Chapter-5

(Use of Various Objects in Daily Life & their Technology)
IRON OBJECTS

The people of the entire northern India became familiar with the use of iron much before the beginning of the Mauryan period. However, the period between c.600 - 320 B.C witnessed the spurt in the use of iron, both, spatially and technologically. The iron objects excavated in various forms (Table No 3 & 4), such as arrow-heads, spear-heads, daggers, chisels, tongs, adzes, plough-shares, spades, sickles, diggers etc. at different sites belonging to this phase provides a record of their extensive use.

According to Sahi, the above mentioned objects can broadly be divided into four categories on the basis of their use:

1. Weapons used for warfare or hunting.
2. Household objects.
3. Craft tools.
4. Objects used in agricultural operations.

But Tripathi's classification is slightly different,
### DISTRIBUTION OF VARIOUS IRON OBJECTS FROM SOME IMPORTANT ARCHAEOLOGICAL SITES OF NORTHERN INDIA BETWEEN C. 600-320 B.C.

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Table No. 3
**NUMBER OF IRON OBJECTS FROM SOME IMPORTANT SITES**

**BETWEEN c.600 B.C. – 320 B.C.**

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Table No. 4
(i) Hunting tools.

(ii) Agricultural tools.

(iii) House holds objects.

(iv) Building materials.

On the basis of reported objects of iron in the period under study, we can assess that Sahi’s categorization is preferable.

(i) Weapons used for warfare and hunting: Tools of warfare and hunting basically consisted of arrowhead, spearhead, dagger and javelin or lance. Iron, here in India was first used for making weapons. Most probably, these weapons were first used for hunting which provided an essential ingredient in the form of meat for the dietary need of the people, and that too along with older and time tested tools of bone, copper or stone. Later the emergence of larger kingdoms led to the creation of standing armies necessitating the use of weapons of warfare.

These iron weapons have been found in use from the kingdoms of Kuru, the upper part of Ganga Yamuna Doab of the Panchala in Bareilly, Badaun, Farrukhabad, the adjoining region of Rohikhand and the central Doab of the Matsyas of Bharatpur, Jaipur and Alwar and then of Madras of Punjab\(^3\). Amongst these political units the

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\(^3\) Raychaudhuri, H C., 1972, Political History of Ancient India. Calcutta. p 21
possession of largest number of weapons may be a matter of speculation. However, our study shows that the archaeological site of Atranjikhera, (Table No 4) which comes under the ancient Panchala kingdom, has yielded the largest number of iron weapons discovered so far. Perhaps this has some relevance to the problem. As such the kingdom of Panchala may have enjoyed an edge over the other contemporary kingdoms.

The use of the arrow and spear as weapons of warfare and hunting are also corroborated by the literary evidence of the related period. The general term used for weapons is praharana in Sanskrit literature. The most common word for the arrow in Vedic literature is isu. Similarly, the Ashtadhyayi of Panini has described different types of arrows along with spear (sakti), long and short lances (kasu and kasutari) battle axe (parasvadha). Various kinds of weapons, which were used for defensive and offensive purposes are also documented in Buddhist literature. Arrow as sara, battle axe.

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4 Sharma, R S , 1983, Material Culture and Social Formations in Ancient India New Delhi, p 72
6 Rigveda, II 24 8, III, 7 4, Atharva Veda, 1-13 4, Vajasaneyi Samhita XVI-3 Yaksa’s Nirukta, IX 8
7 IV 2 38
8 IV 4 59
9 V 3 90
10 IV 4 58
11 Mehta, Ratilal N , 1939, Pre-Buddhist India, Bombay, p 171
as pharasu or kuthari\textsuperscript{12}, jevelin as tamara\textsuperscript{13} and sword as khagga\textsuperscript{14} are mentioned in it. Beside these weapons, the shafts of iron arrowhead reported at Taxila made of reed are corroborated by the following important literary sources. First, the Mahabharata\textsuperscript{15} mentions that most of the arrow shafts were made of reed. Secondly, Herodotus\textsuperscript{16} also mentions that Indians in Persian army were armed with cane arrows tipped with iron.

(ii) House hold objects: The house hold objects mainly consist of knives, knife blades, bangle, ring, razor etc. Almost all the knives seem to have tangs with sharp edge on one side of the blade. The excavator of Piprahwa and Ganwaria discovered knife which he describes as “of interesting shape with straight tapering blade with flattened projection to fit into a wooden handle”\textsuperscript{17} The later Vedic literature mentioned asi\textsuperscript{18} as iron knife, which was used for cutting the animal flesh. However, knife has been reported as household objects in early Buddhist sources\textsuperscript{19} It is very significant to note that the knives made of copper, which were in great use during

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\textsuperscript{12} Jataka I, p 273, II, p 102, IV, p 208  
\textsuperscript{13} Jataka VI, p 400  
\textsuperscript{14} ibid  
\textsuperscript{15} 7 74 8  
\textsuperscript{16} Herodotus, VII 65, Forbes, R J, Metallurgy in Antiquity, Leiden, p 435  
\textsuperscript{17} Singh, Purushottam, 1996, Excavation at Piprahwa and Ganwaria, Memories of Archaeological Survey of India, No 94, New Delhi, pp 253 – 257  
\textsuperscript{18} Atharva Veda, IX 5 4  
\textsuperscript{19} Srivastava, Priya and Tripathi, V , 1998, 'Iron in Early Buddhist texts', in Archaeometallurgy in India, ed by V, Tripathi Delhi, pp 339-345
Harappan and post-Harappan period started disappearing in due course of time. No trace of copper knife from any of the archaeological sites pertaining to the period of our study Atranjikhera fully illustrates our contention (Table No.9). It seems that in this period iron replaced copper for making knife. But it is hardly applicable in case of bangles made of copper because the copper enjoyed its dominant position in making bangles With the help of available archaeological findings, we can make out that the bangles of iron as ornaments were probably used by the poor section of society, because, if they could afford to wear copper bangles, they might have not preferred crude and blackish iron. Perhaps at this very early stage iron may have come to be known for its medicinal or religious significance.

(iii) **Craft tools:** In the category of tools related to craft, we can enlist the objects like nail, chisel, bar/rod, tong, adge, hook, borer, pipe etc. In this sub-phase the wide spread use of chisel and nail proves the use of these objects in carpentry and masonry works Chisels, which were used, probably for carpentry were of lighter type and had a tapering pointed top to be fitted into wooden handle Besides, chisels of heavier type, may have been used to shape hammer stone, grinder, mullers and pestles and other stone objects and also for cutting the iron bar.
The nails documented here are generally broad flat heads with pointed end. The nails recovered from Tripuri are of different nature, which can be divided into two kinds. Under the first category, the long tapering bars were circular in section with flattened head, and the second were roughly square in section with prominent head. When recovered, it appears to have been fitted on timber, among them several were found to have their ends turned upwards according to the height of wooden portion in which they were fitted. The average length of short circular nails ranges from 3-3½ inches, while the square ones are slightly longer about 5-5½ inches in length.

But in comparison to other craft tools, the chisels and nails are available to us in good number, which were probably used by carpenter in the construction of houses of wood. Probably the houses made of sala (Tectona grandis) wood has been the basis of Sharma's postulation that the word sala had come to denote houses in the literature of the period.

(iv) Object used in Agricultural operations: The tools like plough share, sickle, spade, and digger can be discussed under the category of implements related with agricultural operations (Plate No 4). In

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21 Sharma R S, *op cit*, p 107
Ashtadhyayi the term hala\textsuperscript{22} has been used for ploughshare. This consisted of three parts, as it can be seen today. This word hala is still in use in the dialect of the people of Gangetic Valley. The word datra\textsuperscript{23} and lovitra\textsuperscript{24} is used by Panini for reaping implements with short handle and semi circular blade. This description fits in with a sickle. In this regard, it is significant to note that most of the agrarian tools so far discovered are from the upper Ganga Valley. But surprisingly enough, we find acute paucity of tools of the same kind in the contemporary middle Ganga valley especially, from the area which now constitutes modern Bihar. This may be due to the climate of this area which is not favourable for the preservation of iron\textsuperscript{25}. But such type of hypothesis is completely contradicted by the finds of nails and similar kind of other small objects from the same region. It is also a question of inquiry as to how and why the agricultural objects mainly ploughshare perished where as other objects of the same material were not affected by the climate. In this context it would be more plausible to assign a distinct and fresh reason for the absence of ploughshare in the stated areas of Bihar. Thus it may be safe to say that this paucity is noticed because of the restricted use of iron ploughshare in agricultural activities.

\textsuperscript{22} III 2 183, IV 1 42
\textsuperscript{23} III 2 184
\textsuperscript{24} ibid
\textsuperscript{25} Sharma, R S , op cit, pp 93-94
The large number of agricultural tools during the period under consideration is neither supported by literary sources nor by archaeology. Findings reveal that iron metal was not used on a large scale for agricultural purposes. Upadhayaya\textsuperscript{26}, on the basis of documented iron objects from various sites of Northern India between c.600 B.C. – 200 B.C. reached to the conclusion that out of the total finds of iron objects, 36.5% objects related to war and hunting, 35.5% with various craft tools which were used by carpenters, smiths and masons, 18% with house hold implements and only 10% of the total with agriculture, whereas, in pre c 600 B.C 47.9% iron objects were related with house hold objects, 35.1% with war and hunt, 11.9% with various craft and 4.8% with agricultural implements.

\textbf{Tabular Representation of the Above Statement}

\begin{tabular}{|c|c|c|c|}
\hline
 & War & Craft tools & Household objects & Objects of agriculture \\
\hline
pre. 600 B.C. & 35.1\% & 11.9\% & 47.9\% & 4.8\% \\
\hline
600-200 B.C. & 36.5\% & 35.5\% & 18\% & 10\% \\
\hline
\end{tabular}

\textbf{Table No.5}

This dismal figure is, perhaps, because all peasants could not afford metal implements for all types of agricultural operations.

\textsuperscript{26} Upadhayaya, Jagadamba Prasad., 2000, \textit{Metal Implements in Ancient India}, Delhi, pp 242 - 245
In the light of the above discussion, it is difficult to agree with Sharma\textsuperscript{27}, that iron played an important role in bringing about the second urban revolution in northern India. On the basis of the above assumption we may, however, note that the urban revolution was not in consequence to the spurt in agricultural development aided by iron tools and implements. It is evident from Harappa that, even without the use of iron ploughshare surplus production in agriculture was possible as proved by the discoveries of granaries at different sites. The use of wooden ploughshare during Harappan times could make significant surplus in agricultural productions. This perception is also strongly corroborated by the fact that even as late as 1951 about 31.3 million wooden ploughshare was used in agricultural activities.\textsuperscript{28} In comparison to this, the survey shows that the iron ploughshare used in the same period and for the same purpose numbered 9.3 million is far less than the previous number\textsuperscript{29}. Lastly, it may be pointed out that the above study is based on the limited availability of archaeological data, as many of the reported sites do not provide us the detailed statistical figures for more substantial conclusion.

\textsuperscript{27} Sharma, R.S., \textit{op.cit.}, p.72.
\textsuperscript{28} Chandra, Bipin, 1990, \textit{Modern India}, NCERT, New Delhi; p 146
\textsuperscript{29} \textit{ibid.}
IRON TECHNOLOGY

The earliest smelted piece of iron belongs to c.5000 B.C and has been reported at Samara in modern Northern Iraq. It is 4.30 cm long. Evidence of smelted iron in such an early context is indeed a remarkable discovery. It is followed by the findings of three balls of iron from Tape Sialk in Iran. Which has been discovered from a habitation level of period II dated 4600-4100 B.C.¹ Here, in India it is generally believed that the use of iron started first by the people of PGW culture in c.1200-1100 B.C. But this theory is no longer tenable today. There is definite evidence of iron from pre-PGW level at Noh in Rajasthan. Sahi², traces the beginning of iron smelting in India on the basis of the evidence from Noh in early sixteenth century B.C. In other regions, iron is reported from the chalcolithic phase of central India, Bengal, Bihar, southern U.P. and with the megaliths in parts of south India³.

Iron working as practiced during the period under discussion is not easy to reconstruct. It is even more difficult due to the fact that it requires breaking of furnaces at least partially after acquiring the

¹ Tripathi, V., 2001, The Age of iron in South Asia, legacy and tradition, New Delhi, p 8
³ Tripathi, V, op.cit., p.65
iron⁴. The fragmentary remains that come to light during the excavation is not very helpful. However, Banerjee⁵ on the basis of the archaeological remains identifies three types of furnaces.

The first, commonly found in South India, was conical in shape and circular in plan. They were 2-4 ft. (61-122 cm.) tall, about 10-15 inches (25-38 cm.) across at the base and 6-10 inches (15-25 cm.) at the top. They had two openings at the bottom.

The furnaces of second type, reported mostly from M.P. were cylindrical in shape, which were about, 2 ft. 6 inches (76-20 cm.) tall and 15 to 18 inches (34-45 cm.) in diameter.

The furnaces of third type were tallest among all. They were 8-10 ft. (244-304 cm.) in height and square in plan of about 1 ft. 6 inches (45-75 cm.) across with high-perforated platform at the base. Its front wall was damaged after every complex of operations and re-built again. They were mostly reported from U.P.

In all the three cases, bellows of the skin of goat or sheep were used to ensure the blast of air into furnaces.

In India the earliest furnace used for iron smelting is reported at Atranjikhera(Plate No.5)⁶ belongs to c.1000 B.C. the pear-shaped

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⁴ ibid. p.132.
furnace appeared here is in some extent similar to Ujjain\(^7\) (Plate No.3A). At Noh and Jodhpur, furnaces with side hole recovered in which the nozzle or bellows might have been inserted\(^6\) Two furnaces have been found at Suneri\(^9\) in district Jhunjhunu of Rajasthan. These are of open type similar to the Ujjain furnaces\(^10\). The furnaces recovered at Suneri are provided with bellows For such bellows Panini uses the word \textit{bhastra}\(^11\) and the same is probably mentioned as \textit{bhasta} \(^12\) in early Pali text. The Buddhist texts suggest that their bellows made of leather were in use in pre-Mauryan times\(^13\).

On the basis of furnaces recovered at Khairadih, which belong to Mauryan period, Tripathi\(^14\) suggested that the wall of furnaces were made of clay mixed with straw and sand. A bamboo plastered with mud was used as a tuyere at the surface level. The use of furnace for the purpose of iron smelting and tools of ironsmith is clearly documented in literature\(^15\) of the period concerned. The furnace was known as \textit{ayakottha} and the ironsmith handled the

\begin{itemize}
\item \textit{ibid}
\item Tripathi, V, \textit{op cit}, p 144
\item Sharma, R S., 1983, \textit{Material Culture and Social formations in Ancient India}, New Delhi, p 59
\item Banerjee, N R., \textit{op cit}, p 179
\item Agrawal, V S., 1953, \textit{India as known to Panini}, Lucknow, p.57
\item \textit{ibid}
\item Tripathi, V, \textit{op cit}, p 148
\item Jain, K C., 1974, \textit{Lord Mahavira and his times}, Delhi, p 287
\end{itemize}
process of metallurgy with the help of tongs (sandasi) then it was taken out and put on the anvil (ahikarani). Objects such as tongs (Plate No.5), pincer and anvil having their corresponding names in literatures have been recovered from archaeological sites, namely, Atranjikhera\textsuperscript{16} and Ujjain\textsuperscript{17} etc.

The iron bearing levels have generally yielded shadowy looking ash pits and burnt earth with some slags\textsuperscript{18}. In most of the cases generally a round shallow pit full of ash is the main reminiscent. The superstructure is consistently missing. In the light of evidences reported at Ujjain, between c.500-200 B.C., Banerjee\textsuperscript{19} reconstructed the working of blacksmith in these words "... the remains of forge with a groove for the introduction of the working end (or nozzle) of a blower or bellows, an improvised stand made from the sturdy and large neck of a broken vessel to support a water jar to store water for quenching, a small or miniature jar to collect small quantities of water according to necessity, and a shallow but large enough bowl to contain water near the hand for quenching".

We have little in common with iron and copper technology. The craft of blacksmith is basically different from that of a copper metallurgist. Unlike copper, iron objects had to be forged stage by

\textsuperscript{16} Gaur, R.C., \textit{op.cit}, pp.223 and 425, pl. no. XXVII.
\textsuperscript{17} Banerjee, N.R. \textit{op.cit}.
\textsuperscript{18} Tripathi, V., \textit{op.cit}., p.144.
\textsuperscript{19} \textit{op.cit}. 

111
stage from a bloom to a bar and then thinning, pointing, folding and forge welding. The operation specially welding would require higher temperature necessitating the use of forced draught\textsuperscript{20}.

The evidence of smelting is recovered at Ujjain, where huge deposits of iron slags, unsmelted smolten iron ore, lump of crystalline material identified as calcite or aragonite and quantities of a whitish powder probably lime has been reported. The whitish powder perhaps represents the calcium compound resulting from the smelting operation. The calcium compound or whitish powders were used by blacksmith as flux\textsuperscript{21}. The calcium as flux is also known to us from Atranjikhera\textsuperscript{22}. But at Rajghat, as it is evident through chemical analysis, no flux was added. The alkalis present in the charcoal ash might have played the role of flux. The slag removal by liqation smelting must take place around 1180°C temperature otherwise slag would not drain away. The chemical composition of the metal shows the presence of slag particles, which indicates that it was perhaps difficult to maintain a temperature of 1180°C for long which resulted in the retention of some slag particles in the metal\textsuperscript{23}. About the actual mode of

\textsuperscript{21} Banerjee, N.R , ibid., p.178.
\textsuperscript{22} Tripathi, V., op.cit, p.145
\textsuperscript{23} Bhardwaj, H.C., 1979, Aspect of Ancient Indian Technology, Delhi, p 153
smelting, according to Banerjee despite that evidence is not clear, certain broad inferences are possible. This he gives as follows: "Alternate deposits of charcoal mixed with the iron slag and whitish powder, possibly lime, as stated above occurring in an exposed section point to a simple method of smelting employed at Ujjain. The side of this heaped and simple furnace, which was possibly circular in plan, provided with the passages for intake of air and escape of gases, and outlets for molten iron. The molten liquid, after collection, first cooled by dipping into water and then beaten with hammer to drive out the charcoal, which in the course of the hammering went into the (reduced) iron, giving it, to an extent, the properties of steel, and thus eliminating the slag. Here at Ujjain, we do not have any evidence that charcoal was used as fuel.

