

The Role of Iron Tools/ Implements in the Later Vedic/ PGW Culture



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ABSTRACT

The Role of Iron technology in the means of production and its deep impact on the society, economy and polity has been universally recognised by the historians and as well as archaeologists. In the present paper some fundamental questions regarding the issue mentioned above have been raised and answers sought for these questions. A wide range of literary and archaeological sources have been drawn for the discussion in this paper. The later Vedic texts and PGW archaeology emphatically show that the iron technology played a significant role in transforming the pastoral and semi-nomadic life of the *Rgvedic* people into a sedentary/ agricultural life of the Later *Vedic* people. Though, some technological constraints were felt over in the field of agriculture, yet the impact of iron weapons discovered from the PGW phase of culture and frequently referred to in the Later *Vedic* texts have been overwhelmingly accepted. The foundation and growth of *kuru-pancalas* kingdom has been ascribed to the role of iron- weapons possessed by them. The question regarding the role of iron in agricultural production and military purposes has been critically examined and evaluated. The causal connection between iron technology, plough agriculture and clearance of forests for making the land available for the habitation and agricultural expansion has been discussed. The

archaeological and literary evidences under the study indicate that the iron technology also played a significant role in the process of acculturation as well. The role of horse and iron in the spread of Indo- Aryan language has been particularly noticed in this regard. Finally, the historical study of iron technology has been also traced critically in the present paper.

KEY WORDS

Iron technology, Vedic, Aryan language

Recently there has been a good deal of writing on the problem of Iron Age and the role of iron technology in the means of production and its revolutionary impact on the society, economy and the polityⁱ. On the basis of our research material available literary as well as archaeological we would like to raise some vital questions viz.,

- (a) What was the specific role of iron technology in transforming the semi-pastoral nomadic society of the *Rgveda* into a full-fledged agrarian society in the later *Vedic* times?
- (b) was there any qualitative change felt over in the technique of agriculture and warfare due to the introduction of this hard metal? Answers would be sought for these and other related questions in this Paper.

It is rightly argued that “mere occurrence of a metal is not the criterion to judge the ushering of the age of that metal. The discovery of iron heralds only the coming of the dawn. It is only the beginning of the day and not the day itself. The appearance of iron in the PGW levels is, therefore, only the beginning of the use of iron in a very limited sense and not the ushering of Iron Age in India.”ⁱⁱ And it has been further argued “that unlike the valley of Euphrates, Nile and even Indus, the Ganga valley was covered with thick monsoon forests having a completely different ecological background. A harrow effective in the silted deposits brought by the floods of Euphrates, Nile and Indus could not be used in the Gangetic doab for the obvious reason of the presence of deeply rooted tall fibrous tress and different soil formation. It required metal tools far stronger and sharper than the stone and bronze could provide. Thus it is said “Iron was the cheap metal and provided a tool of such hardness and sharpness that no stone, no other known metal could withstand it. Iron made possible field agriculture on a large scale and clearing of extensive forest tracts for cultivation.”ⁱⁱⁱ D.D. Kosambi also believes that a large –scale clearance of forests in the Gangetic valley was not possible without the introduction of iron technology^{iv}. But Amalanand Ghosh and some other scholars however, tries to underplay its crucial or revolutionary role in clearing the forests and inaugurating urban life in northern India. According to him, the forest, if any, could be equally effectively cleared by copper-bronze tools.^v He also argues that the jungles could also be burnt down in suitable seasons of the year. He goes further and says that the effect of iron on the material prosperity of the painted grey ware/ later *Vedic* people, supposedly the earliest iron users in the Ganga-Yamuna doab was not significant. According to him, “No doubt in a slow-moving society the impact of iron was slow. The metal did not produce any spurt in the material prosperity of the society.”^{vi}

R.S. Sharma in his stimulating article^{vii} has refuted the arguments of A.Ghosh and the role of iron technology as revolutionary in the clearance of jungles and making huge tracts of land available for habitation and agricultural operations. He argues that A.Ghosh’s view is influenced by the sociological theory of Gideon Sjoberg and Mumford and “an undue bias for politics in our traditional teaching of history.” Sharma also doesn’t agree with the argument of A. Ghosh that the Egyptian pyramids were built of granite without the use of iron. He states that this view doesn’t carry much weight, because with 5 inches of rainfall and sparse vegetation Egypt did not present the same problem of clearance as the Ganga basin. And further the theory of burning the forest for clearance in the Ganga valley is not supported by the actual ecological factors in this region. Sharma goes further and argues, “even when the jungles are burnt the deep rooted and hard- fiber Sal, seasm, mahua, pipal and similar other trees flourishing in a rainfall of about 50 inches would have to be cut down by the iron axe.”^{viii} Though this debate is basically based on the role of iron technology in the mid Ganga valley.

