

# The origins of iron-working in India: new evidence from the Central Ganga Plain and the Eastern Vindhyas

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*Recent excavations in Uttar Pradesh have turned up iron artefacts, furnaces, tuyeres and slag in layers radiocarbon dated between c. BC 1800 and 1000. This raises again the question of whether iron working was brought in to India during supposed immigrations of the second millennium BC, or developed independently.*

*Keywords:* India, Early Iron Age, Iron working, Ganga Valley, Eastern Vindhyas

## Introduction

The date and origin of the introduction of iron artefacts and iron working into India has remained a much debated research problem, not unconnected with the equally debatable question of its association with the supposed arrival, in the second millennium BC, of immigrants from the west, as often suggested on the basis of the Rigveda. Around the middle of the last century, iron-working origins in India were dated to c. 700-600 BC (Gordon 1950; Wheeler 1959). Subsequently, a combination of an association with Painted Grey Ware (PGW) and the advent of radiocarbon dating began to push this date back towards the second millennium BC, a period which had in fact favoured by some scholars earlier in the early twentieth century (Chakrabarti 1992: 10-12).

Considering the radiocarbon dates for the iron bearing deposits at Ataranjikhhera in Uttar Pradesh (Table 1) and Hallur in Karnataka, and stratigraphic position of iron in the lower levels mainly at Kausambi near Allahabad, Jakhera in district Etah in the Ganga Valley, and Nagda and Eran in central India, dates around 1000 BC were suggested (Subramanyam 1964; Banarjee 1965; Chakrabarti 1974; Nagarajarao 1974). At the same time Chakrabarti (1974: 354) challenged the view of a western origin, stating “*there is no logical basis to connect the beginning of iron in India with any diffusion from the west, from Iran and beyond*”, and further (1976: 122) “*that India was a separate and possibly independent centre of manufacture of early iron.*”

Since then there has been fresh evidence for even earlier iron-working in India. Technical studies on materials dated c. 1000 BC at Komaranhalli (Karnataka) showed that the smiths of this site could deal with large artefacts, implying that they had already been experimenting for centuries (Agrawal *et al.* 1985: 228-29). Sahi (1979: 366) drew attention to the presence of iron in Chalcolithic deposits at Ahar, and suggested that “*the date of the beginning of iron smelting in India may well be placed as early as the sixteenth century BC*” and “*by about the early decade of thirteenth century BC*”

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iron smelting was definitely known in India on a bigger scale". On the basis of four radiocarbon measurements, ranging between 3790 + 110 BP and 3570 + 100 BP, available for the Megalithic period (without iron) Sharma (1992: 64, 67) has proposed a range of 1550-1300 BC (uncalibrated) for the subsequent iron bearing period at Gufkral (Jammu & Kashmir).

On the basis of this evidence a date of around 1300/1200 BC has been suggested for the beginning of iron in India and *c.* 800 BC for the mid Ganga Valley (Allchin & Allchin 1982: 345; Prakash & Tripathi 1986: 568; Gaur 1997: 240). Chakrabarti (1992: 68, 164; 1999: 333) has observed that at Ahar it would be the first quarter of the second millennium BC and in Malwa soon after the middle of the second millennium BC. However, the early dates for iron at Ahar are refuted on the grounds of uncertain stratigraphy (Gaur 1997: 244). As far as Komaranhalli is concerned, it is stated that the TL dates have large errors and hence uncertain (Agrawala 2000: 197, 200).

More recently, early contexts containing iron at Jhusi, located on the confluence of the Ganga and Yamuna in district Allahabad, have been dated to 1107-844 cal BC (Tewari *et al.* 2000: 93). Komaranhalli (Karnataka) has given TL dates in the twelfth – fifteenth century

