© 2001 NML Jamshedpur 831 007, India; Metallurgy in India: A Retrospective; (ISBN: 81-87053-56-7); Eds: P. Ramachandra Rao and N.G. Goswami; pp. 143-162.

7

Prehistoric Copper Technology in India : A Review

D.P. Agrawal*

ABSTRACT

Copper has been used by mankind from 5th to 2nd Millennia BC. The paper traced how metal technology has been part of the reparative of the technologies pertaining to ceramics, stone industry, and even architecture. No doubt, the first use of copper must have been of native copper. With the growth of urbanization, especially of the Indus civilization, the abundance of metal and technology advance progressed by leaps and bounds. The Archaeo-Metallurgical studies help a lot to know about typology of artifacts, technologies used, source of metal, what techniques different cultures used to make them artifact, mining technology? A lot remains to be done: relating ore bodies to the artifact, metallographic studies to known techniques of artifact making, alloying pattern minerals used, geochemistry of ore bodies to devise ways to fingerprint them through trace impurity patterns and lead isotope geochemistry etc. No less important are the ethno-archaeological studies to understand the man behind the technology and his artifact. A lot more can be achieved with the joint effort of metallurgical labs. and the archeologists.

Key words : Ancient Indian copper technology, Archaco-metallurgical study, Ethno-archacological study, Pre-Harappan site.

INTRODUCTION

In the greater Indus region, it is clear that the origin and development of copper metal technology occurred in conjunction with developments in other technologies. The Neolithic and early Chalcolithic pyrotechnologies included the firing of clays to make pots, and the heating of stone materials to enhance colour, workability

*Address : 10, Jayantilal Park, Bopal Road, Ahmedabad - 380058

and hardness. Possibly fire setting was being used to extract native copper lumps and granules that could then be further processed by hammering and annealing. Thus the discovery of metal smelting and melting could be a result of intentional experimentation. An example is the site of Mehrgarh, where during the 5th to 4th millennium BC, changes were occurring simultaneously in metal production, ceramic production, stone working, production of fired and glazed steatite beads, and shell working.

At the outset, we have to admit that archaeo-metallurgical studies in the real sense have been few and far between. A lot remains to be done by way of relating ore bodies with the artefacts, metallographic studies to know the techniques of artefact making, alloying patterns and if they were deliberate or an artefact of minerals used, geochemistry of ore bodies to devise ways to finger-print them etc. In the following pages, we propose to discuss both the copper inventories of these protohistoric cultures and the significance of the technical studies carried out on these artefacts. We briefly survey below the main copper bearing Pre-Harappan sites of the Northwest.

Pre-Harappan Cultures

At Kile Ghul Mohammad, near Quetta, in Baluchistan, Period I is dated to *c.* 4300 BC. But metal occurs only Period III. But at Mundigak, in Afghanistan, two artefacts were pins one with a double-volute and while the other has flattened and perforated end. Similar pins with flat ends and twisted shafts were also found in Period III. However, the greatest number of the variety of "luxury" type objects was found in P. Shaffer (1978) reports that metal artefacts were first found in Period I, and increase in frequency and variety throughout the sequence. Tin in Pd. I was only 1% but increased to 5% in Pd. II.

Mehrgarh and Nausharo, about 100 km from Kile-Ghul-Mohammed (KGM), in the Bolan river valley in the Kachhi plains, provide a continuous evolution from the pre-pottery Neolithic stage (seventh millennium BC) right up to the second millennium BC. In Subperiod IIC, only a ring represents copper and bead, suggesting that metal was still scarce. In Period III, fragments of crucibles with traces of melted copper, and bun-shaped copper ingots were also found, thus hearlding proper copper technology. About 15 km west of Kile Ghul Mohammad lies Damb Sadaat, Period II also yielded copper objects inclusive of a dagger, alabaster vessels, a compartmented seal, clay and shell bangles, bone and ivory beads, human and animal figurines and house-models of clay painted in the Quetta Ware style.

Hargreaves (1929)[1] excavated Nal, located in Jhalawan District, in 1925. The antiquities associated with the Nal complex included: long, narrow, cresent edged axes and seals of copper. Sarai Khola had four cultural periods, numbered I-IV from bottom upwards. From Rehman Dheri, no copper object was found in the Period I. Period II yielded over a dozen copper/bronze objects comprising spearheads, needles, nail-parers, antimony rods with rolled ends, pins, rings and bangles. There are five radiocarbon dates for this period, giving a mid III millennium BC bracket.

Located near Mohenjodaro, on the opposite side of the Indus, Kot Diji was excavated by F.A. Khan[2]. It revealed extensive remains of the Kot Dijian Culture. The Kot Dijian Houses were made of mud bricks of the size 38 x 19 x 9 cm. It shows the same ratio of 4:2:1, which became the characteristic feature of the Harappan bricks. Only a fragmentary bronze bangle represents metal.

About 130 km south from Mohenjodaro is the well-known site of Amri. The finds from period I included chert blades, stone balls, bone tools, terracotta and shell bengles and a few pieces of copper indicating a limited use of metal. Radiocarbon dates place the beginning of period I at Amri to around the middle of the fourth millennium BC.

Mature Harappan Sites

Most of the analysed metal objects come from the major urban centres and date to the Harappan Phase, between 2600 and 1900 BC. Copper or copper alloys dominate the metal assemblage, and can be divided into four categories: (1) crude copper (derived from smelting and rich in sulphur), (2) refined copper, (3) arsenical bronze and (4) tin bronze (Sana Ullah 1931)[3]. No objects of native copper have been identified as yet, but they will undoubtedly be found in the future.

We have to note that not only copper minerals (e.g., chrysocolla, chalcopyrite, malachite, etc.), but other minerals such as haematite, lolingite (arsenic and iron), antimony, cinnabar (mercury), cerussite (lead), galena are also rare at Harappa Phase sites in the core areas of the greater Indus valley. Because of the low occurrence of raw materials one has to assume that most of the initial stages of smelting and preparing ingots was undertaken in the resource areas near the metal ore and forests required for fuel. Copper ores occur in Baluchistan, the northern Aravalli range and Oman. Jodhpura Complex cultures of north Aravallis assume special significance from this point of view, as will be discussed below.

