms an important aspect of any culture as it is a gauge for assessing economic and social developments during the various phases of history. The rate of technological change until the Chalcolithic phase was slow. However, around 6500 years ago during the Chalcolithic period, a momentous cultural transition began, generating new needs and resources and led to high level of technological development. This paper is a review of both pyro and non-pyro technologies as is evidenced from different chalcolithic sites throughout India which could help us in reconstructing the scientific knowledge and their practical application by Chalcolithic Cultures.*

Keywords: Chalcolithic, Pyro-technology, Hydraulics, South Asia, Agriculture, Transport, Architecture

Introduction

The Chalcolithic cultures of India are characterized by attributes of the agro-pastoral economy, trade, social-political and economic stratification, specialized crafts and highly developed technology. Technology forms the most important aspect of any culture, as it is the measure for assessing economic and social developments. It is the systematic study of techniques (craft) for making and doing things that helps us to understand the fabrication and use of artefacts.

The Neolithic economy was followed by the Chalcolithic one mostly in South Asia. In generic way, the Chalcolithic period is defined as the one postdating Neolithic Age, and it has the pottery and copper: the technology-based definition. Subsistence-wise it comprised the sedentary farming communities: the adaptation-based definition. There are specific definitions of the Chalcolithic period by the few Indian scholars. These are as follows:

The Chalcolithic stage implies learning agriculture, making pottery and using copper (Misra 2007: 154); the early farming communities of Deccan and Central India have been referred to as the Chalcolithic, and those of the South India as the Neolithic (Shinde 2002:97).

Development of Chalcolithic Settlement: Cultural Process

The Indian subcontinent has all the favourable ecological conditions necessary to give birth to the early farming communities, which, with growing technological complexities, evolve into the first cities. The region witnessed two independent streams of origin of village economies with the associated technologies, which evolve and develop through the early phases of village societies into the developed and mature complex villages and the early cities hence it is important to trace the ongoing cultural process in the region. On the basis of material culture and technologies in use, the Chalcolithic of South Asia has been sub-divided into Early, Mature and Late phases. The earlier (7000 BC) beginnings are seen in the northwest regions of Afghanistan and Baluchistan while the later (4500 BC) but independent of the former is seen in the southeast Rajasthan on the Banas River. In the rest of India the development of village-based culture started in the later part of the Mesolithic phase and continued into the Neolithic and Chalcolithic between 3500 and 1000 BC.

In the Ganga valley, though the site of Koldihwa has produced an early date (6000 BC) there is a lack of other corroborative C14 dates, hence this date cannot be used for generalisation. The declined phase of the Chalcolithic has been properly studied at the site of Inamgaon in the Bhima basin of the lower Deccan region. Of the early farming communities that came into existence in different parts of South Asia, the Chalcolithic phases in Central India, the Deccan and the South India have been systematically studied, thanks to the pioneering work by Deccan College under the leadership of H.D. Sankalia. Unfortunately, the eastern and north-eastern part has not been subjected to systematic archaeological research and therefore very little is known about these regions.

The large numbers of Chalcolithic cultures identified in the subcontinent have been classified into twelve regional traditions (Fig.1):

1. Baluchistan and adjoining regions (beginning from fifth millennium BCE)
2. Padri and Prabhas Patan traditions of Saurashtra (fourth millennium BCE)
3. Neolithic/Chalcolithic cultures of North India
4. Ganeshwar-Jodhpur of Northwest and western Rajasthan (fourth millennium BCE)
5. Anarta tradition of North Gujarat (fourth millennium BCE)
6. Ahar tradition of Mewar (fourth millennium BCE)
7. Neolithic Kashmir
8. Kayatha and Malwa traditions of the Malwa Plateau (third millennium BCE)
9. Ochre colour pottery/copper hoard tradition of North India (third millennium BCE)
10. Savalda and Jorwe traditions of the northern Deccan (third millennium BCE)
11. Neolithic/Chalcolithic traditions of Eastern India (third millennium BCE)
12. South Indian Neolithic

