

Mining and Civilization

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Abstract: *Ancient ruins or an ancient stone statue recalls the work of miners who brought the material from a quarry so that the sculptor can create a work of art. Carving of massive stone blocks and piercing tunnels in mountains are arts in which the same tools of mining are used and mining engineers are involved. Studying history of mining necessitates also the study of archaeology, art, architecture, and world history in general since it is the history of civilization. The pyramids of Egypt, the gold of Tut Ankh Amoun, the Colosseum in Rome, the Taj Mahal in Agra, and the Gold Rush in California, are nothing but few examples that remind us of the role of mining and quarrying through the ages and will be briefly described.*

Keywords: *Archaeology, Quarrying, History, Carving, Art, Architecture*

1. INTRODUCTION

Mineral resources of a country represent an important national wealth. Localization and exploitation of this wealth requires knowledge of geology, mining, and metallurgy. Construction of shelters and temples were one of the earliest purposes of primitive man. At first people made walls by stacking construction material, but eventually mortar was used to strengthen the dwelling. Mineral resources were also used in making tools, jewellery, etc. But from ancient times rocks and minerals were used by sculptures to create statues, by artists to carve artefacts, and by architects to build monuments. Through the ages this represents our civilization that is based on mining.

Gold has a special place in mineral resources. It is the oldest metal exploited by man and plays an important role in society and in world economics. It caused unprecedented mass migrations, and at least one war. It was responsible for creating many large cities, is highly prized, has been the inspiration of numerous myths, was the ultimate goal of alchemists, stored in the vaults of banks, widely on display in oriental bazaars, and is generously used in decorating churches and temples.

Salt is one of the most important evaporates, found in dry salt beds and in underground mines. When it was discovered that salt preserved food it quickly became a precious commodity. Cities were founded near salt works.

Quarrying is a special type of mining applied to materials of construction, e.g., granite, marble, quartzites, slate, limestone, etc. In this case the intention is to get large pieces of certain dimensions and not shattering the rock. Since the dawn of civilization, people have been building tunnels for accessing tombs or underground quarries. The ancient Egyptians decorated their underground tombs with many coloured paintings from scenes of everyday life (Figure 1).

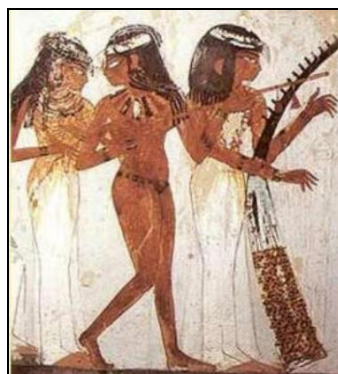


Figure 1. *Wall paintings in ancient Egyptian tomb*

2. ANCIENT EGYPT

The construction of the huge pyramids, the transportation of massive rocks, and the extensive working of hard rock such as granite was conducted on an unprecedented scale. The ancient Egyptians quarried tremendous quantities of limestone, large quantities of granite from Aswan, alabaster, diorite, marble, serpentine, purple porphyry, black slate basalt, dolomite, and other ornamental stones. They also mined for precious stones such as turquoise, emeralds, malachite, amethyst, and other gemstones

The Pyramids

The use of limestone for the first time on a large scale as a construction material was for the Step Pyramid at Saqqara (Figure 2). There are about one hundred pyramids in Egypt the largest ones being in Memphis [present day Giza]. The Great Pyramid is built of large limestone blocks each weighing about 2.5 tonnes (Figure 3). The blocks were made smooth so that they fit one on top of the other without mortar. Quarrying and moving these blocks are a great feat. The Great Pyramid is not just a pile of stones - - it is a grave containing a burial chamber, passages, and ventilation ducts, etc.



Figure 2. *The Step Pyramid at Saqqara build for Djoser (2667 - 2648 BC)*



Figure 3. *The author at the Great Pyramid in 2009 showing the size of the limestone blocks*

Obelisks

An obelisk is a monumental tapering column carved from a single block of granite with a square or rectangular cross-section and capped with a pointed top called a pyramidion covered with gold.