Table 1. Dates\* for early iron-use from Indian sites

Site	Lab-ref	Date BP	Date cal BC	Pub-ref
Ataranjikhera, district Etah, Uttar Pradesh	TF-191 ( <sup>14</sup> C)	2890 + 110 1155 + 110	Ralph	Agrawal, <i>et al.</i> 1964: 267; Gaur 1997: 241.
Hallur, Karnataka	TF-570 ( <sup>14</sup> C) TF-573 ( <sup>14</sup> C)	2970 + 105 2820 + 100	1385-1050 1125-825	Possehl & Rissman 1992, Vol. II: 466;
Komaranhalli, Karnataka	PRL-46 (TL) PRL-47 (TL) PRL-47 (TL) PRL-49 (TL) PRL-50 (TL)	3300 + 140 3360 + 300 3180 + 280 3110 + 500 3420 + 290	1320 + 400 1380 + 300 1200 + 280 1130 + 500 1440 + 290	Deo 1991: 193; Moorti 1994: 122-23.
Veerapuram, Andhra Pradesh	PRL-728 ( <sup>14</sup> C) PRL-729 ( <sup>14</sup> C) PRL-730 ( <sup>14</sup> C)	2930 + 140 2890 + 140 3210 + 140	Stuiver and Reimer 1993* 1374 (1186,1183, 1128) 921 1293 (1047) 899 1679 (1493, 1476, 1458) 1319	Deo 199: 193; Moorti 1994: 122-23.
Ramapuram, Andhra Pradesh	BS-383 ( <sup>14</sup> C) BS-386 ( <sup>14</sup> C)	3240 + 110 3280 + 110	Stuiver and Reimer 1993* 1679 (1517) 1409 1687 (1524) 1432	Moorti 1994: 122-23.
Adam, Vidarbha Maharashtra	PRL-1361 ( <sup>14</sup> C) PRL-1452 ( <sup>14</sup> C) PRL-1456 ( <sup>14</sup> C)	2940 + 160 3080 + 120 2820 + 100	Stuiver and Reimer 1993* 1393 (1205, 1205, 1188, 1181, 1149, 1144, 1129) 917 1490 (1381, 1334, 1321) 1131 1185 (973, 956, 941) 834	Unpublished information from the excavator

\* These dates are calibrated by Dr B. Sekar, BSIP, Lucknow. References for datasets used: Stuiver, *et al.* 1998a.

BC, while the radiocarbon dates for early Iron Age sites of Veerapuram and Ramapuram (Andhra Pradesh) are sixteenth – eleventh century cal BC (Table 1) (Deo 1991: 193; Moorti 1994: 122-23) while in Vidarbha region (Maharashtra), contexts containing iron have given radiocarbon dates between the fourteenth and tenth centuries cal BC (Table 1).

### Recent Findings in Uttar Pradesh

This paper briefly reports the results of some recent excavations conducted by the Uttar Pradesh State Archaeological Department under the leadership of the present author and their implications for understanding the beginning of iron-working in the Central Ganga

