

## **Historical perspective of iron in ancient India**

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**Abstract :** Iron is an important metal which has influenced the march of civilization over atleast 5000 years and it has been in the service of man from the dawn of time. The ancient scriptures and legends have extensive references about the use of iron. The archaeological evidences show that iron was being made all over India and there was no written records of the process of manufacturing iron. The technology has been handed over from one person to another within a limited group. Unfortunately this art phased out with the development of new technology during 19<sup>th</sup> and 20<sup>th</sup> century. The paper discusses the various sources of existence of iron, its utilization and importance right from pre-Rig Vedic period upto the first half of 20<sup>th</sup> century.

**Key words :** *History, Ancient India, Tribal, Iron making, Delhi iron pillar.*

### **INTRODUCTION**

The precise manner in which man discovered iron is unknown. Probably its discovery was the result of an accident. The reduction of iron ore to the metal might have taken place in closed furnaces used for glazing pottery, which reach temperature of over 1000°C. It is more likely that iron was first found in ashes of a fire set up by chance near the outcrop of an iron rich mineral. A folklore of the Bastar tribe of central India states that their forefathers first made iron accidentally in a hollow anthill. According to the folklore the story was as follows: after cutting the branches and upper stem of sal tree, stubs remain which white ants favoured as a site for an anthill. If the top of an anthill is severed horizontally, it reveals a hollow interior. Once in order to catch a rat which has entered such an opening, a hunter covered the opening at the top with a red rock. He then bored a horizontal hole at the base, made fire, lighted leaves and blew in the flame through the horizontal hole to force out the rat. Next day he found that a streak of metal had come out of the bored hole, which was more suitable for weapons than anything used before.

The intentional heating of iron mineral with charcoal heralded the beginning of iron making and subsequently its fabrication into implements and weapons marks the emergence of iron age. Man made iron differed from meteoritic iron which almost always contains high [ 4 ] percentage of nickel. Near east and eastern Mediterranean, iron ore used to be smelted in small furnaces resembling copper smelting furnaces<sup>[1]</sup>. Unlike copper, iron objects had to be forged stage by stage from a spongy mass or bloom to a bar, then thinning, pointing, folding and largely forge—welding at white heat. This knowledge took centuries of a chalcolithic age to obtain the first few pieces of forge—welded iron.

### **HISTORICAL EVIDENCE OF IRON IN ANCIENT INDIA**

The history of iron can be traced back based on the historical and archaeological sources including modern radiocarbon dating.

## Ancient to 1st Millennium B.C.

Neolithic culture started around C. 2450 B.C., when no metal appears to have been in use. The early hymns of Rig-Veda<sup>51</sup> written about 2000 B.C., revealed the knowledge of extracting metals from ores. 'AYAS' (iron) was the third Rig-Vedic metal after gold and silver. The Yajur Veda also has the mention of iron. Rig-Vedic hymns have reference to the soldiers putting on coats of mail and using metallic helmets. Aryans deployed the use of iron in agriculture and warfare. The uses of iron extended down to southern tip of Tamil Nadu. At Pandu Rajar Dhibi in West Bengal use of iron has been traced to first millennium B.C. Based on the weapons and implements cited in Rig-Veda and the puranas, iron making technology existed to fulfill man's needs for war and peace.

Rapid developments in iron making and its use took place around 1400 B.C. The history of early iron smelting, practised by the tribal artisans in different regions of ancient India dates back to 1300 to 1200 B.C. The use of iron was relatively unknown except in areas where iron bearing minerals were abundant. The Indus Valley civilization of around 2500 B.C. to 1800 B.C., formally belonged to the bronze age and a fairly use of iron appears to have come in comparatively late.

Prakash and Tripathi<sup>61</sup> have documented the early iron age cultures, which could have been independent of each other, arising in five different zones of India. These five cultures were (i) Cairn Burial culture in northwestern India (ii) Painted Grey Ware (PGW) culture in north India (iii) Black and Red Ware (B&RW) culture in northeast India (iv) Megalithic culture of central India and (v) Megalithic culture of Peninsular India. Stein and Mockler discovered a chain of Cairn-burials containing iron in the Zhob-Loralai region in northeast Baluchistan.

