Conditions in the Idrija Mercury Mine at the end of the 16th Century and Measures for its Restoration

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Abstract

Introduction

Mining – in any mine – basically depends on the overall geological conditions in the ore deposit, the mine's technical equipment, the excavation method and conditions, and on people – the owners and above all the experts working there. The extraction of mercury in Idrija was begun around the year 1490. Sufficient information is available in archives on the conditions in the Idrija Mine in the 16th century as regards its technical equipment, excavation conditions in the pit, energy supply, and working conditions (Verbič, 1966, 1969, 1990; Valentinitsch, 1981). There is, however, no information from this period on the geological conditions in the mine, because geology did not yet exist as an independent science in the 16th century. It only began to develop in the second half of the 17th and in the 18th centuries. The first reliable data on Idrija's rocks and cinnabar ores were not recorded until 1761 by mine physician Scopoli. As in other European metal mines, mining activities in Idrija in the 16th and 17th centuries were also performed on the basis of practical experience and a knowledge of the basic characteristics of cinnabar ores and mineralized rocks, as well as accompanying rocks in the Idrija ore deposit. Mining activities were therefore not systematic or planned. Excavations were directed by direct tracing of mineralized rocks. The spatial location of rich cinnabar mineralisation in the Idrija ore deposit was complicated due to tectonics. This led to the formation of a nonsystematic and complicated web of shafts, galleries and jack pits, which in all aspects strongly worsened the mining conditions. There are unfortunately no preserved mine maps from this early period of mining that could clarify the spatial conditions in the pit. It is only on the basis of archival data (Verbič, 1966, 1969, 1990; Valentinitsch, 1981) and our present-day detailed knowledge of the conditions in that part of the ore deposit being excavated in the 16th century that we have been able to reconstruct, quite faithfully, the conditions in the pit. In the 16th century, the Idrija Mine was by all means ranked among mines that are most difficult to access and, owing to the difficult mining conditions, among the most cost-demanding mines in the world (Verbič, 1966, 1990). Yet despite the difficult conditions, around 6000 tons of mercury was extracted between 1508 and 1600 and the mine generated a profit.

Conditions in the Idrija pit in the second half of the 16th century

In the 1580's, the conditions in the pit of the Idrija mine were extremely unfavourable. Mining was performed exclusively in the very richly mineralised, soft, highly bituminous (coal intercalations), and black 'Idrija shale', also rich in native mercury, which was later named the 'Skonca beds'. The mine was open in only one daily shaft – St. Achacius' Shaft –, which was 61 metres deep and reached all the way to the water-bearing, Cretaceous base. It was equipped with a horse-driven 'gepelj' used to lift ore and pit water from the pit, transport miners into and out of the pit, as well as to lower wood supports and other materials into the pit. It was also the only path for the entry of fresh air into the pit and the release of contaminated air from the pit.

Because the mineralised Skonca beds descend from the northwest towards the southeast, three jack pits were made on the bottom of Achacius' Shaft and connected with the intermediate horizontal shafts. This provided access to the then final depth of the mine - 156 m, which was located at a distance of 243 m from Achacius' Shaft (approximate depth of level V). The excavation areas expanded in all directions throughout the mineralised beds (Verbič, 1990; Valentinitsch, 1981).

It is difficult to image the toilsome work and troubles caused by mining in the described conditions, particularly in the deepest parts of the mine. Every day miners had to descend along ladders to their worksites. Wood supports were lowered into the bottom of Achacius' Shaft with a lifting device called »gepelj«, and then carried by miners or driven in wooden pit carts called »truhca« to the excavation areas, and lowered into shafts using winches. The excavated ore was transported in pit carts to the nearest jack pit, where it was deposited in vessels, raised to the next level with winches, and loaded into pit carts again. The miners in the deepest parts of the pit had to repeat this procedure at least three times. In Achacius' Shaft, the ore was raised to the surface with a horse-powered »gepelj« (Verbič, 1966, 1990; Valentinitsch, 1981).