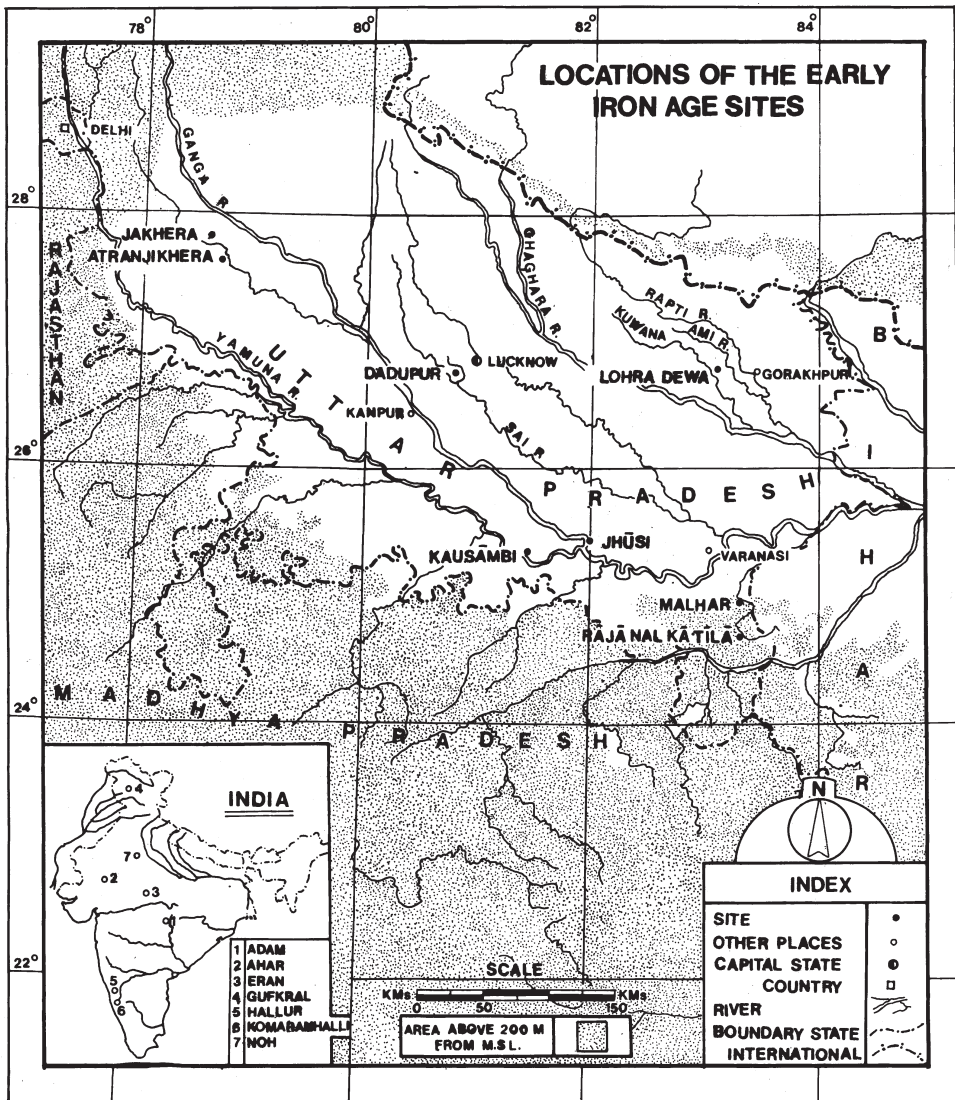


Figure 1. Map showing locations of the Early Iron Age sites in the Central Ganga Plain, the Eastern Vindhyas, and different regions of India.

Plain and the adjacent part of the Vindhyas. This has further implications in defining the beginning of iron in the subcontinent as a whole. The excavated sites are Raja Nala-ka-tila (1996-98), Malhar (1998-99), Dadupur (1999-2001) and Lahuradewa or Lohradewa (2001-2002) (Figure 1) *Raja Nala-ka-tila* (Lat. 24° 41' 55" N.; Log. 83° 19' E.) is located in the upper reaches of the Karamnasa within its loop like meander in district Sonbhadra. The excavations revealed a sequence which

has been divided into four periods (Tewari & Srivastava 1997; 1998). In Period I, no metal was found and is stratigraphically continuous into Period II. Period III is characterised by the presence of Northern Black Polished Ware (NBPW). Period IV is defined as a Gupta/post Gupta phase. Iron was found in pre-NBPW deposits (1.5 to 2.00m thick) of Period II in association of the pottery hitherto supposed to be the characteristics of the Chalcolithic period, placed between early to late second millennium BC, in the area concerned. The main associated ceramic industries were plain and painted black-and-red (Figure 2), black slipped and red wares, in forms which included footed bowl, legged bowl with perforated base, pedestal bowl and button-based goblet. Some sherds also showed cord impressions. Evidence for iron-working included slag and iron artefacts such as a nail, arrowhead, knife and a chisel (Figure 3). Radiocarbon dates for the iron bearing deposits range between 1400 and 800 cal BC (Table 2).

Since the date for the introduction of iron in the middle and lower Ganga Valley was



Figure 2. Painted black-and-red ware sherds, from early iron bearing deposits of Period II, Raja Nala-ka-tila, Dist. Sonbhadra.



Figure 3. Iron artefacts, from the lower and middle levels of Period II, Raja Nala-ka-tila, Dist. Sonbhadra.

Table 2. New <sup>14</sup>C dates for early iron-use from the Ganga Plain and the Eastern Vindhyas

Site	Lab-ref	Date BP	Date cal BC	Pub-ref
			Stuiver and Reimer 1993*	
Raja Nala-ka-tila, district Sonbhadra, Uttar Pradesh (U.P.)	BS-1988 BS-1988 BS-1378 BS-1299 BS-1300 PRL-2047  PRL-2049	2690 + 70 2550 + 110 2830 + 100 3060 + 110 2890 + 80  3050 + 90	902 (828) 800 822 (773) 486 1118 (963) 859 1423 (1307)1144 1196 –1188 1164 –1143 1132 – 976 970 – 930 1406 –1198 1186 –1164 1143 –1132	Tewari <i>et al.</i> 2000: 93.
			Stuiver and Reimer 1993*	
Malhar, district Chandauli, (U.P.)	BS- 1623, BS- 1593 (Pit sealed by Layer No.(3)	3450 + 90 3540 + 90	1882 (1743) 1639 2012 (1882, 1836, 1834)1742	Tewari <i>et al.</i> 2000: 88.
			Stuiver and Reimer 1993*	
Dadupur district Lucknow, (U.P.)	BS-1822 BS-1759 BS-1825: (Pit-sealed by 12)	3270 + 80 3380 + 160 3430 + 90	1679 (1522) 1442 1882 (1685) 1465 1739 (1706) 1695	Tewari <i>et al.</i> 2002: 111
			Stuiver and Reimer 1993*	
Lahuradewa, district Sant Kabir Nagar, (U.P.)	BS-1939	2940 + 100	1205, 1205, 1188.	(Tewari <i>et al.</i> 2002a: 57)
			Stuiver and Reimer 1993*	
Jhusi, district Allahabad, (U.P.)	PRL-2077	2820 + 80	1107 (973, 956, 941) 844	Misra, <i>et al.</i> 2000: 28.

