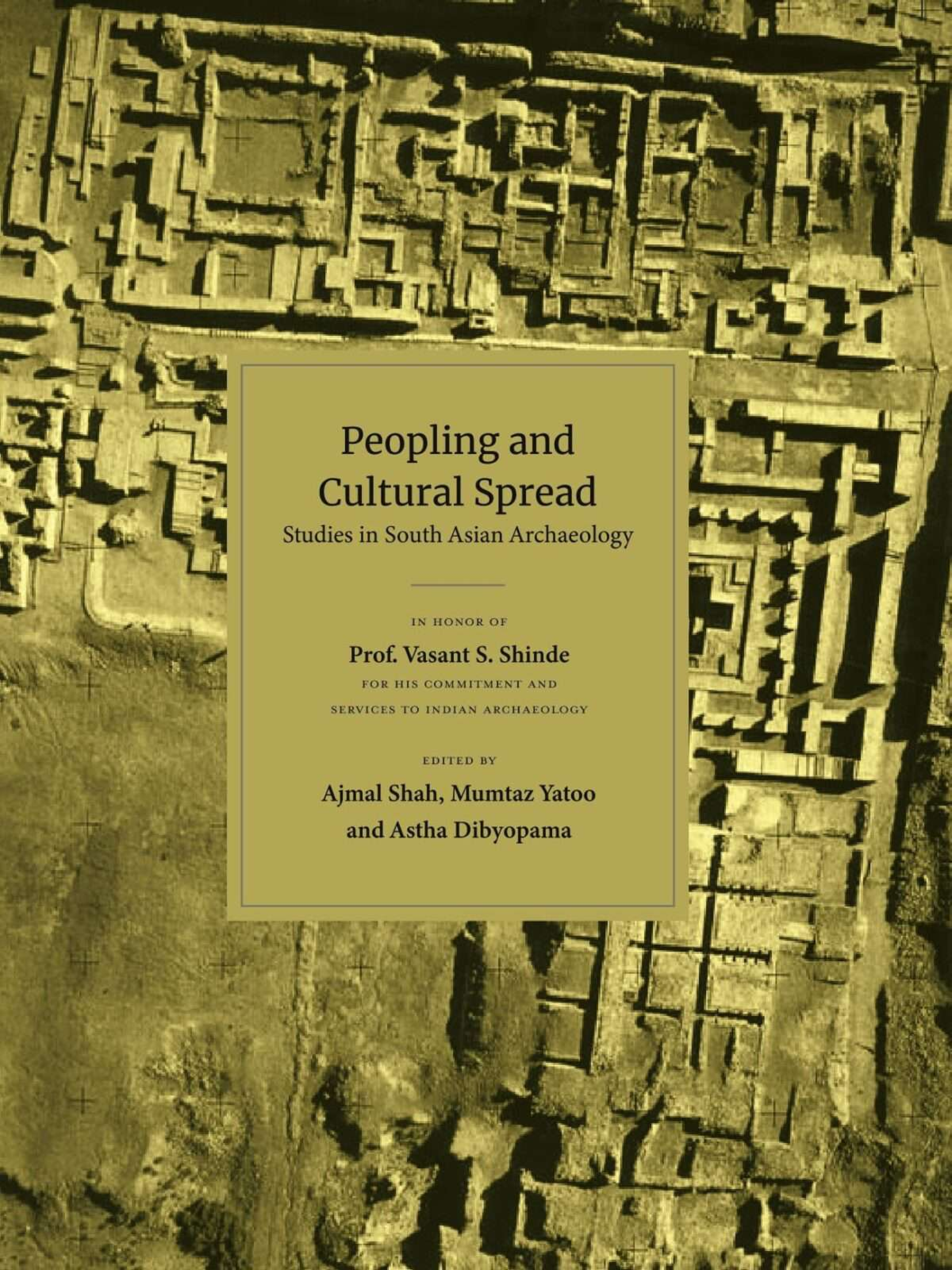

Peopling and Cultural Spread

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11

Revisiting the Metal Working in Southeast Rajasthan: A Historical Study

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Introduction

Metallurgy is an integral part of technology. Generally, the term technology is considered a modern concept but it is a misconception. Technology is as old as the origin of Homo-sapiens. Since the pre-historic times, the various human societies have been evolving and using different kinds of technologies according to their needs and requirements. Thus, it can be inferred that there exists a natural relationship between technology and socio-economic and cultural phenomena in archaeological, historic and contemporary contexts. This study is an attempt to understand the above-mentioned relationship in context of Southeast Rajasthan. Broadly Rajasthan has been divided into Thar and Aravalli Ranges. The Thar is known as Marwar and the Aravalli Range segregates the major part of eastern Rajasthan. Southeast Rajasthan is known as Mewar-an important erstwhile princely state (Gullapalli 2005).