The chalcolithic traditions in (a) the premature and post Harappan (b) Peninsular India and (c) Eastern India gradually gave rise to the iron age cultures in the respective areas. West Bengal and Bihar are endowed with high grade copper as well as iron ores. The iron age emerged from the chalcolithic period without any interruption. The well dated period of 1050-950 B.C., has been termed as 'Terro-Chalcoithic' by Chattopadhyaya and Dem. The Black and Red Ware (B&RW) has very distinct local characteristics in areas of Uttar Pradesh, Rajasthan and Central India. The B&RW culture of West Bengal and Bihar clearly shows the advent of iron age during the period 1200-800 B.C.<sup>91</sup> West Bengal and Bihar region definitely constituted one of the nuclear zones for the ancient metallurgical traditions in India. This zone contributed towards the emergence of the second urbanized culture (after Harappan).

South India evolved mega (big) lithic (stone) culture in which the burials were surrounded by a circle of stone boulders. This culture extending gradually to the central India and even trans—Vindhyan areas, exhibited early traditions of the use of iron. The earliest phase of the Iron Age in the south has been revealed in the excavation at Piklihal and Hallur (1150-1030 B.C.) and the Karnataka sites of Tadakanhalli, Komaranhalli etc. In many of these sites, the iron age started almost from the neolithic stage. Further north in central India, megalithic sites are dated somewhat later 800-700 B.C., and it is possible that the chalcolithic sites imbibed iron age culture from the megalithic people. The traditions of the iron age were evolved over centuries and across a large section of the subcontinent. These definitely started in southern most India, but the origin of the culture is shrouded in mystery. The megalithic iron smelting furnace at Naikund is shown in Fig. 1<sup>101</sup>.

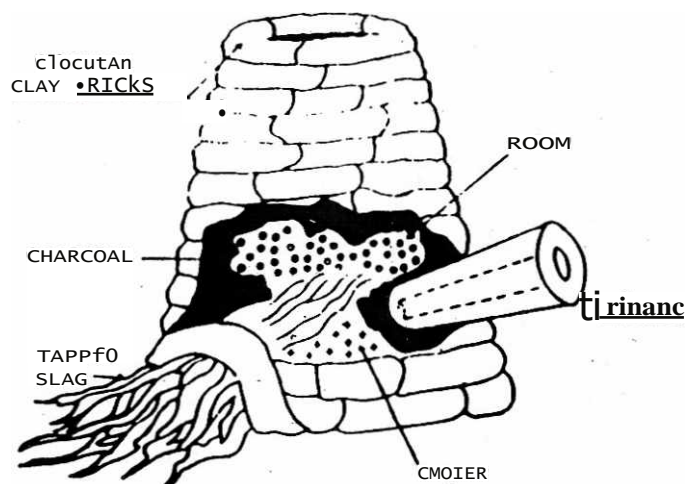


Fig. 1 : Megalithic iron smelting furnace at Naikund (700 BC)

As per the recent review<sup>1</sup>, the dates of the earliest iron age sites in India (Table 1) show that the discovery and use of iron started around 1200 B.C. indigenously and independently in at least three nuclear zones—Karnataka area in the south, U.P.—Rajasthan area in the north and West Bengal—Bihar area in the northeast.

