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### Iron Technology and Social Change in Early India (350 B.C.–200 B.C.)

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#### ABSTRACT

The paper encompasses the social changes that have been encountered with the development of iron technology during 350 BC to 200 BC. A greater exploitation of iron mines fulfilled the growing demands for the metals on one side and subsequent technological advancement on the other side. All these have social implication too. Archaeological evidences also support them.

**Key words :** Iron technology, Social change, Ashokan inscription, Archaeology.

The study of iron in early India, both in its technical and social manifestations, suffers from a serious limitation. Most of the available writings are essentially unidimensional in approach. The society as a prime technological variable gets ignored with the result that social complex is always at the receiving end, almost as hapless passive formation devoid of any dynamism of its own. Such an understanding of the social role of technology sees techniques as independent of the milieu in which these evolve. This tantamounts to taking a position divorcing the process of the origin and growth of a technology from the contemporary social system, a line of argument that can lead to funny conclusions. It has to be emphasized, therefore, that the study of technology must keep in mind the dependent social climate. It is common knowledge that a technological innovation is the product of a social system and, in turn, it becomes viable only when the society gets ready for it. The social readiness depends upon a variety of factors the form of the existing mode of production, the operational dynamics of the

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class formation, the nature of the ecological compulsions, etc. The shifting equations amongst these variables explain the variant role of a technology in differing historical periods. It is with this perspective in mind that the present paper seeks to uncover the social dimensions of iron technology in Mauryan India.

Through the expansion and refinement of iron technology had been considerable since c. 1000 BC<sup>[1]</sup>, it was not until the second half of the 4<sup>th</sup> century BC, that its full impact was felt on society. It is with the arrival of the Mauryas on the scene that dominant economic and political institutions came to be formalized. The period witnessed the strengthening of iron technology both spatially and technically. A study of the NBP sites suggests that many new regions, where the precise beginning of the Iron Age was uncertain till the pre-Mauryan time, now came to acquire its developed traits<sup>[2]</sup>. Both at Hastinapur<sup>[3]</sup> and Sravasti<sup>[4]</sup>, this phase is rich in objects compared to the preceding NBP phase. Similar is the case with Kausambi<sup>[5]</sup>. Out of eleven types of iron arrow heads and five types of spears and javelins reported at the site, as many as eight types of the former and all the five types of the latter occur through this phase<sup>[6]</sup>. This pattern is repeated at a number of sites<sup>[7]</sup>. At a second set of sites, which have recorded cultural antecedents; Ropar, Sonapur and Sohagaura, for instance – iron appears in the 4<sup>th</sup> century BC<sup>[8]</sup>. A third set of sites, where this phase of the NBP is not preceded by any earlier cultural phase, illustrate the physical and spatial progress of iron more poignantly. Excavations at Taxila underline this pattern of technological expansion. In fact as one moves towards the Mauryan times, the site starts yielding a larger number of iron objects<sup>[9]</sup>, fact that gives strength to the suggestion that the Iron Age in India almost reached a stage of culmination in the 3<sup>rd</sup> century BC. Iron objects are forthcoming, for the first time, from Sisupalgarh, Nasik and a host of other sites in Maharashtra and Central India<sup>[10]</sup>. Except a few sites the settlements of the period are decidedly marked by a profusion of iron objects. Iron-yielding sites even in the south, especially in Karnataka and Andhra, suddenly increase in number in the 4<sup>th</sup>-3<sup>rd</sup> centuries BC but it has been suggested that this had nothing to do with the northern developments<sup>[11]</sup>. It is true that a direct linkage between the two cannot be established, but it is difficult to ignore the discovery of some of the typical idioms of Mauryan from the region<sup>[12]</sup>. A sudden spurt in iron-working in the area may possibly be explained in terms of the intrusion of the developed elements of late NBP culture, but with the corresponding admission that the Mauryan stamp on the cultures of this area is not easily discernible from archaeological evidence.

