THE SMELTING PRACTICE OF PRIMITIVE TRIBES IN CONTEMPORARY INDIA AS AN INDEX OF THE EARLY METHODS OF IRON WORKINGS IN INDIA

The methods of smelting and working iron practised till to-day by a primitive tribe of Madhya Pradesh, called the Agarias, and several others in Bihar or Maharashtra may approximate to or suggest the methods of smelting and forging adopted by iron workers in ancient times of which there is no written record, especially, since the scanty archaeological evidence at the moment leaves the inference so tentative or inconclusive. These methods would, therefore, supplement the archaeological evidence and form the basis for further research.

The iron workings of the tribals who comprise the Agarias and Khuntia Chokhs of Madhya Pradesh with a concentration in the Mandla district, Marias and, Marias of Dastar, in Madhya Pradesh, Mahali Asurs of Bilaspur, Birs, Birjhia and Agaria Asurs of Palaman and Ranchi in Bihar; Gonds, Telis and Mannewars of District Chanda, Maharashtra, divide themselves into the twin operations of (a) smelting and (b) forging. The smithy which consists of the furnace for smelting and the forge for working
iron objects, is usually located outside the village under a tree or in an unwalled but roofed hut. The operations are carried on mostly by night. Barring minor variations the furnaces conform largely to the pattern of a vertical or alternatively, a slightly tilted cylindrical shaft, made of clay, about 3 ft./
(± 91 - 244 cm.) high and 3-8 ft./wide. The shaft tapers to the top and is provided with two small openings, one at the top and the other at the base. The opening at the top is for the introduction of charcoal and iron ores. Often a bamboo platform, called the 'machan' resting on poles and plastered with clay is erected in a level with the top of the furnace. This platform is also provided with 3½/ high dwarf walls as protective parapets, and is sloping towards the opening of the furnace for sliding into it the charcoal and iron ore acting as an open hopper. The opening at the bottom is for maintaining the blast and for receiving the bloom and slag. It is significantly called the 'Hagan' or 'Loha Nagara' (aperture for excretion). The wrought iron obtained by hammering the bloom is in the form of lumps or cakes. Bellows were employed for maintaining the flow of air to keep the furnace alive.

Besides the Agarias and other tribes mentioned above, several other people in different parts of India are engaged in the operation of
smelting of iron as much for profit as for utility in modern times.

The Agarias do not use any flux, but the smelters in the Waziri hills submit ores first through a process of roasting, eliminating traces of sulphur and other volatile components, and then smelt them in small furnaces along with a lime stone in the form of coral reefs as a flux.

Iron is also smelted on small scales in simple hearths in the Khasia hills in Assam.

In Kathiyara, the furnaces employed for smelting iron are rectangular in cross section and are horizontal in plan.

In Manipur, Assam, the method in vogue in the preceding century marked a half-way house between the open fire smelting and the blast furnace. The furnace was a small truncated cone about 18 inches high with a slightly diameter. The tuyeres were introduced at the sides, and opposite to them was an opening for the extraction of bloom and slag. The charcoal and iron ore were introduced via the chimney.

The method of smelting in the last century in the Kangra valley, seems to have marked an improvement of sophistication over the primitive methods. The furnace here consisted of a slender upright cylindrical shaft of oval cross-section made of clay resting on a high mud-platform. The tuyeres were introduced at the bottom and through them bellows were worked to maintain the flow of air. The bottom of
of the furnace has a perforated slab through which the slag passed out and was collected in a pit below specially excavated for the purpose. No flux, however, was used for smelting the ores. The bloom was beaten with a wooden hammer upon a granite anvil.

No furnace other than the barest indications of one at Ujjain described above (see page 261), have been forthcoming in the excavations, yet the acquaintance with these indigenous methods would perhaps help identifying even fragmentary remains of furnaces in the excavations.