One of the problems in the pit were the constant inflows and frequent inrushes of water. Because the mine was not equipped in this period with pumps for raising water (kamšt) from the pit, this was done manually using buckets (40 kg). Verbič reports (1990) that in normal conditions, 32 workers – pumpers carried water from the pit every day (Verbič, 1990). During the inrushes of water in 1587, which reached a depth of 156 m, the work in the pit was stopped and all miners were engaged in carrying water out of the pit (around 180 miners).

One of the main obstacles to the work in the mine was the unregulated ventilation of the pit. To ensure adequate ventilation of pit areas, there must be at least two entrances from the surface. Fresh air enters the pit through one entrance, and polluted, spent air leaves the pit through the other. Given the fact that at the end of the 16th century the Idrija mine was accessible through only one daily shaft (St. Achacius' Shaft), it was not possible to provide for effective ventilation of the pit in that period. For this reason, miners worked in the pit only in winter, late spring and autumn, while in summer they stopped working in the pit and were engaged in burning ore. In winter, the fresh, heavier and cooler air descended from the surface along Acachius' Shaft and gradually pushed away the warmer, spent air. However, since the air was flowing through the only entrance and exit in Acachius' Shaft, the two air flows began to mix and thus strongly worsened the ventilation in the pit. Because the pit was widely branched out, the air in many excavation areas was completely spent and even caused pit lamps – the so-called »ripsovka« (oil lamp) – to extinguish, and so fresh air had to be forced into the excavation areas using bellows (Verbič, 1990).

Evidently, the work performed by miners in the Idrija Mine in the second half of the 16th century was extremely difficult and harmful to health. One can image how toilsome it must have been to work hours and hours in an environment where, due to deteriorating organic substances, the air was strongly overheated, smelly and spent,

with high concentrations of mercury vapours and almost 100% humidity. A solution to all the above-mentioned problems was the construction of a second, new shaft leading to the deepest excavation areas, which would be used for ventilation and equipped with a pump (kamšt) and a lifting device (gepelj).