A greater exploitation of iron mines fulfilled the growing demands for the metal on the one hand, and helped its further spread on the other. The literary evidence is very specific on this point<sup>[13]</sup>. The Mauryan state exercised a monopoly over mines and trade in mineral products; Kautilya, realizing the importance of mining, provides for an Akaradhyaksa (superintendent of mines), a Khanyadhyaksa (superintendent of digging), a Laksanadhyaksa (superintendent of elements) as well as Lohadhyaksa (superintendent of iron working). Archaeology, however, attests to the working in gold, silver and copper only<sup>[14]</sup>. The location of numerous small heaps of iron slags scattered all over the iron belt in south Bihar<sup>[15]</sup> however,

suggests substantial iron working. The discovery of a number of pits, containing charcoal, iron slag and sand, from period I at Saradkel near Ranchi<sup>[16]</sup> lends credence to this view. The excavator refers to these pits as iron-smelting ovens<sup>[17]</sup>. This was possibly, seems to have become the hallmark of the period. Kautilya was so conscious of the importance of metals and mining that he went to the extent of asserting that mining was the source of all power<sup>[18]</sup>. This concern of the state and the growing social demands on iron helped the refinement of its techniques. Now we have better evidence, both in terms of quality and quantity, of smelting and forging of iron subjects. The excavations at Dhatwa bear out this development. The smelters here succeeded in extracting 99.76% pure iron. They also devised the technique of manufacturing hard implements, like hoe, in two stage involving the process of "forging-welding"<sup>[19]</sup>. The best set of evidence of the smelting and manufacture of iron objects is forthcoming from Ujjain where lime, representing calcium compounds, was being used as a flux. Analyzing the archaeological data, N.R. Banerjee writes that the remains of a forge with a groove for the introduction of the working end (or nozzle) of blow of bellows, an improvised stand made from the sturdy and large neck of a broken vessel to support a water jar to store water for quenching, a small or miniature jar to collect small quantities of water according to necessity, and a shallow but large enough bowl to contain water near at hand for quenching helps to reconstruct the process of blacksmith's working. The use of an anvil also of iron bar or tool, is clearly lined with bricks and clay, burnt hard, and contains ash and charcoal, suggest the variety of objects produced, sharpened or remade at the forge. This method is even now in vogue and would by itself indicate an advanced stage of development of the process of iron working, with a long background<sup>[20]</sup>.

The post-c. 350 BC, period, therefore, has two dimensions of the social implications of iron technology-manifestation of its full impact on society and furtherance of this trend through technological expansion. The Mauryan state, which is the best expression of the material milieu of the times, was essentially a culmination of the socioeconomic processes, inaugurated during the later Vedic times, which led to the transition from a pastoral/agrarian economy to an established and full-fledge agriculture based economy. The widening and strengthening of the base of agriculture could become possible due to the widespread use of iron plough shares and the extension of agricultural area through deliberate deforestation. Additional foci of agricultural production developed beyond the Ganga Valley, especially in the fertile areas of the Indus and parts of the peninsula. It is needless to add that the political authority, due to both enhanced agrarian production and acquisition of coercive powers over the centuries, was in a better position to extract an unprecedented quantity of surplus. This may give an idea as to how the Mauryan state was able to sustain a huge army and a large bureaucracy. In fact, the Mauryan state, with the help of its coercive arms, seems to be an institutional attempt to organize the earlier tendencies to give it a definite direction. This was sought to be achieved through the formation of centralized Kingdom controlling extensive geographical area, an experiment which was first of its kind in Indian history. It is relevant to note that the distribution of Asokan edicts, given the extent of the Mauryan empire, synchronises with the

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distribution of group of inscriptions in Karnataka<sup>[21]</sup>. Thus, the Mauryan conquests need to be viewed as a process of consolidating the achievements of pre-Mauryan material culture. These conquests were attempts to follow and unify a network that had been expanding for hundreds of years<sup>[22]</sup>. The emergence of the empire became possible only when the urban tradition had reached a level of maturity. The concentration of population in urban centres became possible due to the production of a sizeable amount of surplus, its appropriation and its commercialization. The pre-Mauryan times had three major of communication-the north to southwest route (from Sravasti to Pratisthana), the north to southeast route (from Sravasti to Rajagrha), and the east-west route (along the river courses of the Ganga and Yamuna)<sup>[23]</sup>. The Mauryas capitalized on it by providing better communication facilities to create an additional social basis for the empire -the commercial groups.