The Indus Civilisation or Harappa Culture (named after the first discovered site, Harappa) is remarkable for its uniformity and standardisation in weights, measures, ceramics, architecture, town planning and in other arts and crafts. The hallmark of the Harappa culture is town planning, though fortifications and some amount of planning are also evident in the Early-Harappan levels. The Classical Harappan tradition absorbed some regional traits also. The mother goddess figurines and phalli of the Sind are absent in Rajasthan and Gujarat. At Lothal there are fire altars, but they are different from those of Kalibangan. At Kalibangan the tower platforms with fire altars, approachable only through a staircase, are unique in the whole of Harappan 'empire'.

Harappans tool repertoire

It shows a lack of warlike weapons. The types are simple. Neither the complicated mouldings of Mesopotamia nor the ornate designs of Chinese metal-ware were ever produced by the Harappan smiths. Most of the artefacts appear utilitarian.

Except for two specimens of the dancing girls, no human images are available in metal. Animal copper figurines of dog, swan, elephant and bull were also cast in miniature. But these animal figure examples do show their competence in the lost wax (Cire perdue) method of casting. Unlike the other Chalcolithic cultures of India, one has plenty of pots and pans in metal here. The main tool types are: razors; leaf-shaped knives with incurved end; sickle blades with externally sharpened edge; chisels; spearheads; thin barbed arrowheads; straight and circular saws; blade-axes; mid-ribbed daggers; drills; and eyed needles. It may be pointed out that needle with eyes on the pointed ends, true saws, circular saws, and drills are Harappan contribution to the world of instruments. Shaft-holed axes are rather a rarity and must depict imports. One of the razors from Mohenjodaro was found wrapped in cloth.

About the Harappan tools, Wheeler[4] observes, "They are of copper or of bronze generally poor in tin, and include spears, knives, short swords, arrowheads and axes". It has been suggested that small domed pieces of copper, each perforated with two holes, were sewn on to a garment and used as an equivalent to mail, but there is no supporting evidence and neither body-armour nor helmets (well known in Early Dynastic Sumer), nor indeed shields, can at present be attributed to the Harappans. Spears are invariably tanged and cannot clearly be distinguished from knives. Most numerous are the arrowheads made of copper or bronze. They are thin and flat, with long narrow barbs and no tang, resembling the swallow-tailed flint arrowheads of Egypt and northern Iran.

Out of the 177 artefacts analysed earlier from Mohenjodaro and Harappa, only 30% were alloyed. Tin alloying ranged from 1-12%; arsenic alloying 1-7%, nickel alloying 1-9% and lead 1-32. Tine bronzes were more common than any other alloys. The Harappans knew the techniques of sinking 'rising', 'running-on', cold work, annealing, riveting, lapping closed casting, Cire perdue etc., (Agrawal 1971)[5].

Ornaments and Mirrors

At present, the best clue we have to the role of metal ornaments in Indus society is their archaeological context. Unlike contemporaneous sites in Mesopotamia, almost all of the complete ornaments (e.g., necklaces and belts) found at Harappan Phase sites have been recovered from hoards rather than from burials tabulated the metal objects from Mohenjodaro and Harappa that were found in hoards, versus those found in non-hoard contexts, including burials (Kenoyer and Heather 2000)[6].

Copper/bronze ornaments as well as copper/bronze tools have been recovered primarily from non-hoard contexts. In contrast, gold and silver ornaments and silver vessels have been found almost exclusively in hoards. It is interesting that copper/bronze vessels have been found almost equally in hoard and non-hoard contexts (Fentress, 1977)[7].

Kenoyer and Heaterh (2000)[6] observed that when considering the distribution of ornaments, it is thus necessary to discriminate between copper/bronze and metals such as gold and silver. Gold and silver ornaments have been found stored in

ceramic, copper, or silver vessels that appear to have been deliberately hidden away. Some of these hoards include broken ornaments and melted lumps of gold of silver that would undoubtedly have been remelted and made into new ornaments. Copper beads and spacers are also included with some of the hoards (e.g., Allahdino), but copper ornaments have primarily been recovered in non-hoard contexts, such as in the debris accumulating in the streets or habitation areas, or in some of the burials. Out of 168 total copper/bronze ornaments reported, 130 were found in non-hoard contexts and only 38 were found in hoards, generally in association with gold and silver ornaments. The gold and silver ornaments found in non-hoard contexts are usually tiny beads or gold foil fragments that were probably lost in the muddy streets or courtyards.

Although very little metals was buried with the dead, like hoards, provide a context in which metal ornaments were intentionally placed by the Indus peoples. Metal objects found in burials are almost all of copper/bronze, and include mirrors, finger rings, bangles, and occasional beads. In one instance three gold beads were found, strung together with three stone beads. While the mirrors are invariably placed with female burials, the other metal ornaments have been found with both male and female individuals (Dales and Kenoyer 1989)[8]. It should be noted that no utilitarian copper/ bronze tools have been found in the burials. This pattern suggests that ornaments, which represented wealth or status, were passed on from generation to generation and recycled, much as is done today in the subcontinent (Kenoyer 1992b)[9].

Pyrotechnology and Mining

The Harappans could smelt even sulphide ores, though oxide ores were commonly used. Large quantities of oxide ore were found from a house at Mohenjodaro from a brick-lined pit. The similarity in the trace impurity patterns of the Harappan artefacts and the copper minerals of Khetri mines may indicate its exploitation (Agrawal 1971)[5]. But so far the actual copper working in the Khetri belt have not been dated beyond *c.*1000 BC. The main Indian copper minerals are:

1.	Chalcopyrite	$Cu_2SFe_2S_3$	34.6% copper
2.	Chalcocite	Cu_2S	79.8% copper
3.	Bornite	Cu_2FeSo_4	55.5% copper
4.	Tetrahedrite	$4Cu_2S.Sb_2S_3$	52.1% copper
5.	Covellite	CuS	66.5% copper
6.	Malachite	$CuCO_3.Cu(OH)_2$	57.3% copper
7.	Azurite	$2CuCO_3.Cu(OH)_2$	55.1% copper

Kenoyer and Miller[6] also discuss the problem of arsenic in Rajasthan ores. Sana Ullah[3] did not publish his analyses of Aravalli ores, but Heged[10] mentions that his "sample of Chalcopyrite obtained from Khetri showed 4.28% of arsenic". It is interesting to note that Kenoyer and Miller[6] find that in contrast, copper ore

impurities from the region of Khetri reported by the Director, Indian Bureau of Mines (Rao 1985)[11] are:

Lead : Generally occurs as traces, highest percentage noted is 0.18%

Zinc : Generally occurs in the second decimal, highest percentage noted is 0.18%.

