Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

METTALLURGY IN ANCIENT INDIA

MASKE BHAGYESH RAJESH

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

INTRODUCTION: -

गुरु ब्रम्हा गुरु विष्णूगुरुः देवो महेश्वरा

गुरु शाक्षात परब्रम्हातस्मै श्री गुरुवे नमः

Indic civilization is often called as "golden bird" (sone ki chidiya) all of Indians takes pride of their glorious past but only some actually understand the fundamentals of this civilization it was not called golden bird just because of its wealth but values which do not get rusted with time, stays shinning as gold. We as Bhartiya's only know about that history, which is current controversy, only know about past thousand years which begins with the invasions the glorification of the invaders caused a lack of self-respect among the Indians and we started to their practices the only records we have are those which were written by the invaders.

A new revival of Bharat has begun where the citizens take pride in their culture and practice after the global pandemic world saw India its true nature, our practice of "namaskar" was adopted by the world as world was at a distance ayurvedic medicine and yoga's value was realized by the people all over the world now it is our duty to recognize the past and become a double-edged sword which has the Sankar of the past and technology of today's world.

A country is always recognized by its technology in the ancient world Bharat was the Centre of technology river of knowledge flowed all over the south of Asia from Iraq to Indonesia Indian puranas and itihas mentions of ships, vimanas, weapons, ornaments, idols, tools what is the basis of all of these it is metallurgy let us know the technology used in metallurgy

NEED FOR TOOL

There was a dawn of technology in east Africa by the early humans to strike cores and produce sharp flakes stone age had just started. For more than 2 million years early humans used tools to cut, pound, crush, and access new foods including meat and started farming which was never thought of for years because humans never thought to settle in one place, they lived a life of nomad because of tools all progress of art culture and life began.

The early tools were less efficient and very heavy this made them very difficult to use after a time it would break and new efficient solution was to be found out.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

Metallurgy brought about important changes in the human society as it gives rise to whole new range of weapons and equipment's which made humans more efficient in hunting gathering it made them to make shelters and new ways to conduct life, with the change in time and cognitive revolution humans started to use metals they were more lighter and more efficient than stone tools, it helped significant technological advancement in human history enabling more efficient agriculture, construction, manufacturing the transition from metal was very crucia.

Figure 1 IMAGE CREDIT: - FREEPIK.COM

METALLURGY IN INDIA

India has a long and illustrious history of metallurgy that dates back to ancient times the mastery of metal was not only essential for technological advancement but also very important in shaping Indian culture how it was represented with different forms of art, economy and trade relation. Ancient metallurgy in India is fascinating topic which shows ingenuity of the of its people and started to smelt many metals such as copper, bronze, iron and even previous metals like gold, silver, mercury etc.

It was the bronze age civilization also known as the Harapan civilization first evidence of metal in the Indian subcontinent comes from mehrangarh in Baluchistan when a small bead of copper was dated about 6000 BCE.

The Vedic period (around 1500-600 BCE) marked a significant phase in the development of metallurgy in India. The Rigveda one of the oldest sacred texts of India mention metal like gold, silver, copper highlight their importance in religion rituals and daily life. The "DHARMASUTRAS" and "ARTHASHASTRAS" texts also discuss the regulations of mining and metallurgy activities during the time.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

जाम्बूनदं शातकुम्भं हाटकं वैणवं शृङ्गशुक्तिजं जातरूपं रसविद्धमाकरोद्भूतं च सुवर्णम् । ३ । किञ्जल्कवर्णं मृदु स्निग्धमनादि भ्राजिष्णु च श्रेष्ठम्, रक्तपीतकं मध्य- [illegible] रक्तवरम् । ४ ।

This is mention of gold which is obtain from river, mountains known as satakumbhataka which obtain from mines Valneva that which is product of mountain venue these are different varieties of gold.

Figure 2: IMAGE CREDIT :- ALAMY.COM

These are description of how a pure metal is "Pure metal is that which when melted in a crucible does not give off sparks nor bubbles nor spurts nor emits any sound which does not show anything on the surface but is tranquil like gem.

