South Asian History, Culture and Archaeology

Vol. 1, No. 1, 2021, pp. 73-88

URL: http://www.esijournals.com/sahca

Early Iron Age in Lower Palar Region

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Abstract: *The lower Pala rriver in the Kanchipuram district is considered to be a focus centre of history and civilization in the southern part of India. In this region which serves as human habitation right from the hominids till today, it is possible that the early humans not only made tools on the river bank but also lived there for a very long time. Evidence is indicating to the fact that it took centuries of concerted effort to improve upon the metallurgical processes. The development of metallurgy has been appeared into three stages in different periods in India such as–*

- *EarlyIronAge(bytheendofsecondmillenniumBCE-700 BCE)*
- *Middle Iron Age (700-100BCE)*
- *Late Iron Age (100 BCE/CE-600 CE)*

The foregoing evidence reveals that the early Iron technologies, settlement pattern and socio-cultural system developments in the region. Iron technological know-how gradually penetrated in the region during the early period of the last millennium BCE. The unearthed evidence such as the number of furnaces in more than two kilometer stretch indicates that a mass scale iron smelting and manufacturing objects in the area. Different shapes and sizes of memorial structures in all typologies at one place is not only a rare evidence but also reported for the first time in the burial architecture. Particularly in the shape of turtle, retail, cist and dolman with in a circle, etc. are a new feature in the burial architecture in the region or elsewhere. It is a remarkable unique feature of the lower Palar region during the Early Iron Age.

Keywords: *Civilization, Human habitation, Iron technologies, Settlement pattern*

Received : 18 May 2021
Revised : 25 May 2021
Accepted : 3 June 2021
Published : 30 August 2021

TO CITE THIS ARTICLE:

Pisipaty, S. R. K. 2021. Early Iron Age in Lower Palar Region. *South Asian History, Culture and Archaeology,* 1: 1, pp. 73-88

Introduction

The river Palar is one of the perineal rivers in south India. Its origin is from eastern ghats in Karnataka and travels through Tamil Nadu before discharge into Bay of Bengal in the east coast. It rises from

the Nandidurgam hill in Kolar district, Karnataka and enter into Tamil Nadu flows through the north Arcot district and finally enters into the district of Kanchipuram. It is running right acrossthe district in a south-eastern direction(Henry Frowde. 1908:253-260) and the river system consists of a series of streams which flows from west to east in to the Bay of Bengal.Rivers in the region have provided a suitable environment for human settlement at all times. From the Prehistoric period down to the present day, Man continued to occupy this land-form as it provided natural fertile soils on the river flood plains from raising crops. Kanchipuram, a large settlement with many satellite centres were evolved in the lower Palar river valley by the end of the last millennium BCE. These rivers flow have yet another advantage is that they provide an easy communication for movement from the land to coast (Bay of Bengal). It may be noted that important trade routes of ancient times are located in the river valleys (Gosh, A. 1989 :213). By the end of last millennium BCE, the region has appeared as a hub of various activities and Kanchipuram is developed as the best urban centre (*nagareshukanchi*) in the South.

Archaeological explorations and excavations were conducted by the present author in the lower Palar region from 2000. Many new evidences, ranging from the Palaeolithic to Midlevel were discovered for the first time in the region. The archaeological appendage related to the Early Iron Age is discussed in the present paper. The use of stone to create tools and weapons marks an important stage in human development and begins the era of the Stone Age. The Neolithic (New Stone) Age, though under lithic age, was characterized by the first use of agriculture when humans left their hunter-gatherer days behind them. The Mesolithic (Middle Stone) Age preceded the Neolithic revolution when stone tools became more advanced, which in turn helped humans develop farming techniques.

Lithic users of early societies gradually realized the potentiality of the metals and started to work on ore. Among all, easy accessibility of the iron ore in most of the geographical zones and strong and lustrous character attracted the human and gradually replaced the media in preparation of implements and weapons. Further, started using iron extensively by the end of the second millennium BCE, because of a better metal harder than copper, for making tools and weapons.