Geographically, Rajasthan is located in north-western India which is part of a region that has been described as the heart of India – a triangle between Delhi, the Gulf of Cambay and Bengal. This triangle is an area of physical complexity and transitional between the Indo-Ganges plains and the Deccan plateau on the peninsular landmass and Southeast Rajasthan utilized this peculiar geographical location and secured a unique place in the history of India. Southeast Rajasthan has witnessed the attempts of urbanization at least five times during the last 5,700 years. The physiographic features of Southeast Rajasthan have determined its drainage system, vegetation and the human settlement, thus rising as a centre of human activities right from the pre-historic times. Though the region does not have any perennial river, it always attracted human beings of various cultures because of its geology. The region has raw materials in abundance and was ever exploited by humans from ancient times. The Aravalli formations are rich in metallic as well as non-metallic minerals and played a major role as a centre of attraction (**Fig. 11.1**) (Sinha 2002).

The schist, which has been found in the region, contains fine crystals of Garnet, Mica, Copper, Lead, Zinc, Silver, Iron, Manganese and Beryl (**Fig. 11.2**). Out of these copper and iron became one of the important metals during the proto-historic periods and was exploited for utilitarian purposes by the second half of the third millennium BCE. Therefore, Carlly (1871–72) initiated the exploration to identify old working sites in Southeast Rajasthan and their results were quite rewarding. During the exploration, the evidence of forty-two sites in Delwara-Karoli area were reported (Carlly 1871–72).

These investigations revealed that most of the copper working activities have ceased towards the beginning of the nineteenth century. Following observations were deducted from the explorations:

i). The slag pieces, which were collected and studied are large and heavy. They contain more iron and possibly copper and other silicates.
ii). The lighter type of slag pieces are with less iron and more of silica and other silicates.

iii). The evidence of mining and smelting activities at the same indicates that the habitants have utilized the locally available copper ore for the extraction of copper metal for further fabrication into useful shapes and sizes.

It is clear that ancient people of southeast Rajasthan had developed a skill to extract copper from the available local ore. The various literary sources also bring to light the fact that copper was considered sacred in various religious functions. The Ahar (located in the vicinity of Udaipur) (**Fig. 11.3**) is the first site of southeast Rajasthan which provides the evidence of copper mining and metallurgy.

Previous Studies

During an excavation at Ahar in 1961–62, Sankalia (1969) recovered some copper tools and heaps of slag-like material. After the scientific analysis of the recovered material Hegde (1981) confirmed that the slag is certainly of metallurgical waste. The presence of the remains of the copper-smelting industry in the form of metallurgical slag along with copper artefacts shows that Ahar was probably a copper-smelting centre around 2000 BCE. In addition to this, Hegde (1981) opines that a high percentage of silica in the composition of the metallurgical slag is quite interesting. According to him, it may be due to the deliberate addition of silica during the smelting process as a fluxing agent. In continuation of the analysis of the Ahar material, Hegde carried out the spectrometric studies of copper ore samples obtained from the Harappan and Chalcolithic sites of Rajasthan, Haryana, Gujarat and Madhya Pradesh. The result of the analysis shows that the artefacts and the ore samples have an agreement of over 92% impurity pattern. This study confirmed that Chalcolithic copper objects were made indigenously and the metal was extracted from the Chalcopyrite ore deposits in the Aravalli Hills.

After the Ahar excavation, Misra (1967) excavated Bagor, where five copper objects were recovered. Since there was no evidence to suggest that the people of Bagor themselves practiced metallurgy, an exploration was conducted and a very potential source of copper at Kotri Dariba was located at a distance of 22 km from east of Bagor. The hillsides of Rajpur-Dariba are extensively pockmarked by old shafts having nineteen places of old working sites. The finding of these sites confirms the locally popular name "*Tambavati* of Ahar".