This area description of metals which are gold, silver, copper, iron, tin and lead these are six metals and their resistance to waste (Rusting)is in the order in which they have been mentioned"

The knowledge in order of their oxidation shows the amount of knowledge which the civilization had for the metallurgy.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

INFLUENCE OF METALLURGY ON INDIAN SOCIETY

(A) TECHNOLOGICAL ADVANCEMENT: - The mastery of metallurgy contributed to the development of sophisticated tools, which enhanced agricultural productivity, led the architectural marvel, and improved weaponry.

(B) ECONOMIC PROSPERITY: - India's rich deposits of metals like gold, silver, copper, and iron contributed to its economic prosperity through trade with other civilization such as roman empire and south Asian kingdoms.

(C) CULTURAL SIGNIFICANCE: - Metals were integral to religion rituals with the use of gold and the creation of sacred idols. Metallurgy played a role in the exquisite artwork and craftmanship of ancient India.

(D) SOCIAL HIERARCY: - The control over metallurgical knowledge often translated into power and influence leading to the emergence of metal king builds and craftsmen who held esteemed position in society.

Ancient metallurgy in India represents a remarkable journey of human ingenuity and technological progress. From the early days of Indus valley civilization to the iron age. The people ancient India displayed remarkable expertise in working with various metals creating lasting legacies in the form of artifacts, structures and cultural practice this rich heritage continues to inspires and educate us about the accomplishment of our ancestors and their contribution to world.

SEVEN METALS OF ANTIQUITY

Figure 3: IMAGE CREDITS: - IIT BHU

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

There are 7 metal of antiquity gold, silver, copper, iron, mercury, lead, tin. India had a high tradition of metallurgy skills let us see some of its land.

IRON METALLURGY

While the Indus civilizations belonged to the bronze age its successor the ganga civilization, which emerged in the first millennium BCE, belonged to iron age. The use of iron in India dates back to several centuries BCE, and its revolutionized various aspects of Indian system. Here are some key aspects of iron technology in ancient india.

