

From Pins to Pillars: Saga of Indian Iron and Steel

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Both archaeological and literary accounts testify to excellence of Indian iron and steel. According to recent radiocarbon dates, the antiquity of iron technology in India goes back to early centuries of the second millennium BCE which is a high antiquity for metallic iron anywhere in the world. The salient points of development of iron technology in India have been investigated here highlighting the recent archaeological evidence on the antiquity, and the stages of its development. It is worth taking a close a look at the evolution of metallurgy of iron before its culmination into a world class product and attaining a coveted position. Indian iron and steel attracted the attention of the world from the ancient period to the pre-modern times when the British arrived in India as may be seen in some of the observations being noted here.

Herodotus who is said to be the Father of history stated that in the battle of Thermopylae in the 5th century BCE the Indian soldiers fought with iron-tipped arrowheads (Photis Book VII: 65). Almost at that very time Ktesias the Greek ambassador to the Persian court and a physician gratefully acknowledged the gift of two swords of Indian steel made to him by the king and the Queen mother (Mc Crindle 1882, reprint 1973:9). A century later, Quintus Curtis reported that the vanquished rulers of North-west India paid a tribute of 100 talents of steel ingots along with bags of gold dust and other precious items to Alexander. This suggests (1) that iron and steel produced in India at that particular age was considered valuable enough to be presented as a tribute to a conqueror like Alexander the Great. (2) It also suggests that by 6th – 5th century BCE Indian iron and steel had become some kind of status symbol and an object of value being exported to different parts of the ancient world. This assumption gets corroborated by facts like accounts of Arrian (c. 92-175) who mentions about import of *sideros Indicos* (Indian steel) to Abyssinian ports. From the ancient times up to the British period Indian iron and steel received attention of people whose observations are worth narrating here.

The Periphus of the Erythrian Sea (Schoff 1912) gives a detailed account of exports from India. Barygaza (a corrupt form of Bhrigukachcha- modern Broach or Bharoch) on the mouth of River Narmada was a busy port. Among long list of exports from this port were spices, perfumes, herbs, pigments, precious stones, copper, sandal wood etc. we also find mention of iron and steel. It is stated that Indian ships regularly took voyages to African and Arabian Ports.

The Arab records testify to trade in Indian iron and steel. As noted above, Marco Polo clearly mentions about the high quality of sword blades of Indian origin that was exported to Persia for a long time. *Ferrum indicum* was among the objects imported from India. Idrisi says that Indian steel excelled over all other iron being produced at his time and there was a great in not only in the Arab world but also in Europe where it reached through the Arab traders. It is believed that due to this channel of dispersal of these swords, the Indian steel became famous as Damascus steel in Europe. This tradition of production of good quality iron and steel thrived till as late as 18th CE as testified by the British engineers who analyzed Indian iron as reported in records of GSI and correspondence among the official of the British India. In 19th century CE one Captain Presgrave of Sagar mint tested the iron objects produced at Tendukhera in District Hoshangabad, Madhya Pradesh. His assessment of the finished object of iron is remarkable. He states, “----bar iron...of most excellent quality, possessing all the desirable properties of malleability, ductility at different temperatures and of tenacity for all of which I think it cannot be

surpassed by the best Swedish iron; ... the Agaria piece when brought to the bend it showed itself possessed of the power of elongating and stood the bend better than the general run of English iron purchased in the Bazar" (J. Franklin, 1829, quoted by Dharmpal 1971 p. 289). Sir George Braidwood (1878 cited by Krishnan 1954 p. 70) recorded in the notebook of the British Indian section: "Indian steel was with such properties celebrated from the earliest antiquity and the blades of Damascus which maintain their pre-eminence even after the blades of Toledo became celebrated, were in fact made of Indian iron.....The *Ondanique* of Marco Polo's travels refers originally, as Col. Yule has shown, to Indian steel, the word being a corruption of the Persian *Hindwany* i.e. Indian steel. ---- the swords of Kirman were eagerly sought after in the 15th and 16th countries AD by the Turks who gave great prices for them. Arrian mentions Indian steel '*Sideros indicos*' (that) was imported into Abyssinian ports"

Iron was imported by Britain from India for using in construction of bridges because of its superior quality. A statement by La Touché (1918) in this regard is worth narrating here, "...its (iron's) superiority is so marked, that at the time when the Britannia Tubular Bridge across the Menai Straits was under construction preference was given to use of iron produced in India".

After 'the Great Indian mutiny' in 1857, the British Government confiscated all the sharp edged weapons like swords, daggers and knives etc. kept by people. These weapons of the Moplas of Malabar made with native iron in the Indian blast furnaces are said to be of such high strength that it could not be shredded. It is said, "---and wonderful material they (iron objects) were. To break them was impossible, so a pair of strong hand-shears was made to cut them up. But the remarkable point was this, that if put into the shears with the thin cutting edge first, they could not be cut at all, but notched the shear blades immediately", Charles Wood (1894: 179). The above statements are self sufficient to prove the saliency of Indian iron being produced by the indigenous iron workers in their clay furnaces till the British period. It may be construed from the above accounts spanning over several centuries that India had a rich tradition of iron working from the early centuries before Common Era that lasted right up to the pre-modern times.

The history of iron technology spans over a period of approximately 4000 years. A sustained effort lasting over centuries seems to have taken place in attaining the excellence in iron technology. It is clearly borne out by archaeo-metallurgical investigations. For its systematic understanding I have classified the evolution of iron technology in three stages viz. Stage I, Stage II and Stage III. Iron technology had a humble beginning at Stage I which lasted for a long period (18/17 BCE to 1000 BCE). Bits and pieces of iron appear to begin with. It was followed by small objects like nails, clamps, rods, and arrowheads, spearheads and axes etc. over a period of time. Wrought iron was produced in bloomer process at Stage I. Analysis hardly shows steeling. Incidental carburization may have taken place during forging in contact with charcoal. At the succeeding Stage II (1000/900-300BCE), deliberate carburization quenching and tempering took place. The tool typology shows relative improvement. During the Stage III we come across marked improvement in utilization pattern. There was not only a typological proliferation; forge welding technique was mastered as perceptible in victory pillars like the Delhi Iron pillar. Once perfected iron technology left its mark on the contemporary society, not only in India but in the entire world. The restlessness of the famous Delhi Iron Pillar and the watering pattern of wootz steel are still enigma to the metallurgists of the world.

With this I pay my tribute to Prof. R. Balasubramaniam who not only dedicated his life to study of ancient Indian technology, especially the Delhi Iron Pillar but he tried to build upon it further to create something new taking inspiration from the technological heritage of India.