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BOOK REVIEW

Pranab K Cattopadhayay and Gautam Sengupta: ***History of Metals in Eastern India and Bangladesh***, Infinity Foundation, Pentagon Press, New Delhi, 2011, Pages XL+ 193, ISBN 978-81-8274-512-4

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The book under review attempts to rediscover and study the wonderful metallurgical traditions of Eastern India and Bangladesh. It tries to build up a cogent account of traditional science and technology of metals of this region by focusing on important metal objects which has been unearthed from excavation or obtained by explorations at various places. The book is a contribution to History of Indian Science and Technology by Infinity Foundation and aptly dedicated to Late professor R Balasubramaniam, a distinguished archaeometallurgist who contributed significantly to research in Corrosion Metallurgy. In his foreword to the series professor M.G.K. Menon lauded the effort of foundation for a series on History of Indian Science and Technology (HIST) which covers not only areas of technology but also of science. The aim is to bring together scientists, historian of science, along with those concerned with philosophy, anthropology, religion, ancient Indian language and many such other disciplines. The book is planned in nine chapters apart from glossary of scientific terms, bibliography and an index.

The first two chapters of the book deal with origin of metallurgy and metals and provide historical background and development of archaeological cultures in eastern India and Bangladesh through its trade with China, Burma, Arakan, Vietnam, Laos, Malaysia, Sumatra, and Thailand. The chapters three to seven focus on individual metals like Copper, Iron, Gold, Silver, Minor Metals respectively, and the eight and nine deal with alloys of Copper and Conclusion. The history of metallurgy is closely linked to the history of development of human civilization and the book is an attempt to look into

the development of metallurgy in South-East and near east specially northeast India encompassing the seven sister states. Bangladesh is also included because of its topographical location and common history. Eastern India witnessed a gradual transformation from Neolithic to Chalcolithic cultural and civilizational stages of human development. Pyrotechnology- the science and technology of intentional use and control of fire by humans enabled conversion of minerals into metal and thus the science of metallurgy. The excavation at Senuar containing a crucible with copper slag clearly establishes the evidence of Chalcolithic culture in Eastern India. The date can be roughly ascribed to 1950 BC on the basis of ^{14}C dating.

As to copper technology it thoroughly describes the origin and development of copper in the region and how it changed the face of human civilization. The beginning of copper metallurgy depends on the availability of copper ore mineral, which is available in neighboring districts of Chotanagpur in the Jharkhand Copper belt. These chlorite rocks are spread over 128 km long. The recovery of Puri-Kushan coins from the Rekha mines in Orissa indicates that mining was carried out even before the second century BC. Archaeological evidences of copper, major finds and sites and manufacturing processes for the period 2000 BC to 1300 BC (Neolithic-Chalcolithic Period), 1300 BC to 600 BC, 600 BC to 300 AD have been described. The major sites are Mahasthan in Bangladesh, Chirand, Maner, Rampurva, Senuwar in Bihar, Golabai Sasan, Sisupalgarh in Orissa and Pandu Rajar Dhibi, Mangalkot and Pakhana in West Bengal. The finds are small pieces of wire, fish hook, bangles, copper coins, etc. The process of copper extraction from chalcopyrite ores using cow dung, clay and wood charcoal constituted a three stage process (Datta and Chattopadhayay, 2007). Blowing of air from top through tuyeres in which iron sulphide in the ore was oxidized as iron oxide and gaunge was removed as iron sulphide. The application of silica for separating iron from the heavy metal fluid phase to a light liquid slag phase and in the third phase slag is removed from through slag-notch. The *Arthaśāstra* refers to state control over the mines during the Mauryan period. It is interesting to note that *Rasaratna Samuccaya* (Neogi, 1979) refers to occurrences of copper in Nepal as also in Sikkim. Copper is also known as *pañcaratna* in Goalpara and Karbi Anglong district of Assam.

The metallurgy of Iron was likewise very much in use in the eastern part of this subcontinent from 1000 BC. The chapter describes the process

of Iron extraction (Ball 1880), pre industrial iron making in the states of Arunachal Pradesh, Assam, Bangladesh, Meghalaya, Manipur, Mizoram and Nagaland. The iron implements discovered during excavation in these states include *dao* (Chopper) known differently in different states, knives, sickles, and agricultural implements. In Nagaland iron spearheads have been found from megalithic burial sites at Jotsoma and Kalogie (Jamir 2006). In the western part of eastern India *Agarias* of Palamu (Jharkhand) and Chhatisgarh smelted iron (Ball 1880). It is interesting to note that the status of Agarias has hardly changed even after more than a century. In the Maikala range in Bilaspur and Durg, iron smelting *bhatti* (Furnaces) of conical shape and of about a meter height has been found (Chowdhury 1953). Iron making by Kols of Dumka in Santhalpargana district of Jharkhand has also been reported (O'Malley 1999, Watson 1907). The Asur-Birgia communities of Bishnupur in Chotanagpur plateau, Keriah communities also knew the art of iron forging. The authors have also described Iron in Archaeological context in detail starting from 1300- 600 BC; 600 BC-300 AD and 300-1200 AD. Important archaeological finds in iron has been described in detail during these historic time period. The daily use of metal objects included awls, axes, adzes, chisels, hoes, knives, nails, locks, ploughshares, razors, saws, sickles etc. Archaeo-metallurgy of Iron objects of Eastern India has been described in stages. The introductory stage, better known as Ferro-chalcolithic, slag was retained in the metal in large quantities due to inefficient smelting and forging, the product obtained was much similar to wrought iron of modern day. In stage II the smelters were able to carburise the iron and this stage is technically known as beginning of Iron Age. The stage three better known as advanced stage, the smelters were conversant with the technique of quenching of the carburized iron. It further describes the Cannons of Eastern India in the states of Assam, Bangladesh, Meghalaya, Orissa, Tripura and West Bengal.