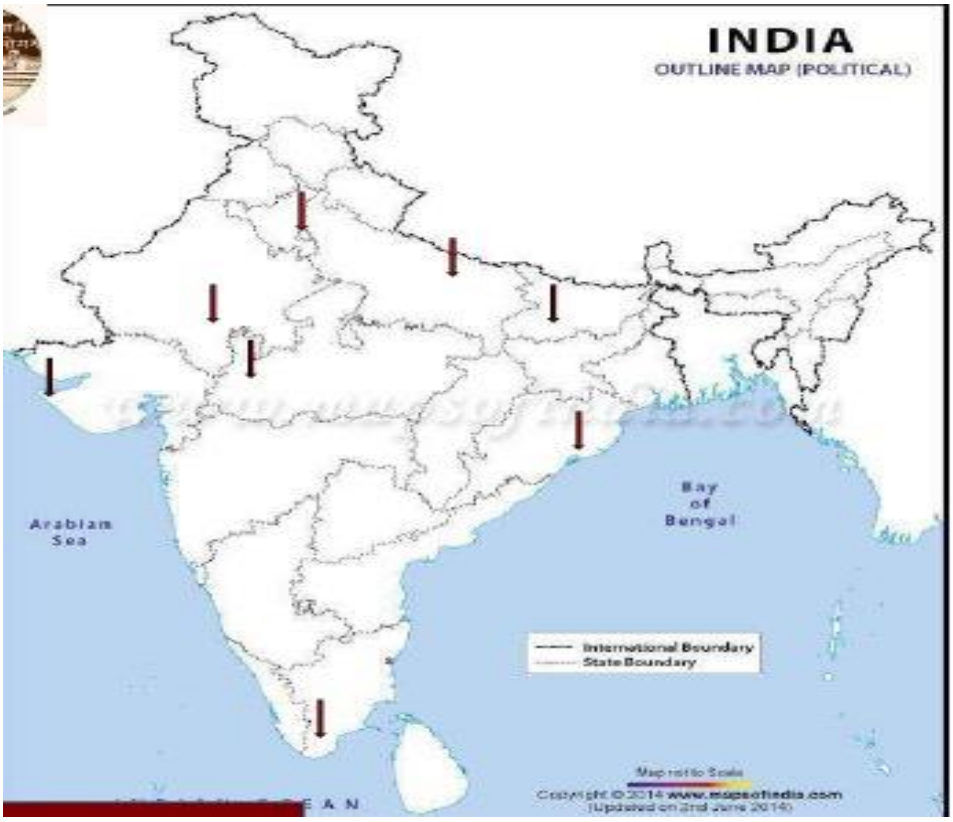

Figure 4 IMAGE CREDITS: - IIT BHU

EARLY IRON SMELTING

Iron smelting and ironworking in India began around 1800 BCE or earlier during the late Vedic period and the early stages of iron age. This marked a significant transition from the previous bronze age as iron tools and implements proved to be more durable and efficient than their bronze counterpart.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

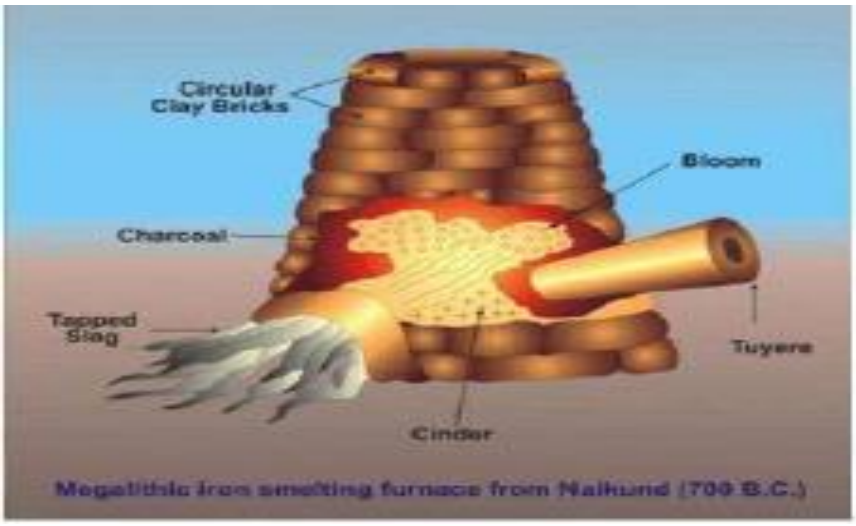

Figure 5 IMAGE CREDITS: - NATIONAL SCIENCE CENTER NEW DELHI

Although iron melts at a higher temperature than copper it is easy to smelt and forge and offer more possibilities for tool making than bronze.

Indian weapons made of wootz during the medieval era. The first British experts who studies wootz steel found it “better than the steel produced anywhere else in the world”.

(Left) Increasing the heat by pumping in air through bellows.

(Bottom) Clay crucibles and the end result.

Figure 6 IMAGE CREDITS: - IIT BHU

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

MARVEL OF ANCIENT INDIAN SMELTING

DAMASCUS STEEL: -

Damascus steel is a famed type of steel recognizable by the watery or wavy light and dark pattern of the metal.

Damascus steel was valued because it maintained a keen edge yet was hard and flexible.

Weapons made from Damascus steel were vastly superior to weapons formed from iron.

Figure 7 IMAGE CREDIT: - IIT BHU

THE DELHI IRON PILLAR

Figure 8 IMAGE CREDIT:- NCERT

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

Erected by Chandra Gupta || as a standard of Vishnu at vishnupadagiri 1600-year-old height of 7.67m made up of 6 tons of wrought iron. A manufacturing marvel made by horizontal forge welding

A thin layer of a compound of iron phosphorus and oxygen makes it rust – resistant.

IRON PILLAR AT ADI-MOOKAMBIKA

Figure 9 IMAGE CREDIT: - IIT BHU

Iron Pillar located in Adi-MookAmbika temple at kodachadri village in Karnataka 30 km from Arabian sea build by tribals of region.

