Chapter – V
CONCLUSION

5.1: Relevance of the work

Till the middle of the twentieth century the metal artefacts from the excavated sites of Indian Sub-continent were subjected to only typological analysis. One of the earliest works on the technological aspects of iron artefacts from the Megalithic context of Southern India by Mudhol (1997). In the context of Vidarbhan Megaliths, chemical analysis of the smelting remnants (slag, cinder, and iron ore) was done by Gogte (1982) to understand the efficiency of the smelting process undertaken by the Megalithic iron-smelters at Naikund. The ore analysis (X-Ray Diffraction and Mossbauer Spectroscopy) also aided in understanding the deposits (magnetite and hematite), which were exploited by the megalithic smelters. The tool assemblage was classified according to typology and not subjected to any scientific analysis.

Similar metallurgical studies have been made on high- tin bronze artefacts (Srinivasan, 1998 and 2006), copper artefacts from Somnath and Langhnaj (Hegde, 1991), iron artefacts from Dhatwa (Hegde, 1991) and iron artefacts from the Early Historic Levels of Gujarat (Patel, 1999). Chemical compositional analysis was done on the zinc ore from Zawar mines (Udaipur, Rajasthan). It helped in reconstructing the ancient zinc distillation process. The production of zinc was important in the advancement of metallurgical science as it aided in the production of an alloy known as brass (copper+zinc) (Hegde, 1991). Nevertheless metallurgical understanding of iron artefacts from Vidarbhan Megalithic sites has not received similar treatment.

Earlier from Takalghat-Khapa one spear was analysed for chemical composition by Munshi and Sarin (1970) and based only on the chemical composition, it was assumed, that, it was steel. The method adopted was incorrect and faulty. Similarly one axe from Mhaurjhari (Joshi, 1973) was also chemically analysed and based on the iron content (99.1%) and carbon content (0.9%) it was assumed that it was steel. Recently two metallurgical studies Deshpande.et.al (2010) and Park and Shinde (2012) had been undertaken on samples from the megalithic context of Vidarbha..

Both studies involved selected samples from only a few sites and the samples studied were not representative of the tool assemblage. They have not contributed much to our understanding of the Megalithic Iron Producing society although metallographic studies of the iron artefacts from this context were attempted for the first time. The Vidarbha Early Iron Age Megalithic sites were excavated in the late 20th and early 21st century. The iron artefacts were recorded and documented, however, the process of making of the artefacts and the chemical composition of the tools remained shrouded in mystery.

Technical understanding of the manufacturing of iron involves the deduction of a number of stages of production, such as, quarrying of the iron ore, extraction of the iron, usage of the flux, construction of a suitable furnace and the final smithy process. The present work attempts to develop the technical understanding of the metallurgical activity undertaken by the iron smelters and smithers of the Early Iron Age Megalithic Society in Vidarbha by adopting the study of metallurgy and inorganic chemistry. Based on the extracted data, a probable societal formation of the iron producing and using Megalithic society was constructed.

The concluding remarks are drawn by integrating the results of the typological, metallographic, chemical, ethnographic and experimental data. It should be noted that ethno-archaeological data was not fully utilized for model building as some of the analogies may misrepresent the archaeological data and the culture whose anthropogenic remnants they were.

5.2: Concluding Remarks from the Typological Analysis

The study revealed that the iron assemblage comprised a variety of tools conforming to various functional groups. Multi-functional tools dominate the assemblage. Tools like adze (Section: 4.1.1.A) and nail parer (Section: 4.1.1.R), which are identified as tools for surgical purpose based on ethnographic evidence (Personal Communication: Ismail Kellellu, 2012) dominate the tool assemblages from all the sites except Naikund, Borgaon and Mahurjhari, where nail parer occupies the third position (Table: 4.2.1).

The variety of tools suggests the existence of various occupational groups. Based on the distribution of artefacts, it is seen that the site of Naikund has the least artefactual variety.

Naikund has yielded considerable evidence of smelting activity in the form of slag. From the archaeological remnants such as cinders, ore lumps, tuyeres, it is possible to suggest that this was the primary centre for extraction of iron and production of tools.