The Mauryan state with the help of iron technology played the role of a homogenizer of cultures<sup>[24]</sup>. An improved network of communications<sup>[25]</sup> alongwith a vast army and a large bureaucracy provided it with the necessary perquisites to achieve this end. The existence of a common script must have helped the process<sup>[26]</sup>. The role of ideology also needs emphasis in this context<sup>[27]</sup>. An attempt at bringing about homogeneity is reflected at the ideational level in the form of the policy of dhamma enshrined in the Asokan inscriptions scattered all over the country. It was an attempt, based on current religious disputations, to provide a common factor. It was sought to be a vehicle of persuasive assimilation, not military confrontation, "in which conforming to the broad ethical ideals of dhamma was central"<sup>[28]</sup>. The military strength of the Mauryas was so substantial that Asoka was not faced with the compulsion of elaborating upon the traditional ideology for the legitimisation of the political system. This, coupled with the emergence of a new pattern of political authority, provided an opportune moment for redefining the "non-imperialistic" political normatives. The dhamma of Asoka needs to be viewed as an alternative ideology armed with the new requirements of the political system. The new political system, represented by a vast bureaucratic complex aimed at complete administrative centralization, forced the pace of agrarian growth with its new found monopoly over a developed iron technology. Their compulsion to tap fresh resources for sustaining the overgrown political structure prompted them to found new settlements and rehabilitate the decaying ones. Kautilya devises an extremely interesting mechanism, to bring the virgin soil under cultivation<sup>[29]</sup>. The state also acquired its own farms worked under the supervision of the *Sitabhyaksa*<sup>[30]</sup>. The agrarian expansion was greatly helped by the initiative taken by the state in the field of irrigation. Iron technology obviously became instrumental in the completion of massive irrigational projects. Archaeology also attests the process of planned deforestation undertaken by the Mauryan state. A recent study of 74 excavated NBP sites identifies<sup>[32]</sup> sites with early NBP culture and 57 sites with late NBP culture<sup>[31]</sup>. The frequent occurrence of ringwells during this period<sup>[32]</sup> now made the founding of settlements away from the riverstreams less problematic. A natural consequence of this tremendous spurt in agrarian activities was an increase in the number of agricultural taxes. The cultivators had to bear the burden of additional levies - the *Pindakara*<sup>[33]</sup>, the

senabhakta<sup>[34]</sup> and an irrigation cess<sup>[35]</sup>, besides the payment of an emergency tax, the Pranaya<sup>[36]</sup>. The state's concern for protection and supporting the pattern of agrarian expansion, illustrated by Asoka's repeated exhortations in favour of non-injury to animals<sup>[37]</sup>, was an essential component of the system.

This large-scale agrarianisation of the Ganga valley as well as the outlying regions generated such a large amount of surplus that a number of new towns came to be established and the material roots of the older urban settlements got strengthened. The transformation of Pataliputra into a cosmopolitan centre conforms to this new reality of the material life. The Mauryan towns functioned as centres of state-control over crafts and commerce<sup>[38]</sup>. Consequently the organization of trade became smoother and "the crafts gradually assumed the shape of small-scale industries"<sup>[39]</sup>. It is significant to note that the earliest discernible well-organized network of long-distance trade belonging to the 3<sup>rd</sup> century BC, connected only those areas that had been permeated by stable settlements<sup>[40]</sup>. The iron technology based rural settlements were undoubtedly providing support, and occasional direction, to the growing urban economic forms of the Mauryan times.