The top 1m of the pillar shows excessive corrosion specially on the surface facing towards the Arabian sea.

Figure 10 IMAGE CREDIT:- IIT BHU

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

THE IRON BEAMS AT KONARK SUN TEMPLE

Konark Sun Temple is a 13th century ce at Konark about 35 km northeast from puri on the coastline of Odisha, India

Iron beams between every two stone blocks. These bars reinforce the overall robustness of the monument.

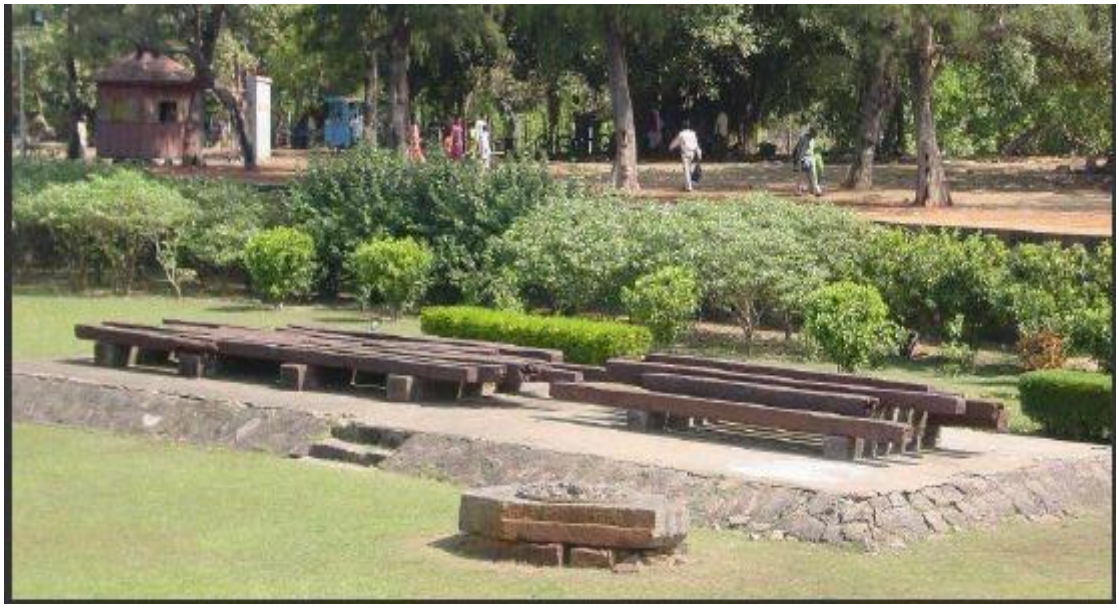

Figure 11 IMAGE CREDIT:- NCERT

Yantras in Ancient Indian

Dola Yantra

A mud pot is taken and two holes are made on both sides of the neck of the vessel, exactly opposite to each other.

An iron or strong wooden rod is inserted through holes. The pot is filled half with the prescribed liquid. A pottali (pack containing the mixtures of substance to be subjected to process, wrapped in a cloth and tied together with thick thread) is tied and it is hanged at the middle so pottali dipped in liquid.The pot is subjected to mild heat so that the liquid does get spiled out of the pot due to boiling.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

Figure 12 IMAGE CREDIT:- VAIDYA NINAD SATHE

URDHVAPATANA YANTRA

Substance to be undergone procedure should be placed in a pot another same sized pot with slightly bigger mouth than first pot is kept over the mouth of first pot and joint is closed with the help of cloth plaster. It looks like a tabor and hence known as damaru yantra.

It is used for the purpose of urdhva patana of substance with low boiling point such as Parada, somala etc.

In this yantra substance is placed over the lower pot and it is subjected for heating. A wet cloth should be placed over upper surface of upper vessel.

Figure 13 IMAGE CREDITS: - VAIDYA NINAD SATHE

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

TIRYAKPATANA YANTRA

Parada triturated with specified medical drug is taken is an earthen pot which is connected to long tube at its neck.