It is widely accepted that “technology is one of the most important instrument for social change and that the history of any technology in any given civilization should, therefore, be of serious concern to any student of history, has long been recognized , more or less universally.”^{ix} Like A. Ghosh, N. Ranjan Ray also doesn’t believe in the theory of radical role of iron technology in the means of production and its impact on the society.^x He is of the opinion that he has “reasons to doubt if the quantitative and qualitative use of iron technology and iron implements in the Ganga –Yamuna valley before c. 321-20 B.C. were such as to induce the sort of great social changes which we are being asked to agree to have taken place.” He further argues that “While my first doubt is in regard to facts and their interpretation, the second is somewhat theoretical, that is, what should be

the quantitative magnitude and the qualitative depth of a technology which, when applied to a given social situation, should be able to bring about effective and meaningful social change.^{xi} He gives archeological evidence in support of his hypothesis. According to him almost all the PGW sites have unearthed overwhelmingly the iron tools and implements presumably used in either hunting or warfare. With the exception of hoes and spades, with which no large-scale extensive agriculture operation could be possible, no other agriculture tools of significance have been discovered in this phase of culture.^{xii} Thus he concludes, "that at present state of our archaeological knowledge we cannot attribute large-scale forest clearance and agricultural operation in the Ganga-Yamuna valley to iron technology, though one cannot deny that the region had definitely entered into the iron age since bronze and copper were fast being replaced. But neither quantitative by nor qualitative by the technology so advanced and diversified as to bring about significant social change, in the Ganga-Yamuna valley at any rate."^{xiii} It seems that Ray also indirectly supports the view of A. Ghosh that in a slow moving society the impact of iron was slow." But the proponents of the theory of radical or revolutionary role of iron technology have not argued in support of such role of iron in Ganga-Yamuna doab in the PGW/ Later Vedic period. D.D. Kosambi^{xiv} and R.S. Sharma^{xv} both have emphatically stated that due to some serious social and technological constraints substantial agricultural progress and complex/ stratified society could not be evolved in this period. They have argued for such role of iron technology in the middle Ganga valley during the period of second urbanization.

On the basis of relevant available archaeological data, now we shall discuss the immediate socio-economic impact of the beginning of iron in different parts of India and particularly in the region and period of our study, but unfortunately, in the absence of adequate

published archaeological reports, a level-wise distribution of iron finds of different sites, the horizontal excavation at several sites and appropriate natural scientific analysis of iron objects make our task difficult. Nevertheless, we will make a brief survey of the geographical distribution of these iron bearing sites and the role of iron in these given archaeological layers.

Archaeological evidence roughly indicates six early iron using centers in India. Baluchistan, The Gandhara Grave culture, Indo-Gangetic divide, Ganga-Yamuna doab, Eastern India, Malwa and Berar in central India and the Megalithic sites of south India.

1. Baluchistan: Two archaeological sites of this region have been associated with the beginning of iron sites of Pirak and Cairn burials.^{xvi} It is difficult to assess the impact of iron technology on the life of the people of this area. Archaeological excavations have not revealed any significant agricultural tools from this area. It is guessed that the occurrence of iron in Baluchistan was only an extension of its occurrence in the neighboring region of Iran.^{xvii} It is further argued that "because of its scanty rainfall and a predominantly hilly terrain Baluchistan could not be a viable agricultural unit and the amount of agricultural improvement that the use of iron was likely to have brought about must have been insignificant."^{xviii}
2. The Gandhara Grave Culture: A well-known Pakistani archaeologist A.H. Dani puts the iron revealing period III between the 9th and 6th centuries B.C. Archaeological excavations have revealed seven types of iron tools. They are: Arrowhead, spearhead, pin or nail, spoon with a handle terminating in two rings, finger ring, check bar of a horse's harness and an unidentified object which does not conform to the other types.^{xix} Jettmar is of the considered opinion that iron tools found at the

Gandhara Grave culture have a convincing central Asian analogy.^{xx} An iron check-piece of a snaffle found at Timargarh, considering the geographical location, and other iron objects indicate central Asian analogies.^{xxi} But R. S. Sharma^{xxii} tries to associate the iron objects discovered from Panjab, Haryana, Western U.P. and the neighbouring areas of Rajasthan with the Gandhara Grave culture. Thus, he states, "the period coincides with the first phase of iron in northern India. Iron appeared in the north-west part of the Indian subcontinent at the beginning of the first millennium B.C. Its use is attested in the Swat valley and in the Gomal valley. Around 900 B.C. or little latter, in the upper Gangetic Basin iron implements are reported from Panjab, Haryana, Western U.P. and the neighbouring areas of Rajasthan. Sanghol in Ludhiyana, where iron implements have been found, is at a distance of about 500 miles from the Swat valley and the Gomal valley." He goes further to state that "in all probability iron technology in the upper Gangetic basin came from either of these two places, although the intermediate region of about 500 miles needs to be explored."