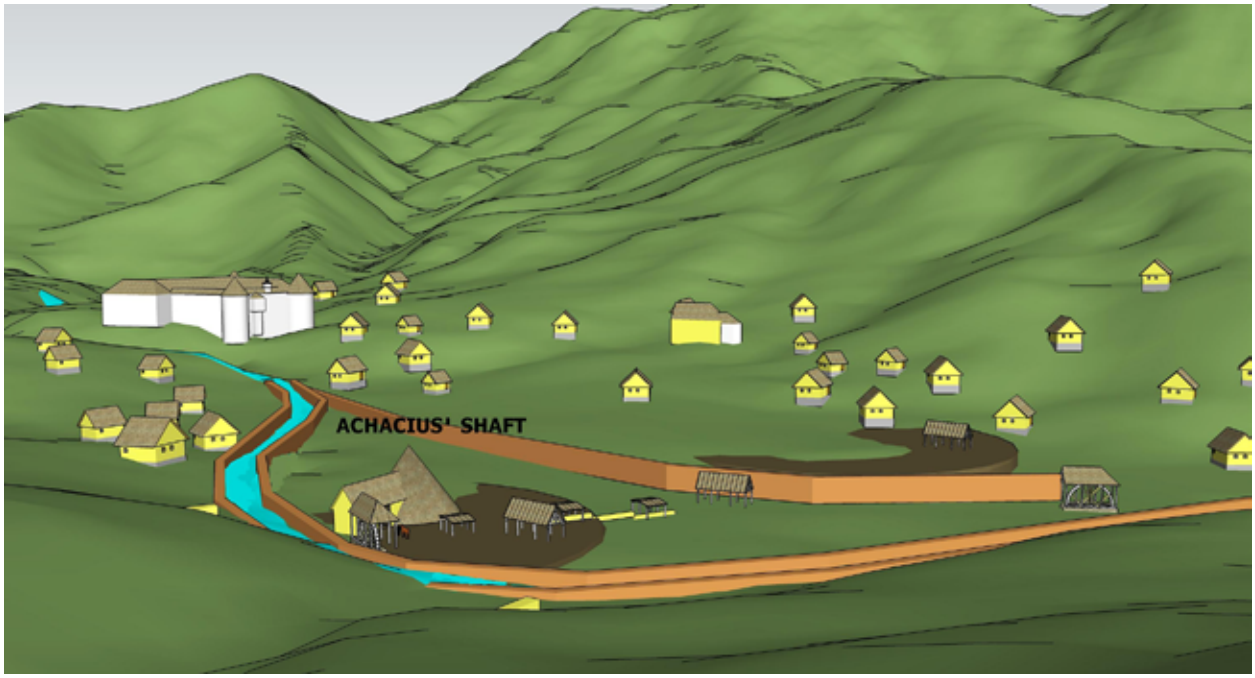

Fig 1: Reconstruction of Idrija at the beginning of the 16th Century (Bizjak, 2013)

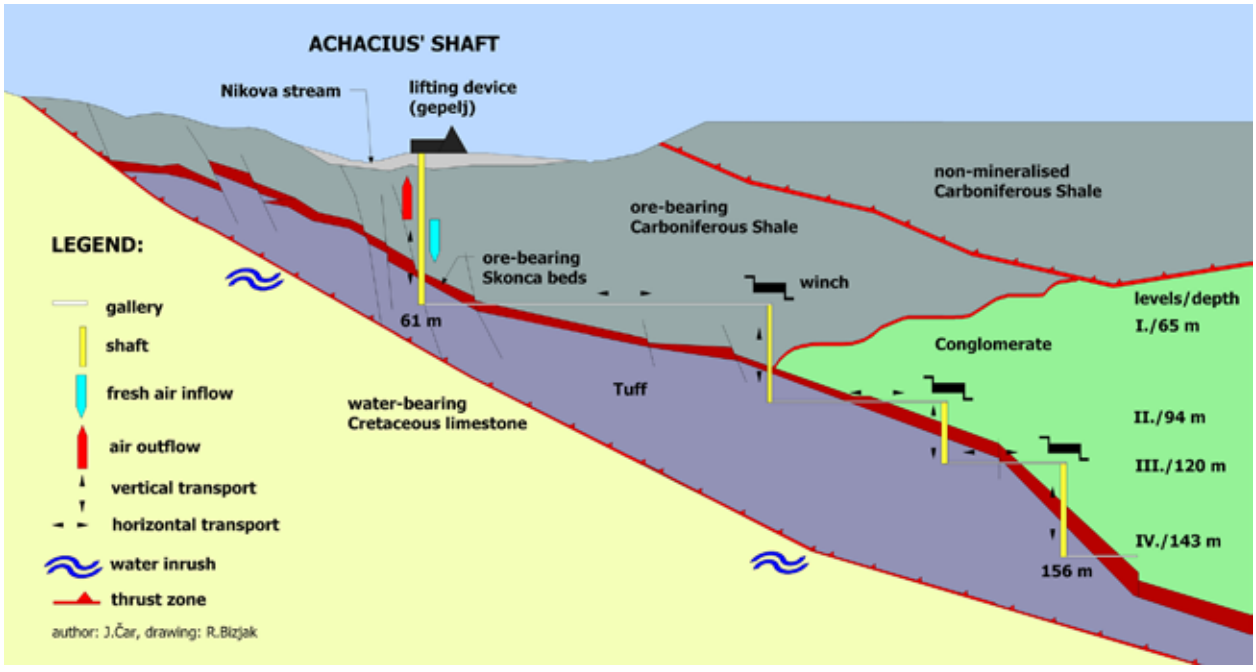

Fig. 2: State of mine machines before the arrival of Gregor Komar in Idrija in 1586 (Čar 2011, Bizjak 2013)