Direction of this tube should be diagonally downward.

This tube is inserted into long neck of another pot and both joints are sealed with mud.

This tube is inserted into long neck of another pot and both joints are sealed with mud.

Pot containing Parada is strongly heated from below while other pot contains cold water.

Figure 14: IMAGE CREDITS: - VAIDYA NINAD SATHE

LOST-WAX CASTING

Lost wax casting also called investment casting, precision casting or cire perdue is the process by which a duplicate sculpture (often such as metal, silver, gold, brass, bronze) is cast from an original sculpture. Intricate works can be achieved by this method.

The oldest known examples of this technique are approximately 6500-year-old (4550-4450 BCE) and attributed to gold artifacts found. A copper amulet from mehrangh, Indus valley civilization, in Pakistan is dated around 4000 BCE.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

Figure 15 IMAGE CREDITS: - NCERT

BRONZE TECHNOLOGY

The bronze technology played a significant role in development of ancient Indian civilization. The bronze age in India dates back to around 3300 BCE and continued for several centuries. During this period bronze was crucial material for making tools, weapons and various artifacts. Here are some key aspects: -

(a) metallurgy

(b) tools and weaponry

(c) artifacts

(d) sculptures

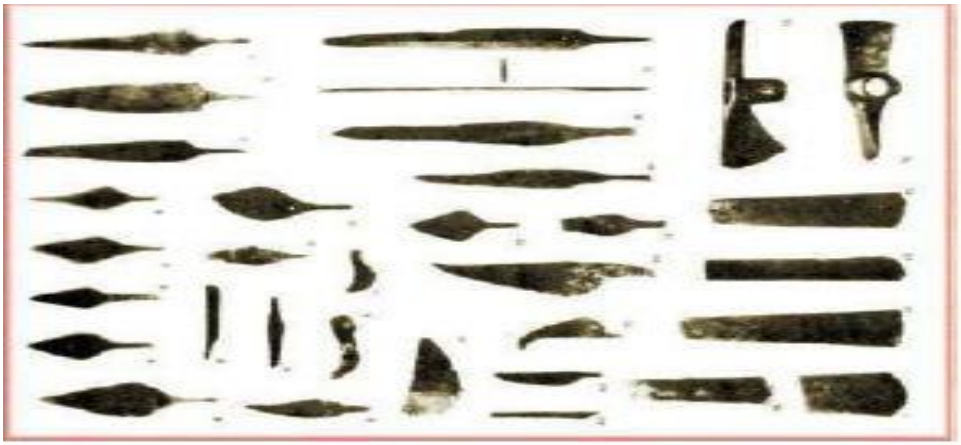

Figure 16 IMAGE CREDITS: - IIT BHU

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

BRONZE CHEMISTRY

Bronze tools from Mohenjo-Daro. Copper was alloyed with tin (producing bronze, arsenic, nickel both of which harden bronze) and lead in varying propositions.

Then, they discovered (by casting)

Copper + tin ---> bronze (corrosion resistant)

It had impurities like nickel, arsenic and lead.

Figure 17 IMAGE CREDITS: - IIT BHU

COPPER TECHNOLOGY

Copper technology may date back to the 4th millennium BCE in the Himalayan region.it is first element to be discovered in metallurgy copper and its alloys were used to create coper bronze images such as buddhas or Hindu manaYana Buddhist deities. Xuan Zang also noted that were copper bronze buddha image manufacturing process is handled by a specialist.

It has been native copper not the smelted metal extracted from ore.

Harappan metal smiths obtained copper ore (either directly or through local communities) from the Aravalli hills Baluchistan or beyond.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

Figure 18 IMAGE CREDITS: - IIT BHU

ZINC EXTRACTION IN BHARAT

Zinc was extracted in India an early as in 3rd and 4th century BCE. Zinc production may have begun in India in the northwestern of India on an industrial scale. The distillation technique was developed around 1200 ad at zawar in Rajasthan.