Despite the above discussion about technology related with iron, we are not in position to arrive at a concrete conclusion. Since most of the mining zones of iron ores have yielded heaps of slags, therefore it appears that the blacksmiths preferred to complete the making of tools near the mining zones itself. Study of these slags is essential to achieve more reliable picture before dealing with iron metallurgy.

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25 ibid., p.179.
The distribution of iron ores in India has a definite bearing on the smelting operations at different times. It gives us an idea about the possible geographical extent of the areas where the iron industry could have developed at early stage. It is very natural that at the earliest stage, only those ores must have been selected for smelting, which was either, easy to work with or were easily accessible. Here one thing is important that all the ores are not uniformly workable or commercially profitable. Now a day hardly any ore that contains less than 50% of iron is considered good for commercial use. In the early stages, such consideration certainly did not play any role, but gradually people learnt it through experience.

The principle mineral of iron comprise of greenalite, haematite, ilmenite, limonite, magnetite, pyrite, pyrrholite and siderite. But in India, the ores are broadly divided into three types.

1. The first type consists of the ferruginous formations of Pre-Cambrian Age, which in the unmetamorphosed state comprises of haematite, jaspers and in the metamorphosed state are in the form of magnetite-quartz.

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27 Banerjee, N R, *op cit*, p 189
28 *ibid*
2. The second type represents the sedimentary iron ores of siderite or limonite composition, known to us from Assam, Bengal, Bihar and parts of Himalayas.

3. The type three includes the lateritic ores found almost all over India. They are the sub-aerial modification of gneiss, schists and lavas under humid tropical conditions. These occur in the Deccan, Western Ghats and many other places. Because of their low (25 to 35%) contents of iron these are not yet, fully explorable commercially.

In India, we have the evidence of the richest deposits of iron, both in quality as well as in quantity such as Bihar, Karnataka, Maharashtra, Madhya Pradesh (Now Chattisgarh), Orissa and Tamil Nadu. Besides it, some ores in Kashmir, Kumaon Hills (Now Uttaranchal), Mandi (Himachal Pradesh) and Patiala (Punjab) are also known to us (Table No.6). The ores of Patiala (Punjab) comprise of both haematite and magnetite, Kumaon ores contain both limonite and haematite, and Mandi ores include both limonite and haematite. The ores of Patiala and Mandi might have played an important role in the development of iron industry in the region. \(^{29}\)

Due to early acquaintance of man with haematite and magnetite and because of their abundance, it is quite likely that the

\(^{29}\) *ibid.*, pp.189-190.
PERCENTAGE COMPOSITION OF IRON ORES FROM DIFFERENT AREAS, WHICH WERE EXPLOITED BY THE PEOPLE DURING THE PERIOD UNDER STUDY.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Location of Ore</th>
<th>Insoluble</th>
<th>SiO₂</th>
<th>Fe₂O₃</th>
<th>FeO</th>
<th>Al₂O₃</th>
<th>CaO</th>
<th>MgO</th>
<th>P₂O₅</th>
<th>TiO</th>
<th>MnO</th>
<th>V₂O₅</th>
<th>SO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ranganj, Jharkhand</td>
<td>10 6</td>
<td>8 5</td>
<td>53 2</td>
<td>13 48</td>
<td>4 07</td>
<td>1 00</td>
<td>0 85</td>
<td>0 57</td>
<td>-</td>
<td>-</td>
<td>0 55</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Palamau, Jharkhand</td>
<td>5 54</td>
<td>69 23</td>
<td>21 60</td>
<td>0 50</td>
<td>0 62</td>
<td>0 11</td>
<td>0 02</td>
<td>0 16</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Singhbhum, Jharkhand</td>
<td>2 42</td>
<td>85 87</td>
<td>2 45</td>
<td>4 31</td>
<td>0 35</td>
<td>0 17</td>
<td>0 18</td>
<td>0 34</td>
<td>0 11</td>
<td>-</td>
<td>0 02</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Singhbhum Jharkhand</td>
<td>0 57</td>
<td>72 17</td>
<td>8 07</td>
<td>2 83</td>
<td>Tr</td>
<td>0 20</td>
<td>0 97</td>
<td>13 84</td>
<td>0 14</td>
<td>0 59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Mandi, Himachal Pradesh</td>
<td>9 22</td>
<td>63 72</td>
<td>24 79</td>
<td>1 28</td>
<td>0 33</td>
<td>0 29</td>
<td>0 003</td>
<td>0 11</td>
<td>-</td>
<td>-</td>
<td>0 25</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Patiala, Punjab</td>
<td>9 38</td>
<td>57 4</td>
<td>57 4</td>
<td>14 8</td>
<td>1 3</td>
<td>-</td>
<td>0 42</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0 15</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Kaladhugh, Uttaranchal</td>
<td>36 62</td>
<td>49 91</td>
<td>5 27</td>
<td>1 10</td>
<td>0 66</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table No. 6


SiO₂: Silicon dioxide  
CaO: Calcium oxide  
Fe₂O₃: Ferric oxide  
MgO: Manganese oxide  
FeO: Ferrous oxide  
Al₂O₃: Aluminium oxide  
TiO: Titanium oxide  
V₂O₅: Vanadium pentoxide  
MnO: Manganese dioxide  
P₂O₅: Phosphorus pentoxide  
SO₂: Sulphur dioxide
early iron smelters used these two ores of iron. Mining is the same as mentioned earlier in the context of copper.

**Result of Chemical and Spectrographic Analysis of Iron Objects from Rajghat and Atranjikhera**

From the chemical analysis of iron objects from Rajghat and Atranjikhera silica, alumina, lime and magnesia are present as impurities. According to Usmani, “impurities suggest the low temperature reduction (below 1050°C), as the metal would never have liquefied and some of the impurities present in the ore remained entrapped.” The carbon contents in these objects at Atranjikhera are generally low, and range between 0.18 to 0.33% (Table No 7) and at Rajghat it range between 0.12-0.42% (See Table No 8) This in the view of Usmani indicates that “these objects were not hardened by heating and quenching. Only the objects having a high content of carbon can be hardened by heating and quenching.”

At present, it is difficult to locate the ores of iron used by smelters. Even the source of technology remains obscure. Bhardwaj points out that “Rajghat iron is often associated with impurities of Ti.

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30 Bhardwaj, H C, 1979, op cit, p 154
32 *ibid*
### CHEMICAL AND SPECTROGRAPHIC ANALYSIS OF IRON OBJECTS OF ATRANJIKHERA

<table>
<thead>
<tr>
<th>S.No</th>
<th>DATE AND OBJECTS</th>
<th>Fe₂O₃</th>
<th>SiO₂</th>
<th>Al₂O₃</th>
<th>CaO</th>
<th>MgO</th>
<th>Cu</th>
<th>Ni</th>
<th>TiO₂</th>
<th>P₂O₅</th>
<th>S</th>
<th>C</th>
<th>MnO₂</th>
<th>Co</th>
<th>Zn</th>
<th>As</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Upper phase of PGW Nail</td>
<td>89.36</td>
<td>0.53</td>
<td>1.33</td>
<td>0.60</td>
<td>0.12</td>
<td>-</td>
<td>-</td>
<td>Tr</td>
<td>0.33</td>
<td>0.08</td>
<td>0.33</td>
<td>Tr</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Middle Phase of PGW Rod</td>
<td>1.80</td>
<td>0.82</td>
<td>1.31</td>
<td>0.19</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Tr</td>
<td>0.21</td>
<td>0.10</td>
<td>0.18</td>
<td>Tu</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Middle Phase of PGW Bangle</td>
<td>1.51</td>
<td>0.96</td>
<td>0.82</td>
<td>0.71</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.18</td>
<td>0.09</td>
<td>0.26</td>
<td>Tr</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Middle phase of PGW Piece</td>
<td>1.32</td>
<td>1.25</td>
<td>0.73</td>
<td>0.62</td>
<td>-</td>
<td>-</td>
<td>Tr</td>
<td>0.21</td>
<td>0.12</td>
<td>0.31</td>
<td>Tr</td>
<td>-</td>
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</tr>
</tbody>
</table>

**Table No. 7**

Gaur, R.C., 1983, *Excavations at Atranjikhera*, Delhi, pp. 489 and 495

- Fe₂O₃: Ferric oxide
- TiO₂: Titanium dioxide
- Si: Sulphur
- Zn: Zinc
- Al₂O₃: Aluminium oxide
- MnO₂: Manganese dioxide
- CaO: Calcium oxide
- P₂O₅: Phosphorus pentoxide
- Cu: Copper
- S: Carbon
- Ni: Nickel
- As: Arsenic
- Co: Cobalt
- MgO: Manganese oxide
- SiO₂: Silicon dioxide
PERCENTAGE COMPOSITION AND IMPURITY PATTERN OF IRON OBJECTS FROM RAJGHAT
BASED ON CHEMICAL AND SPECTROGRAPHIC ANALYSIS

<table>
<thead>
<tr>
<th>S.No</th>
<th>Objects</th>
<th>Date</th>
<th>Fe</th>
<th>SiO₂</th>
<th>Al₂O₃</th>
<th>TiO₂</th>
<th>CaO</th>
<th>MgO</th>
<th>Cu</th>
<th>Ni</th>
<th>Cr</th>
<th>P₂O₅</th>
<th>S</th>
<th>C</th>
<th>Mn</th>
<th>B</th>
<th>Co</th>
<th>Zn</th>
<th>As</th>
<th>Sb</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Blade</td>
<td>600-400 B.C</td>
<td>91.21</td>
<td>0.88</td>
<td>0.5</td>
<td>Tr</td>
<td>0.32</td>
<td>0.15</td>
<td>-</td>
<td>Tr</td>
<td>-</td>
<td>0.24</td>
<td>0.19</td>
<td>0.15</td>
<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Arrow Head</td>
<td>85.7</td>
<td>3.8</td>
<td>2.01</td>
<td>Tr</td>
<td>1.20</td>
<td>0.24</td>
<td>-</td>
<td>Tr</td>
<td>-</td>
<td>0.15</td>
<td>0.12</td>
<td>0.20</td>
<td>-</td>
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<td></td>
</tr>
<tr>
<td>3.</td>
<td>Broken Nail</td>
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Table No. 8


Al₂O₃: Aluminium oxide  
P₂O₅: Phosphorus pentoxide  
B: Boron  
Cu: Copper  
As: Arsenic  
CaO: Calcium oxide  
SiO₂: Silicon dioxide  
Mn: Manganese  
C: Carbon  
Ni: Nickel  
MgO: Manganese oxide  
Fe: Iron  
Cr: Chromium  
Co: Cobalt  
TiO₂: Titanium dioxide  
Sb: Antimony  
S: Sulphur  
Zn: Zinc
Ni, Cu, P$_2$O$_5$ and S which may indicate that titaniferous ores with apatite complex might have been used. Such ores are found in plenty in Singhbhum and Mayurbhanj. However, much earlier Kosambi had suggested that Mirzapur mines produce rich hematite ores which, perhaps, were already explored by the Aryans. As regards the technology Agrawal’s view is that there is a possibility of movement of people of Chirand and Sonpur from east towards the west with their technique which they had for exploiting copper and applied the same to iron.

At Atranjikhera four samples, all belonging to pre 600 B.C., were put to chemical analysis. The result shows that silica, lime, alumina and magnesia are always present as impurities as in the case of Rajghat ores. The carbon content is low and varies between 0.18 to 0.33%. The one tallographic examination of iron objects suggest that it was probably not easy to attain a temperature of about 1180°C for sufficient time during the smelting operations which resulted in the retention of slag particles in the metal. The retained slag particles in the metal have a good chance of escaping during forging process. When the red hot metal is placed on the anvil and beaten with hammer repeatedly. Thus, it is assumed by

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33 Bhardwaj, H.C., 1979, op cit, p 156
Usmani\textsuperscript{36} that the smelting of iron was done at a lower temperature (below 1050°C) and the forging process was not good enough to remove the slag particles completely.

As it has been suggested that the source of iron, here was probably the hill ranges extending from south of Agra to Gwalior\textsuperscript{37} The extensive deposits of banded hematite quartzite found in these rocks are considered important and have been worked out on a large scale by indigenous smelters\textsuperscript{38}. The general pattern that emerges from the above studies is as follows\textsuperscript{39}.

(i) Impure wrought iron was used.

(ii) Flux was not used for the smelting of iron.

(iii) Presence of large amount of slag particles in iron objects indicate that the ancient people were not well acquainted with its reduction process and the role of temperature during smelting. They were not in position to attain temperature of about 1180°C for a long period at the time of smelting.

In conclusion, it can be argued that no sufficient work has been done on iron technology because of two reasons. First, non-availability of the early iron implements in good condition, which is a

\textsuperscript{36} Usmani, Q.S., \textit{op.cit.}, p. 179.
\textsuperscript{37} Gaur, R.C., \textit{op.cit.}, p. 496.
\textsuperscript{38} Usmani, Q.S., \textit{op.cit.}, p. 174.
\textsuperscript{39} \textit{Ibid}, p. 180.
necessary requirement for chemical and metallographic study. Most of the times the objects unearthed from excavations are in a high state of corrosion with no metallic core left. For such type of specimen, no chemical and metallographic analysis is possible.

Secondly, the less-corroded objects are kept in the museum as the important finds from the excavated sites and hence not available for the above mentioned scientific study. From the technological point of view in pre-600 BC iron technology was in a primitive age. The wasteful rich metalliferrous slags show that iron metallurgy was in an elementary stage. Even though the Mesopotamians in 5th millennium BC succeeded in exploiting iron ores and shaping them to form, but the real breakthrough could not be achieved till 1500 BC. In India, as well, though iron metallurgy has its origin quite early but the full scale use of iron is quite late. In the opinion of Tripathi, iron age in the true sense started around c 500 BC in India, when the technology was ripe to take over and to utilize the commonly accessible and available iron ores.

The period under consideration witnessed a revolutionary change in metal technology. Iron replaced copper as the household objects for making tools and implements which have been found in sufficient quantity. Added to this, presence of slags throughout the

40 Bhardwaj, H.C., 1979, op cit, p 158
41 Tripathi, V, op cit, p 100
country during this period also proves the prolific use of iron. The dissemination of knowledge and techniques of smelting iron, which was hitherto not known, gave a tremendous boost to the dependability and serviceability of iron. The discoveries of sources of iron ores found by deliberate exploration and its extensive use for making a large variety of objects had a great impact on socio-economic life of the people. It became possible for the people to clear the forest, to lay roads for easy moveability, and to enrich their life style. Man's technological advances and the utility of iron helped the developmental process to grow rapidly. Thus, the use of this metal may have helped forge a common techno-cultural bond between people of different regions.
COPPER OBJECTS

The introduction of iron a much harder and sturdy metal, for weapons drastically reduced the use of copper (tamba). Before the origin and the use of iron, the copper objects in general comprised the following objects: harpoons, swords, axes and anthropomorphic figures.\(^1\) The use of copper has now come to be used more for making objects like bangles, earrings, pendants, antimony rods, nail parers, borers, pins, needles etc.

Copper objects are reported from several sites during the period under study in Northern India, but, unfortunately, details regarding the objects are available from only few sites. On the basis of the objects made of copper and it use, the recovered specimens (Table No.9) can be classified broadly into five groups:

A) Objects of ornament
B) Objects of Toiletry
C) Tools
D) Objects of Household
E) Miscellaneous objects

A. Objects of Ornament: This group includes bangle, earrings, nose-rings, pendants, beads etc. The ornaments were equally

\(^1\) Lal, B.B., 1951, ‘Further Copper Hoards From Gangetic Basin and a Review of a Problem’, Ancient India, No 7, pp 32-37
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<th>S.no</th>
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Table No. 9
popular among the men and women as evidenced by the relevant literary sources. Panini mentions it as alankara.

Earrings, which have been mentioned by Jataka known to Panini as karnika or kundala. Besides, we are further informed by these sources about the use of other kinds of ornaments like finger-rings, armlets, bracelets and necklace. The use of the above mentioned objects as ornaments have been confirmed by Patanjali. Unfortunately, these literatures do not describe these ornaments. Apart from this, the depiction of such ornaments, may be identified in the existing evidence of art and sculpture in India of the period subsequent to our study.

B. Objects of Toiletry: Panini used the word subhagain-karana for the objects used for this purpose. In this group we can include the objects like antimony rods, nail parers, tooth pick etc. Antimony rods or kohl sticks have been reported from all the cultural periods at Rajghat. In the Gangetic Valley their earliest occurrence is reported from period II of Hastinapura. These small rods, provided with rounded ends or slightly tapering pointed ends were probably used for applying antimony (anjana) to the eyes, by women, specially,as

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2 Agrawala, V S, 1953, India as Known to Panini, Lucknow, p 130
3 Jataka, VI, 590
4 Agrawala, V S, op cit
5 Puri, B N, 1968, India in the Time of Patanjali, Bombay, p 97
6 Agrawala, V S, op cit, p 131
7 Singh, B P, 1985, Life in Ancient Varanasi, Delhi, p 176
8 Ancient India, Nos, 10 & 11, pp 95 & 97
pointed out by Panini. The Mahabarata refers to the fair-complexioned Punjabi women, painting their eyes with anjana. Pantanjali also informed us about the anjana or black pigment being applied to the eyelashes. According to Buddhist literature Mahavagga, the antimony rods were made of copper, besides bronze, bone, ivory etc. Interestingly enough the antimony rods made of all these objects have been documented in the reports of various excavations pertaining to our period of study. The presence of nail parers at various sites gives us an idea that the people of the period under discussion were well acquainted with the use of it.

C. Tools: Under this head, tools such as borers, pins, awls, etc. are included. Carpenters and other craftsmen may have used their tools for preparing various objects. These specimens might have been used to make holes in wooden objects by carpenters (taksha). It is interesting to note here that the borers unearthed from Sravasti is exceptionally long and measures 39.96 cm in length, 0.99 cm in breadth and 0.66 cm in thickness. The borer is square and its working end is in the forms of sharp circular point. Borer of such dimension is not available from any other site, to the best of our knowledge.