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Generally, they have inscriptions on all four sides. An average size obelisk is about 30 m high and weighs about 800 tonnes. There are 26 known ancient Egyptian obelisks which are located in different countries including the UK, USA, France, Turkey, and Italy.

Colossal sculptures

The ancient Egyptians not only quarried large masses of stone for constructing impressive structures but also they created many art works from these hard rocks (Figures 4 and 5).



Figure 4. *One of the colossal monuments in the Egyptian Museum in Cairo*

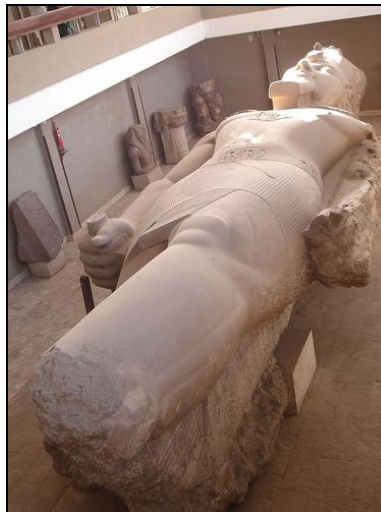


Figure 5. *One of the colossal monuments of Ramses II near Giza*

Gold

The ancient Egyptians were the first to mine gold which was found in the Eastern Desert. They made beautiful jewellery and perfect masks (Figure 6).



Figure 6. *Mask of Tut Ank Amoun*

3. STONEHENGE

Stonehenge (Figure 7) in the Salisbury plain in England consists of a megalithic stone circle featuring a number of massive two vertical stones capped by a horizontal lintel. The earliest portion of Stonehenge dates to approximately 2950-2900 BC. They are assembled from sandstone blocks found in quantity in Kent from the post-glacial remains. There was no quarrying - - only transportation problem.



Figure 7. *Stonehenge, England*

4. ISLAMIC EMPIRE

When the Abbasid dynasty moved the capital of the Islamic Empire from Damascus to Baghdad, they build the new city Samarra about 125 km north of Baghdad. The caliph Al-Mutawakkil who reigned from 847 until 861 built in 847 AD a great mosque out of baked brick. The minaret is 52 m high and 33 meters wide with a spiral ramp (Figure 8).

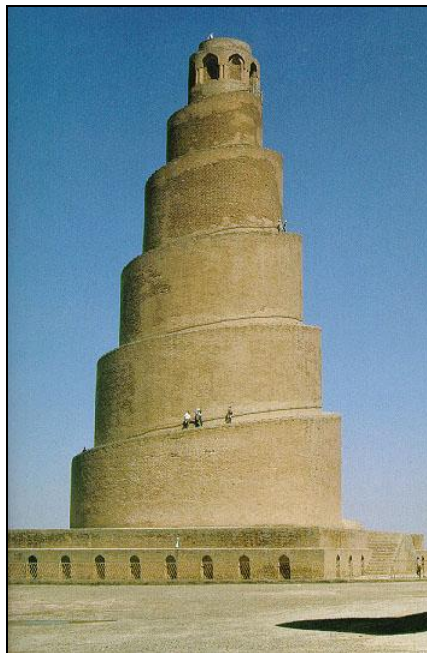


Figure 8. *The Great Mosque at Samarra, 847 AD*

5. PERSIAN EMPIRE

The ancient city of Persepolis near Susa in modern-day Iran is Greek meaning “the city of the Persians” was built around 520 BC. The building commenced with Darius I (550-486 BC). Ruins of a number of colossal statues exists, all are constructed of marble (Figure 9).



Figure 9. Monuments at Persopolis

6. ANADOLIA

The Hittites ruled a great empire that stretched from Mesopotamia to Syria and Palestine. Their empire was at its greatest from 1600 to 1200 BC. The Kingdom of Commagene was founded in the 1st century BC and it became a strong political entity during the reign of Antiochos I Epiphanes (62-32 BC). His tomb at Nemrud Dağ is located on a high mountain where a number of large statues were erected in the first century BC. The heads of the statues are now scattered throughout the site (Figures 10 and 11).