Arsenic : Generally occurs in the fourth decimal, highest percentage noted is 0.06%

Cobalt : Around 0.01%

Nickel : Around 0.05%

Iron : 15 to 20%

My own analyses[5] of chalcopyrite ores from Khetri (Rajasthan) and Singhbhum (Bihar) yielded less than 0.5% arsenic. My studies[5] based on trace impurity analyses, though the data were limited, showed the possibility of the Khetri ores being used by both the Harappans and the Chalcolithic people.

Miller[12] clearly distinguishes between smelting and melting at a site. She says that of the published claims for copper-alloy metal processing areas at Mohenjodaro and Harappa, two do not represent metal processing at all, and two represent melting of copper-alloys, or possibly small-scale crucible smelting (at Mohenjodaro). There is no evidence for large-scale furnace smelting at either site. She emphasises that the types of copper alloy processing slag from both Harappa and Mohenjodaro are in all cases indicative of melting, or possibly very small-scale crucible smelting operations (Heather Miller)[12,13,14].

Miller[12] points out that much of the literature implies or states that smelting of copper took place at Mohenjodaro and Harappa. "I (Miller) found this surprising and rather unlikely, given the distance from any ore source. If the assemblages from Mohenjodaro or Harappa were indeed from smelting, this would be a very exciting find, because bringing ore such a distance to be smelted offers tantalising hints about control of production, control of technological knowledge, the status and power of metalsmiths, and/or the sophistication of Indus tradition metal processing in comparison to that of groups living nearer the ore sources (Miller)[12]".

Oman copper ores are similar to those of the Aravalli region of Rajasthan (below) in that they have little or no arsenic and have relatively high quantities of nickel, cobalt, and vanadium[5]. They are different from Iranian ores in that they have higher quantities of nickel, cobalt, vanadium, and chromium[15]. However, in light of the use of arsenic impurities as a sourcing marker by Indus researchers (see below), it is important to note that copper slag and objects containing arsenic have been reported from copper processing sites in Oman[16].

Mainly because of the cultural contacts between the Indus and Oman, it has been surmised that Oman was a major source of copper for the Harappa culture. But in my opinion the circumstantial evidence goes against this assumption.

Heather Miller[12] has pointed out that several copper prills were found to have been discarded without retrieving copper from them. This shows that there was abundance of copper and it was not treated as a precious imported commodity. On the other hand Geneshwar complex sites have yielded more than 5000 copper objects with a number of Harappan types like thin blades, arrowheads etc. Rakhigarhi was a major Harappan city with rich copper resources of Rajasthan in its hinterland. Besides, the Mesopotamians imported copper from Meluhha, which has been traditionally identified with the Indus region. In view of this evidence, import of copper from Oman on any major scale does not appear likely. We discuss below site-wise Harappan copper artefact repertoire.

Mohenjodaro

It was E. Mackay[17] who had described the metal artefacts in John Marshall's report on Mohenjodaro, as also in his own report on Mohenjodaro. Muhammad Sana Ullah did the scientific analyses. Earlier I had given a general summary of the Harappan tool repertoire[5], recently Chakrabarti and Lahiri[18] have come out with a more detailed description of the earlier finds at Mohenjodaro and Harappa, Chanudaro and Lothal. Recent data follows the reports based on earlier excavations. Following the original older descriptions, we have retained the measurements in inches (For conversion: 1 inch = 2.5 cm).

Many copper vessels were raised from single sheets of metal by hammering. In some cases they were made in two parts and joined with a "rib being casued by the projecting of the jar". In addition, bases were frequently 'lapped no' to the upper parts. There are cases in which the vertical knob handles of lids were secured to the cover both by a rivet and "by pouring molten metal around the base of the rivet for additional security".

The heavy bronze vessels were probably cast, although some bronze vessels could also be raised from sheet metal by hammering aided by frequent annealing. In some cases the final finish could be given by carefully rubbing down the objects or by turning them up on a lathe. In such cases the lathe marks "could have mostly removed by subsequent honing and polishing". The vessels have mostly flat or semi-flat bases, those with rounded bottoms being kept on separate ring-stands. No effort was generally done to strengthen the rims "by turning the metal down a little all the way round". But the common process of flaring the rim partly added to its stiffness. Plate CXL illustrates[19] the outlines of a few representative vessel-shapes.

The blade-axes were carefully rubbed down after they were hammered because hammer marks survive only in one. Both long, narrow, short, and broad type blade-axes were found. Spear/lance-heads are too thin to be used independently, but they could use by mounting them on bamboo shafts. Arrowheads, small knives and daggers were also found. Razors found were classified into double-blade, L-shaped, hook-shaped and simple-bladed sub-types. Other important tool types include: Saws, sickle shaped blades, fishhooks, chisels, awls and reamers, needles, pot and pans, swords etc.

Harappa

Regarding the chronology, Kenoyer and Miller[6] say, "the Indus Valley Tradition includes all human adaptations in this greater Indus region, from around 6500 B.C. until 1500 BC and later. This Tradition can be subdivided into four Eras and several Phases". The broad types of objects found at the site are the following:

Vessel, adze (one socketed), dagger-knife, spearhead, chisel, sickle, scraper, razor, gouge, nail-parer, surgical or toilet set, cobbler's awl (?), needle, pin, antimony rod, mirror, fish-hook, arrowhead, hasp or a typical Indian Kundi made of a round copper bar, hook, and latch (?). Among the vessels, Vats illustrates a carinated jar from Mound AB Pit II, Stratum II, pl. CXXII, 24-height without cover 7.8 inches, diameter at the mouth 7.7 inches and across the body 11.5 inches which is made in two parts, the upper part being lapped on to the lower one by hammering the two together. Owing to lathing the joint is imperceptible.

The most important find was the jar no. 277 (IIIrd Stratum, Square M11/15, Mound F) which contained the following artefacts (Vats 1940)[20]: 13 blade-axes, 8 narrow and long axes, 2 double-axes, 11 daggers with tapering sides and with or without curved tips, 1 mace-head, 13 spearheads and flaying knives, 1 lance-head, 1 arrowhead, 1 copper, 2 saws, 10 chisels with or without shanks, 2 cast-bars for making chisels, 1 flat strip of metal, 1 stylus, 1 beam of a weighing scale, 1 semi-oval, hollow terminal, 5 solid bangles, 1 rod for making a bangle, 3 hollow bangles, 4 flattened leaves for making hollow bangle, 4 thick rectangular copper-pieces, 1 thin bowl with tapering sides, 2 large folded sheets of copper, 2 thick broken pieces bearing prominent hammer marks, several more thick pieces and 1 small lump of lollingite.