Regarding Gold, focus has been made on sources of gold in eastern India, its separation by traditional methods, purification, evidences in historical records and objects found during excavation. In eastern India, alluvial gold is well known from the sands beds of rivers in Jharkhand and Orissa like Subarnrekha, Mahanadi, Sona, Garandi, Mainietc. Some rivers in Assam like Brahmputra and Subarnasiri are also known for enriched alluvial gold. The separation of gold by panning and washing was known to the indigenous

communities like *Dohras* or *dokras*, *ghasis*, *kols* and *mundas* of Singhbhum. These communities practiced gold washing till 19th century (Ball 1880). The method of gold purification during the medieval period has been described in the *Ain-i Akbari* (Blochman 1993, Khan 1986, Sundaram et al 1999). The gold objects has been excavated from places like Mahasthan in Bangladesh, Lauria Nandangarh in Bihar, Sekta in Manipur, Lalitgiri in Orissa, Pandu Rajar Dhibi in West Bengal etc. The concept of gold coins was introduced by Kushan rulers and it has been discovered from many historic sites in Bangladesh, Bihar, Orissa and West Bengal. The coins issued by the Gupta dynasty rulers like Samudrgupta, Chandragupta II, Kumargupta forms another marvelous series and they were known as Dinar. Their coins have been discovered from Samatata region of Bangladesh, Lalitgiri and Cuttack and Mayurbhanj district of Orissa.

Silver was usually famous as a metal and was widely used as ornaments in eastern India amongst the indigenous communities of Arunachal Pradesh, Meghalaya, Tripura and Manipur. Both the forms of silver electrum and argentiferous galena have been discovered in the states of Orissa, West Bengal, Bihar and Jharkhand. Silver also finds its mention in historical record, like in *Arthaśāstra* purification of silver has been mentioned (Kangle, 1997). The traditional methods of separation included washing of the ore in water, drying and crushing. It was placed in a furnace to be oxidized and after that by employing the process of cupellation the remnants of silver were obtained. Punch – marked coins of silver (50% silver and 50% Copper) were in use in the Indian sub-continent during the fifth centuries BC and continued until 1939. These coins had a standard weight of 3.732 grams and were known as *Karshpan*. The standardization of coins helped decide the minimum wages for the labourers. The authors have also reported the technical analysis of the Gupta punch- marked coins. The coins making during the medieval period has also been briefly touched.

The minor metals included Led, Tin, Zinc, their sources, process of extraction and objects found during excavation.

Regarding alloys of copper initially the people of eastern India used pure copper but later on they learnt the art of alloying copper. The authors have looked for inscriptive sources and literary references of alloying copper. Bronze which is major alloy of copper finds its reference in stone inscription

of Nagvamshi king Somesvar (Mahajan 2000). The Chinese traveller Fa-hsein who visited Bengal in fifth century states the use of musical instruments on a large scale. During the medieval period *Brahmavaivrat Puran*, a Bengal specific composition of 10-11th century tells us that copper-bronze class was bracketed as *śudra*. Some examples of use of copper from eastern part of sub-continent have been mentioned in Jharkhand, Assam, Bangladesh, Manipur, West Bengal and Orissa. The metallurgy of high tin bronzes, gun metal, brass etc. has also been mentioned in detail. Image casting specially of religious nature were very much in use in the eastern part of the sub-continent. Bronze images of Buddha, Avloketishwara, Vajrasattva have been found in museums of Assam, Tripura and Bangladesh. Cannons made of Copper alloys dating to medieval period have also been reported by the authors.

The concluding chapter makes a summary of chronological development of metallurgy in eastern India. An overall socio-economic development of this region is noticed with discovery of farming and firing of pottery. Firing of pottery may be said to be the beginning of Pyrotechnology, which led to the conversion of ore minerals into metal. The transformation from Neolithic to chalcolithic was primarily accentuated to invention of copper.

The book under review simply discussed the state of our present knowledge of metallurgy. The authors too confess that there is a need to carry out in-depth studies of the ancient metal objects. The traditional metallurgical technologies should be studied through the tools of modern archaeo-metallurgy. The non-destructive technologies like Neutron Diffraction, Protron Induced X-ray Emission (PIXE), and X-Ray Fluorescence and Lead Isotope Analysis should have been used to resolve the complex problem of dating. More in depth studies should have been carried out using modern methods of chemistry.