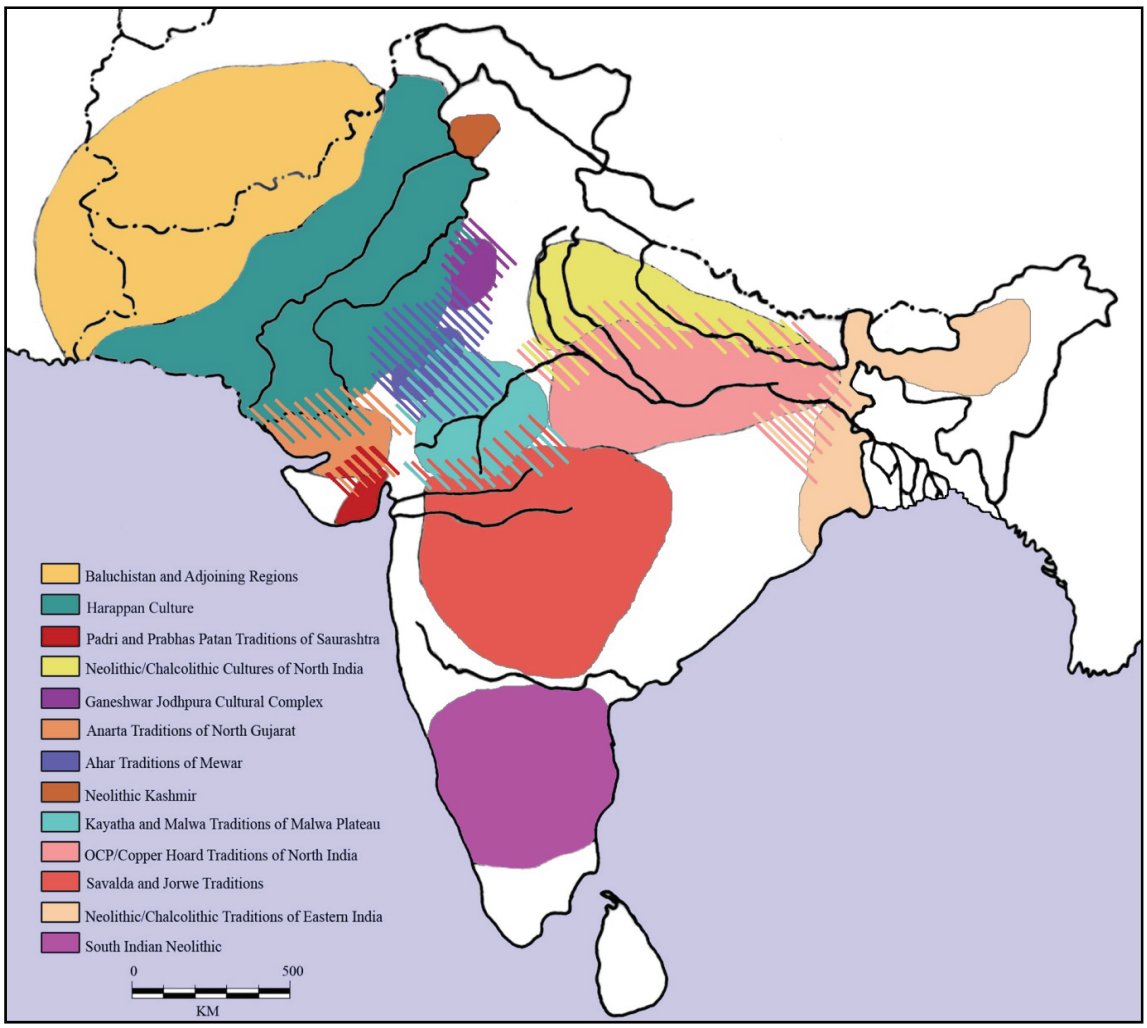

Figure 1: Chalcolithic Cultures of South Asia

Chalcolithic Crafts and Technologies

The introduction of various technologies is considered to be one of the important contributions of the Chalcolithic of the subcontinent. The material culture of the Chalcolithic society of the subcontinent was varied and rich with developed socio-economic and technological features. The presence of a developed craft specialization is an important indicator of the diverse technological milieu present. Craft specialization, as a particular phenomenon may be present in almost any culture, however, it matured in the Chalcolithic period world over. A number of finds that should be expected if craft specialization was present include:

1. Workshop: specialized areas for craft activities
2. Tool kits: specialized tools for craft activities
3. Storage facilities and/or hoards: delimited locations for storing completed craft products
4. Resource exploitation: regular exploitation of particular resource
5. Exchange and trade: distribution of resources or craft products

There is ample evidence in the Chalcolithic levels for pyro-technology (pottery, bricks, terracotta, lime, paste and faience, copper, gold metallurgy, etc.) and non-pyro-technologies (architecture, agriculture, hydraulics, lapidary, flint knapping, and products made of bone/antler/wood, shell, stone, ivory, etc.). Many of these technological aspects that the Chalcolithic people introduced in the 5th millennium BC have continued to the present with minor or no changes.

Pyro-technology

***Pottery Manufacture*:** The earliest evidence of pottery manufacture comes from the site of Mehrgarh in Baluchistan, dated to 6500 BCE. One of the characteristic features of the Chalcolithic period is a well-developed ceramic industry, including fine painted, plain and coarse pottery for a variety of purposes. Ahar, an early farming community of Mid Ganga, and Narhan cultures also produced Black-and-Red wares. Pottery manufacturing was an important craft of the Chalcolithic period and all the three techniques (handmade, slow turned table and fast wheel) were in use simultaneously. Fine pottery was made from fine and pure well levigated clay whereas the coarse variety was made from tempering materials, such as fine sand, chopped grass, rice husk, cow or donkey dung, et cetera mixed into the fine clay. The fine ware was treated with various shades of red colour slip, and then painted with decorations in black or other dark colours and fired at 750° C. All the colours were made from the naturally occurring haematite rock. Usually the fine wares were fired in closed kilns with long fire chambers at the base, the evidence of which is found at sites like Balathal (Fig. 1) (Misra, 2007: 189), Inamgaon (Figs. 2 and 3) (Dhavalikar *et al.* 1988: 251-256), and Daimabad (Sali 1986: 127) etc.