Measures for restoration of the mine under the administration of Gregor Komar (1586 – 1596)

Soon afterwards, when the Idrija Mine had been nationalised in 1575 and its ownership fell under the Vienna dynasty, the Land Prince, Archduke Karel, issued on 6 April 1580 special mining rules, entitled *Idrianisch Haubt Bergordnung de anno 1580*. The previous mining rules, those of Maximilian from 1517 and of Ferdinand from 1553, were no longer appropriate for the new circumstances in the mine. The purpose of the new rules was to force miners into obedience and order, which was supposedly a prerequisite for the existence of any mine. The provisions of these mining rules, which focused primarily on the attitudes of miners towards their work and their superiors, vested the ruler with the responsibility for the existence of the mine (Verbič, 1969). At that time, more precisely, in 1579, there were 121 miners and workers employed in the Idrija Mine (Verbič, 1969).

From 1549 onward, i.e. in the entire period of the above-mentioned significant changes in legislation being introduced in the second half of the 16th century, the Idrija Mine was administered by the otherwise noble and financially well-situated, yet corrupt, *Urban Ainkhürn*. Following the inrush of water into the pit in 1562, incessant warnings were voiced by the owners as well as the provincial authorities regarding the unbearable conditions in the pit and the lack of sufficient energy supply in the mine. After the water had flooded the lowest excavation areas in 1562, *Jakob Lamberg*, a member of the Acachius Society, proposed the construction of a new shaft. The same proposal came in the same year from the Supreme Mine Master of the Inner Austrian Lands, *Jurij Singer*. However, numerous owners opposed such works due to the high costs involved (Verbič 1966, 1969, 1990; Valentinitsch, 1981). Consequently, the mining problems in the Idrija pit began to accumulate. In 1580 the Land Prince repeatedly sent the Supreme Mine Master, Jurij Singer, to Idrija. After 18 years, Singer repeated his proposal of the necessity of constructing a new shaft, adding that it was also necessary to ensure sufficient quantities of water to drive the »kamšt« (water wheel). But Ainkhürn failed to take action. There were many reasons for this, some of which are reported by Verbič (1990). Most unusual is the fact that, even after the mine's nationalisation in 1575, the competent authorities did not replace it. This was undoubtedly due in particular to Ainkhürn's close and friendly relations with Viennese and provincial personalities. In 1586 the Vienna Court recalled the indecisive and aging Urban Ainkhürn after having administered the mine for 37 years, and in his place appointed a highly qualified forestry master from the Friuli region, *Gregor Komar*, who had excellent organisational skills. Komar was instructed by the Land Prince to begin with the immediate reformation and reorganisation of the mine.

After acquainting himself with the conditions in the pit and on the surface, Komar set to work. In the very same year (1586), he managed to convince the Land Prince to send *Hans Huebmayer*, Supreme Mine Master of the Austrian Lands, to Idrija in order to determine the condition of the mine together with the new administrator and other mine employees, and to propose appropriate measures. Their findings were, of course, the same as those reported by individuals and committees during previous visits (Verbič, 1990). They found that it was urgently necessary to construct a new daily shaft in Kukanovo's garden (in the area of the present-day Barbara parking lot), which would lead to the deepest part of the mine, i.e. up to a depth of 90 fathoms (170 m). The shaft was to be modernly equipped with a kamšt (water wheel) for lifting water from the pit and a two-sided wheel (Kehhrrad) for raising and lowering loads. This would essentially simplify the transport of ore and wood, as well as improve the ventilation of the entire pit, particularly the excavation areas. Sufficient quantities of water to drive the shaft would be provided from the Sandtner stream (today the Podobnik stream) and from the spring below Čudnov hill (from Ljubevč mountain?). By abandoning the complicated transport of ore in the pit and the raising of loads from the pit with a winch, the labour costs would be considerably reduced. The new shaft would also provide miners with safer and quicker access to the excavation areas.