The finished artefacts were possibly transported to other settlements, where they may have been utilized by different groups of artisans. It is important to note that 80% of the entire assemblage has been recovered from the burial context as they were ritualistically buried.

The burial artefacts were specifically made for ritualistic offering and did not suffer any use-wear damages pre-deposition. The tools from the habitation complex had suffered use-wear damages, during the pre-deposition phase. The tool types from the habitation area are also limited, as they were not stored for later use. The exact distribution of artefacts in the burial and the habitation complex have been elaborated in Section 4.2 and have been graphically represented in Graphs 4.2.1, 4.2.2 and 4.2.3.

The morphometric analysis of the artefacts also shows that there was parity in the dimensions of an artefact type. In other words there was a standardized, shape, size and weight of the artefacts which is understood through the R-software statistical analysis. The results are represented by the figures 4.3.1.1 and 4.3.1.2 which represent a box-plot showing the length of the adzes. The length of all the adzes falls within a single bracket. The scatter plot 4.3.1.2 shows the relationship between the length and breadth of the selected artefact, where, the change in breadth does not show much change in the length of the artefact. Similarly the R-analysis done on the axe assemblage (Section: 4.3.2) showed the presence of miniature axe at the site of Khairwada.

The other axes found from all the sites except one from MHR- 6229 and another one from DMN, fell within a single bracket. This confirms that the artefacts were standardized.

Similarly the statistical analysis of chisel (Section: 4.3.3) and nail parer (Section: 4.3.4) shows that, barring a single outlier in the chisel assemblage, all the artefacts fall within a single bracket, when analysed with length as the parameter. Weight of the artefacts remained almost constant despite post-depositional changes, with minor variations in the length and breadth of the artefacts which is represented by the scatter-plots (4.3.1.3, 4.3.1.4, 4.3.2.3, 4.3.2.4, 4.3.3.3, 4.3.3.4, 4.3.4.3 and 4.3.4.4) where the co-relation co-efficient between the two parameters has been calculated.

It is interesting to note that diverse craft activities are visible during the Early Iron Age. Although habitation remains are limited but based on the variety of iron artefacts the subsistence and livelihood of the Megalithic people of Vidarbha can be understood. In section: 4.1.1 the variety of iron tools recovered has been elaborated which have brought to light the practice of a technology which required a degree of specialization. The existence of a well-defined iron technology suggests that the megalithic society of Vidarbha practiced a sedentary lifestyle although habitation remains are meager.

5.3: Concluding Remarks on the Metallurgical and Technical Know-how of the Megalithic People Based on the Metallographic and Chemical Analysis of the Iron Artefacts.

The microstructure analysis of the selected artefacts showed that the samples from Naikund were heavily corroded, with minimal metallic core left. However, based on the SEM micrographs it is revealed that smithery techniques such as making steel was in practice and the samples with evidence of steeling (Section 4.4.1) have shown that knowledge of smelting, as well as the quality of metal used was always maintained. The knowledge of smelting is evidenced by the purity of the metal (Fe: 97% - 93%) as well as other beneficial elements included. Manganese has a property of inducing hardness; however it also has the tendency to cause cracking of metal when the artefact is quenched. Therefore it is necessary that the Mn level is below 0.5%. Table 4.4.1 clearly shows that basic knowledge of the properties of elements was known to the Early Iron Age Megalithic iron-smelters .

Along with the steel technique, we have evidence of different grades of cast iron which is distinctively different from steel due to its high carbon content (2- 4%) also have evidence of wrought iron (BMR -112) where slag inclusion was prominent, demonstrating that smelting activity was not fully achieved to eliminate all the unwanted gangue material. Sample BRG 5804B shows the usage of pure iron where no heat-treatment was involved and the artefact was made using a basic forging process. All these stages prove that the metallurgical techniques were still at an experimental stage and that it is proved through multiple failed attempts at steel making. This suggests that probably the iron smelting and smithy developed indigenously in Vidarbha and was improved upon by the smithers, which led to the artefacts being produced through different techniques. It is also important to note both hematite and magnetite were used, although hematite was the most commonly used as its deposits were more abundant. Usage of magnetite, which is identified through the presence of titanium in the compositional analysis, is limited.