Moreover, advent of metals and metal technology was also a major breakthrough in the history of mankind. It has changed the earlier façade of the lithic based culture and great changes in the socio-cultural and economic conditions of the early societies. Early smelting methodologies, though primitive and crude, are base for technological developments. During the period many new trends were evolved for the first time in Indian subcontinent also. They are – settlements with permanent structures, metals and metallurgy, development of various crafts, large scale commercial based productions, socio-cultural systems, inter and intra regional contracts, religion, educational institutions, large settlements of different nature, etc. So many developments occurred which changed the entire scenario of the early lithic based culture to sophisticated way of life throughout the region and many cultural trends prevailed till now. Socio-cultural development during Early Iron Age on the bank of the lower Palar river in the southern part of India drawn many new traits from the recent archaeological excavation conducted by the present author. It may also be noted that a few of which are not only reported for the first time but also new to the archaeological records.

Archaeological Explorations and Excavations conducted in the Lower Palar region

Early Iron Age settlements, both habitation along with iron smelting and workshops as well as monuments with mega-liths were discovered during the explorations in the entire area (Map 1). A few potential Early Iron Age sites were excavated in Kanchipuram district during 2005 and 2014. The details are elaborated in the following under two heading such as – 1. Habitation cum Iron Smelting

area 2. Monuments with megaliths. In the first category of evidences are envisages the dwellings and iron smelting and-or-cum workshops and structures for after death rituals in the second category on opposite mound with in a two-kilometre distance (Map 2) at Vadamangalam.

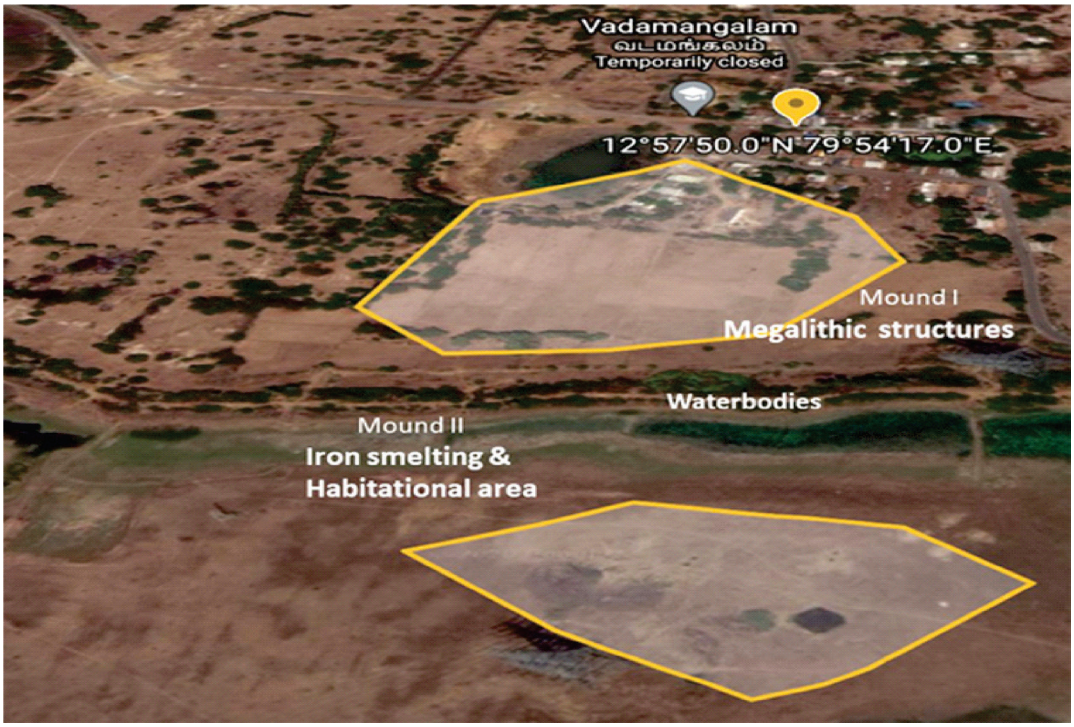
Map I: Lower Palar& Early Iron Age Settlements