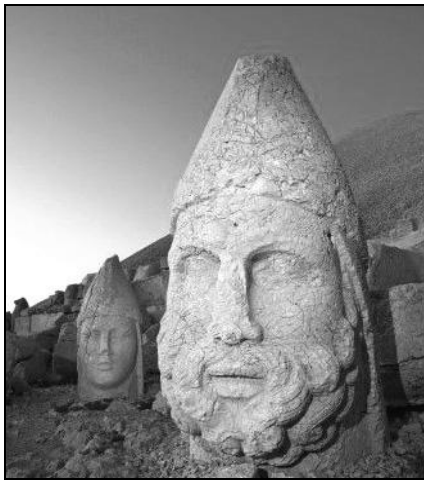


Figure 10. King Antiochus I

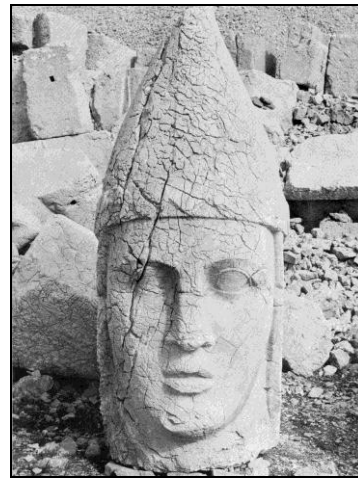


Figure 11. The ruins of mount Nemrud

7. GREECE

Athens financed its wars with silver from Laurium (Figure 12). The Greeks quarried large quantities of building materials to build temples (Figure 13).



Figure 12. Samples of Greek silver coins

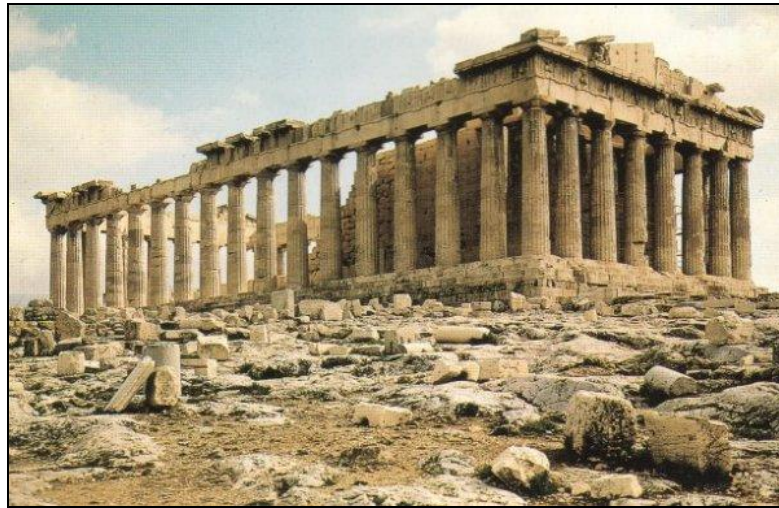


Figure 13. Extensive build materials was quarried by the Greek to build temples

8. ROMAN EMPIRE

Work in the mines was first done by slaves, prisoners of war, or criminals. Beginning with the reign of Hadrian in AD 138, the Roman Empire permitted mining by freedmen in increasing numbers. The Romans quarried large amounts of sandstone known as travertine quarried from nearby Tivoli for constructing the Colosseum, built between 70 and 82 AD in the heart of Rome (Figure 14). It is elliptical in plan, 189 m long and 156 m wide. The height of the outer wall is 48 m. The Romans also constructed numerous aqua ducts (Figure 15), temples, and roads throughout the Empire.



Figure 14. The Colosseum in Rome, 70 and 82 AD



Figure 15. A typical Roman Aqua duct

Imperial porphyry

Imperial porphyry is a deep reddish purple coloured rock with white crystals and is very fine grained. It was quarried in the Eastern Desert of Egypt from 29 AD for around 300 years and transported via the Nile to Alexandria then to Rome. It was carved into a variety of objects (Figure 16).