Some of the iron tools found from the archaeological context were experimentally recreated with the help of a 'traditional' blacksmith to observe the manufacturing techniques, which helped us to understand the method of forging and annealing. The method of sharpening the cutting or the drilling edges of the artefacts was done to ensure wear resistance. The different methods of forging used to give the required structure/shape of the artefact were also understood. This experimental study also aided in understanding that the method of forging and the method and duration of annealing and quenching, if done erroneously by an apprentice or novice, results in cracks on the surface which actually weakens the artefact and increases the probability of its destruction. The metallographic analysis of the artefacts proves that majority of the artefacts withstood the forces of nature as most of the tools have retained the metallic core.

5.4: Discussion on the Probable Socio-cultural System of the Vidarbhan Megalithic Society Based on the Inferences Drawn From Contemporary Gadchiroli Megalithic Society and the *Lohar* Community Residing in Vidarbha.

The main aim of the thesis was to establish a relationship between the administrative unit and the production unit of the utilitarian and ritualistic iron artefacts found from the Early Iron Age levels. The techniques adopted by the Early Iron Ages smelters could be understood based on the indigenous or 'native' furnaces used during the colonial era (1873) and recorded by Hughes (G.S.I.,1873). According to the colonial records, '*Maharattas*' were engaged only in smelting activity and the first stage of refining. They bartered these smelted iron with the '*Lohars*' for the final processing. Seen in the light of this literary record the only smelting evidence found from the megalithic levels is that of the Naikund furnace. There was probably only one group of smelters who acquired the raw material i.e., ores from the nearby sources which were subsequently processed into spongy iron. The mass of spongy iron was bartered with the ironsmiths, who, in turn, performed the second stage of refining which converted the spongy form of iron into a malleable condition. The final artefacts were forged and then supplied to the multiple settlements. Based on ethnographic analogies, it can be deducted that the *lohars* catered to the technological needs of the society (Fig: 6.1).

The artefact assemblage suggests that the society was segregated into groups based on labour specialization. For example, we have multi-purpose tools such as knives and axes which were used by all sects of the society. However tools like hoes, sickle and digging tools were specifically used for cultivation purposes. The availability of such tools proves the importance of agriculture/ food production and the necessity of tools specifically made for tilling soil, or cutting food grains. Therefore, the practice of food grains production/ cultivation form a specialized labour. However it is also important to note that the present iron smith of the Gondi community of Gadchiroli is a seasonal cultivator as well. As he caters to the need of a very small community, his smithy duty is limited to the harvesting season when he has to sharpen the required tools or make new ones. The axe as a tool has been categorized under multi-purpose tool however according to Rao (1988) axe was used only for domestic purpose and was never used as offensive weapons. Ethnographic survey has brought to light the use of the axe for only clearance puposes.

Similarly, tools such as drill points, borers, engravers, chisels, chisel points and rivets suggest that there was also a group of artisans specializing in carpentry.

Groups of people specializing in different activities have been clearly projected in the artefactual assemblage and there was a mutual co-existence. The standardized artefacts (shape, size and typology) also suggests that there was a centralized administrative unit which directed the iron-smiths to make a certain type of products, using a certain type of smelted iron, utilizing a certain type of technique and there existed an exchange network where finished tools exchanged for raw materials or other necessary commodities. Then the acquired finished tools were supplied to different settlements which were located within the same geological zone but were not near enough to be frequently covered by foot. It can be rightly said that the society reflected here is a non-surplus economy, and similar to the present day '*lohar'* community the megalithic community, also engaged in a barter system. In fact, a nexus of exchange was prevalent within the selected megalithic settlements, located within present day Vidarbha, as proved by the similarity in the morphology of the tools, composition and the metallurgical techniques found from all the megalithic sites (Fig:5.2).

Finally, the present study has aided in relating the scientific analysis of iron artefacts to the society that had manufactured them. It has also brought to light the importance of ethnographic survey of non-industrial artisans to understand the technological and cognitive abilities of the Early Iron Age smelters and smiths. The work also helped to identify the cognition processes behind the building of megaliths for the decreased soul and helped to reconstruct the mortuary activities undertaken by the megalithic community.