Rasarnava and rasaratna samuchaya the mineral that turn copper to gold

Chinese tutenague derived from tamil tuthanagam madanapala (13th century) recognizes it as a metal and calls it "jasadam" Paracelsus and basil valentine (15th century) call it a bastard metalor semi metal and fail to recognize it as a metal because its brittleness.

Rasaratna samucaya or rrs 2.163-164 refers to gutikakriti pellets containing sodium bicarbonate and borax. The charge (about 1.5kg per refort) was loaded into clay retorts fitted with funnel like condenser tubes. There were indeed the bringal shaped crucible or ventakamusa as described in rrs. On heating in the furnace zinc oxide was reduced by a carbonaceous matter to zinc vapour the reducing blue flame of carbon monoxide was observed to be substituted by white flame of zinc vapour, indicating the reduction had taken place (Bharat Bila Sita Yadi).

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

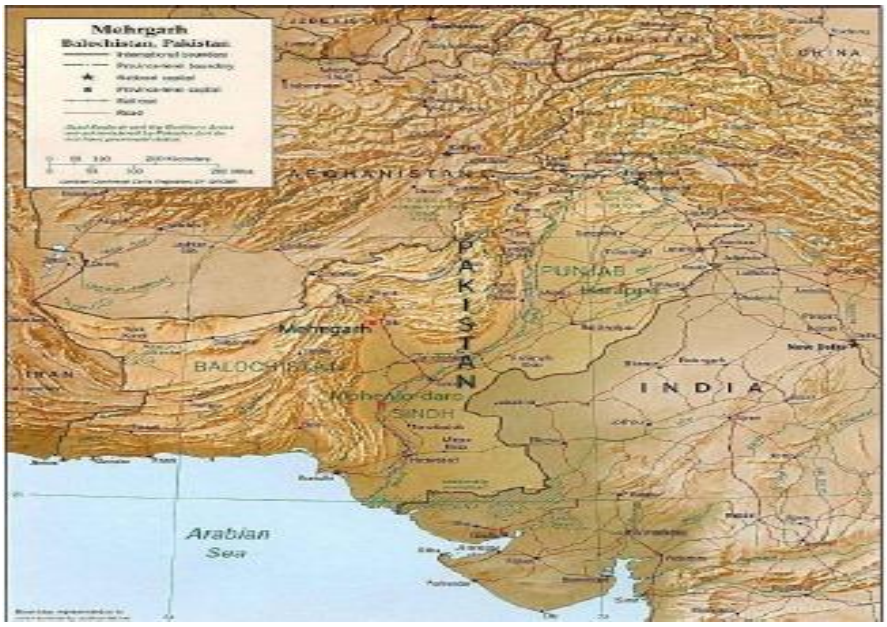

Figure 19 IMAGE CREDITS: - NCERT

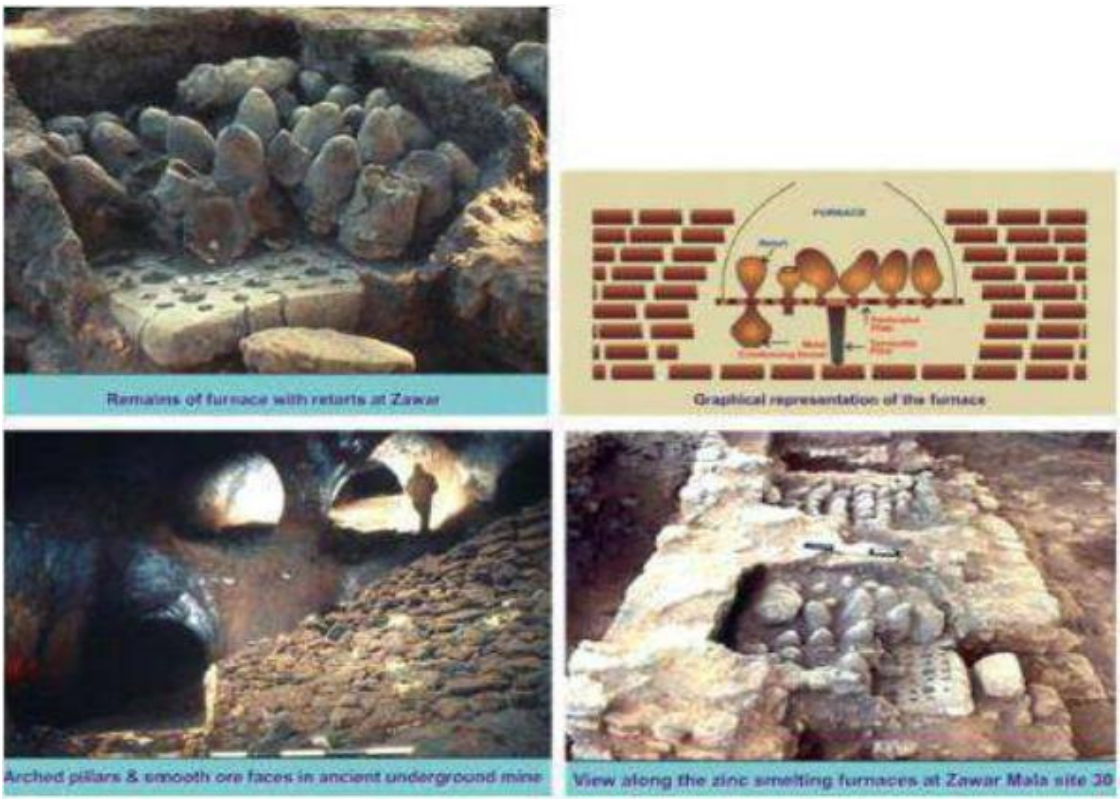

Figure 20 IMAGE CREDITS: - IIT BHU

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

BRASS IN ANCIENT INDIA

Brass technology has a long history in ancient Indian dating back thousand of years brass in an alloy of copper and zinc and its production and use in India can be taken back to Indus valley civilization here are some key aspects of brass technology in ancient India.

Indus valley civilization: - archeological excavation at sites like Mohenjo-Daro and Harappa in the Indus valley have revealed numerous artifacts made of brass. These artifacts include vessels tools and decorative items indicating that Indus valley people had advanced knowledge of metallurgy in India including the production of brass.