9 Agrawala, V.S., op cit
10 Mahabharata, Karnapaarva, 44 18
11 Puri, B.N., op cit., p 99
12 Mahavagga, VI. II. I 2., VI. 12. 1
13 Sinha, K.K., 1967, Excavations at Sravasti, 1959 Varanasi, p 67
Pin, the other specimen in this category, has been reported from Hastinapura. It is round in shape and is bent near the pointed end forming a hook-like shape. While, the object recovered from Atranjikhera is probably used as a hairpin, an awl recovered from Jakhera was probably used by cobbler. The presence of such cobbler is shown in the literatures relevant to our period.

D. Household Objects: Household objects include, vessel/dishes, needle with eye, socket/ring etc. A fragment of a basin (diameter 20 cm, height 5 cm) having featureless rim, rounded base, convex sides, thin section with one whole under the rim (other hole damaged) has been unearthed from Atranjikhera. Gaur suggests that these holes were probably meant to suspend the pot with the help of a string. The excavator unfortunately has not indicated any probable use of this basin. It may be suggest that advanced and specialized craftsmanship had come into existence so far as utensils made of metal is concerned.

From Atranjikhera, needle heavily incrusted has been found. Another specimen is available from Sravasti. It has one end pointed. Though the head is flattened but the eye is not made, probably

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14 Ancient India, Nos. 10 & 11, p. 95 & 97.
16 Singh, Ramjit, 2000, "Copper Bronze Objects from Jakhera", see the Departmental volume of Indian History Congress, Deptt. Of History A.M.U., Aligarh, pp. 371-384
17 Gaur, R.C., op.cit.
18 ibid.
because the needle was in the stage of making. The possible use of such needles may be had from Patanjali\textsuperscript{19} who speaks of the use of needle for either sewing or knitting or both.

E. Miscellaneous objects: Besides the above, there are many other objects; e.g. copper sheet, rod/bar, copper slag, copper wire, weight etc. from various sites of northern India belonging to this phase. They occur occasionally at certain sites and the number of each type is limited to one or two specimen only. Besides this their identification is not always certain therefore they are termed as miscellaneous objects. Nevertheless, their occurrence may suggest uses to which they might have been put in the manifold activities of the people.

In conclusion it may be said that with the knowledge of greater advantage that iron, as a metal has over copper the frequency of occurrence of copper objects in daily use shows diminishing use of this metal. Thus the majority of copper objects now consists of objects of ornaments, toiletries, crafts, households and miscellaneous. The objects of war and defence made of copper are very rare and different varieties of weapons made of iron show that people were fully acquainted with its hardness and reliability for the purpose of warfare.

\textsuperscript{19} Puri, B.N., \textit{op.cit.}, p.95.
COPPER METALLURGY

According to the scheme of dating suggested by Bhardwaj as early as c. 5000-4000 B.C. is the time bracket within which the earliest evidence of copper metallurgy may be placed in Tall-i-iblis¹, near the copper rich range in Iran. Later to this the evidences from Mundigak in Afghanistan and several other sites in Baluchistan points to the knowledge of copper metallurgy in the Indian sub-continent. However, placed in Sindh and Punjab have brought to light that in pre-Harappan times people were well conversant with this technology. But it is almost certain that a great spurt in copper metallurgy took place in the Harappan times; whereas, later to the Harappans Bhardwaj sees a definite retrogression in the various chalcolithic cultures in existence during the period c. 2000 – 1100 B.C. With this temporary decline it is further suggested that great activity in copper metallurgy begins to show during the period 1100 – 800 B.C. as one can understand from the presence of large number of copper hoard materials, as well as, materials of copper from cultural remains from Pandu Rajar Dhibi and Mahisdal (Bengal), Sonepur and Chirand (Bihar) and Atranjkhera, Hastinapura, Kausambi and Rajghat (U.P.).

¹ Bhardwaj, H.C., 1979, Aspects of Ancient Indian Technology, Delhi. p 102
Large number of studies regarding the origin and use of copper metallurgy have been made by scholars like Aitchison\(^2\), Coghlan\(^3\), Forbes\(^4\), Agrawal\(^5\), Bhardwaj\(^6\), and Biswas\(^7\).

Unfortunately, literary sources relevant to our period of study do not help us to know about the methods of copper metallurgy. Bose\(^8\) on the basis of modern practice of smelting of copper at Singhana near Khetri (Rajasthan) tried to trace it out in remote antiquity. According to him, copper ores were crushed to powder and mixing them with cow dung rolls of about four inches length are made. These rolls are first dried under sun light and then roasted in open air in the fire using cakes of cow dung. After roasting, the ore is transferred to the furnace to work the ore at high temperature and this obtains molten copper.

Since the copper ore consisted of various impurities such as iron, tin, lead, aluminum, zinc, sulphur, magnesium, nickel etc., hence, it was essential that impurities are removed from the ore during the smelting process. However, the quantitative presence of the remaining impurities in the metal as evident from the table of

\(^3\) Coghlan, H H., 1962, *Notes on the Prehistoric Metallurgy of Copper and Bronze in Old world*, Oxford
\(^5\) Agarwal, D P., 1971, *The Copper Bronze Age in India* New Delhi
\(^6\) op cit
\(^8\) Bose, D M., et al., 1971, *A Concise History of Science in India*, New Delhi, pp 300-301
chemical composition (Table No 10) may help us to understand the relative skill with which copper technology was handled at that time.

Forbes\textsuperscript{9} visualizing of ancient technology describes five stages of the evolution of copper metallurgy. The first stage, according to him, is shaping of native copper by hammering, cutting, bending, grinding and polishing.

The second stage is annealing native copper by heating and hammering.

Third stage consists of smelting ore in the fire of wood charcoal over a clay-lined pit with air. The slag and regulus are to be separated.

The fourth stage involved the melting of native copper or now regulus over furnace or fire in a crucible and then casting is done in clay, sand and stone moulds.

The fifth stage comprises of smelting sulphide ore. In the same stage other casting properties are alloyed with native copper to improve its hardness and strength.

The several techniques of metal forging practiced in ancient period with special reference to India, according to Roy\textsuperscript{10} are hammering, spinning and cold work.

\textsuperscript{9} Forbes, R J, \textit{op cit}, pp 16-19
\textsuperscript{10} Roy, T N, 1983, \textit{The Ganges civilization}, New Delhi, pp 165 – 166
PERCENTAGE COMPOSITION OF COPPER OBJECTS FROM THE LATE PGW AND EARLY NBPW (PRE AND POST c.600 B.C)

| S.No | Name of the site | Nature of the object | Period and cultural context | SiO₂ | Cu  | Sn  | Pb  | Zn  | Fe  | Al  | Mn  | Ni  | Co  | As  | Sb  | CaO | MgO | S | P₂O₅ | Insoluble R. | Total |
|------|------------------|----------------------|-----------------------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|------|--------------|-------|
| 1    | Sonpur           | Copper rod           | Sub-period 1A Pre-NBP deposit B and RW | 0.17 | 98.43 | 1.39 | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | - | -    | -             | 99.99 |
| 2    | Raghat           | Copper fragment      | Sub-period 1B early phase of NBP | -   | 98.05 | -   | 0.37 | -   | -   | 0.08 | N.D. | +   | -   | 0.85 | 0.17 | Tr | - | -    | -             | 99.52 |
| 3    | Raghat           | Antimony rod         | -                            | -   | 96.38 | -   | -   | 0.21 | -   | -   | 0.08 | N.D. | +   | 2.31 | 0.84 | 0.75 | - | -    | -             | 100.57 |
| 4    | Raghat           | Copper sheet         | -                            | -   | 71.60 | 12.90 | 1.25 | 0.01 | -   | -   | 0.15 | 0.25 | Tr  | 1.75 | N.D. | 0.20 | - | -    | -             | 98.76 |
| 5    | Atranjikhera     | Hair pin             | Period III upper phase of PGW | -   | 52.24 | 29.72 | 0.77 | 16.20 | 1.23 | 0.01 | -   | -   | 0.80 | 0.08 | -   | -   | - | -    | -             | 98.50 |
| 6    | Atranjikhera     | Hair pin             | -                            | -   | 71.60 | 12.90 | 1.25 | 0.01 | -   | -   | 0.15 | 0.25 | Tr  | 1.75 | N.D. | 0.20 | - | -    | -             | 100.43 |
| 7    | Atranjikhera     | Fragment of a crucible | Period IV upper phase of PGW | 55.00 | -     | -    | 5.60 | 1.90 | N.d | -   | -   | -   | -   | -   | -   | -   | - | 1.70 | 35.40         | 101.70 |
| 8    | Taxila           | Copper rod c 400 BC  | -                            | -   | 98.33 | 0.19 | 1.23 | 0.01 | -   | 0.51 | 0.19 | 0.35 | -   | -   | -   | -   | - | -    | -             | 100.02 |
| 9    | Taxila           | Copper rod c 400 BC  | -                            | -   | 98.33 | 0.19 | 1.23 | 0.01 | -   | 0.51 | 0.19 | 0.35 | -   | -   | -   | -   | - | -    | -             | 100.00 |
| 10   | KausamHN         | Copper fragment      | c 535-465 B.C. early phase of NBP | -   | 98.07 | 0.98 | 0.80 | 0.13 | -   | -   | -   | -   | -   | -   | -   | -   | - | -    | -             | 99.98 |

Table 10

Tr - Trace  SiO₂ - Silicon dioxide  Cu - Copper  Sn - Tin  Pb - Lead  Zn - Zinc  Sb - Antimony  
Al - Aluminium  Mn - Magnesium  Ni - Nickel  Co - Cobalt  As - Arsenic  CaO - Calcium Oxide  MgO - Magnesium Oxide  
S - Sulphur  P₂O₅ - phosphorus pentoxide  Fe - Iron  

References:
Specimen No. 1: Agrawal, D P., 1971, The Copper Bronze Age in India, New Delhi, p 169  
Specimen No. 2 to 4: Bharadwaj, H C., 1968-69 Puratattva, no 2, p 32  
Specimen No. 5 to 7: Agrawal, O P., 1983, Excavations at Atranjikhera, edited by R C Gaur, pp 489-90, 497  
Specimen No. 8 to 9: Archaeological Survey of India Annual Report, 1930-34, p 296 and 1935-36, pp 132-133  
Mining: India has always been famous for its mineral wealth. Panini used the word *khan* for mine. Even Megasthenes observes, "while the soil bears on its surface all kinds of fruits which are known to cultivation, it has also underground numerous veins of all sorts of metals, for it contains much gold, silver, copper and iron in no small quantity, and even tin and others which are employed in making articles and accoutrements of war."

Kautilya's *Arthasastra* is a storehouse of information regarding minerals and metals in ancient India of the pre-Christian and Christian Eras. It states that mines were of supreme importance for the economic welfare of the society and the defence of a nation against external aggression. Kautilya also mentions that "the treasury has its source in mines, from the treasury the army comes into being. With the treasury and the army the earth is obtained, with treasury as its ornaments."

The copper belt of Singhbhum provides us a good evidence of copper mining from ancient times. The rich and abundant deposits of copper ores has been a constant source of mining and the mines

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12 McCrindle, J W., 1960, *Ancient India as described by Megasthenes and Arrian*, Calcutta, p 30
13 Kautilya *Arthasastra*, translated in English by R P Kangle, 1986, New Delhi, 2 12 37
here have now reached up to ground water level. From the entire underground area ores have been extracted leaving only support column. The working was approached by a passage made in the hillside. The passage used to be 3-8 ft (0.9-2.4 m) X 4 ft (1.2 m). The miners extracted the veinstone by the help of chisel and hammer to a maximum depth of 60 ft (18 m). Inside mines, chips of bamboo were used for lighting. Evidence of same types of work is found in Khetri area of Rajasthan. Almost the same technique was used for mining by Egyptians in the Senai Peninsula. Fire setting was done to crack the ore which were extracted with chisel and hammer manually. Singh has nicely portrayed the miners at work “seated upon his heels with the lamp upon the head, hammer and chisel in the hand and the small basket upon his knees in which he received all the fragments of ore that were struck off by chisel”.

Hegde and Ericson after the survey of six ancient copper ore mining and smelting sites in the Arawali Hills, out of which Ambaji was studied in details, concludes “there were many evidences of superficial gouging of the oxide-rich gosson cap; these were the earliest attempts at mining copper ore in Rajasthan”. They further add, “A large majority of these pits measure 7-8 meters in diameter

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15 ibid.
16 ibid.
and three to four meters in depth. There is evidence of fire treating of 
the host rocks on the mine walls to widen the joints rock”.

The above evidences lead us to conclude, that mining was 
undertaken to a very great extent by method, which might not be very 
scientific in an age preceding to Kautilya and Megasthanes Taking 
into account the mines and the copper industries of northern India 
during the period earlier to Mauryan times we have rich evidences to 
postulate that copper played a significant economic and other 
utilitarian role in the life of the people. Copper mines belonging to 
Jharkhand (earlier part of Bihar) and Rajasthan, it seems, were 
exploited by the people of ancient India. Extensive slag heaps lying 
in these areas bears testimony to this.

MINES: The names of some important mines\(^{16}\) are given below

**Jharkhand:** Surda, Lokesera, Mosabani, Dho
bani, Rekha mines, 
Roam, Kendadih, Puranapani, Ramchandra Pahar and Rajdeh in 
district of Singhbhum.

Baraganda* and Geyjadih in Hazaribagh district.

**Rajasthan:** Agar, Birat, Baldeogarh, Bhagoni, Dariba, Jod
hawas and 
Nalladeshwar in district of Alwar.

\(^{16}\) Bhardwaj, H.C., *op.cit.*, pp. 191 – 199.

*This mines of Hazaribagh district having extensive old workings over a length 
of 1200 metres and slag heaps having 0.08% to 13.04% copper (Biswas, A K , 
*op.cit.*, p. 188)
Begor, Ajitsagar, Akwali, Gurha, Dhandaota, Khetri, copper belt between Singhana and Baba in Jhunjhunu district of Alwar Chanpura near Rakhabdeo and Dariba in Udaipur district Mawaika Poora (Bharapur), Bidasar (Bikaner) Baleshwar (Jaipur) and Nathoka (Sikar)

Smelting: Hegde and Ericson\textsuperscript{19} has described in quite detail the process of smelting in ancient India. They state, "The small size of furnace and high yield of metal indicate that the ores used to be roasted to oxide stage and the smelting technology was efficient. Many groups of ore-crushing pits found near the foot of the hills. Larger pits among them measure 60 cm in diameter and 70 cm in depth. Smaller ones measure 30 cm in diameter and 40 cm in depth. The finely crushed ore was concentrated by gravity separation at the smelting sites which were invariably located near the banks of the hills streams. Ore separation devices found are smooth gently inclined rock surfaces, nearly marked with rows of round shallow pits 3 to 4 cm in diameter and 3 to 4 cm in depth. Presumably the finely crushed ore was allowed to slowly flow down the inclined plane and by repeating this process, much of the gangue was effectively separated from the ore. Flowing film segregation, settling of the

\textsuperscript{19} cf Biswas, A K, op cit, p 181
heavier ore particles in the pits and elutriation of the lighter gangue particles were the principles involved”.

They also observed, “Large slag heaps were found spread out in the terraces, littered with broken remains of furnaces and broken tuyere. Some of the slag pieces clearly revealed the cylindrical flow structure and the fact that the tapped slag was molten. The examination of the unbroken part of the furnaces showed that this was assembled by putting three curved segments (made of clay) together, one of them containing the luted tuyere, another with the slag tapping hole, and a plain third one”. On the basis of this observation the above mentioned scholars\textsuperscript{20} visualized, “The approximate dimensions of ancient furnace: 35 cm in height and diameter 18 cm at the rim, 14 cm at a mid-level and 10 cm near the base”. According to them again, “This simple furnace appears to have been continuously used in India over the millennia without little innovation” (Figure No.1).

From the above observations it appears that during the period of our study the copper smelting furnaces were small, crucible shaped, clay walled, slag-tapping furnace worked on forced draught blown into it from bellows. It was composite made of three moulded segments set up on a brick platform and was surrounded with bricks

\textsuperscript{20} ibid, p. 182
Figure No.1- Ancient Copper-making Furnace at Ambaji, Rajasthan
and earth to keep the three segments of the furnace tightly in position and also to conserve the heat within the furnace.

**Emerging Picture of Copper Metallurgy from Atranjikhera and Rajghat**

Archaeological findings of Atranjikhera\(^1\) does not show any evidence of copper slag, flux material, roasting pits and furnaces in pre c. 600 BC and thereafter, which were essential for the smelting of copper. It seems that its smelting was not done at this site in the period under observation. The copper recovered here may have been obtained in metal form and the tools were finally shaped at Atranjikhera\(^2\) Usmani\(^3\) has a view that the source of the copper here may be the chalcopyrite copper ore deposit in the Arawali region. The ores were roasted first and later smelted. The temperature of roasting was adequate in most cases though thorough molten condition was not achieved for a long and sufficient time during the removing process of impure material. It is realized by the presence of impurities. It is possible that the smelting was done at a lower temperature (below 1200°C) this might be because of primitive nature of the furnaces.

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\(^2\) Usmani, Q S ., 1999, "Copper at Atranjikhera – A Scientific & Technological study", proceeding of India History Congress, Calicut, pp 1069 – 1076

\(^3\) *ibid*, p 1070
At Rajghat, we have the evidence of the presence of iron along with sulphur in the form of impurities in copper as shown in the table. This indicates the use of chalcopyrite ore of copper for the purpose. The same seems to be true of Atranjkhera, as well. Bhardwaj who examined the copper objects of Rajghat reached to the conclusion that the people using copper here were migrants from the region east of Varanasi, probably Bihar. Agrawal, too appears to be of the same view. Further, to strengthen his hypothesis, Bhardwaj compares the impurity pattern of copper materials recovered at Rajghat and the copper ores from Jharkhand (Masabani and Rekha Copper mines of Singhbhum district) and finds both to be compatible. It is quite likely that these rich mines of copper of the newly created state of Jharkhand were used by Rajghat smelters.

