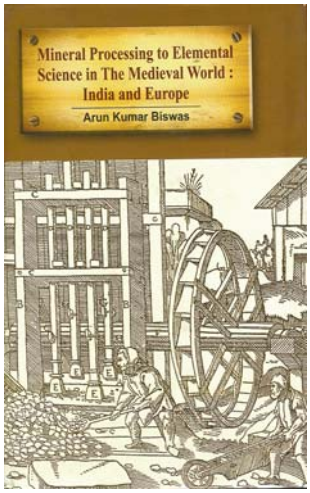

Mineral Processing to Elemental Science in the Medieval World: India and Europe. Arun Kumar Biswas. The Asiatic Society, 1 Park Street, Kolkata 700 016, India. 2011. ix + 427 pp. Price: Rs 580.

This book is the outcome of a research project dissertation which critically reviews the birth and progress of mineral processing to elemental science in the medieval period, with special relevance to Europe and India. In historical perspectives and scientific analysis pertaining to minerals, metals and minerals processing, alchemy and modern chemistry are critically illustrated with examples from medieval Indian and world history. Archaeological and literary evidences corroborating ancient India's primacy in the fields of mineralogy, metallurgy and chemistry in the medieval era make interesting reading. Vedic literature on minerals and metals, Harappan era minerals and metals, Iron Age in India during 1200 BC to AD 600, mines, gems and minerals during 600 BC to AD 600, the *Ratna Sastra* texts and iron and crucible steel in pre-modern India are critically laid out and analysed to illustrate the predominance of India in the field of mineral processing during ancient and medieval periods of history. Instances from *Rigveda* and *Arthasastra* are quoted to emphasize ancient India's prominence in precious metals, jewels and chemicals. It is interesting to note that names of minerals such as beryl are derived from Sanskrit. The primacy of India in brass and zinc metallurgy starting from early 5th to 2nd century BC up to the medieval period is convincingly illustrated. Zinc, copper and gold extraction was well known in ancient India and various metallurgical remains dating back to several hundreds of years are convincing proofs of such a marvellous historical past. Mineral processing state-of-the-art in 13th century India is illustrated in a fascinating fashion under chapter 3. India's state-of-the-art on gems, metallic ores, metals and alloys during this period is convincingly analysed through examples from *Rasa-Ratna-Samuccaya*, a chemical treatise authored by Vaga Bhattacharya. Tables illustrating minerals and metals in Indian antiquity showcase the mineral processing during 13th century AD in India. When we compare the current status of mineral beneficiation research and developments in modern India, one cannot help but wonder at the marvels in ancient Indian mineral processing art, artefacts and technology. Extractive metallurgy for non-ferrous metals such as gold, silver, copper, tin, iron, lead, zinc and manufacture of their various alloys was well established in medieval India.

The 16th century marvel of Georgia Bauer Agricola's mineral processing text *De Re Metallica* is discussed in the background of earlier Greek authors and earlier Europen traditions in mining, mineral engineering and other engineering innovations in chapters 4 and 5. Developments and innovations in minerals processing in Europe are highlighted with historical examples. There was a collapse of European prosperity in mining and minerals during the 14th century following the wars with Muslims and Mongols. However, engineering innovations in mining and ore milling progressed in Europe later on, and the Indian and other Oriental civilizations lost the race in science and technology. The question as to why India subsequently lost its pre-eminence in minerals engineering is answered with ample reasons.

Agricola is called the first mineral engineer of the modern world, bridging the ancient tradition with the new spirit of science. His historical contributions in minerals and metals in the European contest have been brilliantly portrayed. The 17th century quest for elemental science in Europe and India is illustrated with examples from Indian scriptures and European chemistry and alchemistry. Scientific renaissance in Europe up to 18th century is covered in chapter 8. Progress in minerals and materials engi-

The Magical Divining Rod for 'discovering' Mineral Veins: Forked Twig and Trench. A, Twig; B, Trench.

neering, and knowledge about gases and pneumatic chemistry are stressed. India maintained its primacy in zinc and wootz steel metallurgy as recently as the 18th century; but it stagnated in the vast areas of mineral processing and chemical investigations.

India's primacy in brass and zinc metallurgy was unshaken. Pyrometallurgical zinc extraction using retorts was invented in the Rajasthan belt of Zawar Mines and Rampura–Agucha. Ancient literature in zinc during the period AD 1374–1886 is presented to indicate progress and decline of the Indian zinc metallurgy. There was technology transfer from Zawar (India) to Bristol (England) before 1730. Iron, steel and wootz were the pillars of Indian metallurgical feats, which were marvelled for their metallurgical acumen and sound technology even today.

Having documented India's primacy in metallurgy and chemistry from the ancient to the medieval era, factors leading to stagnation and ultimate downfall are also discussed with appropriate reasoning, and historical and religious perspectives. Side by side, advancements in this field in China are also highlighted. The question being posed in chapter 10 is: Why did scientific renaissance take place in Europe and not in India?

Casualty factors are analysed, achievements and positive factors in the ancient Indian science evaluated and finally probable reasons for decadence critically assessed. Status of Indian S&T during the Moghul era (AD 1550–1750) makes interesting reading.

In concluding remarks made in chapter 11, the author highlights the important outcomes of his research related to birth stories of mineral processing to modern chemistry in India, Asia and Europe during the medieval period. History of science as illustrated through the years of research in this publication 'may be properly linked to planning of science for the future'. It is also shown that 'science can perpetually serve the society if it works in tandem with other positive approaches and values such as spirituality, secularism and socialism'.

This publication is a welcome gift not only to mineral scientists and chemists, but also to students in science across the world. The epic of saltpetre to gunpowder given as an appendix adds value to the earlier discussions. Towards the end of the book valuable illustrations from India, the Middle East and Europe depicting mineral and metal processing tools and engineering used in the ancient world are provided.

In summary, the author has written an excellent dissertation on the minerals and metals heritage of India compared to that in Europe in the medieval period. This publication will be immensely useful to students, researchers and teachers alike interested in knowing the glorious metallurgical heritage of our country. I feel that every Indian should read such published historical data to gain knowledge into our past and rich heritage in metals. Such knowledge of our historical excellence in metallurgy will open up new enthusiasm in the younger minds to engage in modern research relevant and applicable to current Indian mineral wealth.

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