The strong material makeup of the Ganga valley became instrumental in affecting far-reaching change in the peripheral zones. The process admitted of two distinct patterns—diffusion of iron-based agrarian technology in those areas and helping the organization of the local elements of material culture by assimilating these into the mainstream. Places like Mahasthan<sup>[41]</sup> in Bangladesh and Khanmihirer Dhibi<sup>[42]</sup> in West Bengal, which have yielded the iron implements and indubitable evidence of their emergence as stable settlements in the 3<sup>rd</sup> century BC may have acted as nuclei of the transition to settled agriculture in their respective zones. Areas like Kalinga seem to have received the new elements in a greater measure. The region came into contact with Magadha in the 4<sup>th</sup> century BC, but the transition was possibly affected in the 3<sup>rd</sup> century BC, due to an excessive concern of Asoka for this area after its assimilation within the empire<sup>[43]</sup>. The evidence comes in the form of the earliest iron implements unearthed from five sites in the area—Sisupalgarh, Jaugada, Asurgarh, Kharliagarh and Gudbhela<sup>[44]</sup>. Iron came to be used from 3<sup>rd</sup> century BC, and the objects included agricultural implements. The process of agrarian transformation may have been intensified due to the spread of the knowledge of steel or semi-steel making in the area due to Mauryan contacts. Significantly the growth of material culture in Orissa was not confined to the coastal districts, as is often suggested<sup>[45]</sup>. The presence of the developed elements of material culture iron implements and coin from widely scattered areas points to a process of hospitable reception of iron technology almost in the whole of the province. The cheti kingdom was a product of this agrarian scenario and the Hathigumpha inscription of Kharavela, which shows the king's concern and initiative for providing irrigational facility to the cultivators, amply testifies to the effects of the penetration of iron technology in the area.

The role of the Ganga Valley culture in the dissemination of its elements in the Deccan, however, can not be determined with clarity. The region does have a history of iron use right from the Hallur days but, in the north, it failed to evolve an urban

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culture, at least, till c. 300 BC. This requires an explanation specially from those who advocate for an exclusively autonomous pattern of social formations in that region<sup>[46]</sup>. It is a common knowledge that the area had a strong tradition of iron use, but this point needs to be stated with the admission that the historical transformation in the area could not be brought about the 3<sup>rd</sup> century BC. It is here that the Mauryas seem to have played a vital role.

The earliest documented evidence of Mauryan intrusive elements comes in the form of a concentration of Asokan inscriptions from Mysore and a fragmentary one from Amaravati in Andhra. It is true that the excavations at Brahmagiri<sup>[47]</sup>, where two Asokan inscriptions were found, did not yield any identified material remains of the Mauryas, but the beginning of new ceramic type and the first appearance of iron at the site in Period II (contemporaneous with the Mauryas) are of consequence. This ceramic type also at 'Sisupalgarh'<sup>[48]</sup> Kesarpalli<sup>[49]</sup> (Andhra) and Korkal<sup>[50]</sup> (Tamilnadu). One wonders whether the four sites are providing for a common intrusive element of the Mauryan culture. The Amaravati evidence<sup>[51]</sup> is, however, decisive, about one km. from this Buddhist establishment we have an urban site, Dharanikota<sup>[52]</sup>. It is certain that during the Mauryan phase of contact, the Amaravati Dharanikota complex was emerging as a dynamic religious and commercial urban complex in the lower Krishna region. This transition to an urban settlement in the 3<sup>rd</sup> century BC can be best explained in term of the organizing role of the Mauryan state and the intrusion of iron technology. The available evidence further suggests that Amaravati emerged as local point of the diffusion of material culture in the area<sup>[53]</sup>. The very process of state formation in the region, manifest in the form of the Satavahana polity, seems to have been influenced by the introduction of the new elements of material culture. The new rulers sought to legitimize their rule by adopting some of the dominant idioms of Mauryan administration and culture.