***Burnt Brick*:** The earliest evidence of the use of burnt brick for construction comes from the site of Gilund, dated to the beginning of 4th millennium BCE, which was excavated by the authors. This building material was not common in the Chalcolithic period in South Asia. At Gilund most of the structures on the southern part, identified as a craft manufacture area, have been made of burnt bricks. The Chalcolithic people at Gilund also introduced the header and stretcher construction method. Similar burnt bricks are being manufactured in the rural parts of India by using the same technique as that of the Chalcolithic.

***Terracotta*:** In the subcontinent terracotta art is associated with settled life. A large number of terracotta objects were manufactured and used by the Chalcolithic people for domestic and religious purposes. The domestic objects included spoons, ladles, ornaments, such as beads, bangles, ear-studs, et cetera. A number of sites have yielded animal figurines, such as the bull, tortoise, a variety of birds, human (male and female) figurines and a variety of miscellaneous objects, most of which have been associated with the religious beliefs of the people. Most of the sites producing the evidence of pottery manufacturing will be ideal ones to study for the terracotta manufacturing techniques. There are ample ethnographic parallels in modern western and eastern parts of the country where such techniques can be studied.

Figure 1: Balathal Kiln 2

Figure 2: Jorwe Period Kiln from Inamgaon

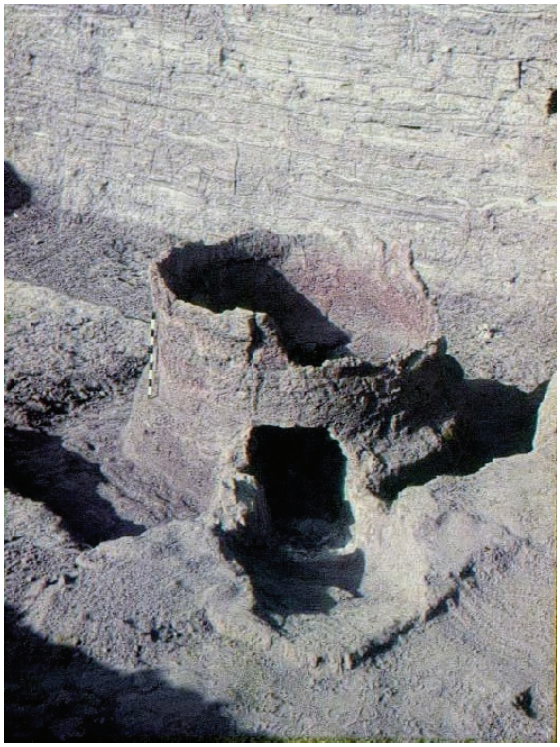

Figure 3: Kiln of the Malwa Period from Inamgaon

***Lime*:** Evidences of lime manufacture among the chalcolithic communities have come from the site of Inamgaon and Daimabad. In Inamgaon it has been observed in the course of excavations that the Chalcolithic people were preparing lime on a large scale, especially during period III (late Jorwe) and less in period II , that is, the Early Jorwe, whereas a small quantity of lime balls of size varying from 0.05cm to 0.25 cm diameter were recovered from several trenches. There were two houses numbered 5 and 116 respectively being identified as lime maker's house of the Late Jorwe period. The identification was based solely on the existence of lime kilns in their courtyards. Not far from this was found a heap of bivalve shells. However it is hard to say that only shell lime was prepared by the Late Jorwe people. It may be noted in this connection that shell lime is even today not very common in the country; it is mostly prepared in south, where it is used for applying to betel leaves. For industrial use shell lime cannot be manufactured on large scale. In India lime which is for house building is prepared of calcium carbonate (kankar). As the kankar is available in plenty around the site, we can safely say that the Late Jorwe people also made lime of kankar. The nearest limestone exposure from the site was some 10 km upstream. Lime balls recovered from the site led the excavators to believe that they were mostly used for plastering silos, house floors and walls. They might have also been used for keeping in pots as insecticides ethnographic parallels in the region also showed that lime mixed with water is also used for the preparation of hides and skins. Based on these facts the excavators deduced that the cattle keepers and farmers of Inamgaon specially the sheep/goat pastoralists of the Period III may have used lime for these purposes too.

In Daimabad, house no 3 has been identified as a lime maker's house on the basis of two pots containing white lime. Other finds associated with this are a shallow circular fire pit, muller stone and few other stones, half a dozen of unbaked kunda type pots, a small flattish stone near the entrance of the chamber with animal bones including teeth (Sali 1986: 134).

