

## Die historische Lösung der Umweltschäden, verursacht durch die Gewinnung und Aufbereitung von Pyrit in Ostböhmen in der Zeit der Habsburger Monarchie

### Environmental Rehabilitation of Areas Affected by Contamination and Associated Problems Resulting From the Exploitation and Processing of Pyrite in East Bohemia in the Times of Austrian Monarchy

Историческое решение вредов,  
вызванные добычей и обогащением  
пирита в восточном Богемском во  
время австро-венгерской монархии

Von/by

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mit/with 9 Fig.

#### Schlüsselworte

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Hüttenwesen (Geschichte)  
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Österreich (Monarchie)  
Pyrit  
Pyrit (Bergbau)  
Sanierung (Umwelt)  
Tschechische Republik  
Umweltverschmutzung

#### Abstract

The impact of mining and affiliated industrial activities in the highly developed countries of Europe were being solved in the last two centuries and earlier. An example of such an attempt was made at

Lukavice in East Bohemia since the end of 18<sup>th</sup> century in the time of the Austrian Monarchy. A water tunnel which drained away contaminated acid water from the Lukavice pyrite mines was built under the bed of the near-by Chrudimka river. Also small artificial water falls and small tailings in the Lukavice brook served for quicker decomposition of harmful pyrite waste material from mines and chemical plant. Only a few remnants of this arrangements have been left. They have been at present suggested as technical monuments.

#### Introduction

All mining and other industrial activities were from their very beginning connected with major or minor impacts on the environment. These problems were simultaneously solved in relation to the development of the human society, especially on certain industrial, economic, social and scientific levels. During the time of the Austrian Monarchy, the Bohemian countries attained rapid progress in this sphere within the European framework. A good historical example of such progressively developed mining and associated industry is represented by the Lukavice pyrite deposit near the town of Chrudim in the Železné hory Mts.

The substantial data about Lukavice mining and rehabilitation were described by several authors, e.g. ERXLEBEN (1794), WOAT (1875), HELMHACKER (1876), BRABINEK (1949), VODICKA (1953) and others.

#### Mining and industry operations

Pyrite ores were continually and intensively exploited there mainly since the second half of 18<sup>th</sup> century when the family of Prince AUERSPERG became owners of the pyrite mines. Pyrite was mostly processed for pure sulphur and sulphuric acid, with the latter being used solely for the manufacture of phosphate fertilizer - superphosphate. Besides the main products, several other materials were produced at the Lukavice chemical factory (e.g. dyes, fertilizers, chemicals), which was the oldest chemical plant to have been operational in Bohemia during the reign of the Austrian Monarchy (Fig. 1). Products of the Lukavice chemical plant were also understood and appreciated by the Monarchy, who took part in several exhibitions of which some were international. Such involvement and expertise resulted in their winning a prize at the World Industrial Exhibition in Vienna in 1873 (Fig. 2). It is worth mentioning that five years after the discovery of selenium as a new chemical element by Jacob BERZELIUS in 1822, the occurrence of this element in Lukavice pyrite ores was mentioned by chemist LEVENAU in his monography.

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Fig. 1: The late so called Prince Mining Office at Lukavice. Behind it used to be the Lukavice chemical factory and close to it pyrite mines. The situation from the 1950's.

A history of pyrite mining at Lukavice ended in 1892. The mines were closed due to economic reasons - exploitation of pyrite was more expensive than the import of pyrite from abroad (mainly from the Smolnik deposit in North Hungary - presently known as Slovakia). The Lukavice chemical plant still existed for several years but was moved to the nearby town of Slatiřany, closer to the railway. In spite of the fact that the chemical industry definitely finished there during the 1950's, it can probably be assumed that the present major chemical industry near Pardubice in East Bohemia is heritage of the old Lukavice and Slatiřany chemical factories.

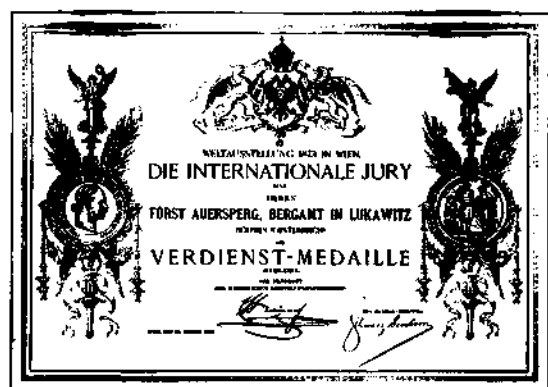


Fig. 2: A Certificate from the World exhibition in Vienna in 1873 accompanying a medal which Prince AUERSPERG was awarded for his merits in the development of the chemical industry at Lukavice.