Even much before pre c 600 B.C., copper hoard people of Chirand and Sonpur had known mining and smelting. These copper were probably smelted from the ores of Jharkhand. The evidence of crucibles made of terracotta during the period under discussion suggests that metal was melted in these pots. These crucibles have became vitrified and enameled on the outer side, indicating that they

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24 Bhardwaj, H C, op cit, p. 98
25 ibid, p. 97
26 Agrawal, D P, op cit, pp. 106 & 107
27 Bharwaj, H C, op cit
were heated on high temperature. That these were used for the presence of green accretion still sticking on the inner walls.  

It is very important to note that the composition of copper hoard people do not show any continuity and similarities in their chemical content and alloying pattern. This indicates that the origin and development of copper metallurgy in India has not been a continuous process. The impurity pattern in the copper objects of Sonpur, Rajghat, Atranjikhera, Taxila and Kausambi shows that the different sources of ores were exploited for obtaining the metal (Table No 10).

28 Singh, B P., 1983, Life in Ancient Varanasi, Delhi, p 218
29 Bhardwaj, H C., op cit., p 106
SILVER PUNCH-MARKED COINS

The most remarkable feature of c.600 B.C. is the introduction of metal coins. These coins bear stamps of one to five symbols in some cases even up to eight symbols punched on one side, generally called the obverse side, of them; while the other side, called the reverse, were either without the symbol or sometimes punched with one or two symbols comparatively smaller in size than the obverse. By reason of this manufacturing technique, they are known as punch-marked coins. The punching devices of these coins bear no legend. Instead, they have devices, viz., various forms of hills, trees, birds, animals, reptiles etc.

Before the beginning of these silver coins in day to day transaction, ingots of gold and other metal of calculated weight were used for the sale and purchase as evidenced in literature. A term karshapana* in the Jataka, the Ashtadhyayi, the Dharmasutra and the Jaina canonical literature has generally been identified with the

* Etymologically karshapana is a compound of two words karsha and apana. Karsha means 'the product which is obtained by ploughing (karsha) i.e. agricultural product.' Apna means to exchange or purchase. Therefore karshapana meant the medium of purchase or exchange of agricultural products and in course of time, it came to be used in general sense as the medium of purchase, i.e., 'coins.' (Numismatic Digest, Vol 18, 1994, p 16)

1 Satapatha Brahmana, XI 4 1,1, Taittiriya Brahmana, 1 8 9 1,1 3,78
3 Agarwala, V.S., 1953, India as known to Panini, Lucknow, pp 258 - 271
4 Gautama Dharmasutra, XII, 6 – 8, 19
5 Uttaradhyayana Sutra, 20 42
punch-marked coins. The Ashtadhyayi gives the various names of the coins, such as satamana, sana, karshapana, ardhapana, bhaga etc while, the Jataka mentioned kahapana, ardhakahapana, pada, masaka, arda masaka. From the above mentioned literary texts, it is clear that currency became well established in c.600 – 500 B.C and was available in different denominations.

Mostly these coins have been found in hoards throughout India. The Bhir mound hoard at Taxila contained two coins of Alexander the Great and one of Philip Ariadeus besides 1055 silver punch-marked coins. Walsh⁶ has observed on the basis of stratification of the hoard and mint condition of both the Greek rulers that the hoard was buried not much later than 317 B.C. The Palia hoard⁷ contained 1245 coins, which belong to pre-Mauryan times. The Golakhpur⁸ and Ramna⁹ hoards of 48 coins have also been assigned to the same period, as above by Walsh. Out of 2873 coins, 709 punch marked coins, of Machhuatoli¹⁰ and Rajagriha¹¹ hoards fall in the same period.

Besides the hoards, the punch-marked coins were also reported in archaeological findings. In excavations these coins were

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⁶ Walsh, E.H.C., 1939, Punch marked coins from Taxila, Memoirs of Archaeological Survey of India, pp 1 – 2
⁷ Journal of Numismatic Society of India, V.II, Numismatic Supplementary No XLVII of Journal of Asiatic Society of Bengal.
⁸ Journal of Bihar and Orissa Research Society, 1919, pp. 16 – 72
⁹ ibid, 1939.
¹⁰ ibid, pp. 91 – 117.
found along with Northern Black Polished Ware (NBPW). The date of this ware has been assigned to c.600 B.C.\textsuperscript{12} The punch-marked coins\textsuperscript{13} are found in association with this ware at Ropar, Ujjain, Purana Qila, Mathura and Kausambi in the context of c.600 B.C.

After analyzing these coins, which are found in hoards and excavation, Gupta\textsuperscript{14} divided them into two groups (Plate No 6). The first group which are the earliest are known as 'local' punch-marked coins. They have been found only in a particular area or locality. These coins found in one area are quite different from another area in their fabric, symbols and weight. The coins issued by powerful Magadha kingdom of the pre-Mauryan times are found throughout the country from north to south and east to west. Interestingly they are of one weight standard, i.e., 3.5 gm (54 grains) and bear uniformly five marks. These coins are termed as imperial punch-marked coins.

The coins of the 1\textsuperscript{st} group are issues of different Janapadas (states). The important states\textsuperscript{15} in which the coins are known in the area of my research are Dakshina Panchala, Kashi, Kosala, Magadha, Malla, Sursena, Uttar panchala and Vatsa (Table No 11).

The shape, symbols and weight of their coins are as follows:

\textsuperscript{12} Ray, S.C., 1959, Stratigraphic Evidence of Coins in Indian Excavations and Some Allied Issues, Varanasi, p 6
\textsuperscript{13} Journal of Numismatic Society of India, V XX, p 26
\textsuperscript{15} Gupta, P L., 1985, Coins, New Delhi, p 10
<table>
<thead>
<tr>
<th>State</th>
<th>Shape</th>
<th>Symbols</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dakshina Panchala</td>
<td>Appear very blurred because of the punching of reverse minute marks</td>
<td>Symbols are round, composed of dots, solid and hollow circles, pellets, lines square, taurine etc (reverse is found stamped with quite a large number of minute marks)</td>
<td>25 grains</td>
</tr>
<tr>
<td>Kashi</td>
<td>Thin and elliptical fabric (they appear little saucer-like due to the mode of punching the symbols)</td>
<td>Symbol composed of a complex form of whorls, consisting of four arms and having several curved branches. Some of the symbols appear like a lotus pattern. The four symbols on the coins are found in two distinct orientations (i) Two symbols in two pairs constitute the four symbols (ii) One pair of one symbol and two odd symbols, i.e., the three symbol constitute the group of four symbols</td>
<td>75 grains</td>
</tr>
<tr>
<td>Kosala</td>
<td>Broad, thin roundish pieces and have a battered observe due to large number of minute punchings on the reverse</td>
<td>Geometrical patterns, elephant, bull, hare, tree etc</td>
<td>42 grains</td>
</tr>
</tbody>
</table>
| Malla               | Dumpy ingots                                    | (i) Two symbols, one bigger than the other and one composed of simple lines  
(ii) Coins of the series are of two denominations  
(a) with four symbols  
(b) with two symbols  
(Symbols of (a) & (b) type of 2nd series are simple geometrical patterns) | 65 grains  
48-50 grains  
10-12 grains |
| Sursena             | Tiny thick pieces                               | Cat or lion like animals placed over two inverted semi-circles and taurine suggestive to a hill | 25 grains |
| Uttara Panchala     | Tiny thick pieces                               | Fish, bull, elephant with or without rider | 25 grains |
| Vatsa               | Broad, thin pieces and round in shape           | Geometrical patterns, animals, whorls, six armed symbols, a scorpion like insects associated with some other unidentified marks | 25 grains |

Table No. 11
To understand clearly the evolution of punch-marked coins from local to imperial series, the entire issues of the Magadhan punchmarked coins, from its beginning has to be taken into account. The local coins of Magadha have been divided into six types by Gupta on the basis of symbology and weight. They are as follows:

**Type-I:** The dies of the symbol are cut shallow and have not penetrated deep into the metal. Besides this, these coins are straight cuts from plain and even sheets and are quite big in their size. No attempt seems to have been made to clip the sides of the pieces to make them approximate the weight standard. The weight of these coins fluctuated between 3.0 and 5.9 gm (47 to 91 grains). The number of symbols on these coins varied from 1 to 8. These types of coins discovered as a hoard in a village in district of Gaya in Bihar, which was close to Rajagriha, the first capital of Magadha Janapada. They were issued possibly when Rajagriha was its capital. Gupta attributed this type of coin to king Bimbisara.

**Type-II:** The number of symbols on this type too, varied from two to six or seven and probably even eight. Interestingly the striking feature of these coins is that the six-armed symbol (three arrow and three ovals alternately placed) is quite big and bold and is placed almost in the center of the flan of every coin. The other symbols

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were gradually added and placed around it but are smaller in size. The other common symbol, of average or middle size, is the sun. These two common symbols, in course of time became the integral part of all the subsequent Magadhan punch marked coins. In weight, they were as low as 64.8 grains (4.20 gm) and as high as 92 grains (5.83 gm). But most of the coins weighed between 75 to 85 grains (4.8 – 5.5 gm). Gupta dated this type to pre-Ajatsatru period, i.e., earlier than c.554 B.C. and identified it as the same type as in Bimbisara’s period (c.605-554 B.C.), his father.

**Type-III:** This type of coins was found at Katra in Muzaffarpur district (Bihar) within the territory of the ancient Vajji Janapada. They have four symbols along with the six armed and the sun symbol. They weigh 5.4-5.5 gm (approximately 84-85 grains). The same type of coin was reported at Narhan (Gorakhpur), situated in the ancient Janapada called Malla.

**Type-IV:** This type of coin too has four symbols. The six-armed symbol (three arrows and three oval alternately placed) punched in the center of the flan and other three placed around it. All coins of this type virtually seem to be the same as the coins of type-V (below) but are quite distinct from them by their heavy weight (71-73 grains). For this reason, these coins are differentiated as a separate type.
Type-V: The coins of this type were first found at Golakpur (Patna) hoard. In this type besides the coins with five symbols few other coins having groups of only three or four symbols are also included. Since these coins had the same weight as five symboled coins of the hoard, it was not realized than that they had some separate identity of their own. Here too, Gupta noticed that the six-armed symbol was placed in the center of the flan, which is generally not seen on the five symboled coins. Two coins of this type weighed 3.5 gm. (54 grains) and 3.0 gm. (46.7 grains), respectively.

Type-VI: This type of coins, belong to the period when Magadha had gradually risen from a small kingdom (Janapada) to the status of an empire. These coins are found scattered all over the country possibly because the Magadhan empire so created had increased trade contracts with other parts of India which lay outside the pale of the Magdhan empire. They uniformly bear five symbols and weigh in the proximity of 48-54 grains. They are known in several hundred varieties.

Regarding the five obverse symbols, different opinions have been advanced by scholars, taking into account the time of these issues, the authority or person responsible for their issues. Smith thought that the numerous obverse punches seem to have been

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impressed by the different moneyars through whose hand the metallic pieces passed. But later the same symbols noticed in large number of coins of a single hoard according to Allan "were stamped on the coins at the same time by the issuing authority and not from time to time by private individuals." 18

There are divergent views relating to the reverse marks of the coins, which are similar to the obverse mark but small in size. Walsh 19 thought these reverse symbols as 'the mint or the area mark', Allan 20 suggested that these symbols were 'shroff mark', while Gupta 21 argues that these reverse marks are banker's symbol. These coins while in circulation may have suffered in their weight necessitating these marks to be punched by the examiner of the coins after their verification. These symbols were punched probably to reauthenticate the metal or the correctness of weight to avoid counterfeiting of the coins about which Kautilya 22 writes in detail.

Now, with regard to the identity of the issuer of these coins, Smith 23 observed that these coins were private coinage issued by guilds with the permission of the ruling authority. But after the

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19 Walsh, E H C., op cit p 59
20 Allan, J., op cit p XX
21 Gupta, P L and Hardakar, T R 1985, Silver Punch-marked coins of the Magadha-Maurya Karshapana series, Bombay, p 37
22 Kautilya's Arthashastra, tr By R Shamasasatry, p 220
23 Smith, V A., op cit
systematic study of the coin hoards, Spooner, Bhandarkar and Walsh suggested that the punch marked coins were issued by a central authority, i.e., the state. Banerjee too, rejected Smith's views and seems to be in agreement with Spooner, et al. saying "that there is little doubt that the marks were those of central authority that guaranteed the genuineness of the metal and the correctness of the weight". In the Arthasastra's we are informed by Kautilya that mint should be under the most rigid control of the state. Kautilya, also, names rupadarshaka as officer who regulated the currency.

But the biggest problems about these coins are related with the significance or meaning of these punched symbols, in antiquity. Nearly four hundred varieties of symbols have been identified till now. Earlier, it was believed that these various symbols were punched in a haphazard manner on the coins by persons who issued them. In the past, many scholars attempted to trace the origin, the meaning, and the significance of these symbols. The problem, however, remains baffling to scholars.

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28 II.12, IV. I and IV. 4.
In the light of resemblances with various symbols, depicted on other objects, the origin and significance of the coinage, these several punched symbols were treated by scholar as follows: Bhandarkar\(^\text{29}\) has traced out a few symbols found on punch-marked coins as existing on some megalithic pottery of Hyderabad. He, therefore, concluded that the coinage must have been handed over to us from pre-historic age. Theobold,\(^\text{30}\) as cited by Agrawal, et. al., recorded that most of the symbols noticeable on punch-marked coins occur in such a diverse lands as Assyria, Egypt and Scotland. Bandarkar\(^\text{31}\) also shared his views regarding some of the symbols. But, according to Agrawal; none of the above scholar have explained the universal nature of some of the symbols in respect of the punch-marked coins.

Many scholars have identified punch-marked coin symbols with religious characters. Spooner at first suggested that many of the symbols stood for Dharma-chakra and Bodhi tree. But later on he\(^\text{32}\) discarded his hypothesis for a second one and held that many of them were Zoroastrian in nature. Thus, according to spooner, the solar symbol stood for mithra, the tree for naoma tree etc. Though the symbols found on punch-marked coins do resemble with some of

the symbols known in the Buddhist and Zoroastrian religion. But there is no reason to associate these punchmarked coins with either Zoroastrianism or Buddhism for the reason that Zoroastrianism practically had no hold in India during the period when punch-marked coins were introduced and became common in use. Even Buddhist symbolism is a later development.

Besides it, the meaning of group symbols has also been attempted by few scholars. Chakravarti suggested that the four constant symbols out of the five, the two most common ones probably had religious significance and of the other two symbols, one may be of the locality, where it was struck and other of the mint master. Allan holds that the symbols may represent a series of diminishing areas of jurisdiction. The last and the most varying symbols would represent the actual issuer of the coins. The constant sun symbol would represent the highest official, perhaps the king himself. the next commonest, the six armed symbols the highest official under him. Durga Prasad ignoring the first two common symbols (the sun and six armed symbols) indicated that the third symbol most probably stood for the king and the fourth and fifth one for the year and place of issue. Kosambi is of the view

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33 Journal of the Royal Asiatic Society of Bombay, V XXIV and XXV, p 35
34 Allan, J. op cit, p. LXXII.
35 Numismatic Supplement, V, XLV, p. 80.
that they may refer to the names of ruler, his father and his grandfather.

To know the meaning of the two commonest symbols i.e. the sun and six armed, one has to go back into antiquity when the kingdom of Magadha first introduced its local series. Scholars, so far, have given no satisfactory nomenclature to these particular symbols. As it has been mentioned earlier that Gupta\(^\text{37}\) divided them into six types. The two hoards of third type, one in Muzaffarpur (Bihar) in the territory of ancient Vajji and the second in Gorakhpur district in the territory of Malla have been found. According to Jain\(^\text{38}\) and Buddhist\(^\text{39}\) tradition, the Magadhan king Ajatsatru attacked the two Janapadas, Vajji and Malla, and assimilated them into his own kingdom. Precisely for this reason that local series of Magadha have been found there, as well. There can, therefore, be no doubt that these coin types belonged to the reign of Ajatsatru. The two common symbols, i.e., the sun and the six armed were first reported in the second type of local coins of Magadha. Gupta on this basis attributed the second and the first type to Bimbisara preceding Ajatsatru. The striking feature of coins of second to fourth types is that the six-armed symbol is quite big and bold and as placed almost in the center of the flan of every coin.

\(^{37}\) Numismatic Digest, 1994, V 18, pp 1 – 18
\(^{38}\) Uvasaga Dasao, II Appendix, p 7
\(^{39}\) Book of Gradual Saying, IV, 14 etc
features of these coins are that amongst these average or middle size symbols, one is the sun symbol and it is seen on all the coins along with six armed symbol placed close to it in every type of coins.

Surprisingly both symbols are not present in the $1^{st}$ type of coins. Certainly the question arises, why it was so? Bimbisara was the first historical king of *Magadha* who initiated the policy of expansion of his kingdom by first annexing the Anga *Janapada*.\(^{40}\) It is quite likely that he may have issued the coins of type-II after the annexation of Anga. The six armed symbol in the middle of the coin possibly emphasizes the extension of his kingdom by means of the use of this type of war equipment (the six armed symbol which is described as a circle with pellet in the centre, surrounded by six arms, three of which are arrow-heads and other three are taurine, fishes, triskles is an oval, dumb bell symbols etc.). The radiating sun symbol may have been the royal emblem of *Magadhan* kings characterizing their all pervasiveness. Mughal ruler Jahangir's coins also bear similar symbol. Hodivasa\(^{41}\) takes this as a manifestation of royal glory and brilliance.

The other symbols portrayed on the coins have some special significance with respect to time and clime. These symbols provide

\(^{40}\) *Parisistaparvan*, VII. 22.
a rich illustration of every day life of the period. The interest lies in the choice of objects as they may have been in common observance of the people of those times. Seeing to these symbols, today an impression may be gained that they show the interest of the people in their agrarian activity. Depiction of natural and man-made objects, religious symbols and elements of nature such as animals, birds, fish, reptiles, insects, trees and plants of many kinds, thus, appears to be their subject matter.

The elephant is shown on one type with rider, the dog as a popular subject, and the horse, camel, buffalo, goat are all represented. Some dangerous creatures of nature are also represented such as the rhinoceros, snake, scorpion, crocodile etc.