***Paste and Faience*:** From the beginning of the Chalcolithic phase, paste and faience beads formed an important part of their jewellery, as is evident at Mehrgarh, Padri, Prabhas Patan, Balathal, Gilund, et cetera. The paste beads were made from the white quartz powder by adding alumina, sodium and potassium as flux. Faience was made from ground quartz sintered with glassy bonding material made with alkalis and lime and glazed with bright coloured alkaline and lime glazes containing metal oxides. Both were then fired in small kilns; however such kilns for firing paste beads have not been identified at any Chalcolithic site. Also there is a need to identify workshops and tools used in the manufacture this craft. This craft has not been properly studied and therefore we have not yet understood various aspects, such as the exact nature and source of raw materials, manufacturing process, firing techniques, et cetera. The Harappan site of Kuntasi in Saurashtra, Gujarat, contemporary to the Chalcolithic period, has produced a large, circular fireplace, which is identified as a paste-bead firing kiln (Shinde 2004: 8-14). A large circular kiln, built in a pit and provided with a thick layer of sand all around, called a sand bath, contains a large pot, which may have

been used as a container for the beads to be fired. The Chalcolithic craftsmen might have used a similar kind of kiln for firing purposes. However Dhavalikar is of the opinion that there were no separate kilns for baking faience beads (personal communication with Dhavalikar).

***Copper Metallurgy*:** Evidences regarding copper metallurgy have been found in many Chalcolithic sites Located in Northeastern Rajasthan, the Ganeshwar Jodhpur Culture Complex (GJCC) is a collection of Chalcolithic settlements having similarities in material culture, production of copper tools, and geographic proximity to copper mines is the largest copper producing community in Chalcolithic South Asia (Rizvi 2007: 1). Apart from GJCC evidences of coppersmith's workshop have been reported from the site of Daimabad. House no. nine represented this coppersmith's workshop with a well made floor plastered with mud. It contained remains of two furnaces, four pots, a rectangular fragment of stone and mud platforms which were partly exposed. Of the four pots, one was represented by the base of a thick jar which lay between the two furnaces. The second was a *kunda* type vase found lying in slanting position against the third pot which was the base of a bulbous pot embedded in ground and the fourth was a globular pot with high featureless vertical rim partly embedded to the south of the *Kunda*. The rectangular stone was found lying close to the pots. Both of the furnaces contained ash, but the one on the north yielded one heart-shaped razor of copper. That this workshop was provided with a roof supported by wooden posts was apparent from the presence of postholes in its mud-plastered floor. Both the furnaces were U shaped and their walls, made by a mud, were burnt red. The mouths of both of them faced the mud platform meant for taking a seat by a coppersmith. Just opposite the coppersmith's workshop but separated from it by a north-south running channel, 75cm was another house numbered as 10. It consisted of a mud-plastered floor and postholes of what may be the front courtyard of the coppersmith's house. An interesting find from the floor of this house was a crucible (Sali 1986: 93-98). In the Ahar Cultural site of Gilund a number of structures, some complete some partially, were excavated on the southern end of the long mound (GLD-II). Most of the structures yielded evidence in the form of furnaces, slag deposits or burning activities inside them. Based on this evidence these structures are associated with the manufacture activities and hence identified as an 'Industrial Area' (Fig. 4). However this is still a speculation based on the evidences. Further excavation is needed for a more comprehensive conclusion.

***Gold*:** A small number of gold ornaments have been reported from selected sites, including mostly beads and pendants made by foil techniques. In all probability the Chalcolithic people acquired gold from Hatti mines near Gulbarga in Karnataka. A small circular furnace found in one of the structures at Inamgaon and a pair of tongs may have been connected with gold ornament manufacture activity (Dhavalikar *et al.* 1988: 662). Beyond Chalcolithic site, evidence of gold pieces have been found from Harappan site like Kunal, which includes beads (C. There is no convincing evidence of the use and manufacture of silver objects in the Chalcolithic levels in the subcontinent.

Figure 4: Industrial Area of Gilund

Non Pyro-technology

***Architecture*:** The Chalcolithic period in general is characterised by simple to complex structures made of mud, wattle and daub, stones, mud bricks or burnt bricks. In addition, multi-room complexes, public architecture and well-planned settlements were also built. Architecture of different categories, such as dwellings for common and elite classes, workshops for various craft manufacturing, and public buildings, such as fortifications, granaries, irrigation canals, jetties, religious structures, et cetera have been identified at a number of excavated Chalcolithic sites. The simple dwelling structures included subterranean or over-ground circular huts and single or double-room square and rectangular units. These structures had low mud walls and wattle and- daub construction over them (Sankalia 1974). Most of the structures had well made plastered floors and walls, while cooking and storage areas exist inside. There is no direct evidence for the manufacture of these architectural features in the archaeological context. Similar types of structures are being built till today and a study of these structures has yielded ample information about their construction method (Shinde 1991: 796-807). The structural complexes excavated at a number of sites, including Mehrgarh, Balathal and Gilund were made of mud bricks or stone, depending upon the availability of raw material in the vicinity. These complexes had stone foundations and mud brick walls. Some of the complexes excavated have over a dozen rooms of different sizes, and on the basis of contents it was noticed that each room of the complex served different function including dwelling, storage, craft manufacture, cooking, et cetera. In addition, multi-room complexes, public architecture, such as fortifications and granaries and well-planned settlements are also found. The site Balathal had a stone fortification wall, whereas Gilund, Eran and

Nagda had mud brick fortification walls. Mud walls fortified Inamgaon and Daimabad. The stones and mud bricks were set in mud mortar, whereas the mud walls contained stones at places for strengthening purposes. These walls, broad at the base and narrow towards the top, have survived to a considerable thickness. One of the aims of this research will be to study their exact function and method of construction. A surrounding ditch also protected sites like Inamgaon and Nagda and this technique introduced by the Chalcolithic people continued through the Early Historic into later periods in India.