Vadamangalam (VDM)

There are two mounds (Map 2) in the Vadamangalam village surrounded by three *eri*/ lakes and separated by a small lake. On the southern side mound, an Early Iron Age settlements and iron smelting areas were traced in the region for the first time by the present author during 2013 field season's explorations. It was also noted that a series of iron smelting areas, more than a five km long stretch towards the south with scattered iron slag and conducted excavations near Kariamankalanieri region. Vadamangalam is situated very near to Sriperambatur in Kanchipuram district conducted excavations in between 2013 and 2015. Early Iron Age settlements and iron smelting areas were traced at Kariamankalani village, near Vadamangalam. It is not only an interesting discovered but also iron smelting and habitation areas reported for the first time in the Kanchiupram region.

Habitation cum Iron Smelting areas (Mound II)

It may be presumed from the available evidence that the circular aligned dwellings **(Fig 1)** with perishable materials with big boulders demarcation were the construction style of the Early Iron Age people in this region. Floor with post holes **(Fig 2),** mud packed rubble floors, brickbats, etc



Map 2: Location Kariamankalani (Mound II) &Vadamangalam (Mound I)

were noticed in the habitation area. It may also found that the entire settlement boundaries were well demarcated and also well protected with water bodies on two sides and huge bolder fencing on other sides. A huge boulders alignment like a cyclopean walls (30 X 1.5 to 2 m) was noticed in disturbed condition (Fig. 3)**.**