### 9<sup>th</sup> to 1<sup>st</sup> Century B.C.

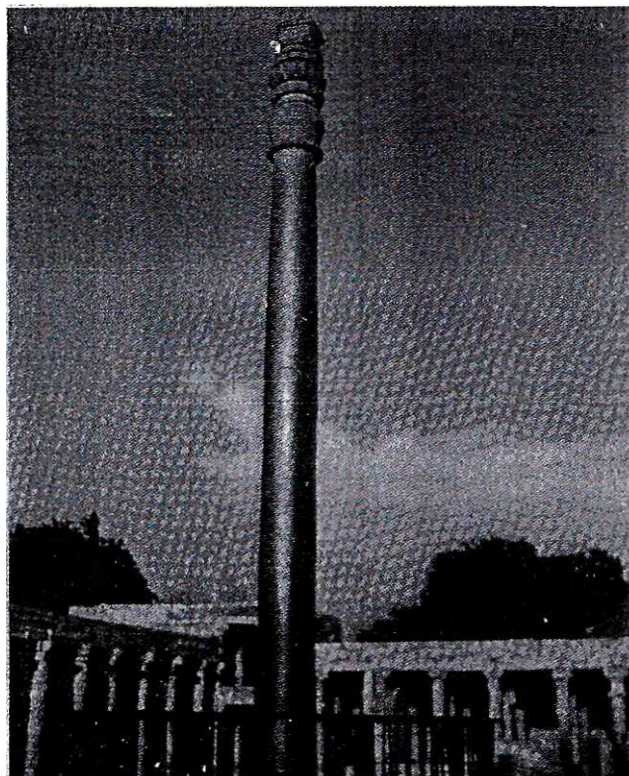
Matured iron age had existed around 8th century B.C. in Pandu Rajar Dhibi. The hardening and quenching methods were observed in a third century B.C. sickle, which is so far one of the earliest Indian specimens exhibiting the steeling process. The length of the sickle was 255 mm and the maximum width 22 mm. The internal curved region of the agricultural tool had a sharp cutting edge. The chemical analysis revealed that it was low carbon steel—carbon 0.22%, copper 0.15%, nickel 0.13%, cobalt 0.11%, rest iron. The metallographic structure showed that of tempered martensite. The structure also exhibited retained acicularity at certain places. Chattopadhyay<sup>11</sup> had studied a second century B.C. sample of iron razor from Ror, district Kangra, Himachal Pradesh, which showed, apart from massive ferrite, martensite plates indicated the technique of rapid quenching. The iron clamps at Bodh Gaya temple are of the period of 3rd century B.C.

Alexander defeated Porus of Taxila in 326 B.C. and received from him a gift of 100 talents of steel. The excavations at Bodh-Gaya monastery built by Ashoka in third century B.C., have brought to light the iron clamps. A large number of iron implements have been unearthed at Adittanallur at a burial site which is dated to around 250 B.C. The great battle of 'Kurukshestra' was fought (probably around ninth century B.C.) which witnessed the extensive use of iron weapons and armour.

Sushruta, the great surgeon of ancient India indicated that even in the early period, the Hindus had learnt the art of manipulating the lancet and handled the simple surgical instruments made of iron and steel. Excavations at the Garh Kalika mound on the outskirts of

The earliest iron age sites in India

		Carbon percentage in iron samples		
		0	2	
Komaranhalli		0	2	
Tadakanhalli		0	2	
1250-1050 BC		0	2	
Barudih in Singhbhum		0	2	
Pandu Rajar Dhibi		0	2	
Noh and Jodhpura, Rajasthan		0	2	
Alamgirpur, U.P.		0	2	
Pirak and Swat Valley		0	2	



*Fig. 2 : Iron pillar at Delhi (4<sup>th</sup> century AD)*

Ujjain revealed that iron was known to its ancient dwellers from the earliest period. The technical informations regarding the iron samples in the Historical period pre-Christian era India are summarized in Table 2<sup>11</sup>.