Granaries have been identified at Gilund and Inamgaon. The one found at Gilund is a large 15 m X 12 m structure made of parallels walls of mud-bricks (Shinde & Possehl 2005: 297). Five parallel walls placed at a distance of 1.5 m from each other have been plastered from inner and outer faces. It is hypothesised that the place between the two walls was used for storage purposes. The structure identified as a granary at Inamgaon is a large square mud structure containing half a dozen circular platforms and the same number of cylindrical underground pits (Dhavalikar *et al.* 1988: 189). The top of the mud platforms and sides and bottoms of cylindrical pits (silos) were plastered with cow dung and lime. The platforms were used for supporting storage bins whereas the underground pits were used as storage containers. There are ethnographic parallels for both and hence it is not difficult to study their methods of construction in order to identify the tools used for making them.

A rectangular platform found by the side of the river Ghod close to Inamgaon has been identified as a jetty (Dhavalikar *et al.* 1988: 248). The structure is 9.8m long and 4.5m wide. It may have been larger but successive annual floods have destroyed a considerable part of it. Whatever remains is enough to suggest that the structure might have served the purpose of a landing platform for descending into and getting out of boats in the river. It may be recalled in this connection that small boats with high prow and stern and with oars have been depicted on Jorwe vessels recovered from the burials of period II in Inamgaon (Dhavalikar *et al.* 1988: 248). A massive embankment of rubble masonry (Dhavalikar *et al.* 1988: 241) was also found in Inamgaon and demonstrates the community effort for building the embankment in order to protect settlements on low lying area from recurring annual floods.

The site of Balathal has produced unique evidence of a public structure identified as a fortified enclosure (Shinde 2000: 130). This roughly rectangular structure measuring 30 m (east-west) by 20 m (north-south) is the only structure of its kind in the Chalcolithic levels of the subcontinent. It is located in the middle of the settlement with massive walls of stone set in mud mortar and bastions on two corners. The average thickness of the wall is 5 m on top and 7.5 m at the base.

***Lithics and Stone Working*:** One of the characteristic features of the Chalcolithic subcontinent is the presence of a blade industry right from the beginning of this phase. On the basis of the even distribution of debitage and blades at Navdatoli, it has been

suggested that every household prepared its own tools (Sankalia *et al.* 1971). The tools, such as hammer stones, fabricators, antler and copper punches, et cetera found at many sites may have been used for making blade tools.

A stone cutter's workshop has also been identified in the site of Daimabad (Sali 1986: 98). On the partly exposed floor of this workshop were found lying fourteen stone mullers, by the side of a large and deep platter of unbaked clay with vertical sides and flat base embedded in the floor. The mullers were of varied types including rectangular, sub-triangular, tapering, oval and barrel, the last named variety being closely parallel with the modern type used in the region. Their occurrence in large number and in a variety of shapes in association with raw material close to the platter perhaps used for storing water to be used while grinding the surface of the mullers to make them smooth, suggested that they were possessions of a stone cutter dealing with supply of stone mullers to the inhabitants.

Chalcolithic sites in the Deccan and elsewhere have a considerable number of polished stone tools. The most common material used is dolerite, which is found all over the Deccan region. The tools consist of axes and adzes and in both cases grinding and polishing obtained the cutting edge. A large number of polished stone tools have been recovered from Inamgaon, but there is no evidence of manufacturing at the site. The manufacturing technique may have been simple. In the first stage a pebble was converted into a rough-out, which was then polished on the rough stone.

Bead Production: One of the most important industries throughout the Chalcolithic period in the subcontinent was the manufacture of beads of semi-precious stones, such as agate, carnelian, jasper, chert, steatite and serpentine. From the excavation at Inamgaon, 915 beads were yielded belonging to all three periods. Evidences from Period I and II are confined to smaller area of excavation and hence the number of beads from these periods is less than that from Period III which had the maximum excavated area. The materials most commonly used are terracotta, jasper, ivory and carnelian in that order. Among other material mention should be made of agate, chalcedony, quartz, bone, shell, steatite faience, paste, amazonite, serpentine, copper, gold and calcite. Along with finished specimens, a few unfinished beads with perforation, a number of rough-outs and bead polishers have been collected from the surface.