The man-made products of this society are profusely illustrated, though identification of many of them is difficult. Among the most interesting is the steelyard or balance, which must have been used in trading activities. Various utensils can be recognized such as candelabrum, arrow tipped standard, elephant goad etc. The only weapons seem to be the bow and arrow the spear. These are shown in combination with many other objects.

Religious symbols are common though once again it is difficult to know what they mean? The taurine is a mark of auspicious meaning, tree in railing probably represents the sacred tree. After
going carefully through the symbols of local series of coins issued by different Janapada one can easily understand that the same symbols with little modification is also punched on the imperial series of punch-marked coins of Magadha.

In conclusion, we may say that symbols of punch-marked coins may not all be necessarily religious in nature as pointed out by some scholars (above). Some of them as pointed out may have been due to the specific use of such things, in the daily life of those days and for that they may have caught the fancy of the issuing authority. As I have pointed out that, while discussing about animals in terracotta art that most of these animals made by the potters are also found punched on punch-marked coins. Probably it was because of their economic importance in their life. Even today very specific things which the government considers to popularize among the people puts them on the coins and the paper currency, for example, corns, tractor ploughing the field, men and women transplanting paddy, etc.

**Compositions of Metals:** Some of the punch marked coins available from different hoards have been analyzed to know their composition. Gupta⁴² on the basis of the coins recovered from Mambar and Gairola suggested that these coins contain 91.53%

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⁴² Agrawal, Bhanu and Rai, Subhash, *op cit*, p. 17.
silver, 4.93% copper, 1.69% iron and 1.30% lead. The analysis of coins belonging to Sahet-Mahet hoard, Lucknow Museum, showed that they contained 75% of silver, 24.6% of copper with traces of iron and 0.04% of lead. The quantitative chemical analysis of two coins of the Shamiawala hoard showed that one of them had 79.6% and other 80.0% silver.

Several assays of the coins are also known to have been attempted by several scholars. The assay of 113 coins by Cunningham indicated that the silver content varies from 75.2% to 86.2%. The coins of Golakpur hoard contained 82.0% silver, 15% copper and 3% impurities. Durga Prasad on the basis of his study suggested that the percentage of silver varied from 72 to 80%. According to the assay of Bombay mint by Hynes, the coins of Vaihoard contain 89.18% silver.

On the basis of the above-mentioned studies, we can safely summarize that the punch-marked coins made of silver are in fact alloy of silver and copper.

Technique: Punching appears to be the earliest method. The coins manufactured by this method are known as punch-marked coins.

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43 Numismatic Supplement, V XLV, p 12
44 Journal of Numismatic Society of India, V I, p 4
45 Agrawal, Bhanu and Rai, Subhash op cit
46 Numismatic Supplement, V XLV p 14
47 Ibid, pp 58 59
48 Journal of Bombay Branch of Royal Asiatic Society V XI p 400

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This method is quite primitive and is certainly indigenous and without any foreign influence. In the local series of punch marked coins, punching was done on one side only, which may be called the obverse side. The reverse side was left blank. Later in the imperial series of punch marked coins some small symbols were punched on the reverse side too.

The word *ahata* in the Ashtadhyayi⁴⁹ is generally taken by scholars to refer to punching method. The Arthasastra⁵⁰ mentions the things required to manufacture coins. These are metal, alkalis (*kshara*), charcoal (*angara*), bellow (*bhastra*), clapper (*sandansa*), hammer (*mushtika*), anvil (*adhikarni*), crucibles (*musha*) and dyes with design (*bimbatanka*). About the process of minting coins Kautilya mentions that, first the metal was melted in a melting pot (*musha*), purified with alkalis (*kshara*), then the metal was beaten into sheets on an anvil (*adhikarni*), after that hammered (*mushtika*), then cut into pieces with clips (*sandansa*) and finally they were stamped with punches having symbols (*bimba tanka*). The punching, I may say on the basis of my personal observation of the punch-marked coins, were done with the help of punches that may have been heated to redness so that it may make a deep and lasting incuse.

⁴⁹ Agarwala, V.S., *op cit*, p. 272
⁵⁰ IV. V., II, p. 137.
Thaplyal and Srivastava\textsuperscript{51} have noted that silver was beaten out with hammer into sheets of required thickness. Thereafter, slightly more than one centimeter wide strips were cut off from these sheets. The strips were further cut into pieces of approximate weight (in case of standard silver coins generally 3.3 – 3.5 gm or 51 – 54 grains). Adjustment of weight was done by clipping one or more corner of heavier piece without bothering about the shape. By this act it acquired different shape such as, pentagonal, hexagonal, heptagonal or even octagonal. Devices were impressed on the blanks by separate punches. These punches must have been made of hard metal. They further point out, “Often the devices are applied irregularly on the surface, and, when punched in large numbers, the symbols are at times so placed as interfering with one another or even overlapping and giving a look of confused jumble” Earlier Smith,\textsuperscript{52} as well, held similar views about the technique of the minting of punch marked coins.

This method of punching technique was introduced earlier in India, it continued to be used for some time along with the cast and dye struck methods, which are technically more advanced.

\textbf{Prices:} In the literature of the period, mainly Buddhist, we find the prices of almost every vendible commodities. In these texts fees,

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\textsuperscript{51} Thaplyal, Kiran Kumar and Srivastava, Prashant, 1998, \textit{Coins of Ancient India, (from Earliest times to c.650 AD)}, Lucknow, p 34.
\textsuperscript{52} Smith, V.A., \textit{op cit}, p 134
pensions, fines, loans, price of stored treasures and incomes too are stated in terms of number of coins or their fraction. We even come across the mention of the price of a dead mouse. In most of the cases prices given are fantastic and fabulous. Here only a few references given below may be regarded as reflecting to the actual market prices of certain commodities.

According to the *Vinaya* texts, a small quantity of ghee or oil could be bought for a *karshapana* only. Meat of a chameleon could be bought for a *kakini* or an *addha masaka* and a fish cost only seven *masaka*. A jar of liquor was available for one *masaka*. It is further said that a *masaka* was sufficient for an ordinary wage-earner to buy a garland, perfume and some strong drink. Animals of inferior quality were cheap, while, those of superior quality were costly. A thorough bred horse cost 1,000 *karshapana*, a donkey only eight *karshapana* and a pair of oxen twenty-four *karshapana*. The prices of different commodities give us enough scope that in day-to-day transaction the punch-marked coins and their different denominations were used on a large scale.

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53 *IV*, pp 248 – 250
54 *Jataka*, V – VI, p 346
55 *Jataka*, V II, p 426
56 *Jataka*, V I, p 350
57 *Jataka*, V III, p 446
58 *Jataka*, V II, p 306
59 *Jataka*, V VI, p 343
60 ibid
BONE AND IVORY OBJECTS

In the period under study, besides stone, the bone and ivory played an important role in the economic activities of the people. These objects were used in making different types of tools such as awls, needles, pins, comb teeth, weapons like arrow-head and ornaments like bangle. But the most common objects were arrow-heads, points (having points at one or both end) and styluses.

BONE

Objects made of animal bones\(^1\) have been found restricted to smaller objects of daily use, e.g., awls, mirror handle, etc. Narain\(^2\) explaining the paucity of objects made of animal bones remarks, basically bone is a hard substance, forming the skeleton of the higher animals. However it is important to note in this regard that the fresh bones, filled with blood and marrow were not used for making objects because of its breaking in irregular way. Bone is less fibrous and more fragile than ivory and splinters easily. The blood passages or tubes of bone are larger and of inferior variety. So, the use of bone is restricted to the manufacture of smaller things like awls, mirror handles, etc.

\(^1\) Dwivedi, V.P., 1976, Indian Ivories, Delhi, p 7
\(^2\) Lala, Aditya Narain, 1974, A study in the Technique of Neolithic Bone Tools Making at Chirand and their Probable Uses, patna, p.2
Following are the descriptions of important findings of bone objects:

**Arrow-heads:** These have been recovered from Ropar\(^3\), Allahapur\(^4\), Noh\(^5\), Taxila\(^6\), Raghat\(^7\), Kausambi\(^8\), Atranjikhera\(^9\) and Eran\(^10\). The arrow-heads unearthed at Kausambi were designed for shafts made of cane, reed etc. Some points of arrow here show a black stain probably due to poison or blood. On the basis of their shape, they can be divided in five kinds. The first is with long point and circular cross-section, the second is socketed and the third is with double grooves, while the fourth is bud shaped and the last is irregular rectangular in cross-section. At Atranjikhera, a bone point inserted with an iron shaft is an interesting find of this period. These arrow-heads reported in the context of the period under study were not capable of killing a human being; so, they might have been used as hunting tools for shooting birds and small animals.

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\(^4\) ibid.
\(^5\) ibid.
\(^9\) Gaur, R.C., 1983., *Excavations at Atranjikhera*, Delhi, pp.412-420
\(^10\) *Indian Archaeology- A Review* (Here after IAR only) 1962-63, p.II, pl.XXXVA
Bone Points: These bone points are discovered at Atranjikhera, Prahaladpur, Champa, sonpur, Eran, Taxila & Hastinapura. Most of the bone points recovered at Prahaladpur are sharply pointed and some of them are decorated with circle and dot patterns. These points were probably used as awls or pins. But at Allahapur, Alamgirpur, Ropar and Hastinapura these points are described as styluses. But in the absence of any definite evidence of writing in any form the hypothesis of the use of styluses does not hold much ground and remains mere conjectural. However, it may be pointed out that in view of the fact that the terracotta discs, balls etc contain deep incisions and sometimes also engravings, these may have been done perhaps, with the help of these styluses. It may further be added that since in the preceding period (pre-600 B.C.) the styluses were generally crude in making which may suggest that they were potters tools, while in the period of our concern the styluses seems to have attained some degree of sophistication (as

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11 Gaur R C. *op cit*
12 *IAR, 1962-63*, p 41
14 *IAR, 1956-57*, p 19
15 *IAR, 1962-63*, p 11, pl XXXVA
16 Marshall, J. *op cit*
17 *Ancient India, Nos 10 & 11*, p 105
18 Ghosh, A. 1989. *An Encyclopaedia of Indian Archaeology*, New Delhi, v 2, pp 14-15
19 *ibid, p 13*
20 Sharma, Y D. ‘Past Patterns in living as unfolded by Excavations at Ropar’, *Lalit kala, Nos 1-2*, p 121
indicated at Atranjikhera) and hence may now have had its use in other purposes, as well.

Besides the above mentioned objects made of bone, other things such as antimony rods have been recovered from Taxila\textsuperscript{21} and Allahapur, pendent from Taxila\textsuperscript{22} and Atranjikhera\textsuperscript{23}. The pendants unearthed at Taxila are dagger-shaped, while, Atranjikhera specimen is a beautifully carved, taurine shaped with the three holes in the upper part and two transverse holes in each of the two legs. A fine specimen of a bird with sharply pointed beak, flaring tail and pin hole like tiny eyes along with socket base in the place of legs to fix a rod or stick like thing also reported at Atranjikhera\textsuperscript{24}. This figure is dark brown in colour. Besides the above mentioned objects of Atranjikhera has brought to light bangles, socket, games man and beads. The evidence of bangles also comes from Hastinapura\textsuperscript{25}, Allahapur\textsuperscript{26} and Sardargarh\textsuperscript{27}.

**IVORY**

The period from c.600 – 320 B.C. is characterised by a high watermark in the development of ivory industry as it does for other fields of arts and crafts. The different objects made of ivory have

\begin{footnotesize}
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\item[22] \textit{ibid}, p.654.
\item[23] Gaur., R.C., \textit{op.cit}, p.417
\item[24] \textit{ibid}, p.419
\item[26] \textit{ibid}.
\item[27] \textit{ibid}.
\end{itemize}
\end{footnotesize}
been reported at Ataranjikhera, Kausambi, Champa, Rupar, Sonpur, Vaisali, Ujjain, Prahaladpur etc. These objects consists of plain and decorated bangles, combs, hair pins, antimony rods, ear cleaners, figurines of human being, arrow-heads, points, needles etc.

The details of ivory objects found at different sites are given below.

Ivory Figure: A unique large female figure of ivory recovered at Champa, has no parallel from in India dated to the 6th – 5th century B.C. This type of articulated limbs made of wood have been found in Egypt and west Asia earlier to this period. The figure from Champa is blackened, perhaps, due to accidental firing. Its right hand and leg are missing. This figure is well proportioned and measures 7 inches in length from waist to foot and the length of the head is 1.2 inch. This figure has developed breasts, slender waist and long arms. The eyes and eye brows have been well delineated, the nose is prominent aquiline and fore head is broad, the face is oval and there are evidence of holes for fixing the hair or hair wig. The figure wears bangles on the left hand and sandal in the feet. The excavator has observed that different parts of the body were fashioned out of separate ivory pieces and finally 'screwed'.

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28 Sinha, B.P., op.cit., p.146
29 ibid

* It may be noted that in India at this period time to which the ivory figure belongs to the system of screw was unknown. In fact, the photograph of the
together at proper places. The grooves are well marked and finished.

**Arrow Heads and Points:** Sites such as Taxila\textsuperscript{30}, Tripuri\textsuperscript{31}, Kausambi\textsuperscript{32}, Sonpur\textsuperscript{33}, Atranjikhera\textsuperscript{34} etc have yielded the evidence of arrow-heads and points. The specimens of Taxila belongs to c 600 B.C. They are roughly sharpened at both ends but those reported in 4\textsuperscript{th} to 3\textsuperscript{rd} Century B.C are fine in appearance and may be categorized as follows:

(A) This type has smooth circular point and well defined tang,

(B) Another has a point similar to above but has a hollow socket hole behind for the shaft tenon, and

(C) The point is trilateral and there is hollow socket hole behind it

Similarly the finds at Kausambi can be divided into five kinds as in the case of bone arrow-heads.

**Comb:** This has been recorded at Ropar\textsuperscript{35} and Ujjain\textsuperscript{36}. The comb at Ropar is decorated with incised circle and dot design. The teeth and lower portion are missing. The comb had a decorative design of circle and dot in the mid portion and the hole nearby. Probably for a

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\textsuperscript{30} Marshall, J, *op cit*, p 654
\textsuperscript{31} Dikshit, M G, 1955, *Tripuri-1952, Nagpur* p 132
\textsuperscript{32} Sharma, G R, *op cit*, p 47, pl 39
\textsuperscript{33} Sinha, B P, *op cit*, p 146
\textsuperscript{34} Gaur, R C, *op cit*, pp 412-415
\textsuperscript{35} Sharma, Y D, *op cit*
\textsuperscript{36} Sinha, B P, *op cit*
convenient grip one of its sides has been rounded. The comb found at Ujjain's has, unfortunately, not described.

Beside the above-mentioned findings, the other important things such as hairpins are recorded at Chirand\textsuperscript{37}, Nagda\textsuperscript{38} Ropar\textsuperscript{39} and Ujjain\textsuperscript{40}. The specimen from Ropar has the top in bud-shape and the pin tapers down to a point. A ear-stud with grooved concentric circles, has a small central knob, flaring edge on the frontal side and the backside being plain is recovered at Atranjikhera\textsuperscript{41} The die, handle and antimony rod made of ivory is reported at Vaisali\textsuperscript{42}, antimony rod, knitting needles, and mirror handle from Ujjain\textsuperscript{43} antimony rod and cross-shaped bead from Champa\textsuperscript{44} and bangles from Vaisali\textsuperscript{45} and Oriup (Bhalpur)\textsuperscript{46}.

Our ancient literature where on the one hand corroborates to the presence of the above archaeological finds in ivory, on the other hand, it adds to the repertoire. In early Vinaya texts, it has been mentioned that needle-cases\textsuperscript{47}, sword handle\textsuperscript{48} ear cleaner\textsuperscript{49} were

\begin{footnotesize}
\begin{itemize}
\item Pathak, B P N., 1988, \textit{Society and Culture in Early Bihar}, Patna, p 83
\item IAR, 1955-56, p 14, pl XXIV B
\item Sharma, Y D., \textit{op cit}
\item Sinha, B.P., \textit{op cit}
\item Gaur, R.C., \textit{op.cit}, p 420
\item Sinha, B.P., \textit{op.cit.}, p.146.
\item Banerjee, N.R., 1965, \textit{Iron Age in India}, New Delhi, p 201
\item \textit{ibid}, p.97.
\item Deva, Krishna and Mishra, Vijayakanta, 1961, \textit{Vaisali Excavation-1961}, Vaisali, pp.192-197
\item Ghosh, A., \textit{op.cit}, p.321
\item \textit{Bhikkhu Patimokkha}, V.86 and \textit{Bhikkhuni Patimokkha}, IV, 12.
\item \textit{Satthakandanda}, \textit{Challuvagga}, V.I,12
\item \textit{Karnamalaharin}, \textit{Challuvagga}, V.III.7.
\end{itemize}
\end{footnotesize}
made of bone, horn and ivory. In *silavanaga Jataka* we have the evidence of a separate market of ivory workers at Benaras\(^5^0\), where the ivory workers carried on their industry, rather handicrafts\(^5^1\). Ivory work (*dantavanijja*) was a well-known industry and ivory workers are mentioned among the important artisans (*silpaarya*). The ivory workers made various small objects of diverse form and shape, such as bangles, costly carvings, different types of ornaments, handles for mirror and inlayings of royal chariots\(^5^2\). But their further details are not reported. A sharp saw (*kakacha or khara kakacha*) is known to have been used for shaping the ivory pieces\(^5^3\).

Ivory was obtained either from the dead elephants or the living ones\(^5^4\). *Arthasastra* reports that if any body kills an elephant in the forest reserves meant for the supply of elephants the penalty was death. However, those who brought the tusks of dead elephants were duly rewarded\(^5^5\). The living elephant’s tusk was considered worth a great deal more than a dead one’s\(^5^6\). This shows that the value of tusk of a living elephant is greater than the tusk of dead elephant. Since the ivory objects were being crafted, the craftsmen may have been catering to the demand from the people, as such, it may be

\(^{50}\) Jataka, I, pp 175-176  
\(^{51}\) Jataka, I, p 320, II, p 197  
\(^{52}\) Jataka, V p 302-G, 37, VI, p 223, G-964  
\(^{53}\) Jataka, I, pp 176, 320, VI, p 261  
\(^{54}\) Jataka, I, pp 320-321, II, p 197, V, pp 45, 49  
\(^{55}\) Shamasasty, R, tr, *Kautilya’s Arthasastra*, Mysore, 1951, p 49  
\(^{56}\) Jataka, I, p 176
visualized that this may have given rise to such people who perhaps provided the craftsmen with the tusks of elephants dead or alive.