#### **First Five Centuries A.D.**

Iron articles such as spikes, nails and pieces have been unearthed in the monastery at Piprahwa, about 20 km from the ruins at Kapilvastu (near Nepal border). They are regarded as specimens of iron from 1<sup>st</sup> to 2<sup>nd</sup> century A.D. Iron implements and weapons belonging to the 4<sup>th</sup> century B.C. have been unearthed at Adittanallur in Tamil Nadu and also at Taxila belonging to the period 3<sup>rd</sup> century B.C. to the 5<sup>th</sup> century A.D. comprising of agricultural implements, blacksmith tools etc. Besides numerous ingots of iron, iron spearheads, spikes and nails belonging to the second century A.D. have been found in UP, near Basti and Kapilvastu. The famous pillar at Mehrauli, near Kutub Minar in Delhi (more than 7 meters in height and about 7 tonnes in weight) was originally erected at Mathura and later on re-erected at Delhi (Fig. 2). It represents the high level of technology of the time. It shows that Megalithic iron smiths had evolved the technique of forging small blooms into huge iron piece.

#### **Middle Age (6<sup>th</sup> to 14<sup>th</sup> Century A.D.)**

The Dhar pillar is dated to 12<sup>th</sup> century A.D. It was intact till 1304 A.D. and then broken into three pieces. Its height was more than the double of Delhi pillar. The pillar at Mount Abu stands at the temple of Achaleswar, which was built in 1412 A.D. It has a trident on

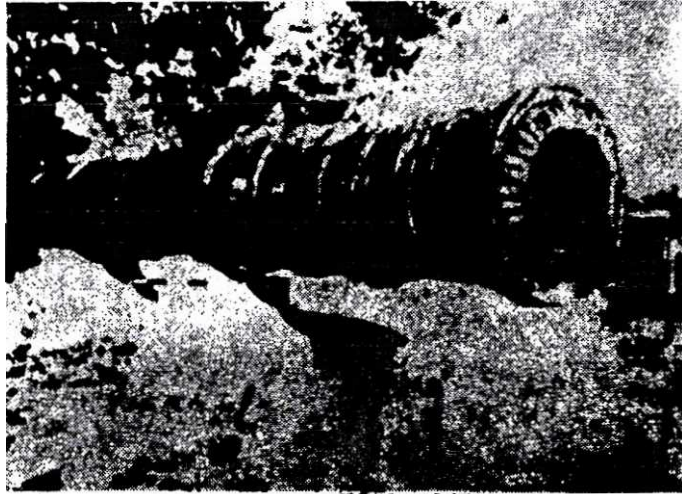
Time Period	Location	Material	Quantity	Notes
750-550 BC	Ujjain	...	...	...
528 BC onwards	Ujjain	...	...	...
615-540 BC	72 Sites around Nagpur	...	...	...
	Takalghat	Negligible	...	...
	Naikund	1.0	...	...
	Mahurjhari	0.9	...	...
	Dhatwa	...	...	...
500 BC		...	...	...
600-400 BC	Rajghat Varanasi	...	...	...
600-300 BC		...	...	...
3rd century BC	Pandu Rajar Dhibi	...	...	...
2nd century BC	Ror, Kangra, H.P.	...	...	...
	Besnagar, Vidisha, M.P.	...	...	...
	Kausambi, U.P.	...	...	...
	Prakash, Maharashtra	...	...	...
	Oringverpura, U.P.	...	...	...

its top. The famous sun temple at Konark in Orissa has wrought iron beams. They are dated to 13<sup>th</sup> century A.D. Several iron beams have been used in the ancient temple of Konark in Orissa which was built in the 9th century. Even in the Jagannath temple of Puri in Orissa, built in the 12th century A.D. 239 iron beams have been used. The iron trident in Tanginath temple belongs to 12th century A.D.

15th to 16<sup>th</sup> Century A.D.

Babar used guns in first battle of Panipath in 1526 A.D. They were subsequently introduced in southern India by Portuguese. Fig. 3 shows one such iron gun of Tanjore. The description of iron guns are available in 16th century literature. Most Mughal guns were generally constructed of iron bars of square section. The metallurgical knowledge developed in India lay dormant for centuries. Various tools and implements made out of ancient iron with the growth of iron technology are listed in Table 3<sup>01</sup>.