From the site of Kayatha 352 beads were yielded from the chalcolithic levels (Ansari & Dhavalikar 1975: 115-123). The preferred raw material in this site was carnelian followed by terracotta. Besides, 40,000 micro beads of steatite were found in a house belonging to Period I (Ansari & Dhavalikar 1975: 115). As to the manufacturing technique of the steatite micro beads attempt has been made by Hegde *et al.* (1982: 239-244) from the Harappan context. They have deviced a simple yet a laborious and unhurried job. The description of the process is as follows: "All that is needed is a circular copper or bronze disc with a few one millimetre diameter perforations near the

centre. Each perforation must have a copper or bronze wire of 0.5mm diameter with one end soldered or riveted near the perforation and the other end bent and positioned to be at the centre of the perforation. The disc has fine holes at its periphery which allow it to be stitched all around to a well-knit piece of cloth. If into this device a paste of finely ground talcose steatite is put and the cloth gathered together and squeezed by hand, talcose steatite paste emerges through the perforations as tubes. These soft tubes can be cut as they emerge, at quick intervals, to convert them into microbeads. Three skillful persons are necessary to do the job: one for squeezing the paste, the second for the cutting the soft tubes and the third for collecting the soft micro beads, over a layer if fine ash on a dish to avoid damaging them. The beads can be baked at 900- 1000° C in a kiln to harden them." The Ahar culture has produced terracotta beads in largest number and a variety comes from Ahar. They are of two types- plain and decorated with incised designs. The plain ones are of globular, truncated barrel, bi-convex, plano-convex, conical, with flat base, straight sides and sloping shoulders and areca nut types. Those decorated with incised designs are of plano-convex, biconical, truncated bi convex, collared, globular, biconvex and short cylindrical type. The designs comprise zigzags of four or five delicately incised lines, triple linear incisions on horizontal lines, groupd of multiple short curved and wavy lines, groups of chevrons, horizontal lines, vertical lines, multiple loops, hatched triangles and diamonds, et cetera. Sankalia noted the close affinity between the biconical terracotta beads found at Ahar and those found at Tepe Hissar in Iran, Anau in Turkeministan and Troy in Anatolia (Sankalia *et al* 1969: 223). These large beads are believed to have been used as spindle whorls.

From the site of Daimabad, bead maker's house has been spotted which was represented by a plan of postholes filled with gravel measuring 4.4 sq m. on the floor of this structure was collected one unfinished bead of carnelian, long barrel, polygonal in shape. Based on this the excavator (Sali 1986: 137) identified this as a bead maker; house although no debitage of raw material was found in its association.

A number of scholars have studied these techniques and systematically documented them (Kenoyer. 1991: 44-63). Apart from south Asian Chalcolithic sites, in the course of excavations at the site of Harappa, a large number of beads, drills and bead making debris have been recovered from different parts of the city and from all major chronological periods (Kenoyer 2003: 157).

***Agriculture and Food Processing*:** Agriculture was the mainstay of Chalcolithic communities and the people grew a variety of crops, including wheat, barley, rice, a variety of pulses and oil seeds in the fertile black cotton or alluvial soils surrounding most of their settlements. Plough cultivation is inferred in the Chalcolithic levels although there is no direct evidence for the implements. The possibility is that the hard wood of *khair* (*Acacia catechu*) may have been used for making ploughs, which may not be different from the Harappan plough found in the form of a model at the site of Banawali. However, the actual discovery of a ploughshare made of a shoulder bone of

cattle at Walki (Pune district, Maharashtra) demonstrates that such ploughs may have been made (Dhavalikar *et al.* 1990: 197-228). it is roughly triangular in shape (16x10cm) and has two perforations. It has no parallels so far in the country (Dhavalikar e*t al* 1990: 197-228). Besides, antler picks and perforated discs referred to as mace heads found at many sites may also have been used for digging purposes (Shinde 1987: 214-227).

Food processing equipments like saddle querns and grinding stones are available in all Chalcolithic sites. By constant use the querns become hollow and curved and are hence referred to as saddle querns. Grinding stones come in different shapes: round, oblong, rectangular and so on.

Hydraulics: The best evidence of this comes from the site of Inamgaon in the lower Deccan region. The evidence of an irrigation canal, 240 m long and 2.5 m wide and deep was discovered. Parallel to it was constructed an embankment wall of stones set in mud mortar. It was build with a view to preventing the canal from silting up (Dhavalikar *et al.* 1988: 248). This is the best hydraulic evidence associated with the Chalcolithic in the subcontinent. The site has yielded a number of antler picks, which may have been used for digging this canal. A number of small rivers, particularly tributaries of major rivers, may have been dammed for irrigation purposes.

However the recent excavation at Lahuradeva (Tewari *et al.* 2006: 347-373) has yielded an irregular channel (drain) connecting two large deep (Fig. 5), depressions from sub period 1 A dated to 7th millennium BCE to 3rd millennium BCE. In the light of this new finding, the history of hydraulics associated with early farming communities in India goes back to 7th millennium BCE.