Lothal

According to S.R. Rao[11], the excavator of Lothal, personal ornaments form the bulk of the copper and bronze objects, about 1500 in number. Main types are saws, chisels, blade-axes, spearheads, and nails. Among the personal ornaments

Table 1 : Provisional prehistoric chronology of Harappa

Period 1A and 1B Early Harappan	*c.* 3300-2800 Cal. BC (Ravi-Hakra Phase)
Period 2, Early Harappan/Harappan Transitional (Kot Diji Phase)	*c.*2800-2600 Cal BC
Period 3, Harappan Phase Period 3A	*c.*2600-2450 Cal. BC
Period 3B	*c.*2450-2200 Cal. BC
Period 3C	*c.*2200-?1900Cal. BC
Period 4, Harappan/Late Harappan Transitional	No dates
Period 5, Late Harappan	?-1700 Cal. BC

occurred bengles (one type cast in a mould and with a corrugated edge-average internal diameter 2 inches), rings (both coiled and plain), ear-ornaments (rings and pendants) and beads (including spacer beads and facetted beads). Animal figurines comprised a couchant bull; hare, dog, bird, fowl, etc. Chain-links spoons, a mirror and a carinated jar have also been reported from Lothal.

Rao[11] mentions a small sandstone bowl-shaped crucible used presumably for melting metals and two rectangular slabs of sandstone with groove-like depressions used for casting pins and needles. Three areas seem to be connected with copper crafting/smelting. Five rectangular sink-like brick pavements have been interpreted as a coppersmith's workshop. That they were used by metalsmiths is suggested by the presence of a pot furnace containing ash near each sink as also bits of muffles. The other relevant finds in this area are two terracotta crucibles, small lumps of copper and the crescentic sleeved axe mentioned earlier. A circular kiln of mud bricks (1.8 m diameter and 62 cm deep) is located near the workshop and was possibly used, according to Rao, for the remelting of the ingots. The relevant finds here are an earthenware bowl and large copper sheets, recovered in the form of flattish chunks. A rectangular furnace of burnt bricks was found in a room of a mud brick structure. The contents of the kiln were ash and fragments of terracotta crucible while a cubical stone anvil with signs of use was in situ near the kiln. The presence here of a stone mould for casting pins and awls, a copper pin a broken copper chisel and a hammer stone with a socket for hafting also suggests copper/bronze manufacture.

Banawali

To the excavator (Bisht 1993)[21], the advent of the Mature Harappan (Period II) at the site appears a bit abrupt. Among the tools, there are objects of copper: arrowhead, spearheads, a fragmentary sickle blade, the typical razor, chisels, rings, double spiralled and simple pins, ear/nose rings and fish hooks. There are points, a knife and scrapers of bone. Chert blades and fluted core and flakes are also present. Other objects include clay net-sinkers, balls, pallets, sling balls, longish cones and solid wheels made of clay, besides numerous other household implements.

Chanhudaro

As most of the copper and bronze artefacts found at Chandudaro came from Squares 8B, 8C and 9C Mackay[17] thought that this was 'the quarter of city inhabited by the metal workers'. The main types are: utensils with handles, jar covers, scale-pans and beams, blade-axes, adzes, saws, spearheads, daggers, large and small knives, razors, arrowheads, chisels, fish-hooks, awls, rods tubular drills, ingots and plumb-bobs, similar to those found at Mohnejodaro and Harappa. The scale-beams have slightly thickened ends to prevent the strings holding the pans from slipping off. The blade-axes, both long and short, are inscribed in some cases. The adzes are longer and slender than axes.

Heidi Miller (1998)[22] has studied 521 objects from Chandudaro, out of which 64% are tools, 26% are ornaments, 7% are vessels, and 3% are miscellaneous objects. She hopes that in the future it will be interesting to see if this same broad functional pattern is represented in the assemblages of metal objects from other sites in the Indus Valley, and how this pattern may vary through time and space. Within each category, she distinguishes certain patterns.

For example, out of 37 copper vessels found at Chandudaro, 27 (or almost 73%) were dishes. In the tool category, rod shaped tools make up 52.1% of the sample while blade tools are 47.9%, showing a relatively even distribution between the two shapes. There are 334 metal artefacts classified into 15 tool types and no single type makes up more than 17.2% of the category. There appears to be a range of tool types with no dominating specific type, suggesting that copper alloy tools were used for a variety of purposes. Only three copper objects from Chanhudaro are inscribed: type 14, described by Yule as a 'snarling iron', and two examples of tool type 3A blades.

Dholavira and Other Gujarat Sites

At Dholavira in Kutch even from pre-Mature Harappan levels there is ample evidence of copper working. Further, a well established settlement is indicated by the presence of structures, of which, incidentally, the bricks were in the ratio of 4:2:1, the actual measurement being 36 x 18 x 9 cm (Bisht 1991)[23]. Some of the radiocarbon dates for Rojdi in central Saurashtra (Possehl)[24] take it before the middle of the third millennium BC about which time the Mature Harappan civilisation appeared.

In the western coastal area, Prabhas Patan (Somnath) has yielded the remains of what has been termed as the 'Pre-Prabhas Culture' which on the basis of radiocarbon dates, viz., 2911 BC and 2892 BC, seems to have antedated the Mature Harappan (Possehl)[24]. Padri, in Bhavnagar District, has two radiocarbon dates, viz., 3084 BC and 3680 BC (Calibrated; respectively nos. PRL-1785 and PRL-1787). Yet another noteworthy site in Gujarat to have yielded pre-Harappan remains is Nagwada. Dholavira is a massive site with stone fortification, which has been excavated by Bisht for about a decade. Main Harappan types are: spacers, rings, bangles, blades, arrowheads and chisels.

Rojdi

From Rojdi, a Harappan site from Gujarat, Chitalwala[25] reports the abundant presence of metal tools within the Post-urban, Rojdi C, context within Saurashtra. The main types are axes, bar celt, parasu, bangles, ornaments, pins etc.

Padri

Shinde and Elizabeth[26] report a unique type of fishhook from Padri. "From the surface of the floor of structure 12 was recovered a unique copper fish-hook, which is 14 cm long, with a barbed point and a loop on the other end. It weight 45 gm. Such a large fishhook would probably be used to catch large marine fish".

Surkotada

The site yielded 129 objects, besides a hoard containing an unspecified number of beads and bangles[27]. The main types are: simple blade and crescent-shaped blade, long or short chisel with rectangular-section long and narrow blade, arrowhead, knife with thin leaf-shaped blade, drill, spearhead with a tang, lid with raised edge, socketed axe, fishhook, antimony rod, bangle, ring, ear-ornament, hook and chain. In addition, fragments of a crucible have been found.