It is important to add that the AUERSPERGS' era was connected with a modern approach to not only both mining and chemical industries but also to agriculture, forestry and water management, and provided a fine example of a careful approach to the cultural and industrial development of the countryside. Many problems connected with the impact of mining and chemical industry on the environment were solved due to Adam AUERSPERG's activity, which involved the invitation of some of the most well-respected mining experts to Lukavice to solve technical mining problems (such as the use of water power). These included montanist Joseph Alexis DE ADDA from Příbram and Royal Master of Metallurgy Ferdinand LOENHARDT from Jachymov (Joachimstal). One of the worst problems was the occurrence of strong acidification and contamination of both surface and ground waters in the proximity of the Lukavice area. Today, this problem would be known as acid mine drainage. The principles of this consist of the destroying of pyrite at mining dumps and the rest of chemical processing by oxidation (Fig. 3) of which the principle products are acid sulphur and iron oxides (limonite). This became the frequent cause of disagreement between the owners of the mill on the Chrudimka river, fishermen and Municipal Council of Chrudim, and also the root cause of a number of judicial contradictions. This contamination usually increased after heavy rains or after accidental spillages at the Lukavice chemical plant. MILLERS observed a rapid corrosion of their machines due to the acid river environment. Also, fishermen complained about the damage done to the fish in the Chrudimka river.



Fig. 3: Old pyrite mine dumps at Lukavice. In front of them there are remnants of an evaporator basin for the production of sulphuric acid.

#### Mining impact rehabilitation

Obtaining the assistance of the above mentioned experts and others aimed to solve such topical problems based on the broadest experiences and knowledge to hand at that time. At the end of 18<sup>th</sup> and the beginning of 19<sup>th</sup> century

a water gallery was built measuring 1592 m (Fig. 4). It not only facilitated the transport of water from the mines at Lukavice but also helped to solve the environmental problems that have been mentioned. At the mouth of the water gallery a sophisticated arrangement was built, represented by a tunnel draining acidified mine water from the gallery under the base of the Chrudimka river. It was here that unique "two-levels-water crossing" originated. The mine water was sent through this tunnel which was built separate from the riverbed, thus preventing any contact with the mill water channel starting at the wooden weir in the river.

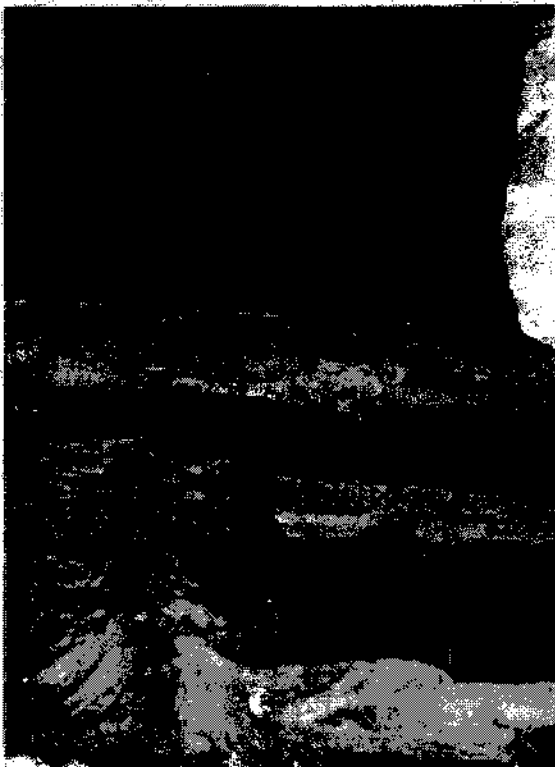


Fig. 4: A part of a small shaft at the beginning of the water gallery on the first level of one of the Lukavice mines as recorded during exploration carried out in the 1950's.

The other device was a chain of smaller tailings and cascades on the Lukavice stream which enabled quicker oxidation of pyrite waste material. Continual technical improvements in the chemical factory at Lukavice, which aimed at a better environmental situation of that time.

## Conclusions

We can summarize that the historical approach to rehabilitation of mining damage at the Lukavice pyrite deposit was very diligently and carefully carried out at this time, and differed widely from the geological exploration and experimental mining of the Lukavice pyrite on the above mentioned site during the 1950's, when no rehabilitation or reclamation were done there (Fig. 5).



Fig. 5: Old mining gallery at Lukavice reopened in the fifties.

The remainder of historical technical arrangements accomplished during the time of Austrian Monarchy were slowly forgotten. There are only a few remnants of the former pyrite mining and chemical factory left today (Fig. 6 - 9). But with the enthusiasm of a small group of people, some of these achievements have been suggested as technical monuments, thus reminding contemporary and future generations of the commencement of mining reclamation connected with exploitation of raw material in Central Europe.



Fig. 6: Sandstone landmark with mining attributes at Lukavice village.



Fig. 7: A baroque altar in the church of Saint Bartolomeus at the village of Bitovany near Lukavice decorated with two statues of miners.



Fig. 8: Figures of miners decorating a hand-grip of a mining foreman stick from Lukavice.

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Fig. 9: A mining emblem from the former Lukavice Mining Office.

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