The erection of megaliths by the Gondi community of Gadchiroli has aided in interpreting the need for such practices. If we take ethnographic analogies into consideration, then stone circles or cairn circles seem to have been for immediate burial whereas menhirs and dolmens were memorials erected for commemorating death anniversaries. It is important to note menhirs were erected only for males and dolmens for females.

A similar approach can be adopted for studying the iron artefacts from the Early Historic period of Vidarbha, which could help in analyzing the degree of advancement in smelting and smithy activities within the same zone.

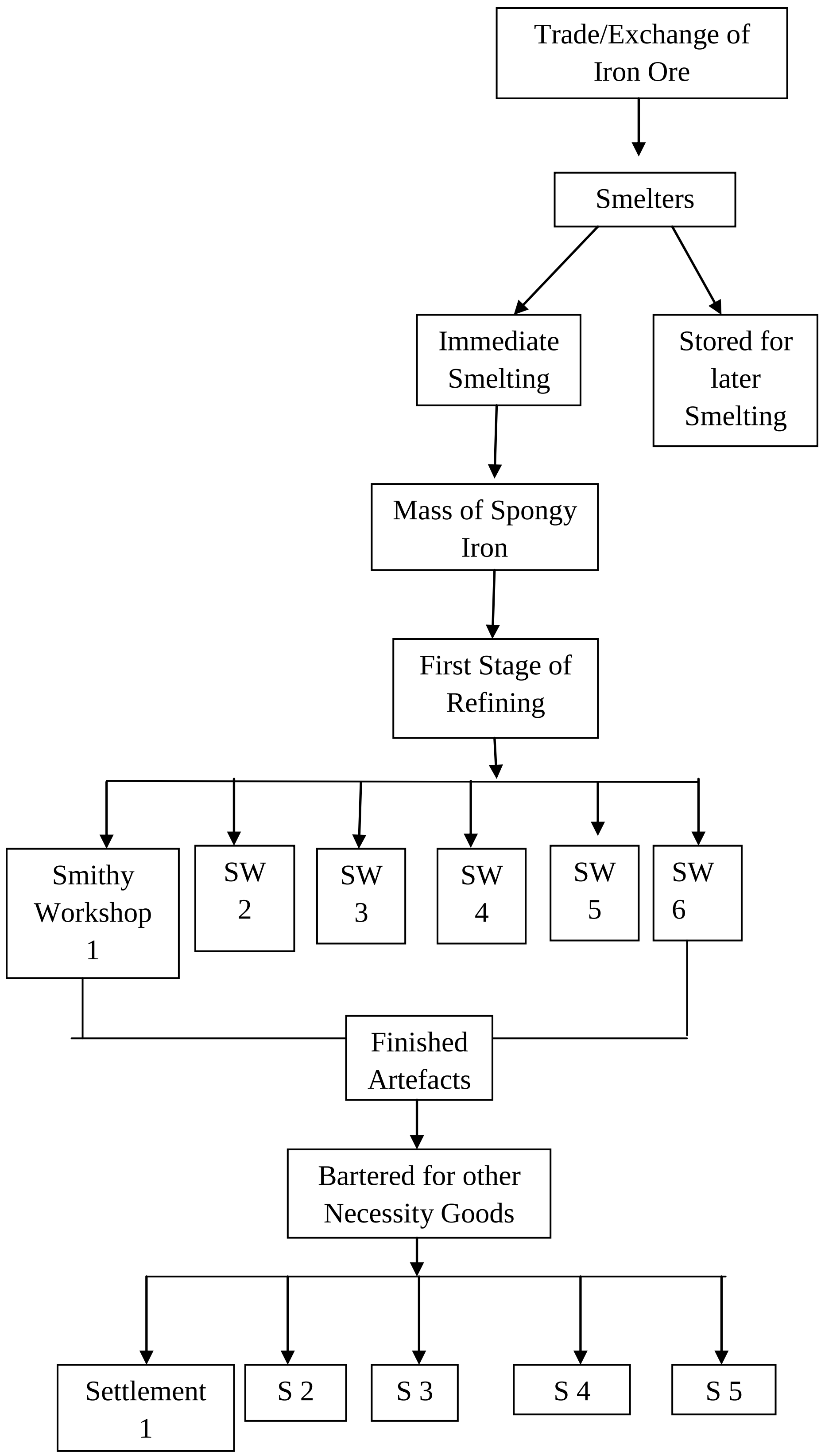

Fig. 5.1: Flowchart Showing the Probable Structure of the Iron Tool Producing Community