\* These dates are calibrated by Dr B. Sekar, BSIP, Lucknow. References for datasets used: Stuiver, *et al.* 1998a.

being considered as *c.* 800 BC (above), its appearance in *c.* 1400/1300 cal BC at Raja Nala-ka-tila posed new questions. Realising that this should not be the only site with such early evidence and that there should be examples of experimental iron-smelting which were earlier still, we started a new search. These efforts were rewarded in locating a potential site near a village called Malhar.

*Malhar* (district Chandauli; Lat. 24° 59' 16" N.; Long. 83° 15' 46" E.) is on the bank of the Karamnasa which at this point flows through a rocky, haematite-rich terrain before joining the Ganga near Banaras. The excavations carried out at this site also revealed a sequence of four periods: defined as Period I: Pre Iron; Period II: Early Iron; Period III: NBPW; Period IV: BC 200 to 300 AD (Tewari *et al.* 2000: 69-98). There is no stratigraphic interval between the layers of Period I and Period II. Iron is present in all the layers of Period II, and identified finds include a nail, clamp, spear-head, arrow-head, awl, knife, bangle, sickle and plough share (examples in Figure 4). As well as iron slag, there were *tuyeres* and several elongated clay structures, with a burnt internal surface. The ceramic industries of this period are represented by mainly red, black-and-red, black slipped, and grey wares. Red ware and black-and-red ware sherds



bearing cord impressions on their exterior were found in greater number in the lower levels (Figure 5). The presence of the coarse variety of corded potsherds implies that the iron appeared earlier here than in Period II at Raja Nalaka-tila. This assumption was endorsed by two radiocarbon dates ranging around 1800 cal. BC (Table 2).

The area around Malhar may have been something of a centre of iron production. A small mound, of a kind known locally as *lohsan* or *lohsanwa*, about 500m south to the main site of Malhar, which looks like a heap of iron slag, on excavation revealed two damaged clay furnaces, one of them is illustrated here as Figure 6, filled with iron slag along with a few sherds of the red, grey, and black slipped wares, an axe, and *tuyeres*. Survey revealed several *lohsanwa* sites near Musakhand village, the site known as Phakkada Baba located within the Musakhand dam, to the north-west of Malhar, on Baba Wali Pahari (Tewari *et al.* 2000) and near Naugarh *kot* (Singh *et al.* 2000: 143). Plans of damaged clay furnaces within heaps of iron slag along with *tuyeres* stuck with smelted iron, and potsherds of the grey, black slipped, NBP and red wares were found at these sites. The pottery assemblage at Phakkada Baba also included examples of dish or bowl-on-stand and other forms, comparable to those from Malhar Period II, in red ware, and black-and-red ware. This extraordinary concentration of iron-slag heaps on Baba Wali Pahari and Naugarh *kot* suggest that large-scale iron smelting activities continued at these sites for a long time.



Figure 4. Iron artefacts, from the lower and middle levels of Period II, Malhar, Dist. Chandauli.



Figure 5. Important cultural components of the early iron bearing deposits, showing corded ware sherds, iron artefact, slag, tuyere, stone and bone artefacts, painted and incised potsherds, stone and terracotta beads. Period II, Malhar, Dist. Chandauli.

As discussed elsewhere (Tewari *et al.* 2000) the sites at Malhar, the Baba Wali Pahari, and the Valley are archaeologically linked to the area of Geruwatwa Pahar which appears to have been a major source of iron ore. The Geruwatwa Pahar situated to the southeast of the Baba Wali Pahari, is full of hematite. Villagers reported (as a tradition passed down from several generations), that the *agarias*

(a particular tribe known for their iron smelting skills) from Robertsganj side, used to come in this area to procure iron by smelting the hematite. Probably hematite was being primarily smelted at the Baba Wali Pahari and carried over to the valley sites (situated at a distance of about 6-8 km) for secondary smelting. The presence of *tuyeres*, slags, finished iron artefacts, above-mentioned clay structures with burnt internal surfaces and arms, revealed at Malhar, suggest a large scale activity related to manufacture of iron tools. It appears that smelted iron was being carried to this site to manufacture the artefacts and the clay structures were used as the furnaces for forging purposes. Thus this part of the Karamnasa Valley would have been a regional centre for iron production and the Malhar a workshop-site for the manufacturing of the iron artefacts.