Shell Industry**:** The Chalcolithic people made bangles and beads (Fig. 6) using conch or chank shells. The nearest source for this variety of shell was Saurashtra and the Harappan trade networks distributed it. The outer surface of the shell was removed and then it was cut in a circular manner with the middle stem called columella thrown away (Fig.7). A number of sites have produced evidence in the form of finished and unfinished products indicating its local production. Copper knives and stone blade tools found at many excavated sites may have been employed for manufacture (cutting).

Ivory**:** Some to the Chalcolithic sites have yielded small disc beads of ivory. Since only small quantities of beads were found, no effort has been made so far in reconstructing technique used for manufacturing them. Ivory chunks may have been acquired from Gujarat and Southern India and the production of beads may have been local.

Transport: Evidences of transport facilities from Chalcolithic phases throughout Indian subcontinent indicate two types- transport via land and transport via water. The main vehicles of transport on land consist of simple carts drawn by bullocks, wagon vehicles; chariots, et cetera excavations have not revealed remains of parts of actual carts or any other wheeled vehicles. As they were made probably of perishable

materials, such as bamboo, wood, leather, et cetera they have not withstood the ravages of time. On the other hand, a large number of miniature vehicles have been reported from a number of sites giving insights into the technique of their manufacture and use. These model carts were perhaps used by children as toys and at the same time testify to the skill of the toy makers.

Figure 5: Irregular Channel from the Site of Lahuradeva
(Photo Courtesy: Rakesh Tewari)

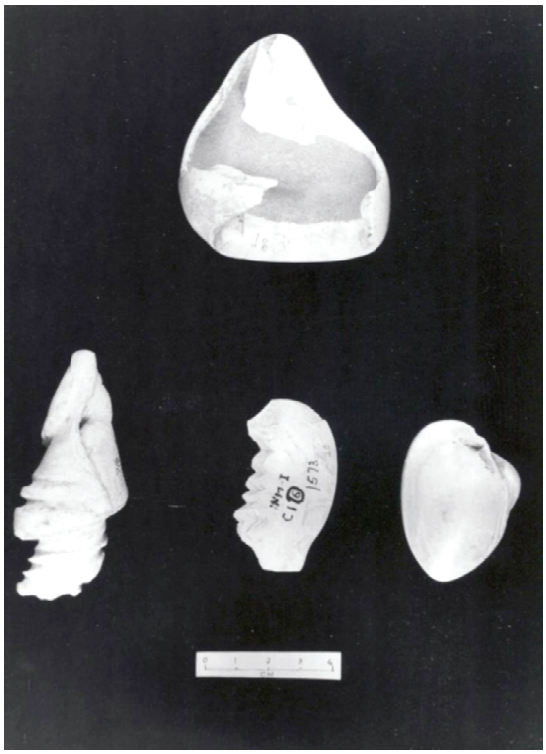

Figure 6: Remains of Conch Shells
(Courtesy: Dhavalikar et al. 1988: 693)

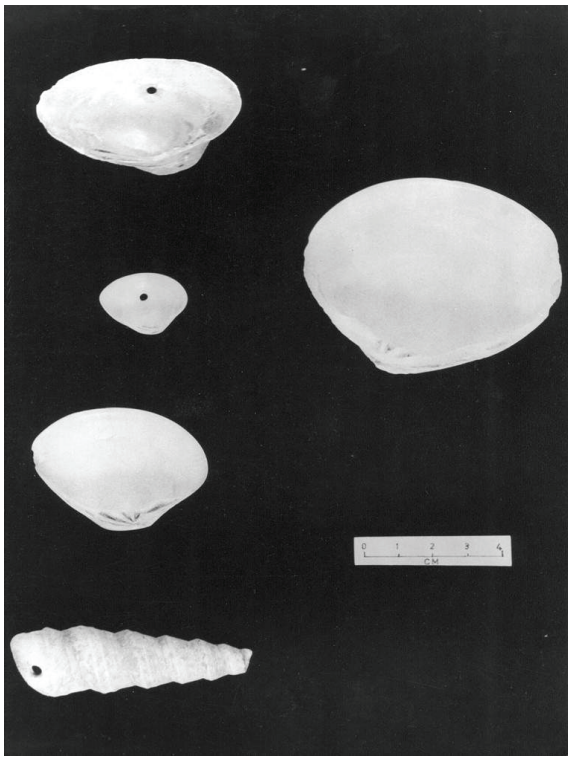

Figure 7: Shells Made into Beads
(Courtesy: Dhavalikar et al. 1988: 690)

The earliest toy carts with and without wheels and frames have been reported from Chalcolithic times as at Harappan sites. The bronze artifact of that of a man driving a bullock cart from the site of Daimabad also deserve special mention. The terracotta artefacts comprises of cart frames made of terracotta with four vertically pierced holes on each side to take stakes of wood. The four holes at the middle took longer stakes, which projected from the underside of the frame in pairs, between which the easily removable axle of the wheels was held. There were also horizontal holes for shafts through one end of the frame and the middle cross piece. With probably a floor of matting or rope work the open frame of these carts are well adapted for carrying goods and passengers. The Indus Valley Civilisation may have been the first civilisation to use wheeled transport. These may have included bullock carts that are identical to those seen throughout South Asia today. Discoveries at many Harappan sites have revealed that carts were often two wheeled. Cart ruts found made on the roads of sites Harappa and Farmana and even from the Chalcolithic site of Gilund in Rajasthan indicate that the body of the cart were not very small compared to modern ones.