Figure 16. A large bowl carved from imperial porphyry in Rome

9. GREAT CATHEDRALS AND CASTLES

Construction of the magnificent cathedrals and castles in the Middle Ages necessitated quarrying of huge amounts of stone. An example is Notre Dame de Paris constructed between 1200 and 1250, and Conway Castle in Wales, built between 1283 and 1289 by Edward I (Figures 17 and 18).

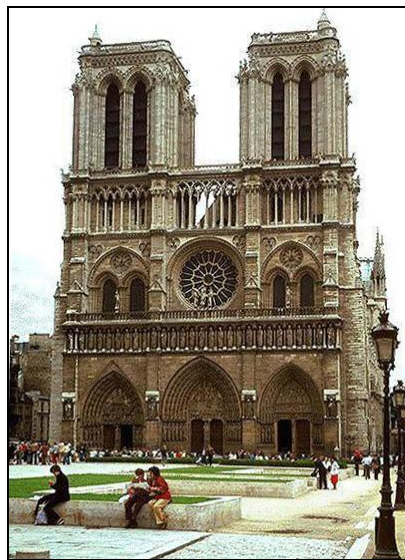


Figure 17. Notre Dame de Paris 1200-1250

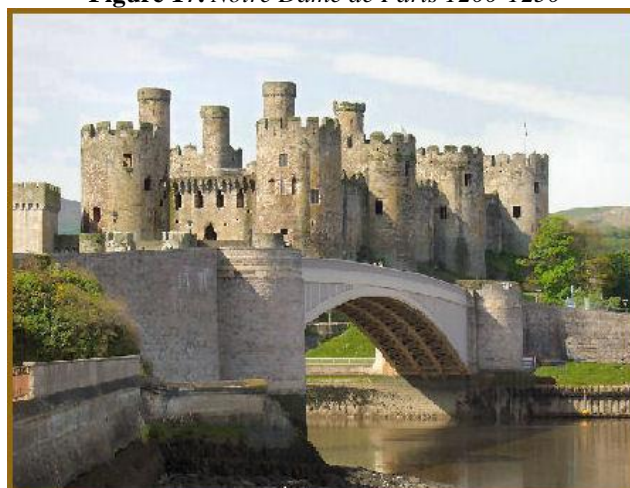


Figure 18. Conway Castle in Wales, built between 1283 and 1289

10. GREAT WALL

During the Chinese Warring States period from the 5th century BC to 221 BC, extensive fortifications were constructed to defend their borders. Walls were made mostly by stamping earth and gravel between board frames. What survives today are the stone and brick walls predominately from the Ming Dynasty (1368-1644) (Figure 19). The main wall is around 3,460 km long with an extra 2,860 km of branches and spurs, 7 m high in some places and ranges from 5 - 10 m wide



Figure 19. A portion of the Great Wall from the Ming Dynasty

11. AMERICAN INDIAN CIVILIZATION

Olmec

The Olmec were an ancient Pre-Columbian civilization living in the tropical lowlands of south-central Mexico, in what are roughly the modern-day states of Veracruz and Tabasco. They flourished from 1400 BC to about 400 BC. Their colossal heads are among ancient America's masterpieces. There have been 17 colossal heads unearthed to date which are believed to be portraits of rulers (Figure 20).



Figure 20. An example of an Olmec head

Pre-Inca civilization

Located near the southern shore of Lake Titicaca in present-day Bolivia, the city of Tiwanaku was the capital of a powerful pre-Inca civilization that dominated the Andean region between 500 and 900 AD. The monumental remains of this great culture include several temples, a pyramid, symbolic gates, monoliths and mysterious carvings of alien-like faces. Puerta del Sol (Gateway of the Sun) (Figure 21) constructed of a single block of andesite, an extrusive igneous volcanic rock estimated to weight about 44 tonnes. The surface is decorated with bas-relief designs and a sculpture of a deity on one side.