The further excavations at Gilund, Balathal, Ojhiyana, Chatrikheda and Pachmata (all belong to Ahar culture) also provided the significant evidence of copper objects. It indicates that southeast Rajasthan was a major centre of Copper tool production in the third millennium BCE. The evidence of explorations and excavations provide the information that at most of the places where copper ore occur, one observes old pits, a heap of slag and some crucibles. It suggests that copper ore were mined, extracted and processed since long in Rajasthan. But the evidence of numerous deep shafts and large slag heaps indicate that the area of Rajasthan, particularly Aravalli hills were a centre of ancient mining and metallurgical activities. It becomes obvious that during the late third millennium or early second millennium BCE, the people of the region had reached an advance stage in copper metallurgy in Rajasthan (**Fig. 11.4**). It is also confirmed that the copper miming and metallurgy continued to be an important occupation even during the early historic period in the region. An important site Nagri (17 Kms to the north of Chittorgarh) was a flourishing town right from the 4th century BCE to 6th century AD. Besides the inscriptions and architectural activities, a large number of copper coins have also been recovered from the site. In addition to the evidence of copper metallurgical activities in ancient times, other attraction for the early habitants of the region was zinc and lead. The major centres of these two raw materials were Rampura-Dariba, Zawar, Rikhabdeo, Debari, Ghughra, Mando and Waedalia. Among them, the largest zinc-lead deposits have been discovered in Rajpura-Dariba and Rampura-Dariba mines.

Here, we would like to quote from old-world Archaeometry which provides a very impressive picture of the mining at Zawar. The intensive process of mining activities, especially at Zawar, dated back to twelfth century AD. Production was on a considerable scale, and it is not surprising that the first direct historical reference to Zawar occurs in 1380 AD, when Rana Lakshasimha was credited with the founding of the mines. Production continued on a major scale for about four centuries before ending during the wars and famine which plagued Rajasthan in the early 19th century, and in the face of western competition. Ironically the western technology was almost certainly derived from Zawar. Here we would like to draw the kind attention about the popularity of Zawarmata among the

Bhils. It shows their long association with Zawar. Thus it can be said that the contribution of Zawar to mankind is unparalleled. The discovery of charcoal retort dumps at Zawar is positive evidence that the local Bhils were the source who was the fuel suppliers (Misra 1967).

Archaeological Evidence of Metal Working in Southeast Rajasthan

During exploration, it was revealed that many of the mines were worked down to a depth of 120 meters or more. Their deep shaft opened into many galleries and narrow tunnels. All the galleries were provided ventilation holes of 1½ to 2m in diameter at regular intervals. The C^{14} dates of these mining activities are 2120 ± 60 and 1920 ± 50 years BP. It is very interesting to note that during the ancient and medieval times the human settlements have been found in southeast Rajasthan at Nagda, Ahar and Zawar. These places are known for the raw material associated with the population of Bhils, mobilized as miners. An inscription of King Siladitya (646 AD) of Samoli records opening a mine at a place known as Arnyakoopgiri and a temple of Arnyakvasini were also built there for the worship of local population. Both these terms indicate that the region was a hilly and forest terrain and in the context of Mewar, the hills and forests are the abode of Bhils. Thus it can be inferred that the Bhils provided the human resource in mining activities (Pandey *et al.* 2011).

Besides Copper and Zinc, Southeast Rajasthan also played an important role in the mining and metallurgy of Iron. Geologically, Iron ore is distributed throughout the state of Rajasthan with noteworthy deposits in Alwar, Jaipur, Udaipur & Ajmer districts. There are numerous examples which prove the iron working in the past. For example, in 1873 there was a reported (Pandey *et al.* 2011) of about 30 pre-industrial furnaces working in the Alwar area. The explorations and excavations undertaken by various archaeologists (Sankalia 1969, Pandey *et al.* 2011, Udayakumar 2016, 2017) provide the information that Ahar, Gilund, Balathal, Purani Marmi, Aguncha, Bhoion-Ki-Pancholi and Nathara-Ki-Pal were the major centers of iron working in the past. Amongst these Bhion-Ki-Pancholi, Iswal and Nathara-Ki-Pal were spread in an area of more than 75 hectares and it can be presumed that these were the industrial town sites for iron working (**Fig. 11.5**).

In Rajasthan, Noh is the oldest settlement of iron working. The C^{14} date of the site goes back to 950 BCE, and the Southeast Rajasthan does not provide any date parallel to it. Ahar is the first site which provide the evidence of old iron working but archaeologists have different opinions about its presence in Chalcolithic context (Vijay 1998). Probably, Balathal is the first site which provides the C^{14} dates of iron working in this region of Rajasthan. These C^{14} dates confirm that during the fourth century BCE, iron working had begun in this region of Rajasthan. The excavations at Balathal provide the remains of two furnaces which were heavily damaged. Two roughly cylindrical or barrel-shaped clay rolls were also found close to the furnaces. The surface of these clay rolls were embedded with quartz crystals of varying sizes used by the Iron Age people to increase heat and retain it for much longer time. Though the settlements of Iron Age sites are smaller in size, it provides a very good amount of iron implements. The implements which have been recovered from the site, are more than five hundred in number and mostly domestic in nature (Sahi 1979).