*Dadupur* (26° 42' N: 80° 49' E) is in the valley of the Sai, a minor Ganga tributary near Lucknow. It is the earliest dated site (Tewari *et al.* 2002:111) between the Gomati and the Sai rivers. The excavations at this site have revealed a sequence divided into three periods. The cultural material of Period-I consists of iron artefacts such as the arrowhead

shown in Figure 7. Red ware dominates the pottery assemblage of this period, while the



Figure 6. Damaged circular clay furnace, comprising iron slag and tuyeres and other waste materials stuck with its body, exposed at lobsanwa mound, Period II, Malhar, Dist. Chandauli.



Figure 7. Highly corroded iron arrowhead, Period I, Dadupur, Dist. Lucknow.

black-and-red ware is nominally represented. Three radiocarbon dates lie between the eighteenth and sixteenth centuries BC (Table 2). Period II and III are characterised respectively by the presence of Painted Grey Ware (PGW) and NBP ware.

*Lahuradewa* (district Sant Kabir Nagar; 26° 46' N; 82°-57'E) is in the trans-Sarayu plain, the Sarayu being a major tributary of the Ganga. The excavations have revealed new information regarding the early farming cultures of the Sarayupar region, including evidence for the domestication of rice (*Oryza sativa*) in Period I, radiocarbon dated to *c.* sixth and fifth millennium BC. Associated ceramics include mostly plain and corded, hand made red, and black-and-red, besides, some grey, and black ware sherds. Period II is marked by the appearance of copper. Pottery of the preceding period continued and a new type of pottery, *i.e.* black slipped ware is added, and the forms include pedestal bowl, and dish or bowl-on-stand. Iron artefacts appear in Period III in the form of corroded nails and other objects. Other components of the assemblage, however, are the same as in Period II. A radiocarbon date obtained for this level was thirteenth – twelfth century BC (Tewari *et al.* 2002a: 57) (Table 2).

As per K.S. Saraswat's observations (*pers.com.*), the carbonised material dated from the sites mentioned above included the branches of some trees, such as *Acacia* sp., *Madhuca indica*, *Dalbergia sissoo*, *Treura nudiflora*, *Boswellia serrata*, *Aegle marmelos*, *Syzygium* sp., *Tectona grandis*, *Butea monosperma*, *Logerstroemia* sp., *Bambusaa* sp., etc., and the shrubs like *Zixiphus* sp., *Capparis saparia*, *Carissa opaca*. The above species are in mixed content, with the carbonised remains of leaves, stems and seeds of a number of seasonal herbs and grasses. These tropical vegetations referred to above have generally 60-70 yrs of average life span in case of trees and the shrubs and herbs survive hardly from two to three months to the maximum period of a year or two.

There are other observations on the assemblages from these four sites which might be significant. Copper has been found in a lesser proportion in comparison to iron; presence of burnt clay chunks bearing reed and straw marks and postholes are indicative of wattle and daub houses and thatched huts; associated finds include mainly bone arrowheads, terracotta, stone and steatite (?) beads; some storage bins are dug into the surface and bases of the large earthen storage vessels are represented at Lahuradeawa and Raja Nala-ka-tila; a large quantity of faunal and carbonised archaeo-botanical remains have been recovered at all the sites. As a whole the assemblage is suggestive of well equipped and permanent settlements.

## Discussion

These results indicate that iron using and iron working was prevalent in the Central Ganga Plain and the Eastern Vindhya from the early second millennium BC. The dates obtained so far group into three: three dates between *c.* 1200-900 cal BC, three between *c.* 1400-1200 cal BC, and five between *c.* 1800-1500 cal BC. The types and shapes of the associated pottery are comparable to those to be generally considered as the characteristics of the Chalcolithic Period and placed in early to late second millennium BC. Taking all this evidence together it may be concluded that knowledge of iron smelting and manufacturing of iron artefacts was well known in the Eastern Vindhya and iron had been in use in the Central Ganga Plain, at least from the early second millennium BC. The quantity and types of iron artefacts, and the level of technical advancement indicate that the introduction of iron working took place



even earlier. The beginning of the use of iron has been traditionally associated with the eastward migration of the later Vedic people, who are also considered as an agency which revolutionised material culture particularly in eastern Uttar Pradesh and Bihar (Sharma 1983: 117-131). The new finds and their dates suggest that a fresh review is needed. Further, the evidence corroborates the early use of iron in other areas of the country, and attests that India was indeed an independent centre for the development of the working of iron.

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