3. Indo-Gangetic divide and the Ganga- Yamuna doab: most of the archeological excavations have revealed the iron implements from their third level. The important sites are Atranjikhhera, Hastinapur, Noh, Bairat, Vatesar, Jodhpur, Jakhera and Alamgirpur.^{xxiii} The archaeological level is represented by the PGW phase with signs of swastikas, sigma, short spirals etc., on most of the potteries.^{xxiv} The PGW potteries are generally bowls and dishes. PGW phase represents a village culture with wattle and daub houses and a subsistence pattern based on the cultivation of rice, barley, sesame etc. These sites have also revealed the bones of domestic

cattle, Sheep, goat, buffalo, pig, horse etc., with sharp cut marks on them. This indicates that these cattle were domesticated during this phase of culture. The main iron implements types are spear head, arrow head, knife-blade, dagger, hoe, fish hook, tong, adze and nail etc.^{xxv}

4. Central India Zone: Iron tool types discovered from this region are the ladle, dagger, spear head, sword, arrow head, knife, chisel, spike, axe. rod, Fish-hook and some other objects.^{xxvi}
5. Eastern India Zone: Iron tools are reported from the level of black and red ware. The main tool types are knife, fish hook, spike, nail etc.^{xxvii}
6. South Indian Zone: The advent of iron in south India was due to the builders of Megalithic culture. Iron was much more profusely used in the south than in north India, as is indicated by the rich deposits of iron objects in the Megalithic graves.^{xxviii}

Some geologists have identified and published the scientific analysis of iron findings in north-west part of Indian subcontinent and north India. North-west frontier zone: Bajaur (black magnetic iron sand), Baluchistan and Bolan area: (clay iron stone), Panjab and U.P. Himalayas: Kangra (Magnetic and Micaceous), Mandi-Himanchal Pradesh (magnetic and haematite micaceous schists), Nanital, Almorah and Garhwal region: (red and brown haematite; pre-industrial melting). Rajasthan, Alwar, Jaipur, Udaipur, Ajmer, Bhartpur, Bundi, Jodhpur, Kota (basically haematite and magnetic)^{xxix}. These findings can be useful in identifying the techno-chemical analysis of iron tools discovered from the area under our study.

Now we shall examine the evidence of iron mentioned in the literary texts relevant to our period and geographically distributed area. On the basis of our archaeological and techno-chemical analysis we can assume that later

Vedic people should surely have started smelting and manufacturing iron objects some time before circa 800 B.C. The later *Vedic* texts viz., the *vājasaneyī samhitā* of the white *yajurveda* refers to six metals, namely *ayas*, *hiraṇya*, *lohā*, *śyām*, *śīśa* (lead) and *trapu* (tin).^{xxx} The *Brāhmaṇa* texts and *upaniṣads* clearly mention *lohitāyas* or *lohāyas* and *kārṣṇāyas* or *kṛṣṇāyas*. The reference to *śyamāyas* is also found frequently.^{xxxii} These references indicate the division of metals into the red metal and the black metal. These have been identified generally as copper and iron, respectively. But do the common Hindi and other north Indian languages term *lohā*, which has been undoubtedly derived from *lohita* convey the same meaning as Iron? Some scholars^{xxxiii} try to make us believe and accept this meaning. It is said that “iron is red when it is heated red-hot, black or steel grey when it is in normal temperature and reddish brown when first manufactured, blackish when it is held in use and greenish when it rusts or oxidizes. As iron is black in cold and normal condition it may have been designated as *kārṣṇāyas* and copper, which is red when first manufactured, may have been called *lohitāyas*. It is possible, therefore, that *ayas* was used to cover both copper and iron to begin with i.e., in the *Rgveda*. It would *ipso facto* imply that the iron was already known.” We have an important reference to *tejoayaso na dhārāṇi* in the *Rgveda*.^{xxxiii} Thus it states, “*sa idasteva prati dhādāsishyañ chhisita tejoayaso dhārāṇi.*”