Numerous representations of ships and boats on Harappan seals and terracotta model of ship from Lothal give us some idea of the model of riverine and maritime transport. Three sided molded tablet has been found from Mohenjo-daro depicting a boat. One side shows a flat bottomed boat with a central hut that has leafy fronds at the top of two poles. Two birds sit on the deck and a large double rudder extends from the rear of the boat. On the second side is a snout nosed gharial with a fish in its mouth. The

third side has eight symbols of the Indus script. The site of Lothal in Gujarat has been envisaged by the Archaeological Survey of India as a dockyard. Spanning an area 37 meters east- west and nearly 22 meters north- south, the dock is said by some to be the greatest work of maritime architecture before the birth of Christ. It was excavated besides the river Sabarmati, which has since changed course. The structure's design shows a thorough study of tides, hydraulics and the effect of sea water on bricks. Ships could have entered into the northern end of the dock through an inlet channel connected to an estuary of the Sabarmati during high tide. The lock gates could then have been closed so the water level would rise sufficiently for them to float. After a ship would have unloaded its cargo, the gates would have opened and allowed it to return to the Arabian Sea waters in the Gulf of Cambay. To be sure, not all archaeologists are convinced that the structure was used as a dockyard and some prefer to refer to it as a large tank that may have been a reservoir. Evidences of river transport has also been retrieved from the site of Inamgaon where painted designs of boats with oars was found to be the most common designs on the spouted jars of the Early Jorwe period. On the eastern slope of mound I in Inamgaon a stone cluster sloping towards the river with three courses of pebbles set in mud mortar has been identified as jetty (Dhavalikar *et al.* 1988: 248)

***Bone/Antler/Wood*:** Almost every Chalcolithic site has the evidence of bone and antler tools, indicating local production at almost every site, save temporary settlements such as farmsteads or camps. A few beads made of bone have also been reported. Bone and antler tools such as chisels, knives, points, awls, punches, picks, etc. were made either from whole long bones or from the splinters. Simple technique such as chiselling and grinding may have been practiced for the production of these tools. Tools such as copper chisels, parallel-sided stone blade and grinding stones may have been used in the manufacture of implements of bone and antler. Of course the Chalcolithic people may also have used a lot of wooden implements, which have not survived over such a long period. Special effort will be made to gather data on the tools and technology used in the bone and antler industry.

***Stone*:** Locally available stones were used for manufacturing objects such as rubbers, mullers, sling balls, hammers and saddle querns. By constant use the querns become hollow and curved and hence referred to as saddle querns. Grinding stones come in different shapes; round, oblong, rectangular and so on. Usually battering or use makes such as striation marks are found on the stone object used for hammering or grinding purposes. Stone balls or sling stones, which occur in large quantity, may have been used for hunting birds and small games. These objects of day-to-day use may have been manufactured locally at every site. None of the sites has yielded any evidence of the manufacture technique and therefore efforts will be made to reconstruct this technology.

***Textile*:** The site of Balathal in Mewar region of Rajasthan has produced the physical remains of woven cloth, indicating that the Chalcolithic people developed this art.

Almost every Chalcolithic site has produced a large number of perforated discs, identified as spindle whorls.

In addition to the above-mentioned craft there may also have existed technologies for making colour and medicine.

Conclusion

Early farming or Neolithic/Chalcolithic cultures flourished almost all over the Indian subcontinent mainly in the proximity of fertile arable land. This phase bridges the gap between the Stone Age and Early Historical age and provides an important clue to the missing link in the history of mankind in the subcontinent. Systematic research carried out in various parts of the subcontinent on the Chalcolithic phase has enabled reconstruction of social-economic and religious life of the people of that period. The presence of large-scale manufacturing activities within some of the settlements is a clear indicator of craft specialization and this is considered to be one of the characteristic features of a chiefdom society. The long distance hinterland trade for acquiring basic raw materials required for the craft manufacture and distribution of finished goods and chiefdom social organization are also important features of the Chalcolithic culture in India. Many traditions and technologies developed by the Neolithic/Chalcolithic communities continued though the ages and have survived in India even today. Rural India has preserved these traditions and it proves to be a very useful source for the reconstruction of various aspects of the Chalcolithic lifestyle, including technology. There is a major scope in such Ethnoarchaeological work which might help us in reconstructing these various technologies in more details. Besides, for the analyses of artefacts and ecofacts most of the important scientific methods such as Microware, X-Ray Diffraction, Chemical Trace Element (including Nitrogen and phosphate), metallurgical, botanical, zoological, physical anthropological, etc., should be brought in frequent use to understand the process more clearly. This article is an attempt to summarize the technologies used in the Chalcolithic period India based on the evidences found from major excavated Chalcolithic sites in India.

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