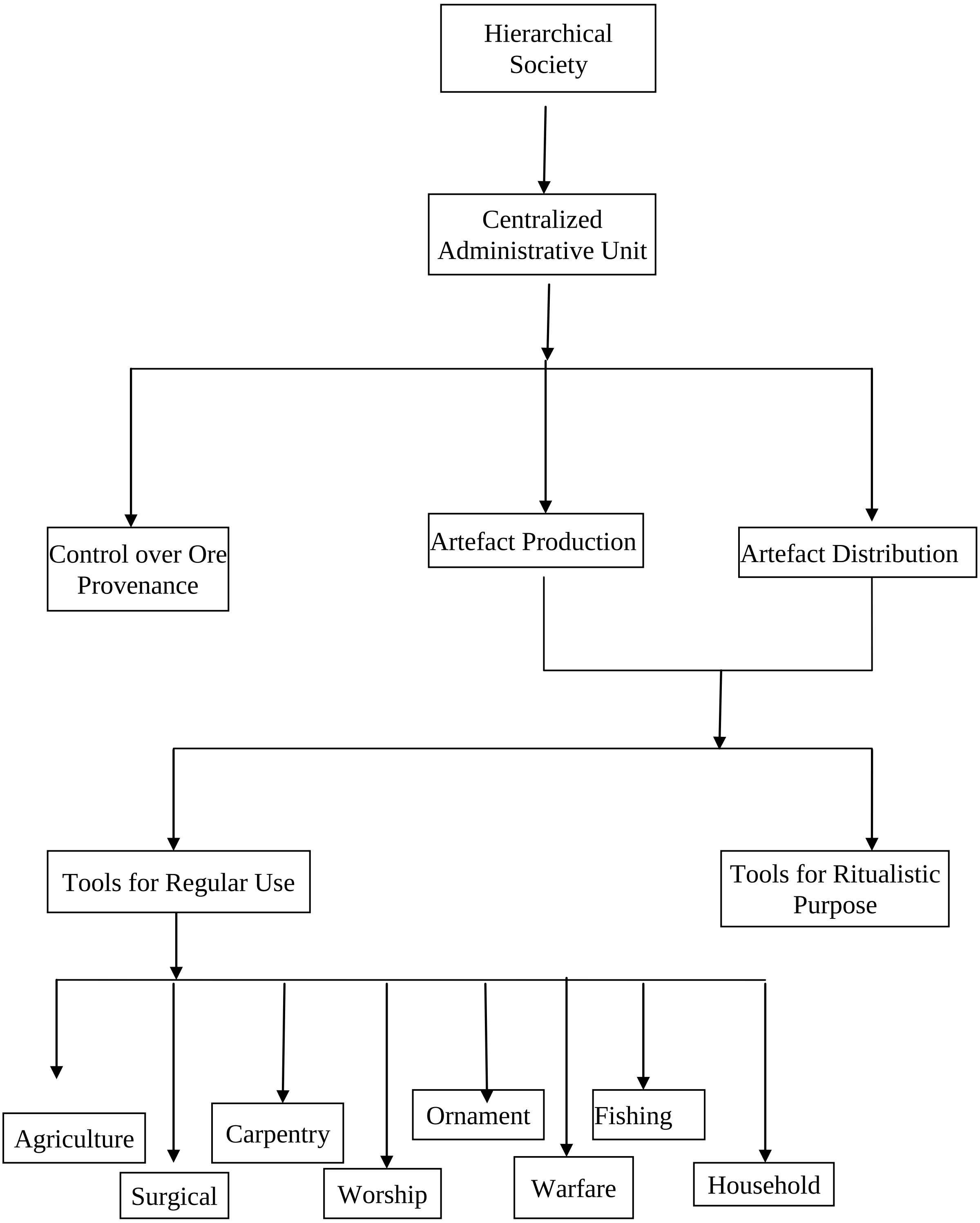

Fig. 5.2: Flowchart Showing the Probable Societal hierarchy present in the Megalithic Early Iron Age Society