Walter Ruben has dealt with the topic of the Asuras of literature and legend vis-a-vis the Asurs, a modern tribe which constitutes an exclusively iron-smelting folk in central India. He makes a basic distinction between the two by spelling the former as Asura and the latter simply as Asur. According to him Asuras were evil spirits, to be found in the youngest strata of Indian mythology and identifiable with such figures as Mara, the tempter, against whom the Buddha himself had to contend. In this context the Asurs, who dwelt on the Ganga plains and spoke a Munda language before the arrival of the Aryans were the objects of suspicion among the neighbours, being
also iron smiths.

The Asuras assumed gradually the position of totem ancestors and gods of these folks and as such they were potent sources of danger to the matriarchal peasantry of the Ganga plains on the one side and to the Aryan settlers of the region in later times on the other.

This is, no doubt, a simplification of the problem, though the question of the ultimate fate of the Asuras of Indian mythology can scarcely be said to have been answered. The problem of the identification of the ancient sites with the ancient remains of the present day Asurs is, no doubt, fraught with difficulty though a reasonable reconciliation between the cultural assemblages of the ancient sites with the present day cultural repertoire of the Asurs would be a fair tentative basis for the attempted equation.

According to Ruben, the few modern villages of the Asurs lie amid the hills called Pahar-Barwe in the neighbourhood of Ranchi, in Bihar, representing the extreme limits of the wanderings of the tribe under the pressure of their struggle for existence. The scale of production of iron by these people is now much smaller than before in view apparently of the competition from cheaper products of the factories, though the industry is not altogether
extinct yet, and continues to be their principal occupation.

In earlier times the Asurs lived in the valleys. The hills in the neighbourhood provided the iron ores, the principal wherewithal of their occupation. Potsherds lying everywhere on the inner slopes of the surrounding hills point to the ancient settlements. Remains of bunded up tank sites, ruins of bricks and megalithic graves are attributed to this day to the Asurs. These, especially the tanks called Asur pokra, are associated with slags and bits of rusted objects of iron. The brick ruins are called either Asurgarh or Asurdipa. Furthermore, stone artefacts, objects of copper and bronze and coins etc., have been attributed to the use of the Asurs. It may, however, be pointed out that neither do the objects exposed on the ancient site represent a unified culture of one particular period nor can their suggested association with the Asurs be held as proved or correct.

Copper or bronze objects do occur on the sites, but they are all surface finds and cannot be connected with the iron-using Asurs of to-day. To-day, they do not burn bricks, nor build bunded tanks nor even make any stone beads, though the latter occur plentifully in the ancient graves. There is no apparent connection between the microliths
found in the region and the Asurs either.

The Asurs of to-day live in primitive conditions, and there is practically nothing in their tradition except their dwindling industry in iron to remind the present generation of the technological advance which iron implied in the earliest days of its discovery and use.

Such a retrogression as the Asurs of to-day in contrast represent would further discourage and disclaim any attempted equation between them on the one hand and the ancient iron-using dwellers of the region on the other. Iron was apparently known anciently in the region, but the antiquity of iron in India can hardly be traced to this ancient source for the simple reason that the earliest discoverers of iron would surely have been able to disperse their cultural traits, if any, over a widely expansive area by virtue of the superior fighting equipment which it made possible to build up. But the cultural unity which came into existence anciently and is the connecting link amidst the Indian people till to-day, notwithstanding the small barriers of language, came in the wake of the Aryans, who synthesised the achievements of their forerunners and evolved a common pattern of life which reached far and wide, except perhaps the impenetrable mountain fastnesses and the tribal
enclaves, where primitivism reigns supreme. Even the deliberate proselytising activities of the medieval and post-medieval times, and more recently of the Church, with the active backing of the state, have scarcely been able to reach the tribal areas with any appreciable degree of success. The difficulties of imposing any cultural conquest over these people in the times with which this treatise deals can well be appreciated. If any connection is sought to be established between the primitive Asurs of to-day with any identifiable ancestor, conditions of still greater primitivism have normally to be conceded for them. Such people can scarcely be expected to impart any cultural trait or concede a technological point in favour of any people unless they are comparatively still less advanced.

Even if it is possible for the superior numbers of a invading folk to wrest from their numerically circumscribed adversaries a point of technological achievement unknown to the invaders, the assumption, as is often made, that the Aryans acquired the knowledge of the manufacture and use of iron objects from the primitive iron smiths in India cannot be proved archaeologically, nor sustained in the light of other evidences in hand.