Geldner, in his *Der Rigveda* (II, p. 95), translates *ayasodhara* as a blade made of iron, which is sharp as a flame (Monier Williams, A Sanskrit English Dictionary, 1960, p. 85). He translates almost all combinations of the word *ayas* as occur in the *Rgveda* as having the meaning of iron. The *Rgveda* also mentions the words *tejmānaḥ* *śvadhiti* which has been explained as the destruction of large trees with the sharp and hard strokes of the *śvadhiti*.^{xxxiv} The *Rgveda* also refers to the word *kṣura* which is considered as a sharp knife or razor in the hands of the

barber.^{xxxv} It is said that it was made of iron metal.^{xxxvi} The *Rgveda* also refers to several other tools besides *asi*, *śvadhiti* and *kṣura*, which are sharp, hard and awe-inspiring.^{xxxvii} The proponents of iron being known to the people of the *Rgveda* believe that these implements, in all probability, were made of iron.^{xxxviii} The other important implements mentioned in the *Rgveda* are: *paraśu*, *vaśi* and *pavi*.^{xxxix} *Pavi* has been described as *āyudhāni* (weapon) of the *maruts*. It was hard like the *vajra* and sharp like *kṣura*. It was probably a weapon with a metallic head or top.^{xl} N.R. Banerjee believes that the *pavi*, which had the hardness of the *vajra* (thunderbolt), was certainly used for extensive cutting down of the forest.^{xli} Banerjee tries to equate this term with Latin word ‘*pavio*’ which mean ‘to strike and clean’.^{xlii} Thus, on the basis of above discussion it has been concluded that the stock or ranges of iron objects indicate to the multitude of its application, comprising as it did, comprehensively, of knives, arrow-heads, spear-heads, wedges and axes. There is also indication of local manufacture of iron objects in the form of slags, found at Hastinapur. This meant indeed not only mining of ores but also smithy, involving the twin-action of smelting and forging. It is argued that the axes and wedges helped the Aryans to fell trees to provide them with fire wood and charcoal and cut down forest on a large scale to make available areas for habitation and expansion than may have been possible earlier. The use of arrow and spears helped them to defend themselves from wild animals and their human enemies. Knives may have been used for cutting the flesh of animals (including fish).^{xliii}

But, the overwhelming literary as well as archaeological evidence do not support the view of the use of iron technology during the *RgVedic* period. The meaning of the *Rgvedic* *ayas* as iron metal is considered doubtful.^{xliv} R.S. Sharma has analytically examined the term *ayas* referred to in the Later *Vedic* texts. Thus, according to him,

“several terms for iron are found in the later *Vedic* texts. The term *śyāma* occurs in the *vājāsaneṣi saṃhitā*, the youngest of the *yajus* collection, which might belong to about 800 B.C., for it is later than the *Taittirīya saṃhitā*. The term *śyamena* is found in the *Atharvaveda*, IX.5.4. and *śyama ayas* in X1.3.1.7; but these books are part of priestly literature rather than of ‘popular poetry’, and are possibly later in time. Since in its present form the *Atharvaveda* is certainly the latest of the four *saṃhitās*, these references cannot be attributed to a period earlier than 800 B.C. The terms *kṛṣṇāyas*, *kārṣṇāyas* occur in the *Jaimini Upaniṣad Brāhmaṇa*, II.90, which is later than the *Śatapatha Brāhmaṇa* and *Aitareya Brāhmaṇa* and may be placed after 600 B.C. Curiously enough, the Egyptian word for iron is black copper from heaven, which is almost the same as *kṛṣṇāyas*.^{xlv} From the foregoing arguments it seems that R.S. Sharma’s emphasis is on the term *śyāma ayas*, *kṛṣṇāyas* and *karṣṇāyas* frequently referred to by the later *Vedic* texts which clearly distinguish them with *ayas* found in the *R̥gveda*. The former term was used for iron and latter term used for copper or bronze. Romila Thapar also argues^{xlvi} that “The use of

iron doesn’t seem to have influenced agricultural technology until the middle of the first millennium B.C. Its major impact in the earlier phase was to facilitate the clearing of land to a marginal extent, but much more significantly in its use in weaponry. If *kṛṣṇa ayas* of the *Vedic* texts taken as iron, which is very possible, the use of iron would have been mainly in the making of arrow-heads, spear-heads, knives etc. This would undoubtedly have been the monopoly of the *rājās* in their role as protectors.^{xlvii} But Thapar regrets that the role of iron hoe has not received sufficient attention in the evaluation of technological change during later *Vedic* period.^{xlviii} The word *stambhaghna* occurs frequently in the *Vedic* literature. The term *stambhaghna*, literally means that which destroys clumps, has been equated with iron hoe. She says, “the significance of these improvement is that the socketed iron axe is more efficient in a heavily forested region, the iron hoe makes a substantial difference in rice cultivation where more continual weeding is necessary than in other crops.”^{xlix}

Endnotes

ⁱ R.S. Sharma, *MCSF*, pp. 59-60, 71-72, 91-95, see also Romila Thapar. *AISH*, pp. 19,60-61,71-223, 259,343; *From Lineage To State*, Oxford University Press, Delhi, Calcutta, Madras, 1984, pp. 22,68,73,75,94.