The process of the diffusion of the material culture of the Ganga Valley in outlying regions was also aided by Buddhism. It is significant that the earliest surviving Buddhist monastic sites emerged in the 3<sup>rd</sup> century BC<sup>[54]</sup>. The original zone of their distribution was located in the Yamuna-Ganga Valley with stray examples in central India (Bharhut and Sanchi) and the Deccan (Amaravati). All the early Buddhist centres, laying either close to early monastic sites or along routes connecting urban locations, were situated within the distribution areas of either the Asokan inscriptions or the NBP. Thus, in the first phase of its evolution the Buddhist monastic settlements "were closely linked to the major forms of political and economic organization that were developing at the same time"<sup>[55]</sup>. Buddhism seemingly strengthened the hands of the Mauryan state in the former's endeavour to extend the material culture of the Ganga Valley to outlying areas. The emergence of an all-India economic pattern by the 2<sup>nd</sup> century BC bears testimony to the positivity of this effort.

By c. 200 BC iron technology, thus, came to occupy a position of centrality in the mechanism of production. The improvement in its techniques and the wide area of its expanse helped large-scale growth of stable settlements. This was a prelude to economic unity of the whole of the subcontinent. The Mauryas played a

decisive role in this process by formalising, standardizing and diffusing the earlier trends. The technology that shaped the character of the Mauryan empire once disseminated to the peripheral regions ironically forced the pace of its own dissolution.