The Tools and the Technique: The tools and techniques adopted by bone and ivory workers during the period under review were perhaps more or less the same as they were in the earlier stages of development during the Neolithic period. In the Neolithic phase at Chirand\textsuperscript{57}, the recovery of more or less one hundred fifty bone objects helps us to understand the technical process through which these objects were made.

Despite the difference between the material being either bone or ivory, objects made of both were carved in the same fashion and almost with the same tools. The carved figure of Champa attests to the use of chisel and hammer, the exquisitely cut ivory pieces of Sonpur, attests to the presence of saw, the holes in pendants of Atranjikhera and Taxila attests to the presence of borers. A close observation of these objects gives us an idea that the continuance of application of these same earlier tools is now with greater dexterity, skill and variation. The result of this is clearly visible to us in the form of the products becoming much more attractive, durable and refined.

\textsuperscript{57} Lala, Aditya Narain, \textit{op. cit}, p.13.
About the preparation of bones for making objects Dwivedi observes that after dismembering the bones, the marrow were removed by boiling them, probably in soda and calcium, remains of which have been found in pots. According to him, again, "Then the porous surface of the boiled bones was filled with liquid wax to provide strength and also to prevent them from absorbing moisture. It is well known that boiling makes the bones soft and they can be cut, hold or bent while still warm." To this Dahiya adds "The activities of dismembering the bones and cleaning them for removing marrow and particles of flesh were probably carried out by a separate section of workers (charmakaras)."

As regard the making of tools of bone Narain observes that "Once the desired shape of piece was detached from the original bone, it was dressed with stone blade to make rough-out of a tool which the craftsman intended to make. It was rubbed against sand stone piece to make the surface smooth. Finally, the tool was filed down to give regularity to the form and to provide a sharp working end. Eyes or holes were made in the tools with the help of bone

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58 Dwivedi, V.P., op.cit., p.13
59 ibid.
60 Neelima, Dahiya, 1986, *Arts and Crafts in Northern India (from the Earliest times to c.200 B.C.)*, Delhi, p. 103.
drills of various sizes. The tools were made durable by subjecting them to fire, but before it, they were covered with clay." ^{61}

In ivory carving, as well, Dwivedi ^{62} on the analogy of modern times suggests that "first the heavy outer bark of the tusk has to be removed. The inner portion is then cut to a small section according to convenience. While cutting the tusk into small sections, care is taken that the pieces are cut in the direction of the grain. The artist then draws a sketch of the article proposed to be carved. An ivory piece of the required size is then cut from the tusk, after fixing it in a vice. The portion of ivory gripped in the vice is wrapped with cloth so that the jaws of the vice may not leave any mark on ivory piece, it is fixed in clamping device with jaws and then cut by a hand saw. After obtaining required piece of tusk, again, it is fixed in clamping device and with the help of chisel and hammer (made of wood), a rough shape is carved out. Chiselling of ivory requires tactful handling because there is the possibility of breakage at every stroke. The rough-cut is then smoothened by a file. The carvers again use chisel according to need. After removing every minute unwanted particles, the beautiful shape emerges.

The method of carving human figurines in ivory during the period under study gives us the idea that artists applied two

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^{61} Lala, Aditya Narain, _op.cit._, pp.3-5.
^{62} Dwivedi, V.P., _op.cit_, p.13.
types of different techniques Dahiya points out "Either the figure was carved out in a single block of ivory or each limb was made from a separate piece before screwing them together."^{63} It appears that the first technique was more common. Since there is only one example of the second technique, that of, ivory female figure from Champa, it may perhaps be suggested that an innovation, perhaps on the analogy of some external model, has been attempted. Thus, the bone and ivory workers of this period made an intelligent and skilful use of all the available techniques such as dismembering, cleaning, cutting, sawing, chiselling, boring, filing, finishing and making design by incision.

The description of various finds in the preceding pages is quite convincing that in period under conclusion, artists were quite skilful in bone and ivory carvings. And if the number of objects has anything to do with popularity, ivory was much more popular than stone. The material was preferred for certain categories of objects, such as handles, points, arrow-heads, bangles, hairpins, combs, human figurines etc. One of the reason why the use of ivory was restricted to the production of certain kinds of objects, could be that it was perhaps, more expensive to procure, and the supply may have been limited. One thing is certain that due to higher cost involved in it due to

^{63} Neelima, Dahiya, *op cit*
delicate carvings, ivory was used in making either luxurious goods or ordinary objects for people of higher social and economic status satisfying their aesthetic sense.
STONE OBJECTS

The working in stone is one of the most important industries since the stone age. The stone objects recovered during excavations and explorations throughout the length and breadth of India constitute one of the major sources of our knowledge about the development of arts and craft in stone. The industry of stone seems to have been in a thriving condition during the period of this research. The excavations have brought to light several types of household objects, more important among them are grinding millstone of granite (round in shape and made up of two parts), querns, mullers, pestles, mortars, balls, etc. These stone objects and their use along with stone ornaments like finger rings are mentioned in literature relevant to the period. Also, rings made of precious stones were reported. Agates were used sometimes for bangles as reported at Hastinapura. The few pieces of bangles made of stone were also unearthed at Kausambi, Kumrahar, Vaisali, and Sonpur. The

1 Jain, K C, 1974, Lord Mahavira and his times Delhi p 340 Gopal R 1959 India of Vedic kalpasutras Delhi p 133
2 Ancient India, Nos 10 and 11, p 90
3 Sharma, G R, 1960, The Excavations at Kausambi, 1957-59, Allahabad p 93
4 Altekar, A S, and V. Mishra, 1959, Report on Kumrahar Excavations K P Jayaswal Institute, Patna, p 130
evidence of the incidence of ornaments made of precious stones being less gives us the idea that probably they were used sparingly. Interestingly whatever objects and ornaments used, were found in large quantities; however, very little evidence of unfinished objects has led Thakur to remark that there was the "lack of local manufacturing activities".

The objects of stone like querns, mullers, pestles, and mortars are mainly associated with the treatment and preparation of plant foods as kitchen equipment. The first appear with the food producing or Neolithic-Chalcolithic stage in the archaeological record and still continue to be used in the region of rural areas unaffected by modern technology. The most common rocks employed in the making of these artifacts are basalt, dolerite, granite, quartzite, sandstone, and schist. As regards the technique employed in shaping the blocks of raw material, Ghosh suggested that two methods namely flaking and pecking were common.

Querns: Studies on querns from early historical sites did not receive the attention of scholars until a paper published in Antiquity by Curwen in 1937. Quern dating back to 8000 B.C. have been found

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7 Thakur, V.K., 1981, Urbanization in Ancient India, New Delhi, p 118
9 ibid
earliest at Sarai Nahar Rai\textsuperscript{11} (Pratapgarh) They were possibly used to grind wild grains. The querns are made of stone of large blocks and used to grind grains of various types, such as wheat, pulses of various kinds etc. On the basis of their shapes they are divided into three types. However, pertaining to the period 600 – 320 B.C only two types\textsuperscript{*} have been found. They are as follows:

(i) Saddle Querns

(ii) Legged Querns

(i) **Saddle Querns**: The type occurs first in Neolithic phase and continues through Chalcolithic to the period under research. The saddle querns are unearthed at Jaderua (Gwalior\textsuperscript{12}) and Champa (Bihar). They are made of large blocks of stone, which became hollow in the middle because of continuous use. Banerjee\textsuperscript{13} view is that the saddle querns were used more for crushing grains. The saddle querns with flat surface are also known to us, about which he\textsuperscript{14} suggested that they have been used for grinding herbs and spices. But Dhavalikar\textsuperscript{15} differs with the suggestion that such type of

\textsuperscript{11} Habib, Irfan, 2001, *Pre History*, New Delhi, p 45
\textsuperscript{*} The third is rotary querns about which Childe would ascribe the introduction of this type in the Indian sub-continent to the early centuries of Christian era. Rotary querns first appeared at Taxila dated 100 B.C – 50 A.D
\textsuperscript{12} IAR, 1971-72, p 29
\textsuperscript{13} Banerjee, K.D., 1957, ‘Querns and Anvils from the Narmada Valley’, Bulletin of Daccan College Research Institute (BDCRI), Baroda, vol 18, p 10
\textsuperscript{14} *ibid*
\textsuperscript{15} Dhavalikar, M.K., 1999, *Historical Archaeology of India*, New Delhi, p 172
difference however is not valid because the flat ones can become saddle querns after long use. This observation by Dhavalikar appears to be reasonable.

(ii) **Legged Querns:** In this type of quern the base is provided with four short legs at equal distance, in the form of short conical stumps. These short legs, which were, presumably, embedded in the floor in order to prevent it from displacement and tilting. This tradition is still alive and in Haryana, ukhala, the term used in local dialect. The type begins to appear from 400 B.C. and marks a distinct development from the preceding one. The upper portion and sides show the better preparation. The working surface is either slightly flat or concave. As regards the shape Ghosh observes, "they are elongated with straight sides and straight and rounded ends"\(^{16}\).

This type appears to be most commonly associated with the period under study, at Nadner\(^{17}\) and Taxila\(^{18}\). The Taxila, querns have the ends, as well as, the sides ornamented with incised decoration and include also the symbols such as swastika and triratna. The details of Nadner specimens are not available.

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\(^{17}\) IAR, 1986-87, pp.56 & 57
\(^{18}\) Ghosh, A., *op. cit.*
Muller: Mullers are the elongated objects made suitable for grinding operations on querns with a flat working surface. They appear to have been shaped through the technique of flaking and chipping. But in some cases river pebbles and nodules are used without any preparation. The mullers are of various shapes such as oblong, rectangular, oval, hexagonal or circular. Mullers have been found at Atranjikhera\(^1\), Daulatpur\(^2\) and Jaderua. Muller from Atranjikhera is 3.2 cm. in height. They are of brownish sandstone and hexagonal in shape. Depression occurs on both the working surfaces because of their continuous use.

Mortar: Mortar is a stone block with a central depression as receptacle for the material, mainly grains, to be pounded or crushed with a pestle. In west Asia\(^2\) mortar and pestle have been found dated to pre. 9000 B.C. They are generally squarish in plan and are of different sizes. Their use has been suggested by Dhavalikar to polish the grains like jawar (mize), bajra (millet) and to this, on the analogy of the present days, wheat may also be added for this the grains were made wet with water. Finally, then pounding it with the help of stone pestle called musala in vernacular. For the above-mentioned purpose the mortar is today made of wood is still in use.

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\(^{19}\) Gaur, R.C., 1983, *Excavations at Atranjikhera*, Delhi, pp 410-412

\(^{20}\) Tripathi, V., 1976, *The PGW, An Iron Age culture of Northern India*, Delhi, pp.12, 29, 34 & 112.

\(^{21}\) Habib, Irfan, *op. cit.*
in rural areas of India. In the present time grains are pounded in this mortar by one or more persons with the help of long wooden pestles. Mortar has been reported from Ujjain\textsuperscript{22}.

**Pestle:** Like muller this object is also used for pounding. These pestles are elongated round block of coarse-grained rock\textsuperscript{23} and the one end, is used as working side\textsuperscript{*}. Their working end shows clear traces of battering, which goes to show that they were used for pounding. Their size generally measures about 20 cm in length, 4 to 5 cm in diameter and in shape they are cylindrical with featureless or tapering ends. These pestles have been recovered in excavations at Atranjikhera, Bateshwar\textsuperscript{24}, Champa\textsuperscript{25}, Chirand\textsuperscript{26}, Nadner etc. Pestles from Atranjikhera are made of red and grey sandstone. One specimen, however, has smooth flat working surface. The top being roughly convex and the side rounded.

**Technique:** The basic tools and techniques employed by the people in the period under study are not fundamentally different from the methods used in the preceding ages. But in the able and dexterous hands of craftsman they achieved more refinement and perfection.

\textsuperscript{22} Ghosh. A., *op.cit*., p.144.
\textsuperscript{23} *ibid*, pp. 185-186.
\textsuperscript{*} Now in most part of India pestles made of wood are in use like mortars and both their side use as a working portion.
\textsuperscript{24} IAR, 1974-75, pp. 42-43
\textsuperscript{25} Sinha, B.P., 1979, *Archaeology and Art of India*, Delhi, p.97.
\textsuperscript{26} IAR. 1968-69, pp.5-6.
Dahiya in the context of Harappa mentioned different tools made of stone to shape various objects made of it. The tool kit of craftsmen in stone consisted of hammer, chisel, engraver, borer or drill, burnishers or rubber, polisher, anvil etc. But here in the period under study, it is also very likely that some of his tools made originally of stone may have been replaced by iron tools, such as the chisel, borer etc. The manufacturing process of stone tools generally involved two stages, i.e., shaping or manufacturing the tool and smoothening and beautifying it. After making rough out of the tool, the unwanted parts were carefully eliminated through further chiseling. When the craftsman had fashioned the shape to his satisfaction, the tools were subjected to grinding, rubbing and burnishing.

The objects made of stone such as quern, muller, mortar and pestle came into existence as soon as people came to know about the agricultural products. All these objects are the part of kitchen utensils. These above mentioned objects are used even to this day with little modification in their shape and size.

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27 Neelima, Dahiya, 1986, Arts and Crafts in Northern India (from Earliest times to c. 200 B.C.), Delhi, p. 34.
From the earliest times people used terracottas as the most popular medium of artistic expression. Its continuity can, however, be followed right up to the present days. Clay as a medium for the purpose of art seems to have originated in the malleable nature of it, as it easily can be twisted and squeezed with fingers. On account of its extreme cheapness and easy availability of clay people started preparing household utensils, objects of worship, goods for domestic decoration and toys for children. Objects made of metals and stones are rare. The reason seems mainly to be that these materials being hard, demanded exceptional skill labour and patience on the part of ancient craftsmen. The plasticity of clay offered excellent opportunities to the ancient potters for experimenting in a variety of human and animal figurines.

The location of main centres of terracotta art in India was its northern part as evident from excavations. The art of making objects of clay did not flourish in the southern region because of the non-availability of fine clay. The rivers in these areas run through deep gorges and consequently do not bring or deposit fine silt on their

* Technically, baked clay figurines are known as terracotta. The word being derived from French, means the figure of clay.
banks. Even in the Deccan, clay of good quality was not available. Therefore, in some areas artists had to work in Kaolin. North India in general and Ganga-Yamuna doab in particular seems to serve as the area of concentration of this terracotta art. The soft clay of Ganga-Yamuna doab immortalised the plastic art of this region. Mathura, Kausambhi, Bhita, Rajghat, Achichchatra, Atranjikhera, Jakhera in the Doab region and even beyond that Buxar, Pataliputra, were the chief production centres of terracotta art.

The terracotta objects here in the North comprise mainly animal and human figures, toys of various kinds, such as, rattles, whistles, carts and chariots and also figures of gods and goddess and other related cult objects. About the toys during the time of Lord Buddha and Lord Mahavira, we get some mentions in literary sources. In the Bhaddasala Jataka, reference is found to princes receiving presents of elephants, horses and other toys from their maternal grand father. There are little doubt that the large numbers of figurines were toys for children. Other Buddhist literature shows potters were manufacturing various kinds of figurines and selling them in the market. Kashyapa Samhita, a medical treatise of the 3rd century A.D.

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1 Dhavalikar, M K 1977, Masterpieces of Indian Terracottas, Bombay, p 2
2 ibid
3 Jataka No 465
4 Maaghima Nikaya, I, 38, 3 13 II, 6 0 20, Jataka, Vol Vi, p 12
refers to various kinds of toys, such as, birds, boats, animals, chariots, vehicles etc. These, it says should be given to the children of different age groups. Another text Naradiya Samhita\(^6\) of the same period informs us about the method of preparing objects of clay. It prescribes that clay required for figures should be collected from the banks of rivers, thin and dry cloth should be used to remove the rough pieces of clay and get fine quality of dust clay. It should be mixed with metal powder, sand, sugar and finally with adequate quantity of water.

For historians, these terracottas throw invaluable light on material and cultural life of people of the period. Unfortunately they have not been tapped properly as source of history writings. Even Roy\(^7\) who has written much about the archaeological remains and their interpretation during the period under our scrutiny has not given due importance to these terracotta finds. Coomaraswamy\(^8\) was the first scholar who wrote about it. He was followed by Agarwal\(^9\).

\(^7\) Roy, T.N. 1983., The Ganges Civilisation, New Delhi and 1986, A study of Northern Black Polished Ware Culture. An Iron Age in India. New Delhi
Gordon, Stella Kramrisch, Johnston, Kala, Das Gupta, Dhavalikar and Pratiba. On the basis of the find in excavation these terracotta figures can be broadly divided into two types, viz., animal and human.

ANIMAL FIGURINES

After the downfall of the Harappan civilization till the beginning of 600 B.C. there was one animal, the bull which seems to have gained favour among the potters of the time. Perhaps for two main reasons: (a) religious and (b) economic. It is generally considered that bull was worship from Harappan times and from Vedic literature we have definite evidence that its utility in agricultural process had been fully realized. However, during the period of our study appears to be a spurt in the representation of animal figures. In addition to the figure of bull excavators have brought to light the figures of elephants, dogs, rams, snakes and horses are frequently reported from the excavations.