Bairabi Prasad Sahu (ed.), *Iron and Social Change in Early India*, OUP, Delhi, 2006; Bharti Jagannathan (Reviewer of this book) has expressed his opinion that, “Perhaps the finest aspect of this collection of essays however is the comprehensive introduction where Prof. Sahu’s remarkable erudition and grasp of the course and the complexity of the debate are evident. So well are its ebbs and tides charted, and so carefully are the findings of a range of historians who have contributed to the subject analyzed that the lazy historians could do no better than read just this introduction carefully to appear sufficient well-

informed about the entire subject ! Indeed, this reviewer suggests that the introductory essay deserves to be essential reading in its own right.” In our opinion not only lazy historian but even serious researchers can’t afford to miss-out this researched excellent introductory essay of this book. Nevertheless, we shall try to investigate the role of Iron further, particularly in the context of its impact on the later *Vedic* society.

Tracing the historical study of iron technology and its impact on society B.P. Sahu opines that even since the thought- provoking observations of D.D. Kosambi, made in 1950s and 1960s linking the emergence of peasant societies, settlements and states in northern India in the middle of the first millennium B.C. to the introduction of iron tools, the idea has been elaborated, refined, criticized and even rejected, but never ignored. While today, it has come to assume the status of a systematic theory

among its advocates and adherents, the thesis has been continuously contested by others over the last three decades on numerous counts. With the loss of innocence in the writing of ancient Indian history, new set of questions were framed and issue was problematized in the course of the 1980s and 1990s. If these developments, and flowing from it the emergent picture, disturb the earlier cherished notions, that is inevitable. There is more to the debate insofar as it has stimulated some discussion on the regional dimensions of iron technology, including the time, period of its spread and entrenchment.

ⁱⁱ O.P. Tandon, *op.cit.*, p. 54.

ⁱⁱⁱ K. Marx and F. Engels, *Selected Works*, (Moscow), 1955, p. 311.

^{iv} D.D. Kosambi, *The Culture and Civilization of Ancient India in Historical Outline* (London, 1965), p. 84

For the contribution of D.D. Kosambi on the role of iron technology see B.P. Sahu (ed.) *Iron and Social Change in Early India*, *op.cit.* p. 2. According to Professor B.P. Sahu, Kosambi for the first time posited the causal connection between iron technology, plough agriculture, clearance of the fertile but densely forested plains of the Ganga Valley leading to assured supply of food, including a surplus on the one hand, and increased trading networks, metallic money, emergence of towns, a new religious ideology, and state –society on the other: Kosambi's observations on the introduction of cheap iron tools and the implications thereof for contemporary socio-political formations and religions, like his ideas on the Gita and feudalism, were extremely stimulating and influential... His efforts at explanation marked the beginning of a movement from a descriptive to an analytical representation of early India. Kosambi's formulations on iron technology and plough agriculture have had a pervasive influence, and notwithstanding the enormous addition to the corpus of empirical details and variations in interpretations over the last forty years and, more we owe a debt to him for our understanding of historical processes in the mid-first millennium BC in the Ganga Valley for it was he who pioneered a new thinking and thus triggered a debate. Kosambi did not subscribe to the usually predictable cause and effect narrative or story of unilinear progression. He was aware that historical realities were far more complex. To elaborate, iron produced in quantities sufficient to be important in the means of production especially in agriculture and not just its introduction was considered to be significant. Thus, it was not enough to know the metal and the knowledge of smelting and forging iron; procuring it in necessary quantities was deemed essential for the use of the appellation the Iron Age.

^v Bridget and Raymond Allchin, *The Rise Of Civilization in India and Pakistan*, Cambridge world

Archaeology, CUP, London, first Published 1982, Chapter 12, pp. 309-346. '*The Iron Age and the Emergence of Classical Indian Civilization.*'

See also, A. Ghosh, *The City in Early Historical India*, Indian Institute of Advanced Study, Shimla, First edn., January 1973, p. 4; Dilip Chakrabarti; 'The Beginning of Iron in India', *Antiquity* (ed. By Glyn Daniel, Vol. L, No. 198, June 1976, pp. 114-124, Nihar Ranjan Ray, 'Technology and Social Change in Early Indian History: a note posing a theoretical question, *Puratattva*, no. 8, pp. 132-38; N.R. Banerjee, *The Iron Age in India*, Delhi, 1965, p. 104; O.P. Tandon, 'Alamgirpur and the Iron Age in India; *Puratattva*, nos. 1-4, 1967-71, pp. 54-59. R.S. Sharma, "The Later Vedic Phase and the Painted Grey Ware Culture", *Puratattva*, No. 8, 1975-76, pp. 66-67.