The construction of a new shaft was in all respects a highly demanding investment that required qualified experts and sufficient energy sources. At the time, Idrija had neither of these. On the committee's proposal, the Austrian Archduke Karel made arrangements with the German Emperor Rudolf II for water wheel masters (Kunstmeister) from German mines to come to Idrija (Verbič, 1990; Valentinitsch, 1981). Following some complications regarding the arrival in Idrija of the imperial construction and water wheel master, *Ruprecht Pebinger* from Kuttenberg in the Czech lands, intensive works were immediately begun on the construction of a »kamšt« (water wheel) above Acachius' Shaft. In October 1587 the complex pumping device was installed above Achacius' Shaft. Due to the long distances in the pit and the multiple repositionings/rewindings of the pump from horizontal to vertical position in the jack pits, there were frequent breakages of rods that prevented the pump from functioning properly.

Owing to an inrush of water into the pit on 23 March 1587, the digging of the new daily or main Barbara's Shaft was delayed for almost a year, until the spring of 1588, for which an expert from Schlackenwald, *Hans Roth*, was engaged.

Fig. 3: Signature of Gregor Komar, Mine Administrator (Valentinitsch, 1981)

Fig. 4: Signature of Hans Huebmayer, Supreme Mine Master of the Austrian Lands (Valentinitsch, 1981)

The works subsequently progressed without major complications. The kamšt for pumping water above Barbara's Shaft began to operate in 1593, followed one year later by a two-sided wheel for the transport of ore and wood. The shaft was completed in its entirety, i.e. down to a depth of approx. 200 m (depth of level VII), in 1596. The simultaneous construction of horizontal connecting shafts between the two main daily shafts in the pit also significantly improved the ventilation of pit areas, thus allowing miners to excavate ore in summer as well.

In the second half of the 16th century, the Idrija Mine had extremely poor and inadequate energy sources. The mine's new administrator, Gregor Komar, was well aware of this problem. Concurrently with the construction of Barbara's Shaft and the connecting shafts in the pit, the energy supply in the mine was improved, otherwise the new devices above the shaft would not have been able to operate. The labour of human hands and horses was expensive even in those times and above all too weak to overcome such energy-demanding works as raising heavy burdens from great depths. As many as four attendants (Kunstwarter) were employed day and night to operate the kamšt. The only available energy source in Idrija was water power. First of all, the catchment of water for driving the kamšt was improved at nearby dammed streams with low water levels. Later on, more distant streams were dammed (Ljubevč, Podobnikov graben, Kovač stream below Čudnov hill), and water was conducted in wooden channels for distances of up to 2 km. Gregor Komar proposed that the Idrijca River be dammed at Pri Kobili (near Črno jezero (Black Lake) or Divje jezero (Wild Lake)), 3.6 kilometres south of Idrija. Due to high costs, the proposal was temporarily rejected.

In the spring of 1595, the renovator of the Idrija Mine, Gregor Komar, had to quickly leave Idrija because of his Protestant beliefs (period of the Counter-Reformation). He was replaced by an equally hard-working administrator, *Georg Adler* (1596-1602), who completed the works already commenced. By 1604 the Pri Kobili dam was completed and the 3.6 km-long Rake water channel leading to both daily shafts in Idrija was constructed (Acachius' and Barbara's Shafts). The mine was thus provided with the necessary and sufficient energy.