Hakra-Ghaggar Basin

In the Hakra Ghaggar area, there was a considerable increase in the size of the Mature Harappan settlements in the region. Kalibangan on the bed of the Ghaggar is in District Hanumangarh, Rajasthan. It has a large mound on the east and a relatively smaller one on the west. Altogether the three mounds have a periphery of about 1.5-2 km. Kalibangan Period II is typically Mature Harappan and Period I, is Early Harappan (Lal)[28]. Even the pre-Mature Harappan settlement was fortified. Even from the limited excavated area Period I yielded an axe, a parasu and a bangle of copper/bronze.

Banawali is located about 120 km from Kalibangan in District Hissar, Haryana, on the right bank of the Sarasvati. Excavations carried out by R.S. Bisht[21,23] have brought to light three cultural periods: I pre-Mature Harappan; II - Mature Harappan; and III - post-Mature Harappan. Period I of Banawali yielded an arrowhead and a fish-hook of copper, beads variously of carnelian, lapis lazuli, steatite, and clay, bangles of shell, faience and clay and two spatulae and a handle of bone.

Kunal, in District Hissar, not only has the pre-Mature Harappan pottery but also an extraordinary yield of a variety of ornaments in gold and silver (Khatri and Acharya)[29]. These include spiral bangles, 'crowns' and discular beads with axial perforation - all of silver and over twelve thousand beads variously of carnelian, agate, lapis lazuli, steatite and shell.

However, the site did not yield any Mature Harappan, assemblage. Three radiocarbon dates place the pre-Mature Harappan occupation at Kunal in the first half of the third millennium BC.

Indus Trade and Meluhha

The Mesopotamian texts refer to trading and supply centres like Dilmun, Magan and Meluhha. Without going into this polemics, we would like to mention that there is general consensus about identifying Dilmun with the Bahrein area and Meluhha with the Indus region. We have however made a case of identification Meluhha of the Mesopotamian texts specifically with the Jodhpura Complex area. With its rich copper and tin mineral hinterland and evidence of a large number of Harappan vintage artefacts, the Jodhpura Complex has a clear claim to such identification. With the recent discovery of tin mines in Haryana, the importance of Jodhpura Complex as the manufacturing centre gets enhanced.

Table 2 : Artefacts from Haryana and Punjab Sites

Sites	Artefacts
Bara	bead, fish-hook
Bhagwanpura	rod
Dadheri	chisel, hook
Daulatpur	bangle, fish
Hulas	bangle, chisel, ring and wire
Mitathal II B	several pieces of bangle, flat
Raja-Karan-Ka-Qila	Spearhead
Sanghol	chisel, Celts, 1 Parasu

Late Harappan Repertoire

The late Harappan levels are stratigraphically established at many excavated Mature Harappan or Indus civilisation sites. The quantity of metal used is now limited and no new tool-type seems to appear

Daimabad Bronzes

We will discuss the big statuary bronzes discovered from the site. The types are: man driving a chariot, elephant, buffalo, rhino, and bull. About these bronzes, we have to be careful. We have to note that: 1. They do not have lead in any significant quantity compared other Harappan artefacts. 2. They show significant presence of As, in contrast to the Chalcolithic artefacts. 3. In typology they are totally different than any objects found in protohistoric India 4. They are very heavy - some weighing 29 kg! – and so much of precious metal was never used

Table 3 : Copper objects from Daimabad

Phase Objects	I	II	III	Overlap III/IV	IV	Overlap IV/V	V	Total
Bangles	2	x	x	x	2	3	8	15
Chisel	x	x	x	x	1	x	x	1
Celt (frg.)	x	1	x	x	x	x	x	1
Spearhead	x	x	x	x	1	x	x	1
M. Goddess	x	x	x	x	x	x	2	2
Rect. piece	x	x	x	x	x	x	1	1
Trap. piece	x	x	1	x	1	x	x	2
Razor	x	x	x	x	1	x	x	1
Wire	x	x	x	1	x	x	1	2
Lump	x	1	x	x	x	x	1	2
Slag	x	1	1	x	x	x	x	2
Total	2	3	2	1	6	3	13	30

in statuary in the whole Harappan or Chalcolithic repertoire. Such large-scale use of metal on statuary is known in India from Historical period only. Spending so much of metal on non-utilitarian artefacts goes totally against the grain of the Harappa culture. We know of tiny animal figures and the dancing girl which weigh only a few grams. If we take into account all these facts and also the fact that the discovery is not at all from a controlled excavation but an accidental find, I don't think one can include these finds among the Harappan artefacts.

We will therefore not enter into further discussion about these bronzes here. From the Daimabd excavations Sali reports a number of copper artefacts as given in Table 3.

The Copper Hoard Culture

A variety of copper tools, mostly in hoards, hence the name Copper Hoards, were accidentally discovered from a number of sites in Uttar Pradesh, Bihar and Madhya Pradesh. The hard core of the Copper Hoards consists only of the anthropomorphy, the harpoon, the hooked sword, and the antennae sword. These types are found associated together: for example, at Bisauli harpoons and anthropomorphs occur together; at Bithur antennae swords and harpoons are associated; antennae swords and anthropomorphs were found together at Fatehgarh. The hooked sword was associated with the other three types at Fatehgarh, Sarthauli, Bahadurabad and Noir.

In our recent analysis of Copper Hoards, 46% artefacts showed arsenic alloying (up to 7%) which marks them apart from the Chalcolithic artefacts where no arsenic alloying was resorted to (Rapp 1986)[30]. On the other hand, only a small percentage (8%) of the analysed Harappan artefacts shows arsenic alloying. The Copper Hoard people used closed moulds for casting, employed cold work and annealing; however, no pots and pans were known. There are no ^{14}C dates are available for the Copper Hoard culture.