^{vi} A. Ghosh, *op.cit.*, pp. 98-9.

^{vii} R.S. Sharma, "Iron and Urbanization In The Ganga Basin", Review Article, *IHR*, March 1974, Vol. I, No. 1, pp. 98-101. For critical comment see, B.P. Sahu (ed.), *Iron and Social Change in Early India*, *op. Cit.*, pp. 3-4, B.P. Sahu has given the critical summary of A. Ghosh's opinion on the role of iron technology. He says that – "A.Ghosh was the first to caution against the tendency to perceive iron artifacts as the main agent of historical change. He recognized the importance of iron but did not concede it the assumed centrality. In fact, he underplayed its role in facilitating urban life in north India. He underlined that copper-bronze tools and, drawing inspiration from the videgha-Mathava legend in the *Satapatha Brāhmaṇa*, even burning the forest could effectively produce the same result as iron in matters of land clearance, though relating slowly. He pointed to the poverty of material culture of the PGW people and also the absence of the extensive use of iron implements in early NBPW horizons (dated from around 500 B.C. to the mid-fourth century B.C.) in the Ganga Valley. In a primarily slow moving agrarian society the effect of iron is also seen to have been slow... Ghosh suggested that surplus is socially and culturally determined, technology alone cannot produce it unless society is ready for it."

See also M.S. Randhawa, *A History of Agriculture in India*, Vol. I, pp. 300-22. It has been conjectured that invention of the socketed iron axe gave an efficient tool to man which enabled him to clear jungles for cultivation. It was with the use of fire and iron axes that the Aryans cleared the dense jungles of

Uttar Pradesh and Bihar. The hard clayey soil of U.P. and Bihar could not be easily cultivated with wooden ploughs. When the wooden ploughs were provided with iron- ploughshares, their efficiency increased. This improvement enabled the Aryans to cultivate virgin lands, thus leading to greater mastery over food production. It almost led to a Green Revolution, which was sparked off by the invention of two most important tools, viz., the socketed iron axe and the iron ploughshare. In due course, all small tools of agriculture, viz., sickles and hoes, were also manufactured from iron.

viii R.S. Sharma, *op. cit.*, p. 99.

ix Nihar Ranjan Ray, 'Technology and Social Change in Early Indian History : A Note Posing a theoretical Question', *Puratattva*, no. 8, pp. 132-38.

x *Ibid.*, p. 133.

For cohesive and analytical comment on the views of Nihar Ranjan Ray see B.P. Sahu (ed.), *Iron and Social Change in Early India* (Herein after referred to as *ISCEI*); *op. cit.*, p. 7. Professor B.P. Sahu states, "Another early reminder of the simplicity of the argument of technical determinism came from Nihar Ranjan Ray. Who in 1970s contested the simple straight line causality on archaeological considerations. Having analyzed the archaeological evidence from north India, he proceeded to show how iron-aided tree felling and tillage, which could produce the surplus necessary to bring about urbanization, was unsupported by the tool repertoire, even at the NBPW levels. There was a conspicuous dearth of agricultural tools and implements in general were small and light. In view of the evident numerical superiority of iron weaponry. Ray reflected on their possible role in the process of the formation of territorial states. Conversely he pointed to the quantitative and qualitative inferiority of iron tools associated with production and the dependence of contemporary agricultural operations on the not as effective hoe and wooden plough. With reference to the combined testimony of Buddhist literature, Greek accounts, and archaeological evidence he posted that iron may actually have entered society in a big way from around the fourth century B.C. and yielded the social consequences ascribed to it from the Mauryan period onwards.

xi *Ibid.*, p.137.

xii R. Pleiner, 'The Problem of the Beginning of Iron Age in India', *Supra*, No. 7, pp. 5-36. See Also B.P. Sahu (ed.) *ISCEI*, *op. cit.*, p.6. According to Professor Sahu – Pleiner's study was one of the first to collate both literary and archaeological data to investigate when iron acquired the capacity to promote both the process of innovation and the wealth of regional societies. Professor Sahu goes further to analyse and evaluate the unique contribution of