Thus, it can be presumed that Balathal was an important industrial centre during the early historic period. Therefore, extensive surveys were undertaken around the site to locate the source of the iron. After an extensive survey (Misra 2007), the sites like Iswal, Bhoion-ki-Pancholi and Nathara-Ki-Pal have been identified as the major source of iron within a periphery of 50 to 75 kms from Balathal. It appears that Bhoiyon-Ki-Pancholi was a very promising centre of iron ore. During exploration, three mounds were discovered having thick iron deposits in the central part which perhaps contain a high percentage of iron ore as it was exploited till 50 years ago (Misra 2007).

After continuous excavations, the remains of three furnaces along with several working levels were recorded. A close examination of the section has revealed that there were several working levels, characterized by the presence of mainly circular or roughly square furnaces. Each level was separated by a plastered and rammed layer of soil. After a continuous excavation for seven years at Iswal (Gullapalli 2005), the site has provided very interesting and useful data concerning the smelting and melting of iron. The site covers approximately 75 hectares, with an area of approximately 130 x 130 m of concentrated production debris primarily in the form of slag. Based on the available evidence, it is divided into a production area and a habitation zone. The excavation (Pandey *et al.* 2011), which concentrated on the iron working area during the last four seasons, provide the evidence of a large amount of slag, ash, a series of furnaces, pottery associated floors and a fair amount of lime. The presence of lime, suggests that the metallurgists of the period have used lime as influx. The site also reveals a very important and unique feature of a large settlement which separate from the working area at a very considerable distance appears as workers colony. As far as the existing knowledge is concerned there is only one site Khairadih in Uttar Pradesh which also provides the evidence of working area as well as an area for the artisans (Vijay 1998). As Iswal is associated with intensive production of Iron that might have been utilized for commercial/industrial purpose, it becomes imperative to discuss the archaeological evidence of furnaces from the site.

Archaeological Evidence of Metal Working at Iswal

Furnace-1: The furnace appears to be pear-shaped and sealed by a well plastered and rammed layer on the top and the base. The height of the surviving lateral wall was 75 cms from the outer surface and 65 cms from the inner surface. The base of the furnace is measured 83 cms in width and was 12 cms in thickness (**Fig. 11.6**).

Besides the furnace 1, two more furnaces were noticed in the cut section. This indicates that there were several furnaces of different kinds used by the workers. Furnaces noticed in the lower levels are well made and large. They were built in situ over a stone foundation. The walls of these furnaces were made of clay and had become red burnt due to their constant use.

Furnace-2: Furnace 2 measuring 80 cms long (N-S) with a width of 60 cms (E-W) was roughly triangular. Total three broken retorts were noticed at the upper part of the furnace. Their average measurement was 12 cm in length with 8 cm in width. All these had a hole of 1 cm at the centre (**Fig. 11.7**).

Furnace-3: Measuring 90 cms (E-W) in length with a width of 70 cms (N-S) having lateral walls of 24 cms in thickness, furnace-3 was full of ash and slag. The colour of the lateral walls was red and roughly oval.

During excavations (Pandey *et al.* 2011) a cluster of broken retorts was encountered and were 32 in number having average length of 15 to 22 cms. The section of the furnace had alternative slag levels which were separated by a rammed clay floor. The total number of slag levels were nine. Their average thickness was 10 cms and the colour was dark greenish-yellow. The evidence suggests a long duration fire activities at the place. Besides the retorts, slag, ash and furnaces, a broken rectangular terracotta object, which has four holes, was also recovered. It appears that it was a part of the furnace system. A single piece of the broken retort of about 40 cms is also recovered during excavations suggesting long retorts were used for the proper supply of air. The evidence of these long retorts can be seen even today at Iswal and Losing village.

Besides the evidence of smelting activities, a good amount of ore was also recorded at the site. A few samples were examined by Ritesh Purohit (Pandey 2005–06) having following results:

I. The ore sample is Goethite ore which is mainly a hydroxide of iron. The mineral is brown to dark-brown blackish in appearance having opaque to translucent section with earth luster. It is similar to limonite, another hydroxide of iron, but distinctly distinguished based on two properties, crystalline with parallel extinction, Goethite occurring in Iswal area is mainly a withered product of Hematite ore. A very huge and open iron mining site, which is now abandoned, can be seen in the proximity of the site (**Fig. 11.8**).
II. It appears that the slag samples, which were collected from the site, were used for smelting of the iron by the erstwhile natives. The presence of a huge quantity of slag also signifies that art of smelting the iron ore was well developed in the area.
III. A sample of the rusted knife-like object was also analyzed. It indicates that it was made at the same place where it was smelted.