Copper Hoards in Kumaun

There are three significant finds of Copper Hoards from Kumaun, one from Bankot, the other from Haldwani, and one from Pithoragarh. In 1989 at Bankot, a hoard of 8 anthropomorphic copper objects was discovered while digging a stone quarry close to the Bankot Inter College. These anthropomorphs have an oval shaped head and their arms spread horizontally across the body. It may be noted however that there are no traces of mining and smelting activity within 10 km area of Bankot. The Bankot copper anthropomorphs contain 98% copper, 1.22% iron, and a minor impurity of arsenic. It appears that they were made in an open, single mould, probably made of stone as their measurements show some uniformity. Their obverse side shows some gas cavities, which suggest that they were made in an open mould, without green poling, and left unfinished. The so-called Bankot anthropomorphs could simply be copper ingots as their weights suggest. We need to note here that the Bankot specimens are a bit crude type and have stub like arms, unlike the typical anthropomorphs of the

Doab. They are either in the range of 3.4 + 0.1 or 2.4 + 0.1 kg (Agrawal and Kharakwal 1998: Agrawal 1999).

Ganeshwar Culture

In my view, the Ganeshwar Complex, holds clue to the Harappan copper artefact supply. The Ganeshwar complex artefacts probably represent a manufacturing activity. The probably catered to the Banas Culture and the Harappa Culture. More than 5000 artefacts have been reported from a small area. Their nearness to the rich copper ores of Rajasthan perhaps explains the abundance of artefacts here. It may however be noted that no typical Ganga Doab type anthropomorphs, swords etc., have been reported from the Ganeshwar area. The following discussion is mainly based on Agrawala[34] and Hooza and Kumar (1997)[32].

In 1977 Agrawala located a Copper Age site at Ganeshwar[33], 75 km from the actual Khetri copper deposits of Ahirwala-Chiplata. Baleshwas and Dariba mines are within 10 to 15 km from Ganeshwar. From this site he discovered some copper arrowheads (without any holes) and a spearhead (Agrawala 1984)[34]. In fact, the supply of copper to the site of Mitathal seems to have been from the Ganeshwar-Narnaul region. A number of copper deposits are still available all along the Dohan river as well[34]. The copper celts from Ganeshwar measure 20 to 25 cm in length and weigh between 1 and 1.5 kg. The Geological Survey of India has given the following analysis of a typical copper celt:

The copper arrowheads from Ganeshwar, were cut out of thin sheets, perhaps with a sicssors-like instrument as the arrowheads are quite thin. They were mounted on wooden sticks or reed shafts with a vertical slit at one end, and fastened with the help of a white glue which is still to be seen on most of them. At some places, the marks of decayed wood are seen quite clearly. The copper percentage in the Ganeshwar arrowheads is 96.5; arsenic being 1% and tin only 0.2%. The Ganeshwar types of arrowheads are available from the Harappan levels at Banawali, in Haryana, as well.

Geological Survey of India has analysed an arrowhead from Ganeshwar: copper 96.5%, silver 0.3%, arsenic 1%, lead 0.03%, tin 0.2%, nickel 0.04%, zinc 0.25%, iron 0.2%. Thus with such a rich repertoire of copper artefacts and abundant mineral resources, the Ganeshwar Complex seems to have played a pivotal role in supplying copper artefacts and ingots to the Harappans and the Banasians,

Table 4 : Composition of Ganeshwar celt

Copper	97%
Silver	0.2%
Lead	1%
Arsenic	0.3%
Tin	0.01%
Nickel	0.6%

and perhaps has nothing to do with the Gangetic Copper Hoards. With the discovery of Tushan tin mines nearby (Kochar et. al. 1999)[35], Ganeshwar Complex assumes more importance for the Harappan metal supply. We have therefore suggested that the Ganeshwar Complex be identified with Meluhha (Agrawal and Kharakwal)[36].

Chalcolithic Metal Technology

The Chalcolithic cultures in India include non-urban, non-Harappan cultures characterised by the use of copper and stone. These cultures make their first appearance at the turn of the second millennium BC. These cultures show a distinct regional identity, probably determined by smaller ecological units. South-eastern Rajasthan gives rise to the Banas culture, the Malwa region to the Kayatha culture and the Malwa culture and the mid Gangetic valley to the Ochre Coloured Pottery (OCP) culture. The main difference among these cultures lies in their characteristic ceramics, though economically they have a similar status. A limited amount of copper and an abundance of lithic blades mark most of these culltur[37,38,39]. Below we give a brief account of these cultures with emphasis on metal technology. V.N. Misra at Balathal, near Udaipur has conducted the most recent excavations in Rajasthan.

The Banas Culture

Ahar, a Banas Culture sites is a fairly big mound: 500 x 270 x 13 m and was anciently known as Tambavati (a city of copper), indicating its richness in copper. The excavators into Periods I and II have divided the thirteen meter deposit at the site. Ahar five axes, one knife blade, one sheet, a bangle and two rings of copper have been found. The copper technology however seems to be poor compared to the Harappans.

The axes have blowholes and there is no evidence of work hardening. Agrawala[31] claims that the copper objects from the excavation at Ahar near the town of Udaipur, were prepared from the copper ores available near Ahar. Old copper workings are very well attested to by the heaps of copper slag lying scattered within a radius of 100 to 150 m between the Matoon and Umra mines. The discovery of a copper furnace at Ahar is therefore not surprising. The copper objects include bangles, rings celts, etc. The copper celts from Ahar are, however comparatively thin and small in size, the maximum length is 13 cm, the width of the butt end 8.3 cm and the maximum thickness is 0.5 cm. From Sadali in Chittor district - six copper celts[33] which measure between 20 and 25 cm in length and weigh about one kg each, as compared to about 240 gm of weight of the Ahar celts, were discovered.

The Ahar choppers (Parasu) also bear resemblance to a curved blade from the Pre-Harappan levels at Kalibangan. In fact, this was an object of great utility and bears resemblance with the modern gandasa of frequent use in the Punjab, Haryana, U.P. etc., for cutting stalks of wheat, etc. The available ^{14}C dates suggest a *c.* 2000-1400 BC bracket for the Banas culture.

Balathal

Misra et.al.[39], have recently excavated the Balathal site, near Udaipur. It seems to be the earliest Chalcolithic site of Rajasthan. It has yielded evidence of fortification, incipient urbanisation and a rich repertoire of pottery, and some copper artefacts too.

"The first two seasons yielded about a dozen copper-bronze objects comprising choppers, knives, razors and one specimen each of a chisel, a tanged and barbed arrowhead, and a six-petalled flower-like object and bits of copper. In the last two seasons, however, the number of metal objects and beads of semi-precious stones are very few"[39].

Kayatha Culture

Kayatha, situated on the bank of the Kalisindh, an affluent of the Chambal gives the culture its name. The Kayathans, it seems, were quite well off in copper as from one pot alone twenty-eight copper artefacts were recovered. The two copper axes with a sharp cutting edge and a lenticular section are the finest examples in the Bronze Age India.