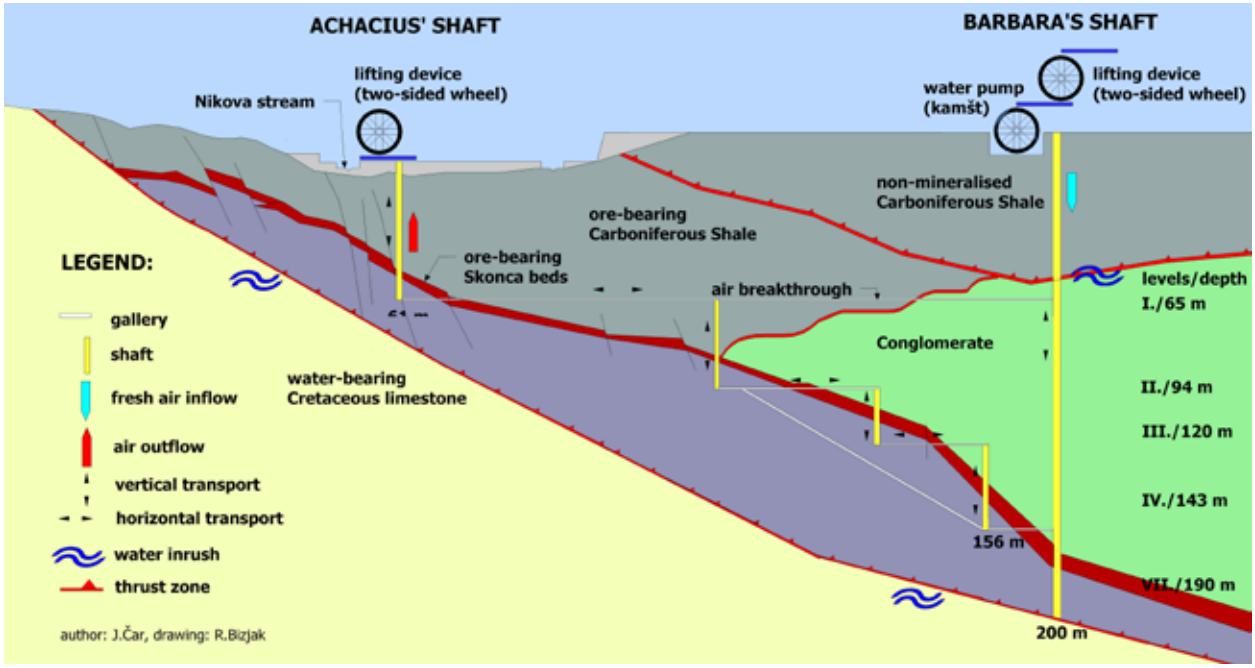

Fig. 5: Conditions in the mine after its restoration and modernisation in the period of Gregor Komar (1596-1602) and both of his successors, Georg Adler (1596-1602) and Ferdinand Igel (1602-1604), (Čar, 2011; Bizjak, 2013)

Conclusion

After its modernisation was completed in the late 16th and initial years of the 17th centuries, the Idrija Mine became one of the best equipped mines of that time in Europe. Its comprehensive restoration enabled the undisturbed operation of the mine for the next 150 years. By damming the Idrijca River at Pri Kobili and constructing a water channel to the shafts as well as catchments at nearby streams, the mine was fully supplied with energy for the next 250 years, until the introduction of steam-driven machines in the mid 19th century.

Sources

VALENTINITSCH, H., (1981): Das landesfürstliche Quecksilberbergwerk Idria 1575-1659. 1-439, Graz.

VERBIČ. M., (1975): Valvasorjeva rimana kronika o idrijskem rudarju. Idrijski razgledi 3-4, 20, Ljubljana

VERBIČ, M., (1966): Rudnik živega srebra v Idriji do konca 16. stoletja. Disertacija, 171, Ljubljana.

VERBIČ, M., (1969): Upor idrijskih rudarjev leta 1579. Idrijski razgledi, 14, 113-125, Idrija.

VERBIČ, M., (1990): Rudnik živega srebra v Idriji in tehnične naprave v njem do konca 16. stoletja. Idrijski rudnik skozi stoletja (zbornik), 17-48, Idrija – Ljubljana.