Pleiner in respect of iron technology. He thus, states, "In spite of its infusionist explanatory framework, which is understandable in the context of the intellectual climate of the times, his essay makes a significant contribution towards opening up aspects of the problem. The caution exercised by the author in his appraisal of the available archaeological data is remarkable. The assumed correlation between living smelting traditions in the vicinity of iron ore deposits and early iron working has been questioned by him. He was perhaps the first to distinguish between introduction of iron weapons and tools and implement, with the former preceding the later by a few centuries, and such distinction had a bearing on the subsequently envisaged broadly two stages in the early use of iron: a preparatory stage when iron was not used for productive purposes followed by a stage when it increasingly entered everyday life. While the period of the entry of iron into north Indian material culture is dated about 800-500 B.C., its familiar use and the existence of Iron Age in the economic sense is ascribed to the second half of the first millennium B.C. (500-300 B.C.), largely because the tool repertoire in the later phase included not only working implements such as chisels, adzes-axes, sickles and knives but also utensil like vessels, pans and spoons."

xiii *Ibid.*, p. 137.

xiv D.D. Kosambi, *An Introduction to The Study of Indian History*, Popular Prakashan, Bombay, 1975, p. 121.

xv R.S. Sharma, 'Class Formation and Its Material Basis in the Upper Ganga Basin (c. 1000-500 B.C.)' *IHR*, July 1975, Vo. II, No. 1, pp. 1-13. And also see his 'Iron and Urbanization in the Ganga Basin', *IHR*, 1974, pp. 98-103; for more analytical discussion on Sharma's view see B.P. Sahu (ed.) *ISCEI*, *op. cit.* pp. 3-4. Thus, Professor Sahu sums up his view as follows: "In an insightful essay on 'Stages in Ancient Indian Economy' for the period immediately following the later *Vedic* phase he significantly used the sub title 'Iron and Towns'. The striking sub-title is unmistakably part of the message. Iron was related to widespread economic changes: form the introduction of bellows, through rice cultivation to the emergence of towns. In his often cited article 'Material Background of the Origin of *Buddhism*', more was to follow. He argued that the use of iron transformed economy and society around 700 B.C. in eastern Uttar Pradesh and Bihar. It was iron, we are informed, which led to plough agriculture,

spread of new settlements, surplus generation, and the coming of towns, culminating in a new milieu of trade, money landing, economic inequities, and the rise of alienated categories, including courtesans.” According to Professor Sahu Sharma has continued with his arguments and defended them against opposition with remarkable persuasive skills.

- xvi Jarrige J.F. and T.F. Enault, 1973, Recent Excavations in Pakistan, in (eds.) D.P. Agarwal and A. Ghosh, *Radio Carbon ad Indian Archaeology*, (Bombay), pp. 163-72.
- xvii Dilip Chakrabarti, *op. cit.*, p. 116.
- xviii *Ibid.*
- xix Dani, A.H. (ed.), 1967, *Ancient Pakistan*, no. 3, pp. 33-36.
- xx Ancient Pakistan, III, *op. cit.*, pp. 203-3.
- xxi Dilip Chakrabarti, *op. cit.* p. 118; see also B.P. Sahu (ed.) *ISCEI*, *op. cit.* p. 8. Evaluating and examining the view of Chakrabarti Professor Sahu says that “Like Sharma, Chakrabarti has also written extensively on the problem. From initially admitting some role for iron technology, however small, in strengthening the agrarian foundations of the region, he has preferred to either ignore or remain noncommittal on the issue of late. It may be added that the protagonist of the iron thesis in general did not posit a revolutionary role for iron immediately after its introduction, but envisaged a more productive function with far-reaching consequences from 500-400 B.C. onwards. Besides, before providing primacy to the political structure, as Chakrabarti is inclined to do, we need to remind ourselves that the state both emerges out of and introduces a series of interrelated changes at different levels.”
- xxii R.S. Sharma, “Class Formation and the Material Basis in the Upper Gangetic Basin (c. 1000-500 B.C.), *IHR*, Vol. II, no. 1, July 1975, pp. 10-11.
- xxiii *Ibid.*, p. 12; see also *IAR*, 1963-64, p. 49, 1969-70, p. 43.
- xxiv R.S. Sharma, *MCSF*, *op. cit.*, p. 63.
- xxv *IAR*, 1953-54, p. 15, 1954-55, p. 17, 1958-59, p. 21; see also A.Ghosh, *op. cit.*, pp. 10-12.
- xxvi See, *Indian Archaeological Reports* from 1965-90.
- xxvii R.S. Sharma, *MCSF* *op. cit.*, p. 60.
- xxviii A. Ghosh *op. cit.*, p. 14.
- xxix Roy, B.C. 1959, *The Economic Geology and Mineral Resources of Rajasthan and Ajmer* (Calcutta), Ball, V. 1881. A Manual of the geology of India, Part III. Economic Geology (Calcutta). Thus on the basis of foregoing discussion it is argued that the iron in central and south India is, on present investigation, earlier than the iron in the north-west region of India. And iron seems to have entered the Indian productive system around c. 800 B.C. The literary texts seem to suggest the same period. The techno-chemical examination indicates that all these early iron bearing centres are either in or near the ore areas. The evidence of pre-industrial smelting also comes from almost all these areas. The iron tool-types discovered in India do not specifically correspond to the iron tools types found in west Asia. Thus it clearly suggests that India was a separate or independent centre of the manufacture of early iron tools and implements.
- xxx Macdonell and Keith, *Vedic Index*, I, pp. 31-32.
- xxxi *Ibid*, I, p. 151; II, pp. 234-5; see also A.B. Keith, *The Religion and Philosophy of the Vedas*, Harvard Oriental Series, Vol. 31, p. 20; M. Winternitz, *A History of Indian Literature*, I, p. 303.
- xxxii N.R. Banerjee, *The Iron Age in India*, Delhi, 1965, p. 104. This book has been considered as a pioneering effort on the role of iron technology. It is the first comprehensive study on the subject (see B.P. Sahu (ed.) *ISCEI*, *op. cit.*, p. 23.
- xxxiii *RV.*, VI. 3.5 .
- xxxiv *Ibid*, III. 8, 11.
- xxxv *Ibid*, VIII.4, 16.
- xxxvi N.R. Banerjee, *op. cit.* p. 104.
- xxxvii *RV*; VIII.4.17.
- xxxviii N.R. Banerjee, *op. cit.*, pp. 104-5.
- xxxix *RV*, VI.3.4; *Vāśī*, *RV.*, III.19.23; *pavi RV.*, I.166.10.
- xl *Ibid*, X.60.3; See also ‘*Payevo rajānaghaśam samjara nichā nī vriśchah vaninaṃ na tejasā.*’; *Ibid*, VI.8.5.
- xli Banerjee *op.cit.* p. 5.
- xlii *Ibid*; see also J Pokorny, *vergleichendes woerterbuch ender Indo-germanischien, sprachen*, II, Berlin and Leipzig, 1927, p. 21.
- xliiii N.R. Banerjee, *op. cit.*, p. 105; see also Pleiner, R. 1971, The Problem of the Beginning of the iron age in India, *Acta Prae historica et Archaeologica*, II, pp. 5-36.
- xliv Dilip Chakrabarti, *op. cit.* p. 124.