Based on the C^{14} dates, it can be summarized that, Iswal was major centre for iron smelting process in south east Rajasthan between 2973 to 1540 BP. After continuous excavation for seven years a total of fifty iron implements were recovered from the site along with 12 furnaces and lot of tap slags in and around the site.

The scientific examination of these implements was performed by Jang-Sik–Park Department of Metallurgy, Hogink University, Korea. The results of the scientific analysis and the findings throw new light on the history of Southeast Rajasthan.

During the excavation one Bi-metallic object was recovered, having rare appearance in the Indian context of early historical period. The object is 131.05 mm in length and 58.68 mm in breadth with a thickness of 5.8 mm. The base and handle of the object are made of Copper-Zinc alloy (Bronze) made by the lost wax technique. The top handle is divided into two sections into which an Iron blade is inserted. It is highly polished and its base displays artistic work. Ethnographic studies (Misra 2007) suggest that in Rajasthan similar tools are currently used as 'Goads' for a camel. Locally it is popular as 'Ankush' or elephant 'Goad' which is very well documented in ancient and medieval sculptures and paintings.

Summary

The results of scientific analysis (Pandey *et al.* 2011) are also noteworthy in context of Iron implements. It is observed that four objects were made of 'Steel' containing a substantial amount of carbon. Thus, Southeast Rajasthan appears to have been following the similar technology which was prevalent in other parts of India like Vidarbha and Junnar in Maharashtra. Another important feature of the site is the recovery of glass bangles (Pandey *et al.* 2011) in large quantity, they vary from monochrome to polychrome. Some of them are translucent and some are completely transparent giving indication that the site was a major centre of pyrotechnological industries for about seven hundred years. Besides the iron and glass working, a single piece of semi-precious gemstone (bead) variety of beryl was also found at Iswal. It is a rare material found in granite rocks and was used as a gem. Its specific gravity is determined 3.6 (approximately) and is translucent. In addition to it, one pendant of lapis lazuli inlaid with gold was also recovered from the site during excavation (Pandey 2005–06) (**Fig. 11.9**).

The evidence retrieved from excavations of several sites help to understand the relationship between the land and the human activities. How Aravalli and its drainage pattern induced the process of the development of society in Southeast Rajasthan has been largely understood from the archaeological record. The combined testimony of the recovered material culture from Nagari, Ahar, Gilund, Bhagvanpura, Chosal, Bagore, Aguncha, Nalathal, Iswal, Nathara-Ki-Pal, Chatrikheda, Javasia and Pachmata and the epigraphic and numismatic evidence along with the archaeo-metallurgical activities confirm that Southeast Rajasthan played a major role in flourishing of Iron technology in India.

It is noteworthy to explain that the unique geographical location of Southeast Rajasthan which decided its role in historical development is further certified by the archaeological and epigraphic evidence. A sufficient number of straight sides with incurved rim shreds of Grey Ware found from Balathal are identical with Hastinapur dated to sixth century BCE (Pandey *et al.* 2011). Typical pottery of the Ganges region which is popularly known as Painted Gray Ware extended up to the Bhilwara.

An inscription of second century BCE from Pratapgarh uses the term 'Aparanta' for Kathiwad, Kutch, Sindh and Konkan regions. An undated inscription of Nahapan (Sankalia 1969) found from Nasik Caves narrates that on the command of Bhattarak, Rishabhadatta (Ushavadatta), the son of Dinika and the son-in-law of Nahapana went to relieve the chief of Uttambhadra tribe who was besieged by the Malavas. "Pay the order of my Lord", he records, "I went in the rainy season to relieve Uttambhadras"; inscription further narrates that after the crushing defeat on the Malavas, Rishabhadatta went to Pushkar Lake for ceremonial consecration.

Thus, it can be concluded that Southeast Rajasthan having specific geographical location was a very prominent centre of natural resources including the mining and metallurgical activities playing an important role in the economy of Ganges plains as well as to the north-western part of India. The erstwhile natives of this region had developed guilds of smiths and mine workers who were successfully running it at an industrial scale without harming the ecology of the region (Agrawal 2000). Another site Nathara-Ki-Pal, which is very close to Chavand – the capital of Maharana Pratap, is more promising and it can reveal certain new dimensions concerning the pyrotechnological industries of the region for about seven hundred years. Thus, it can be inferred that the evidence offered above along with other sites appears sufficient to prove that the metallurgical sites played a vital role in the socio-economic and cultural formation of Southeast Rajasthan.

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