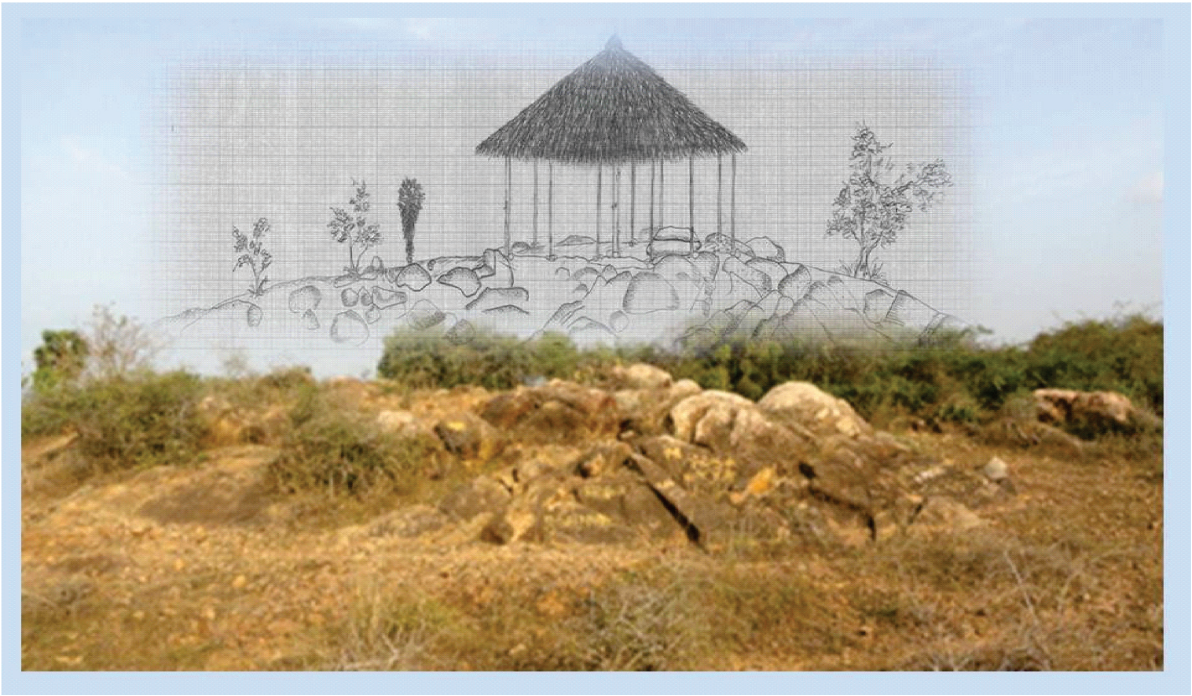


Figure 1: Circular Dwelling, KMK

Figure 2: Floor with post holes, KMK

Figure 3: Cyclopean walls with Huge boulders (30 X 1.5 to 2 m), KMK

Within the settlement, a series of Iron smelting furnaces were noticed with slag **(Fig 4),** terra cotta pipes (tuyeres) **(Fig 5)** on the southern side. From the evidences we can firmly conclude that the bloomery method was the smelting process in the region **(Fig 3).**

Iron Smelting &Technological Evolutions

Early Iron technology landscape can be characterized as having seen different waves of evolution and growth in the region. Metallurgy of Iron in the region gradually evolved over a centuries from slag rich simple wrought iron to corrosion resistance steel iron. By the end of the last millennium BCE,

smiths in the region developed metallurgy of Iron and mastered in large scale production and corrosion free Iron. Such techniques have been prevalent in the region for a very long time and promoted the long-distance trade commerce. Early smelting methods reported from archaeological excavations are discussed in the following. Development in metallurgy has appeared in the region in three different distinguished stage such as -

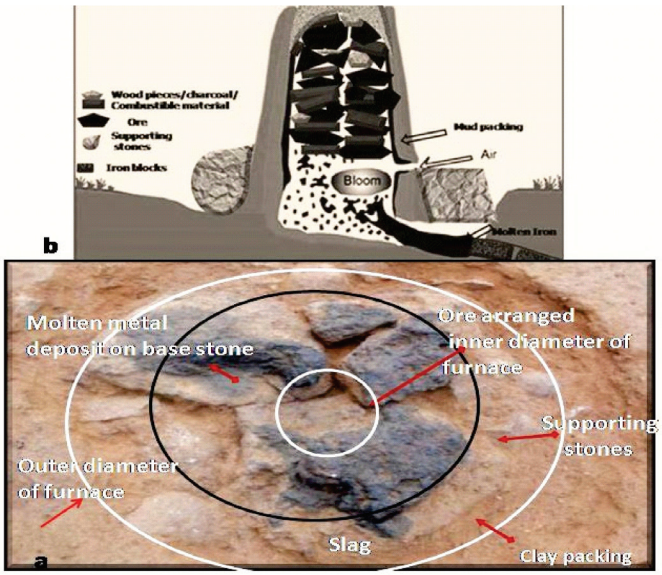
I Bloomery iron
smelting and forging
II. From wrought iron to steel
Carburization - accidental and/or deliberate
Quenching and tempering
III Crucible Iron or Wootz steel

Bloomery Smelting

It was the earliest form of smelter capable of smelting iron. A bloomery is a type of furnace once widely used for smelting iron from its oxides. A bloomery's product is a porous mass of iron and slag called a bloom (an iron bloom). This mix of slag and iron in the bloom is termed sponge iron, which is usually consolidated (shingled) and further forged into wrought iron. The bloomery has now largely been superseded by the blast furnace, which produces pig iron. Tripathi (2001) has discussed various aspects of construction and operation of ancient Indian iron furnaces.

Evidences of Tapping furnace

Tapping Furnace - bloomery smelting furnace had a hole near ground level that could be opened during the smelt, to release a flow of hot, molten waste slag (black), separating it from the solid metal bloom. Furnaces were variable, with an internal diameter at the base of 0.3 m to 1 m. 'Tapping' furnaces (Fig 4), best known from the Early Iron Age to medieval periods, had a hole at ground level in the furnace wall that could be opened during the smelt so that the slag could run out. It may be noted that the evidence of 'slag-pit' or 'non-tapping' furnaces is not reported in this region.



a. Ground plan of the Bloomery Furnace, KNK
b. Tapping furnace

Figure 4: Bloomery smelting, KMK

Figure 5: Iron Smelting area, KMK

Figure 6: Clay Tuyere from KMK

The clay tuyere **(Fig 6)** used for blowing air was prepared from the clay. It had a shape like a trumpet having 25 to 30 mm diameter at the tapper end, and about 150 to 180 mm on the other end,

and a length of about 250 to 300 mm. It had a wall thickness of 10 mm and it was generally used in baked condition lasting for one heat only.