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- ^{xlv} R.S. Sharma, *MCSF*, pp. 59-60, see also *The Vājasaneyi Samhitā*, XVIII.13; B.K. Ghosh, *History and Culture of the Indian People*, ed., R.C. Majumdar, Vol. I, p. 232; Renou, *op. cit.*, pp. 20-21, Wilhelm Rau, *Staat und Gesellschaft in alten Indien*, Wiesbader, 1957, p. 27; Charles Singer, E.J. Holmyard and A.R. Hall (eds.), *A History of Technology*, Oxford, 1954, Vol. I, p. 594.
- ^{xlvi} Romila Thapar, *From Lineage to State*, Oxford University Press, Delhi, Calcutta, Madras, 1984, p. 68., But she still believes that the introduction of the new technology of Iron if controlled by the Indo- Aryan speakers, would have provided this group with the required political and economic edge, reducing the need for extensive conquest (Romila Thapar, *AISH*, *op. cit.*, p. 259).
- ^{xlvii} Ibid.
- ^{xlviii} Romila Thapar, *AISH*, *op.cit.* p. 232; for comprehensive and critical view of Romila Thapar see B.P. Sahu, *op. cit.*, p. 4. According to Professor B.P. Sahu, “Romila Thapar almost simultaneously with R.S. Sharma went on to echo comparable sentiments about the impact of the new technology on

the people’s lives. She acknowledges the significant role of technology in the process of acculturation, especially the horse and iron in the spread of the Indo-Aryan language, and wondered whether the spread of *Vedic* language accompanied the expansion of iron-using agrarian villages. She has discussed how the appropriation and use of new technology transformed the character of tools and helped to create a platform which had a bearing on the second urbanization during the time of the Buddha. The introduction of iron to her signified a qualitative improvement of existing forms and not necessarily the addition of new implements. For example, the iron socked axe as compared to hafted copper axes is more efficient in clearing heavily forested regions and the iron hoe makes a marked difference to rice cultivation.” See also Romila Thapar’s ‘The study of society in Ancient India’, *PIHC*, Varanasi Session, 1969, pp. 19-20,22 and notes 23 and 38; from *Lineage to State: Social Formations in the mid-first Millennium B.C. in the Ganga Valley*, Delhi, 1984, ch.3.

^{xlix} Ibid.