

FROM THE HISTORY OF MINING TECHNIQUE IN CONTEXT OF CENTRAL EUROPE

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Abstract: *An important role in the development of human civilization is the use of tools. In the first stage for their production wood, bones and stones were and in next stage harvesting and their extraction metals was used. Mining is one of the oldest activities of man in acquisition his basic material needs. According to some geologists and historians, mining (extraction raw materials) is even older than agriculture. Paper is dedicated to students of technology and everyone who has interest for the history of mining engineering in context of Central Europe.*

Keywords: History of science and technology, mining

1 INTRODUCTION

The first real mines for the stone raw material are already in the young Paleolithic. The oldest mining labour was done in two ways: the first is based on the digging of funnel shaped pit, the second type is real deep mining [1]. The overburden rocks are broken through a narrow shaft some meters long. Deep mining brings better results but technical problems solved by simple tools firstly and machines later.

On the horizon of suitable layers then the low mine galleries were bored. This system already contained elements of the actual mining activities, and was fundamentally different from simpler methods based solely on vertical digging and stone breaking. The tools used were antler spikes and stone hammers. Leaving or building pillars was a good solution for the stability of mines.

At the turn of the third and second millennium BC there have been major changes in Central Europe and the Balkans in the mining industry, meaning the transition from rock mining to the metals industry. The raw materials for the production of metals have begun to be gained - copper, gold, and later massive use of bronze occurred.

Although in the Bronze Age weapons and tools made of stone were still manufactured and used, for better quality they gradually were replaced the metal products. The importance of prehistoric mining of copper, tin, and later iron ores and their processing has become more and more important.

This civilization milestone is also referred as the beginning of the technical age. In the Bronze Age, the so-called social division of labour has taken place – where the separation of handicrafts from agriculture is meaning. Prospecting and metallurgy due to place and time for work are isolated from agriculture, specialization is taking place: mining, metallurgy, metal-processing is developed.

2 PRE-INDUSTRIAL MINING

The characteristic feature of mining technology is extraction of ore and its transportation to the surface and pumping water from the mine. Mechanical devices have experienced a major expansion in their use in Ancient Greece and Ancient Rome.



Fig. 1 Mine lamps documenting the development of lighting. Důl Michal, Ostrava – Michalkovice, Czech Republic



Fig.2 Gápel, Solivar, Prešov, Slovakia (Mining equipment for the extraction of raw materials (solt water here) driven by animal power)

The theoretical knowledge of mechanics from turn of 15-16th century enabled building of mines with greater depth. There have also been major changes in mining technique and technology. Mechanization was mainly applied in the transport of extracted raw material. The first mechanical devices (dreptak), used as a lifting machine that replaced the winch used to that time was wooden wheel powered by humans. The mining device powered animals (called as Gapel) was used later. A water wheel is used to drive ores mills and pumps.



Fig. 4 Isaac Potter's "fire engine" model. The first steam engine installed in continental Europe. Slovenské banské múzeum, Banská Štiavnica, Slovakia

In the 14th century, the process of population differentiating of mining towns and settlements has progressed at area of Central Europe. It is possible to talk about two different groups:

- Landowners - owners of mineral rights, mines, mills and other production facilities.
- Miners and workers who provided mining.

The hammering of mining corridors and the shaft was very slow.

Mining works were accelerated in the 17th century using dusty powder (firstly in 1627, Štiavnické Bane, present Slovak Republic). The mining works were substantially accelerated when from the 60s of 19th century dynamite and electric ignition was used instead of a gunpowder. In Kingdom of Hungary the machine drilling was firstly used in 1873.

Mining and mapping, as an important part of the mining engineering, prepared documents for the design of mining works and plants. The role of the mine geometers was to produce maps of mined works, but also, for example, to carry the exact boundaries of the minefields from the surface to the underground. The basic measuring instruments were: compass, measuring tape, and inclinometer. The compass was in the Banská Štiavnica, Slovakia used since 1555.



Fig. 3 Office of mine geometer. Důl Michal, Ostrava – Michalkovice, Czech Republic

Mining in greater depth was inhibited by bottom water. This pit water prevents to mining works and has to be brought to the surface by water management methods in order to enable the mine to continue working. During a long period of the mine history the dewatering techniques have been based on manual water haulage and by recurring to buckets and leather buckets mounted on water wheels and on gravitation transportation via dewatering tunnel.

It was only in the 15th and 16th centuries that mine dewatering techniques had some technical advancements as work-efficient pumps made available (Machina hydraulica). The first mention of mine pumps dates back to 1535 from New Bane. The most prominent facilities have been built since the late 17th century and during the 18th century, and rescued mining in the Banská Štiavnica region. These findings relate to the names of Matej Kornel Hell, Jozef Karol Hell, Samuel Mikovini,

The fire machine (Machina pyraulica), invented by Thomas Newcomen, is considered the first water-independent dewatering machine - in the year 1712. Isaac Potter, an English mechanic in 1722 build in Nova Baňa (Königsberg), present Slovakia, the first atmospheric steam engine of the Newcomen concept on the European continent. Although using steam engines successfully managed to deal with mining water problems, but the operation was costly and dangerously consumption of wood was increased, therefore operation of fire machines was closed [2].

Therefore, Jozef Hell designed water-pillar (water-pumping machines) in 1749 (first use 1753) in region of Banská Štiavnica (Schemnitz before). Water pillars were powered from unique water-supply system of artificial lakes (named as Taich) as Banská Štiavnica did not have natural watercourses [3].

3 MINING IN INDUSTRIAL AGE

From 18th century the steam engines were mainly used to pump water out of the mines. The steam engine, during the 19th century has become a universal drive especially for its better technical parameters.



Fig.3 Safety brakes of mine lift. Abandoned coal mine Důl Michal, Ostrava – Michalkovice, Czech Republic

In 19th and 20th century coalfields and ore mines began to be electrified, and mines began to build steam power plants. Electric motors, compressors and turbochargers have been used not only to propel towed machinery, but also to pump mining waters, ventilation and in the transport gradually replaced steam engines.



Fig.5. Electrical drive of mine hoists (1912). Abandoned coal mine Důl Michal, Ostrava – Michalkovice, Czech Republic

Heavy machinery is used in mining to explore and develop sites, to break and remove rocks of various hardness, to process the ore and recultivation after the mine is closed.

Large drills are used to sink shafts, excavate stopes, and obtain samples for analysis. Trams are used to transport miners, minerals and waste. Lifts carry miners into and out of mines, and move rock and ore out, and machinery in and out, of underground mines. Huge trucks, shovels and cranes are employed in surface mining to move large quantities of overburden and ore [4].

Obtaining raw materials in time of industrial revolution and modern industry has influence to many other spheres of life as development of transportation, formation of workers colonies [5-7] and settlements and not in last order changes in society.

4 CONCLUSION

The role of mining engineering in history is very significant. Mining engineering was motor of development of geology, chemistry, metallurgy and mechanical engineering. The Industrial Revolution

brought further advances in mining technologies, including improved explosives and steam-powered pumps, compressed air tools, rail transportation and electrification later. Although mining has a negative impact on health and safety and on the environment, without the extraction of mineral raw materials, it is not possible to further development of the industrial developed society.

Acknowledgements: *This paper was created within the solution of project KEGA 054TUKE-4/2016 “Inovácia výučby predmetov so zameraním na automatizáciu v reakcii na požiadavky priemyslu a služieb.”*

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