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12 Johnston, E.H., 1944, A Terracotta figure of Oxford, Oxford
13 Kala, S C., 1950, Terracotta Figurines from Kausambi, Allahabad
14 Das Gupta, C.C., 1961, Origin and Evolution of Indian Day Sculpture, Calcutta
15 Dhavalikar, M.K., 1977, Masterpieces of Indian Terracottas, Bombay
16 Prakash, Pratiba, 1985, Terracotta Animal Figures in the Ganga-Yamuna valley, (600 B C to 600 A D), Delhi
Bull: The figures of bull have been unearthed from Atranjikhera, Singh Bhagwanpur (Rupnagar, Punjab)^17 Rajghat, Hastinapura, Bateshwar and Alamgirpur. Though the figures of bulls preceding 600 B.C. had the ears and nostrils indicated by simple depression. Sometimes they have shown covered by garment around the neck, but the humped bull, recovered at Rajghat, has the eye and the nostrils indicated by depression made at appropriate places. Transverse holes were made in the lower part of the legs for the fixing of axles and wheel.

Elephant: Representation of elephants in terracotta appears as a new feature of this period. Before the period of 600 B.C. no terracotta representation of elephant's have been recorded in excavation. However here it may be pointed out that during the Harappan time the use of elephant seems to have been well known as can be determined from its representation in the form of ingraving on steatite seals. The elephant figures have been unearthed from Rajghat^18, Prahaladpur^19, Mathura^20, Kausambi^21.

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17 *IAR*, 1980-81, p.49
18 ibid, P 63.
Bhita\textsuperscript{22}, Bateshwar (Agra)\textsuperscript{23}, Buxar\textsuperscript{24} and Atranjikhera\textsuperscript{25} etc. These figures show a simple workmanship and probably it may be regarded as a continuation of the preceding tradition. Figures of elephant are shown with fat legs, the eyes were indicated by incised circles or small pellet and occasionally by round clay in appliqué. Big ears and the head portions are made by clay projection. The figures are generally heavy and solid. At Rajghat, Bhita and Taxila\textsuperscript{26}, elephants figures were shown with rider. It is interesting to note that elephant figures have been reported mostly from the middle Gangetic basin (Allahabad to Rajmahal) during this period. The painted design consisting of vertical and horizontal multiple strokes on the forehead, neck, ears, trunk and legs.

**Horse**: Next to the bull may be considered the representation of horse on the basis of the statistical figure available from the Atranjikhera excavation. They have been documented from Kausambi, Bateshwar, Atranjikhera, Bhita, Daulatpur (Kurukshetra)\textsuperscript{27}, Prahaladpur and Vaisali\textsuperscript{28}. These particular figures are identified as horse because of their thick neck and elongated

\textsuperscript{22} Marshall, J., *Excavations at Bhita*, Archaeological Survey of India, Annual Report, 1911-12 pp 71-80
\textsuperscript{23} Indian Archaeology A Review (Henceforth IAR only) 1975-76, pp 42-43
\textsuperscript{24} IAR, 1960-61, p 5
\textsuperscript{26} Marshall, J., 1951, *Taxila*, vol II, Cambridge, pl IIA, Fig 2
\textsuperscript{27} IAR, 1977-78, p 23
\textsuperscript{28} IAR, 1959-60, pp 14-16, 1960-61, p 6, 1958-59, p 12
mouth. Their representation is not always realistic. The horse figurines recovered at Hastinapura\textsuperscript{29} and Atranjikhera were crudely modelled and do not show any craftsmanship. In the middle Gangetic Valley, however, some of the examples in red fabric, show incised stroke on the body of the animal. This type of treatment was common during this period\textsuperscript{30}.

**Cobra (Naga):** In pre-600 B.C. deposits, representation of snakes in terracotta has not been reported. During the period under scrutiny they have been reported from a number of sites such as Kausambi\textsuperscript{31}, Rajghat\textsuperscript{32}, Vaisali\textsuperscript{33} and Champa. These figures of Naga, too, were more popular in mid Ganga Valley comprising eastern U.P. and Bihar. A common form of representation consists of a raised hood and a human body with circlets and horizontal incised lines over the front side. The figure recovered at Champa is in the form of a snake god. According to Sinha it has “the remaining portion, including legs, represents abstraction of human figure”.\textsuperscript{34}

**Ram:** Ram figurines are mostly identified by their curved horns. These horns bear incised lines. Sometimes these lines extend up to

\textsuperscript{29} *Ancient India*, Nos. 10 and II, p.86, pl.XLII.
\textsuperscript{30} Prakash, Pratiba.. *op.cit*, p.64.
\textsuperscript{31} Sharma, G.R, *op.cit*, p.45.
\textsuperscript{32} Narain A.K and Roy, T.N, *op.cit*, pl. VII B, Fig.2
\textsuperscript{34} Sinha B.P, 1979, *Archaeology and Art in India*, Delhi, p.148.
the shoulder and the waist, as from Vaisali. The eyes are made with
the help of round clay in appliqué. Figures of this animal have been
reported from Prahaladpur, Vaisali, Buxar\textsuperscript{35} and Sonpur\textsuperscript{36}. Ram
appears to have become a popular domestic animal in the central
Ganga-Yamuna Valley.

**Dog:** Figures presumably of dogs are recovered from various sites
of Ganga-Yamuna Valley. No particular feature can be described for
these figures. A clay figure with plain, small mouth and four legs
which is shaped by the help of fingers and raised portion has been
identified as dog. It used to be roughly modelled. Their eyes are
represented by circlets and ears are shown in upward projection. It
is not always easy to distinguish the figure of a dog from that of
bull, stag or deer. The sites of Kausambi and Vaisali have yielded a
large number of the figures.

**Deer and Stag:** The figures of stags and deers, bear the marks of
circlets and incised horizontal grooves over their body. The front
and the hind legs carry marks of vertical and oblique grooves.
Sometimes a transverse hole across the nose is also seen. The
figures of these animals are recovered at Mathura\textsuperscript{37}, Sravasti\textsuperscript{38}.

\textsuperscript{35} IAR, 1963-64, pp.8-9.
\textsuperscript{36} IAR, 1960-61, p.5.
\textsuperscript{37} IAR, 1954-55, pp.15-16, Joshi, M.C and Margbandhu, C., op.cit.
Rajghat and Kausambi. At Sravasti only the head fragment of a stag with beaked face is reported. The eyes are indicated by a hole.

The modelling of deers and stags by artists of the time though may not suggest domestication of these animals, nevertheless, it may be pointed out that these animals may have been in abundance in and around the settlements to fascinate the artists.

**Bird:** This figure is very common in the entire Gangetic Valley. Like other animal figures bird figurines are generally hand made and solid. Sometimes it is represented as a rattle. Bird figures have been reported from Mathura, Rajghat, Vaisali, Noh\(^9\) and Allahapur\(^4\). At Vaisali the spread wings are indicated by a vertical row of punched circlets. Three kinds of bird figurines are reported at Rajghat in the period under discussion. These are as follows: (1) with spread plume, probably it is a figure of dove, (2) a figure of sitting bird, probably a parrot and (3) figures which are very much similar to Vaisali figures.

**HUMAN FIGURINES**

The first human figurine that of a female of the subcontinent has been found in the settlements of the agricultural communities of Zhob, Quetta and Kulli in Baluchistan\(^4\). But the first figurine of a

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\(^4\) *ibid*
male appeared at the Indus Valley period\textsuperscript{42}. However, in the nanals of terracotta art majority of these figurines belong to the female group. These female figurines are generally associated with the cult of mother goddess.

An interesting female figurine found at Buxar is shown seated on a stool like object with the two legs flattened. The figurine holds a child in her left arm and the left leg of the child appears to be separately modelled and affixed. The nose is formed by low pinched up clay and the mouth is indicated by a slit. The mother is wearing wheel-shaped ear rings\textsuperscript{43}. More or less same type of female figure is recovered at Masaon (Ghazipur). The Rajghat figure of a female is red in colour and characterised by broad hips and thighs, a girdle decorated with a row of punched circlet design is in applique. The head, right leg and the arms are broken\textsuperscript{44}. The Mathura figure of a female is hand modelled and bears a dark grey slip as that of the plain grey were of the period. Their facial features such as the eyes and the mouth are indicated by incisions. The figure wears a very complex headdress with round roundels\textsuperscript{45}. At Mahabirghat (Patna) a male figurine with legs shown in vertical lines and arms represented

\textsuperscript{42} ibid.

\textsuperscript{43} Verma, Nisha, 1986, The Terracotta of Bihar, Delhi, p.44


\textsuperscript{45} Dhavalikar, M.K., 1999, Historical Archaeology of India, New Delhi, p.178.
without the indication of elbows was recovered. Beside these above mentioned places the human figurines are reported to us from Taradih, Khokhrakot, Narhan and Bateshwar but their details are not available.

Ornaments such as bangles and ear studs are usually shown on the bodies of figurines recovered in excavations pertaining to our period of research; but besides these objects such as amulets and pendants of terracotta have also been recovered from the excavation and though they are not shown on the body of the figurines very clearly, yet we may surmised that these were the ornaments worn by the people of the time. The figurines so far recovered from the excavations though mostly fragments do not seems to show the dress worn by the people of the time as is attested by literary mentions and also the presence of cotton cultivation and spinning wheels in the excavated materials of the period of our concern. This is, indeed, surprising. Though the absence of dress on the body of the figurines may not be definitely explained, nevertheless, it is possible, particularly in the light of the fact that the available figurines are usually crude showing lack of skill in the artist at work, that the artists were yet to develop their skill for more intricate representation.

\[^46\] Verma, Nisha. *op. cit.*
Technique: From the point of view of modelling it is noticeable that during 600-320 B.C. all terracotta animals and human figurines were hand modelled. Use of mould has so far not been reported from any sites belonging to this period. In this respect the technique is nearly the same as in the preceding period. These are simple modellings and the products are not so good. The techniques\textsuperscript{47} used include:

(i) Pinching (for making nose, ear and head).
(ii) Stamping (for showing eyes, breasts and naval portion circles were stamped).
(iii) Cuts (mouth was made by deep horizontal cut).
(iv) Incision (for showing fingers and hair).

A single lump of clay was used to fashion the figurines The artist appears to be giving broad expression to his idea of making a human form. He does not show much concern for the anatomical details. Exactness is therefore totally wanting In general, they looked like play things for children. There can however be no doubt that the period of our concern shows an overall improvement as compared to the proceeding period in the making of terracotta objects. It is unfortunate that most of the archaeological reports have not been published with the much desired evolutionary or developmental stages clearly marked out.

\textsuperscript{47} Verma, Nisha., \textit{op.cit.}
The descriptions, whatever available, are at best sketchy. This limits one's study in respect of delineating the changes in material life of the people over a span of time.

The animal figurines reported during the period under discussion were possibly used as toys as were the balls and toy carts described in the Jatakas\textsuperscript{46}. These animal figures do not seem to be related to religion of the period as pointed out by Chattopadhyay\textsuperscript{49}. The same figures\textsuperscript{50} of bull, elephant, horse, deer etc depicted on the earliest metal coins of India, known as punch marked coins, in c. 600 B.C. Their earliest hoards come to us from eastern UP & Bihar\textsuperscript{51}. Interestingly enough this is the same region where the above-mentioned animals were popular in terracotta art. This coincidence is probably because it may have caught the fancy of the artist or the coin minters due to their utility in day to day life of the people.

But the figure of naga serpent in the category of animal figurines showed some religious significance. Some of naga Figures in which the lower portion were of human beings may

\textsuperscript{51} Sharma, R.S., 1980, Ancient India, NCERT, New Delhi, p.80
have its bearing on religion. In Buddhist text it has been reported that there was a separate island of naga serpents and they were worshipped by the people with milk, rice, fish, meat and strong drink.\textsuperscript{52} Dhavalikar identified these female naga figures as snake-goddess \textit{Manasa}.\textsuperscript{53} Even in present times, barren women in Maharashtra worship cobras or \textit{nagas} on the day of \textit{naga panchami} every year in Sangali district at Shirale.\textsuperscript{54} It is quite likely that in that remote period of time the same cult may have been in practice.

The human figurines were mostly related with figures of religious cult. About the female figurines scholars\textsuperscript{55} generally agree to their identification as mother goddess, called \textit{Aditi}, \textit{Prithvi} and so on as names of mother earth. They were probably connected with the magical rites performed to preserve the fertility of soil. Women are even today associated with these rituals, because their child bearing capacity is compared to the food producing potential of the mother earth.

\textsuperscript{52} Jataka, vol.1, p.290; vol. V, pp. 46, 67, 84-89, 184 (Nagadipa) vol.1, p.311 (worship)
\textsuperscript{53} Dhavalikar, M.K., 1977, \textit{op. cit.}, p.18.
\textsuperscript{54} \textit{Ibid.}
\textsuperscript{55} \textit{Ibid.}, p.17., Stella kraniris, \textit{op.cit.}
TERRACOTTA DISC

Terracotta disc, a common object is generally reported in the excavations from sites of the upper and the middle Ganga valley in both, pre and post c.600 B.C. But unfortunately they have not received the attention for which they really deserved. They are casually described in the reports of excavations along with other minor and major objects.

Amongst the objects of terracotta these discs are comparatively abundant. They are flat circular usually well fired clay objects. Unlike discs of pottery these terracotta discs are specially made to a purpose and decorated by making incised designs on both surfaces. They have been unearthed in large numbers from the sites such as Allahpur\(^{56}\), Atranjikhera\(^{57}\) (Plate No.7), Ayodhya\(^{58}\), Bateshwar\(^{59}\), Hastinapura\(^{60}\), Jajmau\(^{61}\), Masaon\(^{62}\), Noh\(^{63}\), Prahaladpur\(^{64}\), Rajghat\(^{65}\), Sravasti\(^{66}\), Ujjain\(^{67}\) etc. As we can see that they are fairly common in parts of Rajasthan, Madhya Pradesh.

\(^{56}\) IAR, 1970-71, p.41.
\(^{57}\) Gaur, R.C. 1983, Excavations at Atranjikhera, Delhi, pp. 386-392..
\(^{58}\) IAR, 1969-70, p.40.
\(^{59}\) IAR, 1975-76, p.43.
\(^{60}\) Ancient India, Nos. 10 & 11, 1954 and 1955, p. 88, pl XLVI, Nos. 1 & 9.
\(^{61}\) IAR, 1976-77, p.54.
\(^{63}\) IAR, 1971-72, p.42.
\(^{64}\) IAR, 1962-63, p.41.
\(^{65}\) IAR, 1968-69, p.41.
\(^{67}\) IAR, 1955-56, p.19.
Haryana and even Thapli in the remote part of the Himalayan region. But significantly enough they are totally absent in the lower Gangetic Valley.  

Generally these discs are of medium to fine fabric and in colour they are red, grey and black. Most of them are well baked but some of them are having the signs of ill firing. According to Roy the technique of manufacturing suggested it was very simple “Clay intended for modelling must have been got rid of air bubbles etc and made homogenous throughout by wedding* and slapping”. Further, he writes “after this they were allowed to dry sufficiently enough to withstand pressure of the hand and the modelling tools without causing any damage or deformation in their shapes” After that these discs were decorated with some pointed tools like bone points and finally they were baked in fire.

These discs can be divided into two groups on the basis of their appearance.

i. Plain disc

ii. Discs having decoration and symbols

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* The word appears to be a clerical error for weeding

69 Roy, T N., 1986, *A study of Northern Black polished Ware Culture, An Iron Age Culture of India*, New Delhi, p. 174

70 *Ibid*
The first was quite rare, out of 603 discs in pre c.600 BC at Jakhera\textsuperscript{71}, only six were found plain and in the post. c.600 BC, 12 out of 670\textsuperscript{*} were found undecorated.

The second group of discs were decorated with design all round the edge. These designs consists of incised nail pattern, conventional depiction of sun symbol, arrow, rope impression, star, antelope like design, fish and \textit{swastik} etc. The design appears to be made random all over the surface.

Gaur\textsuperscript{72} suggested that the idea of punch marked coin appearing first in metal in c. 600 B.C. were perhaps derived from these decorated discs. Srivastava\textsuperscript{73} goes one step further and suggests that it is quite possible that these discs were used as medium of exchange in the form of non-metallic coins or as token currency. To support his argument he further says that punch marked coins may have been derived from the long tradition of this discs having various type of symbols on them.

Roy\textsuperscript{74}, on the basis of the weight, diameter and thickness (Table No. 12) of discs from Prahaladpur suggested that the discs show that they might have been used as weights

\textsuperscript{71} Srivastava, O.P. "Terracota discs from Jakhera", paper read at Indian History Congress, Calcutta 2000, see the volume of Indian History Congress, Dept. of History, AMU, Aligarh, p. 438
\textsuperscript{*} Apart from Terracotta, discs of bones, ivory, chert and semi precious stone have also been found in excavation though small in numbers.
\textsuperscript{72} Gaur, R.C. \textit{op. cit.} p. 388.
\textsuperscript{73} Srivastava, O.P. \textit{op. cit.} pp. 440-442.
## TERRACOTTA DISCS REPORTED FROM RAJGHAT

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<tr>
<th>Weight in gm</th>
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<th>Thickness in mm</th>
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<tr>
<td>37.508</td>
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<td>31.368</td>
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<tr>
<td>9.710</td>
<td>33</td>
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<table>
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<th>Weight in gm</th>
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<th>Thickness in mm</th>
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</thead>
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<td>45.270</td>
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</tr>
<tr>
<td>42.912</td>
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<tr>
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<td>36.370</td>
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<td>10.569</td>
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(iii) Post c 400 B.C.

<table>
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<th>Diameter in mm</th>
<th>Thickness in mm</th>
</tr>
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<tbody>
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<td>39.705</td>
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<tr>
<td>3.700</td>
<td>23.0</td>
<td>5.00</td>
</tr>
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</table>

Table No. 12

However, Roy’s conjecture appears to be far fetched. The chart presented by him showing the diameter, thickness and weight of the terracotta discs do not seem to conform to a fixed ratio for their gradations if they had to be really used as weights by the people of the time. It appears that the series of weight in decimal variation shown in the chart are merely because these objects, being hand made, are large in quantity.

Lal is probably more accurate in his observation about these clay objects that they were evidently meant to be used as gaming counters. As these terracotta discs compared to pottery discs were more sophisticated. Indeed, these are still used by children as gaming counters in rural areas. These terracotta discs were infact neither weights nor non-metallic coins nor token currency.