Crucible Smelting

Crucibles used for Iron Smelting were generally wide shallow vessels made from clay. By the end of the last millennium BCE, India was a production center for high- quality steel and exported such products to different parts of the world. It may be noted that Crucible steel is generally attributed to production centers in south India where it was produced using the so-called wootz process. It is also assumed that its appearance in other locations was due to long distance trade. The earliest known potential evidence that may be linked to ferrous crucible processes smelting has been reported at Kodumanal, near Coimbatore in Tamil Nadu (Ranganathan and Srinivasan 2004). The site is dated between the third century BCE and the third century CE (Craddock 2003).

Iron quality has been considered based on carbon content such as cast iron (2–4%) and wrought iron (less than 0.1%). The much more valuable steel has a delicately intermediate carbon fraction, and its material properties range according to the carbon percentage. It may also be noted that the high carbon steel is stronger but more brittle than low carbon steel. Crucible steel sequesters the raw input materials from the heat source, allowing precise control of carburization (raising) or oxidation (lowering carbon content). Fluxes, such as limestone, could be added to the crucible to remove or promote sulphur, silicon, and other impurities, further altering its material qualities. Crucible steel is commonly referred to as wootz.

The crucible is a container (usually terracotta) that can withstand very high temperatures and is used for metal smelting and carburizing. The preliminary investigations are reported that crucible steel production (Corrosion-Resistant Iron) was carried out in the pre-industrial era, in Tamil Nadu in the southern part of India. First time reported at Palnerllur in the Kanchipuram region in 2011 by the present author. An early iron smelting and workshop was found in three different areas in Palnerllur village. Iron ore and slag, terracotta pipes (Fig 9) in different measurements have been unearthed from the village. Unfinished or fritter away objects (Fig 10), crucibles (Fig 8), iron mould like objects, etc., were also unearthed from the excavations. Near the workshop area, an ore dump has been retrieved from the site. The ore is broken into small pieces like round balls reported from Palnerllur excavations. Any large impurities in the ore can be crushed and removed and roasted. It may be made for pre-roasting the ore **(Fig 7).** The ore is roasted in a fire to remove any moisture in the ore. After roasting for a few hours and cooling down, the ore is broken in pieces of an inch (more or less) and together with charcoal (layer by layer) heated in a furnace.

It may be presumed and widely accepted theoretical model for process inside the furnace during smelting is may be the following reaction.

Hydrated iron oxides (FeOOH) –> haematite (Fe_2O_3) –>

magnetite (Fe_3O_4) –>wüstite (FeO) –>iron (Fe)

If we assume the ore has been roasted, and the water driven off any hydrated iron oxides, the chemical reaction can be expressed:

$$3\ Fe_2O_3 + CO \rightarrow 2\ Fe_3O_4 + CO_2$$

$$Fe_3O_4 + CO \rightarrow 3\ FeO + CO_2$$

$$FeO + CO \rightarrow Fe + CO_2$$

Figure 7: Iron ore dump, PLN

Figure 8: Terracotta Crucible in situ, PLN

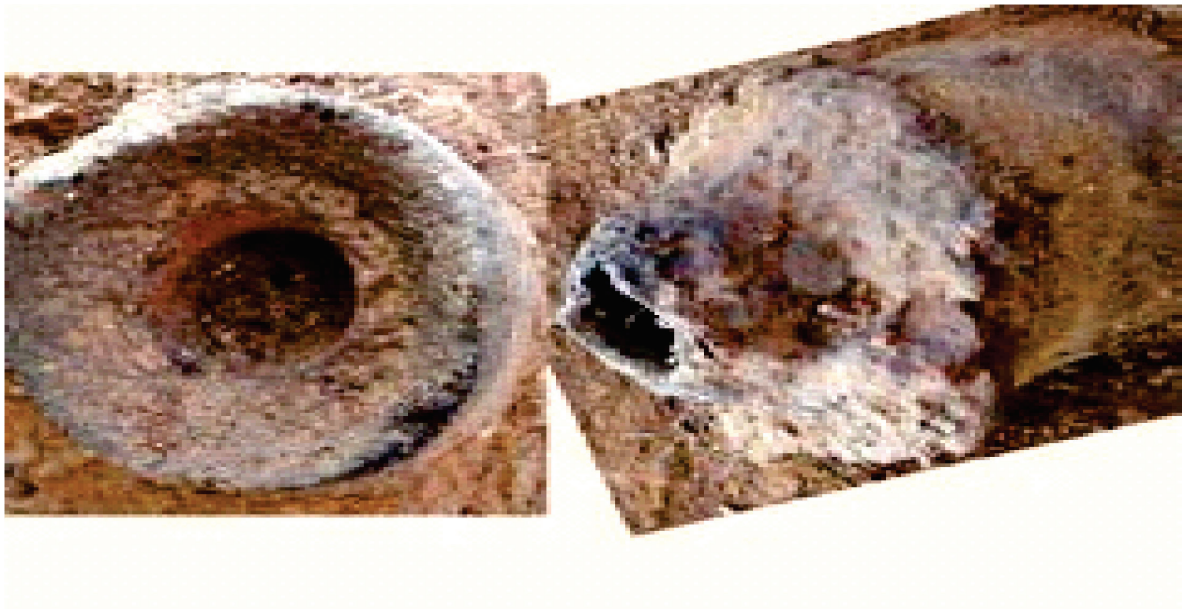


Figure 9: Terracotta pipe with iron deposit from PLN

Figure 10: Fritter/waste iron from Iron workshop, PLN

II. Memorial structures

On northern side mound, with in a twokilometre distance, memorial structures with Megaliths were already reported by Banerjee, N. R. (1966 :29-30). Early Iron Age settlements along with smelting areas near Megalithic structures are not only important but also reported from a very few site in India. In a sprawling area, more than two kilometers stretch hundreds of structures in all typological categories were found in the area. It is a really interesting and significant site for Early Iron Age Monumental activities. All categories in one mound with variety of structures in different combinations not only interesting but also reported for the first time in the archaeological records. For instance, a dolmen and cist within the cairn circle, cist with elongated stone structure looks like a reptile, turtle shaped structure with central boulder circular on a natural bed rock, etc., not only new features in the monumental architecture of Early Iron Age but also reported for the first time. Further another interesting feature of the structures with megaliths in the Vadamangalam are non-sepulchral commemorative or memorial in nature.

Rock Cut Structure in Turtle Shape

Natural bedrock is converted into a turtle shape and digs the central bedrock in circular form. The total length of the structure is in 15.50 m and 12 m breadth of natural bedrock. In the middle made a circular pit and removed the stone upto 1.50 m depth. On four sides not retouched the bed rock and appeared like a head, tail and limbs. The total figure has appeared like a tortoise. The central circular structure is in 24 m circumference and made of 21 huge semi dressed boulders, out of two (No 6 & 21a) are well dressed. The central cist looks like a square in plan and it was divided into two chambers.Two medium sized terracotta legged sarcophagi with domical lid were found from the front portion of the structure. There is no other antiquities except two itched carnelian beads from sarcophagus.

Figure 11: After surface cleaning, VDM

Figure 12: Turtle shaped rock cut structure, VDM

Figure 12a: Ground plan of the structure in Turtle shape, VDM

Twin Structures Within Cairn Circle

A rectangular cist made of seven orthostats and a dolman with huge capstone have appeared with the stone circle. It is another interesting structure at Vadamangalam. Out of seven semi-dressed rectangular orthostats, one is cut in 'L' shape. The cist consists of two medium size sarcophagi made of terracotta with damaged lid were noticed. Iron Objects, may be a knife (?) unearthed from the cist **(Fig 14).**

Whereas other structure is dolman made of three big boulders covered with a huge flat undressed capstone **(Fig 13).** Both cist and dolman structures were well demarcated with irregular medium size boulders in circular alignment with an extension structure on both sides **(Fig 13a).** These two structures look like front and rear portion of a retail. It may be a memory of a couple or same family members.