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5. Sharma, G.R., 1960. Excavations at Kausambi, 1957-59, Allahabad, pp. 45-48.
6. Ibid., pp. 55-56.
7. Roy, T.N. op. cit., p. 142.
8. Ibid.
9. Iron objects at the earlier levels at Bhir Mound consisted of adzes, knives and scrapers, but the subsequent level shows a wider use of iron, including weapons, tools, agricultural implements and household vessels (John Marshall, Taxila Vol. I, Cambridge, 1951, pp. 104, 107, Vol. II, p. 63 ff)
10. Roy, T.N. op. cit., p. 143.
11. Nagaraja, S and Gururaja Rao, B.K., 1979. Chronology of Iron in South India, in D.P. Agrawala and D.K. Chakrabarti (ed.), Essays in Indian Protohistory, Delhi, 1979, pp. 321-29.
12. Amaravati, for example, has a few inscriptions of Mauryan times alongwith a very impressive number of stratified NBP sherds (Indian Archaeology, 1973-74: A Review, p.4). Typical Mauryan polished inscribed granite uprights have also been found (Ibid). Furthermore, Asokan inscriptions have been found in Andhra and Karnataka.
13. Arthasastra, II. 12.
14. Murray, Journal of the Royal Asiatic Society of Bengal, 3<sup>rd</sup> series, Vol. VI, p. 101, cited in R.S. Sharma, Perspectives in Social and Economic History of Early India, New Delhi, 1983, p. 131.
15. Ibid.
16. Indian Archaeology 1964-65. A Review, p. 6.
17. Ibid.
18. Arthasastra, II.2.
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24. The Mauryan state seems to be a very good example of a secondary state. The secondary states, it has been argued, are formed by primary states conquering non-states (R. Cohen and E.R. Service, ed., *Origin of the State*, Philadelphia, 1978, p. 6ff). It is also required that the newly conquered areas be economically integrated into the conquering states. Despite Romila Thapar's objections (*From Lineage to State*, Bombay, 1984, pp. 159-160), the Mauryan state seems to have performed both the functions.
25. Asoka Claims in his inscriptions to have constructed roads on a large scale.
26. For the role of language and script in the process of state formation, see Peter Skalnik, 'The Early State as a Process', in H.J.M. Claessen and Peter Skalnik (ed.), *The Early State*, The Hague, 1978, p. 607. The brahmi script was fairly widespread by the time of the Mauryas.
27. *Ibid.*, pp. 628-629.
28. Thapar, Romila., 1987. *The mauryas Revisited*, Calcutta, p. 22.
29. *Arthasastra*, II. 1.
30. *Ibid.*, II. 24.
31. Roy, T.N. *Op. Cit.*, pp. 89-91.
32. *Ibid.*, p. 37ff.
33. Sharma, R.S. *Op. Cit.*, p. 132.
34. *Ibid.*
35. *Arthasastra*, II. 4.
36. *Ibid.*, V. 4.
37. Seven (Rock Edicts I, II, III, V, VIII, IX and XI) out of the fourteen Major Rock Edicts, to cite an instance of Asoka's concern for non-violence to animals, repeat this request, Kautilya too is familiar with this issue. Almost echoing the same idea he states, "cattle such as a calf, a bull or a milch cow shall not be slaughtered" (*Arthasastra*, II. 26).
38. For details, see Sharmas, R.S., *op. cit.*, pp. 130-131.
39. Thapar, Romila., 1973. *Asoka and the Decline of the Mauryas*, 2<sup>nd</sup> ed., Delhi, p. 72.
40. Schwartzbeg, J.E., 1978. (ed.), *A Historical Atlas of South Asia*, Chicago, p. 19. The use of burnt bricks during the period (T.N. Roy, *op. cit.*, p. 184) is suggestive of the growing strength of the urban tradition.
41. Mukherji, R.R and Maity, S.K., 1967. *Corpus of Bengal Inscriptions Bearing on History and Civilization of Bengal*, Calcutta, pp. 38-39. This is incidentally the the first inscription forthcoming from Bengal suggesting introduction of a script in the area during the Mauryan time. It refers to Pundranagara as a prosperous city where grains and coin were stored to meet the consequences of natural calamities. The establishment of village settlements and the availability of a considerable amount of agrarian surplus in the area, therefore, seems indubitable.
42. *Indian Archaeology 1956-57: A Review*, p. 29ff; 1957-58, p. 51ff; 1959-60, p. 50ff; 1960-61, p. 39ff; 1961-62, p. 62ff; 1962-63, p. 46; 1963-64, p. 63ff; 1964-65, p. 52ff; 1966-67, p. 48.
43. The Kalinga Rock Edicts I and II project this new policy formulation. It has been suggested, however, that Kalinga was a well populated geographical entity before the war implying thereby the marginal impact of Mauryan rule over the area (B.P. Sahu, 'The Archaeology of Early Historic Orissa', *Proceedings of the Orissa History*



- Congress, 9th Session, Rourkela, 1981, p. 2; idem., 'Some Aspects of Early Orissan Economy and Society', PIHC, 41<sup>st</sup> Session, Bombay, 1980, pp. 126-127). The figure of casualties and captives recorded in the Asokan edicts are decidedly inflated and any hypothesis based on these numbers can hardly be reliable. Moreover, Kalinga's association with Magadha from an earlier period is very much admitted but the evidence at our disposal, both archaeological and literary, does not permit us to picture the pre-c. 300 B.C. Kalinga as an area of stable settlements (Sahu has himself cited this body of evidence, *ibid.*, pp. 122-232).
44. *Ibid.*, p. 125. The Ganganagar minor irrigation project area and Biratgarh have also yielded iron implements, but these have a post c. 200 BC. chronology (R.N. Das, Adya Lauha Yugair Orissaarea Sanskriti', Paurusa, Cuttack, June 1978, pp. 69-72). These sites came under occupation in the 3<sup>rd</sup> century B.C.
  45. See Mahatab, H.K.M., 1949. Presidential Address' (Local History Session), PIHC 12<sup>th</sup> Session, Cuttack, p. 278; B.P. Sahu has convincingly controverted this erroneous conclusion (*ibid.*, p. 126).
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  55. *Ibid.*, p. 124.