The iron produced in the indigenous furnaces was wrought iron. It contained low percentage of carbon due the lower absorption of carbon in ancient iron making furnaces. Steel was produced by carburization of wrought iron during this period. It is said that India is the first producer of carbon steel (wootz). In fact, India was considered to be the centre of origin of iron and steel industry in the world. It is possible that iron age in India had started about 3000 years before the industry started in European countries. The Damascus swords which became famous in Europe were made from Indian wootz. In those days, Hyderabad and Madras in South India were the centres of production of wootz. The process of wootz making was specially popular in the districts of Salem and Tiruchirappalli in Madras, besides the Hyderabad area, in Andhra Pradesh and Mysore. The ancient Indian steel highly priced in world market. The possibility of a country wide manufacture of iron existing from quite early times is also indicated by the references to the working of iron mines in Bajuja, Subha Bengal, Keroh, Subha Kashmir, Kumaon, Khasi Hills, Subha Delhi, besides at Nirmal and Indore in Ain-i-Akbari.



*Fig. 3 : Iron gun at Tanjore*

*Table 3 : Various iron tools and implements appearing at the three stages of iron technology in ancient India*

Early stage (up to 600 BC), Middle stage (600-100 BC), Late stage (100 BC—AD 600)

- indicates definite existence; \* indicates non-existence;
- indicates that confirmed data is not available

Tool Type	Name of Tool	Early Stage	Middle Stage	Late Stage
Hunting Tools	Spearheads	•	•	•
	Arrowheads	•	•	•
	Points	•	□	□
	Socketed tangs	•	□	□
	Blades	•	•	□
	Spear lances	□	•	□
	Dagger	□	•	•
	Sword	□	•	•
	Elephant goad	*	•	•
	Lances	*	*	•
	Armour	*	*	•
	Helmet	*	*	•
	Horse bits	*	*	•
	Caltrop	*	*	•
Agricultural Tools	Axes	•	•	•
	Sickles	•	•	•
	Spade	_*	•	□
	Ploughshare	*	•	□
	Hoe	*	•	•
	Chisel	*	•	•
	Pick	*	□	•
Household objects	Knives	•	•	•
	Tongs	•	□	□
	Discs	*	•	□
	Rings	*	•	□
	Spoons	*	•	•
	Sieve	*	*	•
	Cauldron		_*	•
	Bowls	*	*	•
	Dishes	*	*	•
Building materials	Rods	•	□	□
	Pins	•	□	□
	Nails	•	•	•
	Clamps	•	•	•
	Pipes	*	•	□
	Sockets	*	•	□
	Plumb-bob	*	•	□
	Chains	*	•	•
	Door hooks	*	•	□
	Door handle	*	*	•
	Hinges	*	*	•
	Spikes	*	*	•
	Tweezers	*	*	•
	Anvils	*	३.६ ३३३	•
	Hammers	*	*	•
	Scissors	*	*	•
	Saw	*	*	•