USES OF BRASS

(A) RELIGIOUS AND ARTISTIC SIGNIFICANCE OF BRASS: - It played a significant role in ancient India art and religion. Many Hindu Buddhist temples features brass statue of deities and other religious figures.

(B) TOOLS AND WEAPONS: - Brass was metal which was used in tools and weapons in the extraction of the Dhola vera various spears and arrowhead have been found.

Figure 21 IMAGE CREDITS: - IIT BHU

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

CONCLUSION

Indian metallurgy has a rich and ancient history with significant development in the extraction and procession of various metals including gold, iron, copper and bronze here a summary of Indian metallurgy.

Metallurgical knowledge was passed down through generation and was often closely linked to religious practice. Ancient text as arthashastra and Shilpa shastras. The production and trade of metal and metal products were significant contributors to Indian economy and trade relation with other civilization including those in middle east and southeast Asia.

In summary, Indian metallurgy has a long and distinguished history with advancement in extraction procession and artistic use of metal like gold, iron, copper and bronze. This metallurgy achievement played a pivot role in shaping India's culture, economy and technological process through ancient history.

Vidhyayana - ISSN 2454-8596
An International Multidisciplinary Peer-Reviewed E-Journal
www.vidhyayanaejournal.org
Indexed in: ROAD & Google Scholar

BIBLIOGRAPHY

(A) WWW.GOOGLE.COM
(B) WWW.CHATGPT.COM
(C) WWW.WIKIPEDIA.COM
(D) WWW.SLIDESHOW.COM
(E) WWW.EASYAYURVEDA.COM
(F) WWW.JSTOR.COM
(G) WWW.RESEARCHGATE.COM
(H) www.iitbhu.ac.in/dept/met.com