Figure 21. *Porta del Sol, Bolivia*

Mayas

The Mayan Empire was mainly centred in the Yucatán Peninsula, Guatemala, and western Honduras. It is the oldest and the greatest empire before the Spanish conquest. It reached its zenith about the year 1000 AD. The Mayas built temples and pyramids and carved statues. Remains of this empire can be seen in Chichen Itza, Uxmal, and Izamal (Figure 22). Kukulcan's pyramid is 24 m high, essentially a nine-step structure culminating in a flat platform built between 550-900 AD.



Figure 22. *Maya pyramid at Chichen Itza, Mexico*

Toltec

The Toltec Civilization was one of the great empires of the Basin of Mexico, after the fall of Teotihuacan and before the rise of the Aztecs (about AD 900-1200). The capital was at Tula which controlled most of central Mexico, the Yucatan peninsula, and the Gulf coast. The Toltec established trade connections with people as far away as what is now Zacatecas and Guatemala. They mined and carved statues 4.5 m tall (Figure 23).



Figure 23. *Toltec statues, 4.5 m tall*

Aztec

The Aztec Empire was centred around Tenochtitlan (now Mexico City) about the year 1325 and fell before the Spanish in 1519. The Aztecs built pyramids and had elaborate religious rituals. The Pyramid of the Sun is their largest building and was constructed around 100 AD (Figure 24). It has nearly the same base perimeter as the Great Pyramid of Egypt but half its height [71 m] and differently built. It holds fragments of stone, adobe, and earth, with facade of stone arranged in the form of steps.



Figure 24. Aztec pyramid of the Sun near Mexico City

Inca Empire

Cuzco, the capital of the Inca Empire from 900 to 1572 contains buildings made out of stones precisely cut and shaped to closely fit without mortar (Figure 25). Walls of large boulders, shaped to fit perfectly with each other in rectangular and polygonal blocks.

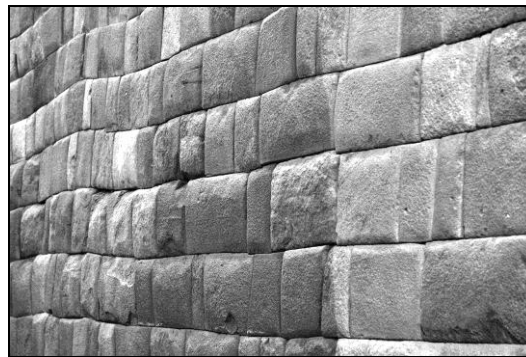


Figure 25. Example of Inca walls

12. KHEMER EMPIRE

Angkor served as the seat of the Khmer Empire that flourished in Cambodia in the ninth century. The ruins of Angkor are located amid forests and farmland near modern town Siem Reap. The temples of the Angkor area number is said to be the world's largest single religious monument (Figure 26). The temples are built from sandstone blocks quarried 30 km north-east of Angkor. The blocks were floated along the Siem Reap River then transported by elephant or ox carts to Angkor. No mortar was used between the stones.



Figure 26. One of the largest temples at Angkor

13. MOGHUL EMPIRE

The Moghul Empire was a Muslim Persians that ruled most of India as Hindustan. They built splendid palaces, tombs, minars, and forts that stand today in Delhi, Dhaka, Agra, Jaipur, Lahore, Sheikhpura and many other cities of India, Pakistan, and Bangladesh. In 1631, Emperor Shah Jahan (1592-1666) built the Taj Mahal in Agra (Figure 27) in 1632 after his wife's death. About twenty thousand workers recruited from northern India, Bukhara, Syria, worked for 20 years using materials from all over India and Asia. Over 1,000 elephants were used to transport the building materials. The translucent white marble was brought from Rajasthan (Figure 28) and precious and semi-precious stones were inlaid into the marble.



Figure 27. Taj Mahal in Agra, 1632-1648



Figure 28. Modern transportation of white marble from Rajasthan

14. CONCLUSIONS

Ancient statues, temples, monuments, and artifacts kept in museums which constitute our heritage were in the first place due to miners who got the raw materials from natural resources.

REFERENCE

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