Apart from the pointed references to the manufacture of iron in India by the tribals and other small-scale iron smelters, upto a recent past, it may be generally stated that the smelting of iron in India was more widespread than has been generally appre-
That iron making was practised all over the country is attested by the fact that there is scarcely a district outside the great Indo-Gangetic alluvial plains where ancient slag-heaps are not found. The indigenous industry must have been once flourishing wherever there was ore and plenty of forests to supply the necessary charcoal for iron making.

The iron makers used to get their ore from almost any source in the vicinity." In this connection, the views of V. Ball on the prevailing methods of method are significant. He writes, "The rude smelting-furnaces of the natives ... are probably, to a great extent, the lineal descendants of a system of iron manufacture, which, in the earliest times of which we have any record, must have been on a scale of considerable magnitude."

In the indigenous processes of smelting iron usually ores rich in contents of metallic iron were employed. No flux was used. This is rather unusual in view of the knowledge of the benefits of a flux as prevailed in ancient Ujjain. The furnaces were of three kinds, the first of which were employed in the Deccan and parts of Madras, the second and the third in North India and U.P. In all the cases, bellows of the hair of goat or sheep skin were employed to ensure the blast of air into the furnace.

The furnaces in use in south India were circular on plan and conical in shape, broader at the
base than at the top. They were from 2 to 4 ft. (61 to 122 cms) tall, about 10 to 15 inches (25 to 38 cms) across at the base and 6 to 10 inches (15.25 to 25 cms) at the top. There were two openings at the bottom one for letting in the blast and the other for extracting the slag. The fuel of charcoal and iron ores were introduced from the top.

The furnaces of the second type, found in the Central Provinces (now included in Madhya Pradesh) were cylindrical in shape about 2 ft. 6 inches (76.20 cms) tall and 15 to 18 inches (38 to 45 cms) in diameter. The spongy mass of bloom or iron used to be removed from the top.

The furnaces of the third type were the tallest of the series, being 8 to 10 ft. (244 to 304 cms) in height but square on plan, being about 1 ft. 6 inches (45.75 cms) across, with a high perforated platform at the base. Its front wall was damaged after every complex of operations and rebuilt. The metal thus produced was a spongy mass called the bloom that has to be hammered to eliminate the slag.

The iron produced in the indigenous furnaces was wrought iron, because of the lower absorption of carbon in the low temperature achieved in the furnaces which lent itself to easy transformation into steel.
Steel was produced in India by two processes, namely, (i) carburisation of wrought iron, known as wootz steel, and (ii) de-carburisation of cast iron.

Wootz is a misnomer for ukku which means steel in the Kannda language, but has come to stay. The process involves the filling of small clay crucibles with pieces of wrought iron and 4 to 5 percent by weight of a good firewood. The crucibles measured 5 inches (12.70 cms.) in length and 3 inches (7.62 cms.) in diameter. After several such crucibles are filled and sealed with clay, they are placed upside down, vertically into a pit 3'6" (107 cms.) deep and 1'6" (46 cms.) wide, which itself is filled with fuel. A blast is then introduced into this pit. The molten liquid obtained is gradually cooled, when it solidifies and, by its absorption of an adequate proportion of carbon, acquires the property of steel.

This process was specially popular in south India and particularly in the Districts of Salem, and Tiruchirappalli (formerly spelt Trichinopoly) in Madras, besides the Hyderabad area, in Andhra Pradesh (formerly Nizam's dominions) and Mysore. The megalith-builders may have employed the same method of smelting ores.
In the other process bits of iron highly impregnated with carbon, in the course of production of wrought iron, are first pounded in a stone mortar to remove the slag and are once again heated in a shallow pit-oven provided with an arrangement for a blast over a charcoal fire. 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 Bajuha, Subah Bengal, in Keroh, Subah Kashmir, in Kumdon in Subah Delhi besides at Nirmal and Indore to the north of Golconda at the time of Akbar in Ain-i-Akbari.