Figure 13: Cist &Dolman with in stone circle, VDM

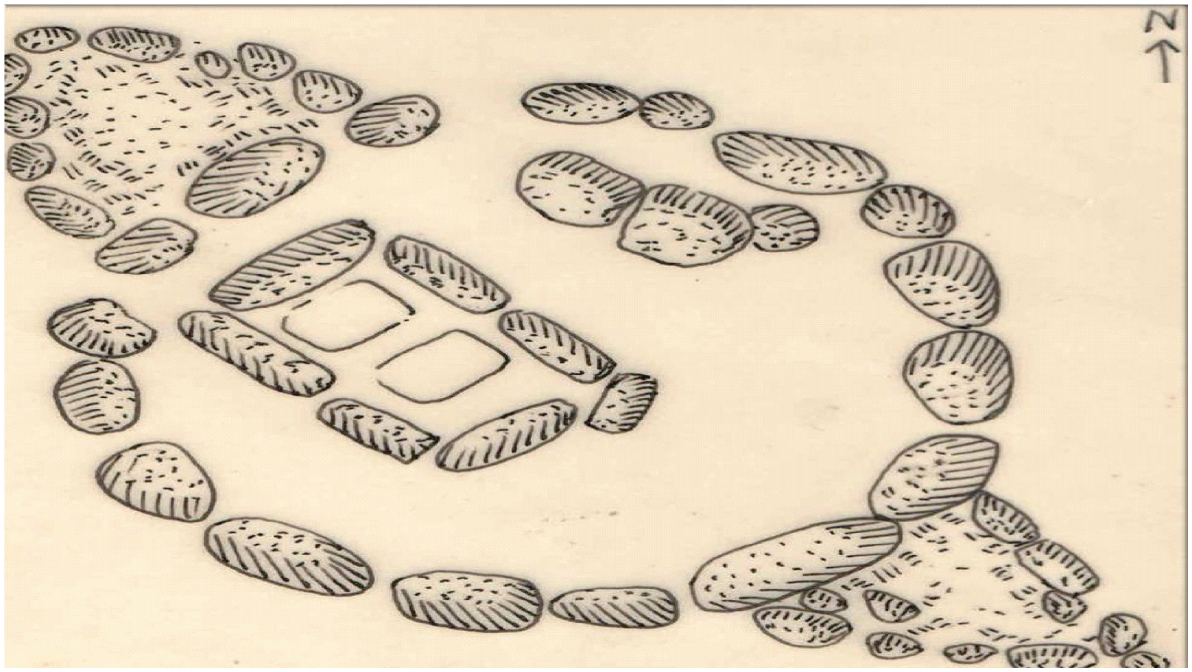


Figure 13a: Cist & Dolman with in stone circle, VDM

Figure 14: Cist with Sarcophagi & Iron objects, VDM

Inferences Drawn

The lower Palarriverinthe Kanchipuram district is considered to be a focus centre of history and civilization in the southern part of India. In this region which serves as human habitation right from the hominids till today, it is possible that the early humans not only made tools on the river bank but also lived there for a very long time. Palaeo-channel on the other hand would have been as ecurecompsite. It may also be true that where stone tools and equipment were fashioned provide an evidence of early human migration. The archaeological record clearly indicates that Acheulian was the earliest stage of hominid occupation of the subcontinent in general (Pappu2001). It may be noted that the history of iron metallurgy had been a long process of evolution. Evidence is indicating to the fact that it took centuries of concerted effort to improve upon the metallurgical processes. It is the spirit of Human Endeavour which allowed manto innovate, improvise and master technology through experimentation. Their on technology has been not only developed from simple wrought iron to corrosi on resistances teel but also from tiny bits and small objects to colossal structures.