The axes are cast in a mould unlike the later Chalcolithic specimens, which were just hammered to shape in Central India and the Deccan. A chisel is also reported from here. A Bagorian type copper arrowhead was found in the upper levels of the Kayatha. The were using bronze bengles 28 of them were found in a hoard. Two necklaces, two celts, 28 bangles and several thousand steatite beads were found from one rectangular room. (Wakankar)[40].

Mawa Culture

Malwa is the main seat of the Malwa and the Kayatha cultures and even the Banas culture extended here. The Malwa Ware, use of copper and stone tools, and small settlements of wattle and daub huts marks the Malwa culture. Though few in numbers, flat copper celts with convex cutting edges, arrowheads, spearheads and chisels from an important part of the tool repertory. Except for the mid-ribbed sword, which must have been cast, other objects appear to have been hammered to shape? Artefacts like blades, bangles and rings were also made of copper. These people knew the cold work and annealing techniques. A comparison of the trace chemical impurity patterns of ores and these artefacts has been carried out to locate the copper mines used. Tin was alloyed up to 3% and lead to about 2%.

The Jorwe Culture

Inamgaon: It is a Jorwe Culture sites. One interesting find of a copper punch has been reported from Inamgaon. It is 6.5 cm long and 1.4 cm thick. This was perhaps used for detaching stone flakes (Dhavalikar et. al.)[41]. Very few artefacts have been chemically analysed. An axe from Jorwe and a chisel from Navasa show 1.8-2.8% tin alloying.

Chemical Analyses

Rapp (1988)[30] has carried out chemical analyses of Chalcolithic artefacts. Table 5 presents thirteen new analyses from the Chalcolithic of India. As can readily be seen, ten of the samples are unalloyed copper (less than 1% if any alloying element), whereas the remaining three (numbers 1, 6, and 10) are arsenic bronzes with 2.06%, 2.40% and 4.84% arsenic, respectively.

In only one specimen (number 5) tin was present in an amount greater than 0.03%, and in this specimen it was less than 0.2%. Zinc is not abundant in these Indian Chalcolithic artefacts. In six of the ten artefacts not considered to be alloyed copper, the percentage of arsenic still ranges from 0.13% to 0.68%. Lead is present in amounts greater than 0.11% in six of the ten specimens. Nickel is present in concentrations about 0.11% in only three of the ten, and antimony is present in only one of the ten. Specimens 1 and 11 contain 2.5% and 2.6% iron, respectively. Specimen 11 showed an iron content of only 0.15% when reanalyzed

Table 5 : Analyses of Chalcolithic Metal artefacts from India (After Rapp 1988)

Lab. No.	Locality	Cu %	Sn. ppm	Zn ppm	As ppm	Pb ppm	Sb ppm	Ni ppm	Fe ppm	Item
1	Ahar	88.65	7.74	296	20,650	5,340	2,460	5,950	25,710	Copper axe
2	Navadatoli	99.91	10.4	<47.9	32	6.7	351	235	<47.6	Copper axe
3	Chandoli	100.9	42.5	<44.5	4,420	689	34.3	40.4	<44.3	Copper axe
4	Jorwe	99.11	135	<49.6	6,810	365	42.7	179	402	Copper axe
5	Nevasa	96.9	1,985	<50.1	1,300	1,180	44.5	38.8	289	Copper bangle
6	Kayatha	95.56	<5.8	<49.8	24,000	1,220	213	1,120	1,360	Copper bangle
7	Inamgaon	98.23	181	51.4	1,840	6,490	30	591	<80	Copper anklet
8	Inamgaon	99.12	119	<49.4	53.3	463	45.7	102	<77.7	Copper bangle
9	Inamgaon	98.84	29.4	<52	490	439	45.8	69.8	<81.2	Copper anklet
10	Inamgaon	95.45	61.4	<39.4	48,400	707	37.9	3,500	<125	Copper bangle
11	Inamgaon	96.2	171	41.4	641	3,680	22.9	90.2	26,100	Copper bangle
12	Inamgaon	99.9	244	<34.7	1,390	3,570	39.1	206	<110	Copper anklet
13	Inamgaon	99.84	308	<33.1	1,610	676	34.1	124	<105	Copper anklet

after the ferromagnetic particles were removed. Of the three arsenical coppers one was a weapon and two were ornaments.

CONCLUSIONS

Through this survey of the archaeological cultures of the 5th to 2nd Millennia BC, we have traced how metal technology has been part of the repertorie of the technologies pertaining to ceramics, stone industry, and even architecture. No doubt, first use of copper must have been of native copper. With the growth of urbanisation, especially of the Indus civilisation, the abundance of metal and technological advances progressed by leaps and bounds.

Though we know a lot about the typology of artefacts, we know very little about the technologies used. What were the sources of metal? What techniques different cultures used to make their artefacts? What has been the mining technology used through the millennia? We have to admit that without exhaustive archaeometallurgical studies, such questions can not be adequately answered. A lot remains to be done: relating ore bodies to the artefacts, metallographic studies to know the techniques of artefact making, alloying pattern and if they were deliberate or an artefact of minerals used, geochemistry of ore bodies to devise ways to finger-print them through trace impurity patterns and lead isotope geochemistry, etc. No less important are the ethno-archaeological studies to understand the man behind the technology and his artefacts. I am sure, with the coming together of metallurgical labs and the archaeologists a lot more can be achieved.

REFERENCES

1. Hargreaves, H., 1929. Excavations in Baluchistan, 1925. Memoirs of the Archaeological Survey of India No. 35. Calcutta: Government of India Press.
2. Khan, F.A., 1965. Excavations at Kot Diji. Pakistan Archaeology 2: 13-85.
3. SanaUllah, M., 1940. The sources, composition, and techniques of copper and its alloys. In Excavations at Harappa, Ed. M.S. Vats. Delhi: Goverments of India Press. pp. 378-382.
4. Wheeler, R.E.M. Mortimer. ,1968. The Indus Civilization (ed. 3rd); Cambridge; Cambridge University Press.
5. Agrawal, D.P., 1971. The Copper Bronze in India. New Delhi: Munshiram Manoharlal.
6. Kenoyer, J.M and Heather M,-L. Miller., 2000. Metal technologies of the Indus valley tradition in Pakistan & Western India. In: The Archaeometallurgy of the Asian Old World. Ed. Vincent C. Pigott. University of Pennsylvania Museum Monograph 89. Philadelphia: University Museum Publications.
7. Fentress, M.A., 1977. Resource Access, Exchange Systems and Regional Interaction in the Indus Valley: An Investigation of Archaeological Variability at Harappa and Moenjo Daro. Ph.D. disseration, University of Pennsylvania. Ann Arbor, MI: University microfilms #77-10, 163.
8. Dales, G.F and Kenoyer, J.M., 1989. Preliminary report on the fourth season of research at Harappa, Pakistan. University of California-Berkeley and University of

Wisconsin-Madison. Unpublished manuscript.