Other Terracotta Objects: Besides the above mentioned objects several other objects made of terracotta have also been reported. Terracotta bangles come from Ropar, Allahapur, Atranjikhera, and Hastinapura. Ear ornaments, in the form of disc were obtained from Rajghat. At Atranjikhera terracotta bangles appear for the first time in c. 600 B.C and becomes popular in later phase as is

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78 Gaur, R.C., op.cit, p.376.
79 Ancient India, Nos. 10 and 11, p.90.
80 Singh, B.P., 1985, Life in Ancient Varanasi, Delhi, p.132.
81 Gaur, R.C., op.cit, p.377.
evident from their prolific finds. Their diameter vary from 3.7 to 6.4 cms. During the same period well decorated terracotta wheels with impressed designs are also known to us from Atranjikhera. The decoration includes spokes, circlets and floral motifs.

Other objects of terracotta belonging to this period include beads, games man, rattles, pestles and querns. The pestles and querns, studded with small stone chip (mosaic) on the working surface, have been recovered from Atranjikhera\(^8\). Though the pestles were generally of cylindrical shape but the fragmentary quern pieces do not give any specific idea of their shape and size. Therefore, the above discussion about different objects of terracotta offers us invaluable material for the study of different facets of life of the period under our study. This art of making these objects are quite distinct from stone sculpture and copper, both, in form and character. This art may be considered as the best representation of popular life and mind, and of the changing moods and modes. They in all likelihood served, both, the religious and secular ends of the contemporary society. Some of these figurines must have been worshipped as household deities, some were votaries or votive offerings, some may have had purely decorative value while a large number of them were possibly play objects for children.

\(^8\) ibid, p.379
POTS AND PANS

The idea of pottery probably emerged from man’s need to store, truck and barter. In the first instance, a hallow stone or skull bone might have served their needs. But as we know that the human being’s desire never comes to an end. The people might have found the objects available in nature inadequate to meet their requirements. Then by some stroke of chance, it would have struck his inquisitive mind to use clay, which is abundantly available, soft, flexible and easy to handle. Containers of desired shape and size made out of the clay were then sun-dried. But the problem of making these pots waterproof and hard, so that they could be used for cooking food, still remained. Only after trial and error, people would have learned the baking of clay pots and making it water tight. The earliest fragments of pottery were documented in Mesolithic levels at Bhainsaura in Mirzapur, Kutch in Gujarat and Mangaureki - Bauthi and Mohana in Banda district.2

In this sub-chapter an attempt has been made to discuss the major ceramic industry and the functions of different variety of utensils used by the people. As I have already mentioned above, among the materials of utensils, the clay was most extensively used.

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1 Dahiya, Neelima, 1986, Arts and Crafts in Northern India, Delhi, p. 36
2 Ibid.
Others were copper and stone, which were available in lesser frequency. Besides, some other materials like wood, leather and shell* of fruits might have also been used for making vessels for daily use. Unfortunately, due to their perishable nature, archaeological evidence is lacking. But their possible use is summarized on the ground that all these are still used in pot making. The Jaina3 and Buddhist4 literature too, provide a list of materials in which all the above mentioned things are employed in pot making. But among all these materials, only the earthen vessels offer us an opportunity for detailed study, the rest is so meager that no generalization appears possible.

The idea of ceramic industry made of clay, can be had from the discovery of pottery pieces from the excavations carried out at different sites. The potteries of the period under research generally include, Black and Red Ware (BRW), Black slipped Ware, Grey Ware, Red Ware and most importantly the NBPW, which will be discussed one by one.

**Black and Red Ware (BRW):** The Black and red ware is pre-NBPW in origin but continues even after introduction NBPW in use as

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* The shell of fruits are normally used by Sadhus (hermit) of the present days.
3 According to Acharanga sutra, a wide variety of materials was used in pots making viz., iron, copper, lead, silver, glass, tin, brass, pearl, bells metal, horn, ivory stone and leather. Deo, S.B., 'Pots and Utensils from Jain literature'. BDCRI, Vol. XIV, No.1, 1952-53, pp.33ff.
4 Mahavagga, VI, 14.2.
reported from most of the sites in India. In excavations different forms of BRW are known to us. They consists of basins, bowls, dishes, dish on stand etc. The specimens of BRW are available in both coarse and fine varieties. The former occur more frequently than the later. The coarse ones were fired under low temperature while the finer ones are the result of firing under high temperature.⁵

About the place of origin and date of BRW, Singh⁶ has pointed out that BRW has been found mainly in two contexts, one belonging to the proto-historic period from southeastern Rajasthan with Ahar as the type-site. The second, in association with the megalithic pottery found in innumerable iron-age graves and urn-fields of south India. But Subbarao⁷, Wheeler⁸ and Soundra Rajan⁹ have traced its origin at Ahar.

Black Slipped Ware: It has been observed that the fairly smooth surface of the black slipped ware has a basic resemblance with NBPW, if we minus its gloss.¹⁰ In this ware generally the bowl of different types is the most common, the dish, followed by the jar, vase and miniature vessels, comes next in order of frequency. Its

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⁵ Kumar, D., 1986, Archaeology of Vaisali, New Delhi, p 76.
⁶ Sinha, B.P. (ed.), 1969, Poteries in Ancient India, Patna, p. 67
⁷ Subbarao, B., 1958, Personality of India, Baroda, p 179.
earliest occurrence has led to the assumption by Ghosh that it represents an experimental stage in the development of the NBPW.\footnote{ibid.}
In U.P., Bihar and M.P., they have been found at Rajghat, Prahaladpur, Kausambi, Sravasti, Hastinapura, Ahichchhatra, Ujjain, Vaisali, Rajgir, Pataliputra, Chirand and, Sonpur etc. At the above mentioned places, the black slipped ware have been found in NBPW levels along with black and red ware and are occasionally painted.\footnote{ibid.}

**The Grey Ware and the Red Ware:** These two ceramic industries were the most common ones. The types of the grey ware pottery commonly found are dishes, bowls, lipped bowls, vessels, carinated handis etc. At Chirand, according to Kumar "the Grey ware is found in the neolithic stratas and continues in the chalcolithic period".\footnote{Kumar, D., *op cit.* p. 90.}

The increased frequency of red ware as compared to other wares suggests that it was the most commonly used ware in all cultural periods at each site. The ware includes usual types, e.g., basins, vases, dishes, bowls (lipped and plain), handis, big jars, pots with decorative spouts, pans and other miniature pots including goblets (glass like object with stand).\footnote{ibid.} Deva\footnote{Deva, Krishna and Mishra, Vijayakanta, 1961, *Vaisali Excavation: 1950*, Vaisali, p. 42.} suggest that miniature pots might have been used as toys for children and some
of them as thimbles. The different shape may have served different purposes. Basins, vases and handis were used as kitchen utensils, i.e., for cooking purposes. The red wares\textsuperscript{16} have also been found in fine, medium and coarse fabrics. But, all these wares were not plain. Some have been found with decoration, too. We notice interesting decorations on some large jar at Vaisali.\textsuperscript{17} These decorations include taurine symbol, which have been punched deeply, impressed rosette resembling spoked wheel with pellets and solar designs. Some sherds are also found impressed with srivatsa or purnaghata motifs on the body and small rosettes on the neck with angling hooks on the shoulder.

**Northern Black polished Ware (NBPW):** This period is marked by the introduction of the distinguished ceramic industry. This ware marks the zenith of technology in the pot making. The NBPW ware has a very wide distribution. About its geographical distribution Thapar\textsuperscript{18} writes that it was from "Charsada near Peshawar and Udegram in Swat in the north, Tilaurakot in the Nepalese ‘tarai’, Prabhas Patan on the Kathiawar littoral in the west, Ujjain, Maheshwar and Nasik on the trunk route from the Ganga-Yamuna Doab to the Arabian sea, Ter and Brahma Puri in the Daccan, Kauandanpur and Berachampa in the east."

\textsuperscript{16} Kumar, D., op cit.
\textsuperscript{17} ibid, p. 92.
The shapes\(^{19}\) in the NBPW are represented by (i) the dish with inverted or straight sides, (ii) the bowl with inverted, convex, corrugated or tapering sides, (iii) the lid with flat terminal and (iv) the sharply carinated \textit{handis}. Of these bowls and dishes are the most common types. This ware was made of well-levigated clay and fired to a high temperature under reducing condition. The uniform firing of NBPW suggests that they were possibly fired in a sagger.\(^{20}\) The ware ranged in different colours like black, steel blue, pinkish, silvery, golden etc. The similar shades are reported from Kausambi, Prahaladpur, Hastinapura, Ahichchhatra, Vaisali, Sonpur, Oriup and many other sites of Bihar.\(^{21}\) The available shapes and frequency in totality of the NBPW from different excavations shows that this ware had a restricted use, either for eating or, in some cases, storing liquids or any precious material.

But at Rajghat\(^{22}\) the NBPW accounts nearly 50\% of the total pottery recovered from c 600-200 B.C. They can broadly be divided into two groups, monochrome and bichrome. All the monochrome specimens have a fine thin fabric. They are made of well-levigated clay with little tempering material. They are invariably potted on a fast wheel and have a strikingly lustrous surface. The core is

\(^{19}\) Ancient India, V, 10 & 11, 1954 - 55, p. 51.
\(^{20}\) Kumar, D., \textit{op cit}, p. 85.
\(^{21}\) Singh, B.P., 1985, \textit{Life in Ancient Varanasi}, Delhi, p. 84.
blackish grey but in some cases reddish. The colour of the surface, of almost 90% in this group is jet-black, brownish black or bluish black. But the other 10% are either steel blue, pinkish, silvery, golden, brown, chocolate, violet and deep red. The bichrome ware is much less frequent though it shares all the features of the monochrome group. The NBPW found in such, large numbers suggests that the industry was in a flourishing state. The production was not possibly of local consumption but to exports to other centers. It may also be surmised that besides catering to the local requirement the pottery may also have its trade significance. Since Rajghat is generally identified with ancient Varanasi it may, on the evidence of a Jataka\textsuperscript{23} be postulated that the potter's industry here was in a flourishing state. Moticandra citing Dhammapada Atthakatha states "a potter from Varanasi loaded his earthen vessels on a donkey, carried them from city to city to sell them".\textsuperscript{24}

Archaeologists generally consider the pottery as the primary cultural material. They study the pottery mainly with a view to identify cultures and establish the chronological sequence of sites. However, except Sankalia,\textsuperscript{25} who in his short articles attempts to

\textsuperscript{23} No. 408, A separate suburban village of potters near Varanasi is shown to exist.
\textsuperscript{24} Chandra, Moti., 1977, Trade and trade routes in Ancient India, New Delhi, p. 57.
discuss the functional significance of vessels of the earlier periods along with other objects, no serious attempt in this direction has yet been made.

Besides the above, there is yet another difficulty that even one pot might have often served more than one function as today. Examples in this connection may be given of the bowls and dishes, which will normally come under the broad classification of vessels used for eating. But during the course of the present study, it has been observed that they might have been used for various purposes, depending on their size and forms. The bowls could have been used variously such as container, lid-cum-bowls, and drinking cup. Bowls recovered at Nagara\textsuperscript{26} and Kumrahar\textsuperscript{27} have the outer surface of their base blackened due to fire. This gives us an idea that some of them were even used for cooking purposes. Similar instances of different use may be given for other pots as well.

On the basis of the forms and size of potteries recovered in excavations, we can broadly classify them as follows:

(i) Cooking vessels,
(ii) Eating vessels,
(iii) Drinking vessels or vessels for storing water,
(iv) Pots for storage purposes and

\textsuperscript{26} Mehta, R.N., 1968, \textit{Excavations at Nagara}, Baroda, p. 43.
(v) Industrial utensils.

(i) Cooking Vessels: In this category we can safely put the handis, karahi and basin having a lipped spout. On the basis of ware were classifications of potteries it may be shown that cooking vessels were generally red, grey and black slipped. Majority of the cooking pots, which were large in size, were made of red ware. The percentage distribution of these wares suggests that the most frequent variety was red ware. Cooking vessels in this variety were often decorated. The appliqué mode of decoration of the preceding phase, which was very poor in execution, greatly improved during this period under study. In addition to this, incised decoration was also introduced. These decorations on the vessels have been noticed at three places, viz. at the edge of the rim, on the external part of the body, and occasionally on the neck portion, particularly in the case of miniature pots. There is very few examples, in which the decoration is noticed below the mid portion of the pot.

(ii) Eating Vessels: This type of vessel comprises of dish, bowl, and lipped bowl. The dish can be identified as thali for taking daily meals, either in dry or liquid form. They were represented in almost all types and varieties of pottery assemblage of the period. They were of varying sizes and forms. Singh on the basis of diameters of

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29 Singh, B.P., op cit, p. 84.
the dishes at Rajghat, divides them into three types, viz., small, medium and large. Of these, the diameter of the first group, according to him ranges from "20.4 mm. to 26.2 mm. with their main concentration being between 20.4 mm. – 25.5 mm". All these have flat or flattish bases, which would not require any support when placed on the ground. The specimens belonging to the second and the third varieties "range in diameter from 26.3 mm. to 38.4 mm. But their main concentration being between 30.3 – 37.6 cm. Most of them were thalis, to be used by the adults. These were mostly with rounded, straight, convex and straight tapering sides and usually, flat and flattish bases".

The bowls, (vernacular katora or katori) have been found in fairly good number. All these specimens have either incurved, convex, rounded or vertically straight sides. The last one is mainly available from Sarai Mohana.

(iii) Drinking Vessels or Vessels for Storing Water: A fragment of a tub and surahi of red ware reported at Vaisali are the best examples of vessels of this category. Singh divided the Rajghat vessels of this kind into three types. "(i) stemmed bowl, (ii) bowls

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30 ibid, p. 86.
31 Ibid.
34 ibid, fig. 37, No. 19, fig. 40, No. 21.
35 Singh, B.P., op cit, p. 80.
used as cups or tumblers, and (iii) lota like vessels" and adds, "of these three, first two are made mostly in the slipped variety, while the last in the ordinary red ware" At Rajghat, large number of lota like objects made of dull red ware is reported in the pit of privies. Since these pots are without slip or wash and their fabric being rough, Roy, therefore, suggested "it is not unlikely that they were used as lotas for carrying water by persons using these pits as privies or latrines." 36 A lota type of miniature vase of red ware is also reported at Vaisali. 37

(iv) Pots for Storage Purposes: In this category two types of vessels makes its appearance in several excavations, this may have been produced for purposes of storage. One for the ordinary foodstuff or grain and the other for storing liquid. The vessels of the first type were mostly made of red ware, whereas the vessels used in latter purposes were mostly produced in black slipped and other slipped ware 38.

In the literature the word kumbha 39 is used for the vessel used to store liquid, while kusula 40 for storing grains. They are of various

36 Roy, T N, 1986, A Study of Northern Black Polished Ware Culture New Delhi, p 98.
37 cf. Sinha, B P., and Roy, S R 1969, op cit, fig 44.
sizes. Their height, in majority cases, could not be determined. As mostly rim portion are available, therefore their sizes are tentatively gauged on the basis of their diameters of rim and their thickness. The vessels of the first group were most probably used for storing grains. This can be postulated on the basis of their forms. Most of these have carinated neck and their body in all cases is rounded.

Group second comprises vessels which are pitchers (*ghara* or *mataka* in vernacular). Their purpose appears to have been the same as that of *ghara* of the present days. From Champa, Prasad cites an interesting miniature waterpot (*surahis*) made of NBP ware. Which according to him has “thin section, the outer surface of which seems to be polished with silvery colour having bluish stinct and finally fish scale design is painted on it in buff-like colour”. Such type of pots is not available from the other site.

The above mentioned vessels though broken are found in large quantity from different sites. These vessels, it seems, were used by the people to keep their surplus grains for ready availability in times of need. Besides such storage vessels, granaries also were discovered at Atranjikhera and Mathura. The granary found at Atranjikhera has three cells, each partitioned by walls. Each cell

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rectangular in shape, measured 1.75 meters in width and are provided with two openings or doors.\(^{43}\) (Plate No.8)

(v) **Industrial Utensils:** In this category pots generally used as crucibles are reckoned. The pottery of this kind is reported at Kausambi\(^{44}\) and Rajghat.\(^{45}\) Two crucibles were also found at Rajghat in this phase. One of them is smaller and almost intact. Its capacity is given to be 46cc. The other one seems to have been of a longer size. Both these specimens show a vitrified and enameled outer surface. This phenomenon is said to be due to high temperature of heat to which it may have been subjected. Both have rounded base and convex side. Singh suggests that “they were used for melting purposes, which is evidenced by the presence of green rusted bits of metal sticking on the inner walls of the specimens.”\(^{46}\)

Each of the above mentioned utensils, in different varieties, are reported in excavation. The different shapes and varieties of the ware lead us to suppose that the grey ware and the red ware were the common men's pottery. The black and red ware (BRW) and NBPW are available in certain specific types but grey and red wares were of all necessary shapes required for household works, namely cooking, storing and eating. The small to medium sized vessels

\(^{43}\) Gaur, R.C., *op. cit.*, p. 249.
\(^{45}\) Singh, B.P., *op cit*, p. 88.
\(^{46}\) ibid.
seems to dominate the NBPW at every site. It appears that NBP vessels has a restricted use, either for eating, or in some cases, for storing only liquids or any precious materials like ghee, oil etc. This pottery is so unique and delicate that it is regarded as the prince among the potteries or the deluxe ware. The value attached to this ware can be judged from the repair done by means of copper wire or pin rivetttings as reported by the excavator of the sites at Rupar, Bairat, Ujjain, Sonpur, Kumrahar, Khairadih etc. It appears, therefore, that instead of throwing away these pots they were used or preserved by the people. It is also interesting to note that these repaired vessels are found not only from those places where they might have been imports, but also from Sonpur and Khairadih which have been suggested as centers of production. From the above discussion, it is possible to infer that NBPW was a prized commodity of the period and produced largely to cater to the need of the elites in the society.

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47 Prasad, Ram Chandra, op cit, p 96
48 Sinha, B P (ed ). 1969 op cit , p 146
49 Sahay, Sachchidanand. 'Origin and Spread of the Northern black Polished Ware', in ed Sinha, B P, Potteries in Ancient India, p 146
50 Ibid.
51 Ibid.
52 Ibid.
53 Ibid.
54 Ibid.
55 Singh, B.P., op cit, p. 85.