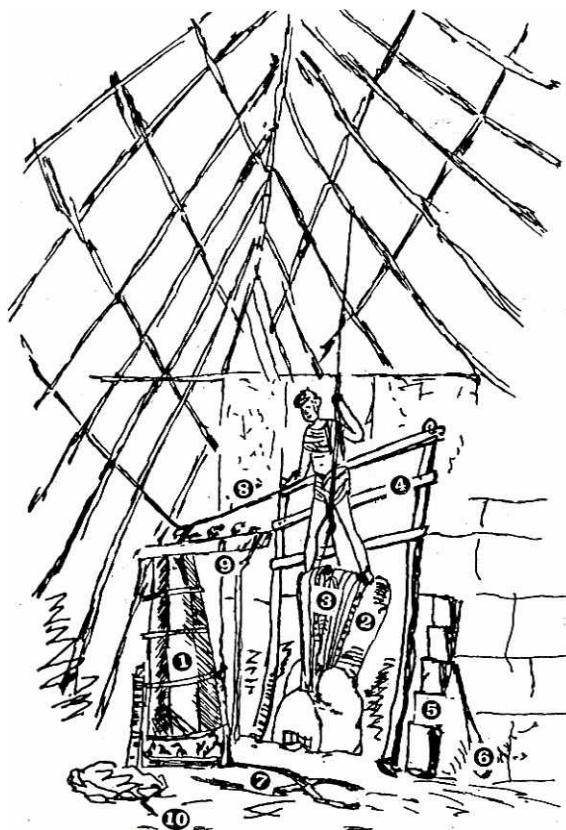


Fig. 4 : Iron smelting furnace of the Khasi Hills (Meghalaya), Legend : (1) Chimney of the furnace with supports, (2) Pair of bellows (open), (3) Pair of bellows (shut), (4) Frame, (5) Primitive ladder, (6) Wooden mallet, (7) Tongs, (8) Spoon, (9) Trough supported by wooden fork and (10) Large stone as an anvil for beating softened iron.

#### 17<sup>th</sup> to 18<sup>th</sup> Century A.D.

During this period the iron industry got a fillip and artisans producing iron and black-smiths making weapons were kept busy. Ironmaking was practised widely in many parts of the country, basing on naturally available iron ore and charcoal for reduction. Such people were called lohars. This industry was active in various places in U.P., Bihar, Bengal, Orissa, Maharashtra, Madhya Pradesh, Mysore, Assam and Madras. The furnaces were small upto 3' in height and made of mud, with bellows being used to blow the air. The profile of a typical furnace used at Salem in the early 19<sup>th</sup> century resembled the blast furnace in miniature. The travel records of Voysey<sup>021</sup>, Buchnant<sup>131</sup>, Hadfield<sup>11</sup>, and Varier<sup>151</sup> clearly show the supremacy of Indian iron and steel technology even in 18<sup>th</sup> century. The industrial revolution in the 18th century led to the West gaining superiority in materials development and utilization over the rest of the world.

#### 19<sup>th</sup> Century to Middle of 20th Century

During the period close to 19th century, attempts were made in India for the manufacture of iron by modern methods. Kulti works consisted of two blast furnaces, each capable of producing 20 tonnes of grey pig iron for casting and foundry. Attempt was made in steelmaking and rolling at Kulti but could not be economical and closed down.

Tata Iron and Steel Company which was founded in 1904 at Jamshedpur. Its much preliminary work had gone in during the closing decade of 19<sup>th</sup> century itself. With the establishment of Tata Iron & Steel Company Limited (TISCO), there was gradual extinction of old indigenous smelting industry carried on by persons known as Asura, Lohars, Agarias etc. The extinction was also due to limited supply of charcoal as a result of forest conservation. Later on many smelters started purchasing ready made iron and started working as a blacksmith in the villages.

Charls Wood, the in-charge of the Beypur Iron Works, referring a paper by Prof. Turner<sup>61</sup> mentioned that his company could not produce metal similar to Indian swords used in Indian Mutiny of 1857. Unfortunately this art phased out with the development of new technology during 19<sup>th</sup> and early 20<sup>th</sup> century. Metallurgical skills gained in India receded to the background being restricted to making of utensils, idols, ornaments, industries specializing in exquisite crafts of idol making, jewellery etc., in selected areas including tribal areas all over the country. The ancient industry is still in existence in several parts of India such as Bastar in Chhathisgarh State, Salem in Tamil Nadu, Jiragora (Koraput) in Orissa, Kamajoda (Joda) and Bishunpur in Bihar and also Nalanda, Valley, Mandla, Nagpur, Rajdoha and some remote region of Northern Eastern India.

### CONCLUSION

The discovery of iron changed the entire civilization. Its discovery was sudden but growth took place over many centuries. The tradlyons from ancient to the modern times had been carried over by the tribals of India. Ara time India was the workshop of the whole world when the famous Damascus sword was being prepared with indigenous steel making technology. However, like any other historical event; there were ups and down in the history of iron in India due to various internal and external reasons.

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