The development of metallurgy has been appeared into three stages in different periods in India such as–

- ❖ EarlyIron Age (by the end of second millennium BCE-700 BCE)
- ❖ Middle Iron Age (700-100BCE)
- ❖ Late Iron Age (100 BCE/CE-600 CE)

Iron implementsat the first stage were sometimes replicaso fearly bone and /orstone objects of the Neolithic period indicating a gradual transformation of medium that is modeled after bone prototypes.

Secondstageor Middle Iron Agein India (7-6thcentury to 2nd-1stcentury BCE) though the smelting is common but the techniques of carburization and quenching discerned. Carburized iron production of the region has not only increased the inter regional trade activities but also attracted the long distance. Production of different trade items were also increased. For instance, bead making industries, ceramic industries to meet the consumption of local and long distance traders, and so many. Through trade, regional contracts and socio- cultural exchanges also happened. No need to mention that the trade and commerce affluent the settlement.

During this stage, it may be noted that many socio-cultural changes for the first time appeared in the region. Among, memorializing the death and construction of structures with mega-liths is sumptuous and significant. The tradition has appeared throughout the region with little variation. It may be due to availability of raw material and geographical condition. It may also be noted that very strong faith and dedicated worship has appeared more on the Southern part. Highly skilled and more laborious efforts have appeared in the construction of complicated structures with huge dressed or semi-dressed blocks for after deathrituals. By the end of the last millennium BCE, large settlements with urban features grew with satellite centers in the lower Palarregion. A not her advantage to the Kanchipuramregionis thatconnectivity, water transportation through the Palar to the East coast further facilitates trade and traders. Through trade, religious thoughts were spread within the continent up to inter continental. Along with the religion, educational and philosophical centers were also developed which attracted not only indigenous but also long distance traders. Third stage is considered as an advanced stage of Iron metallurgy. By this time them etallurgy as well as utility of iron objects were tremendously increased. Commercial based good quality iron/steel production of the region has attracted the trade of other continental regions and became a major demand product of the region.

It may also be found that inquite a few of the tribalzones, we have comeacrosse thnological evidence and survival of iron working in traditional methods until recent decades. This reinforces the assumption that the reisalong and widespread tradition of iron making in different parts of south India. It may be note worthy to mention in this context that thereisa frequent occurrence of pre-industrial iron working in the remotehillyparts whicharerich in ironoreand fuel. Further, the seregions are stillinhabited by the irons meltingethnic groups. It may also be found thats melting and producing high carbonironis stillinpracticeina few groups, however, many changed their profession because of lack of demand. Thusthere is anuninterrupted history of earlyironworking tillvery recent. There must have been stages through which this iron working must haveg one through.

The foregoing evidence reveals that the early Iron technologies, settlement pattern and socio-cultural system developments in the region. Iron technological know-how gradually penetrated in the region during the early period of the last millennium BCE. The unearthed evidence such as the number of furnaces in more than two kilometer stretch indicates that a mass scale iron smelting and manufacturing objects in the area. It may be true that the location of early habitationsites was dependen ton environment and resources for subsistence economy. Needless to say that the continuous occupation at a region for a longer period is not only an increase of population over a period of time, increase of the settlement size but also increase the popularity and all round developments. Kanchipuram region by the end of the last millennium BCE, became one of the popular and the best urban centers in the southern part ofIndia. Memorization of the death has also appeared in a special manner and different from other region. Highly skilled and laborious efforts of the builders of the Early Iron Age has appraisable. Different shapes and sizes of memorial structures in all typologies at one place is not only a rare evidence but also reported for the first time in the burial architecture. Particularly in the shape of turtle,retail, cist and dolman with in a circle, etc. are a new

feature in the burial architecture in the region or elsewhere. It is a remarkable unique feature of the lower Palar region during the Early Iron Age.Hundreds of structures in sprawling area are further indicating that a very large settlement lived very long time in the region during the Early Iron Age in the lower Palar basin.

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