9. Kenoyer, J.M., 1992b. Ornament styles of the Indus tradition: evidence from recent excavations at Harappa, Pakistan. Paleorient 17(2): 79-98.
10. Hegde, K.T.M., 1969. Appendix I: Technical studies in copper artifacts excavated from Ahar. In Excavations at Ahar (Tambavati) 1961-. Eds. H.D. Sankalia, S.B. Deo and Z.D. Ansari. Poona: Deccan College. pp. 225-228.
11. Rao, S.R. 1985. Lothal: A Harappan Port Town (1955-62), Vol. 2. Memories of the Archaeological Survey of India No. 78. New Delhi: Archaeological Survey of India.
12. Miller, H. M.-L., 1994. Metal processing at Harappa and Mohenjo-daro: information from non-metal remains. In South Asian Archaeology 1993. Eds. A. Parpola and P. Koskikallio. Annales Academiae Scientiarum Fennicae;Series B, Vol. 271. Helsinki: Suomalainen Tiedeakatemia. pp. 497-510.
13. Miller, Heather M.-L., 1997. Locating ancient manufacturing area: high temperature manufacturing debris from surface surveys at Harrappa, Pakistan. In South Asian Archaeology 1995. Eds. Raymond and Bridget Allchin. Delhi: Oxford & IBH. pp. 939-946.
14. Miller, Heather M.-L., 1999. Pyritechnology and Society in the Cities of the Indus Valley. Madison: University of Wisconsin Unpublished Thesis.
15. Berthoud, T and Cleuziou, S., 1983. Farming communities of the Oman peninsula and the copper of Makkan. Journal of Oman Studies 6(2): 239-245.
16. Hauptmann, A and Weisgerber, G.P., 1980b. Third millennium BC copper production in Oman. In Revue d'Archeometrie: Actes du XX Symposium International d'Archeometrie, Symposium for Archaeometry, Paris 26-29 Mars 1980, Vol.III. Bulletin de Liaison du Groupe des Methodes Physiques et Chimiques de l'Archeologie. pp. 131-138.
17. Mackay, E.J.H., 1937-38. Further Excavations at Mohenjodaro. Voll. I text, Voll. II plates. Delhi: Government of India Press.
18. Chakrabarti, Dilip and Lahiri, Nayanjot.,1996. Copper and its Alloys in Ancient India. Delhi: Munshiram Manoharlal.
19. Marshall, J., 1931. Mohenjo-daro and the Indus Civilization. Vol. I, II text, Vol. III plates. London: A. Probsthain.
20. Vats, M.S., 1940. Excavations at Harappa. Delhi: Govt. of India. 2 Vols.
21. Bisht, R.S., 1993. Excavations at Banawali: 1974-77. In Harappan Civilisation. Ed. G.L. Possehl. Delhi: Oxford & IBH. pp.113-124.
22. Miller, J. Heidi., 1998. A functional typology for metal objects from Chanhudaro. In South Asian Archaeology-1997. Ed. M. Taddei. pp. 3,6-7, 11-12.
23. Bisht, R.S., 1991. Dholavira: new horizons of the Indus civilization. Puratattva 20, pp.71-82.
24. Possehl, G.L., 1999. The Indus Age. Delhi: IBH & Oxford Publishers.
25. Chitalwala, Y.M., 1989. The small finds. In Harappan Civilisation and Rojdi Eds. G.L. Possehl and M.H. Raval. Delhi: Oxford & IBH. pp. 157-197.
26. Shinde, V.S and Thomas, Elizabeth., 1993. A unique Harappan copper fishhook from Padri, Gujrat. Man and Environment 18, pp. 145-147.
27. Joshi, J.P. .1990. Excavation at Surkotada 1971-72 and Exploration in Kutch. New Delhi: Archaeological Survey of India.
28. Lal, B.B., 1997. The Earlist Civilisation of South Asia. Delhi: Aryan Books International.

29. Khatri, J.S and Acharya, M., 1995. Kunal: a new Indus-Saraswati site. Puratattva 25, pp. 84-86

30. George, Rapp., 1988. On the origins of copper and bronze alloying. In The Beginning of the Use of Metals and Alloys, Ed. R. Maddin. Boston: MIT. pp. 22-27.

31. Agrawal, D.P., 1984. Metal Technology of the Harappans. In Frontiers of Indus Civilization. Eds. B.B. Lal and S.P. Gupta, New Delhi: Books and Books, pp. 163-168.

32. Hooja, R and Kumar, V., 1997. Aspect of the early copper age in Rajasthan. In South Asian Archaeology: 1995. Eds. Raymond and Bridget Allchin. New Delhi: Oxford & IBH. pp. 323-339.

33. Agrawal, R.C., 1979. More copper finds from Rajasthan. Man and Environment 3, pp. 91-92.

34. Agrawal, R.C., 1984a. Aravalli, the major source of copper for the Indus Civilization and Indus related cultures. In Frontiers of the Indus Civilization. Eds. B.B. Lal and S.P. Gupta, New Delhi: Books and Books, pp. 157-162.

36. Agrawal, D.P and Kharakwal, J.S., 1998. Central Himalayas: an Archaeological, Linguistic and Culural Synthesis. New Delhi: Aryan Books International.

37. Misra, V.N., 1970a. Evidence for a new Chalcolithic culture in South Rajasthan. Indian Antiquary NS, (Festschrift Sankalia). pp. 85-95.

38. Misra, V.N., 1970b. Cultural significance of three copper arrowheads from Rajasthan, India. Journal of Near Eastern Studies 29(4), pp. 221-232.

39. Misra, V.N., Shinde, Vasant., Mohanty, R.R., Dalal, Kurush., Mishra, Anup., Pandey, Lalit and Kharawal, Jeevan., 1995. Excavations at Balathal: their contribution to the Chalcolithic and Iron Age cultures of Mewar, Rajasthan, Man and Environment 20(1), pp. 57-80.

40. Dhawalikar, M.K., Sankalia, H.D and Ansari, Z.D. 1988. Excavataions at Inamgaon. Vol. I. Pune: Deccan College.