Occupational Medicine in Idria Mercury Mine in 18th century

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Summary

Of all medical sciences in Slovenia, occupational medicine has the longest tradition. It is not a mere coincidence that it had developed already at the beginning of 18th century in Idria. The Mercury mine in Idria, is the second largest European mine of its kind, next to the Spanish Almaden, and has been owned by the Habsburg dynasty for four centuries. To attain higher production, the miners in Idria received medical and social care much earlier than anywhere else; chronic intoxication caused by mercury fumes grea tly hindered their working ability. The first and, at the same time, one of the most prominent doctors in Idria, J. A. Scopoli (1723-1788) perfectly described the symptoms of chronic intoxication with mercury in his workDe Hydrargyro Idriensi Tentamina Physico-Chymico-Medica (Venice, 1761) and thus ranked himself among the early medical writers of occupational medicine, medical hygiene and toxicology. His predecessors were Ellenbog, Paracelsus, Mattioli and some others.

The article describes the situation in the mine of Idria in the 17th and 18th century and focusses on Scopoli's mineralogical and medical discussion on mercury miners and mercurialism.

Résumé

La médecine du travail possède une longue tradition en Slovénie. Ce n'est pas une pure coïncidence si elle existe depuis le 18e siècle en Idrie. La mine de mercure est une des plus importantes en Europe, après celle d'Almaden en Espagne; elle appartenu aux Habsbourg pendant 4 siècles. Pour arriver à une forte production, les mineurs étaient particulièrement bien choyés, notamment lorsque les vapeurs de mercure entraînaient des intoxications au plomb. Celles-ci ont été décrites par un célèbre médecin, le DrJ.A. Scopoli (1723-1788) dans son livre De Hydrargo Idriensi Tentamina Physico-Chymoco-Medica, publié à Venise en 1761. Ses prédécesseurs sont notamment Ellenbog, Paracelse, Mattiol et d'autres.

Ce travail rapporte les conditions de labeur des mineurs et insiste plus spécifiquement sur la contribution de Scopoli à l'intoxication aux métaux.

Introduction

We spend most of our lives working; work gives us personal satisfaction, psycho-physical balance and social identity, as well as contributing to a sustainable development of our society.

Assist. M. Sc. Zvonka Zupanic Slavec MD Institute for the History of Medicine, Medical Faculty, University Ljubljana, Zaloska 7a, 1000 Ljubljana, Slovenia However, it might also have negative effects on health and human relations. Too much hard work, not enough breaks, unsuitable qualifications, the poor physical condition of individual workers, inappropriate or even hazardous working conditons and exposure to noxious chemical substances all provoke illnesses. In medical literature we find information on illnesses caused by specific work. These recods date from the old Egyptian period. The ancient Greco-Roman culture with its slavery system was unfavorable to the development of occupational medicine. During the medieval feudal period there devedoped a type of medicine related to certain trades and some working standards were set. Later industrialization brought new demands for work efficiency, as well as for working conditions. This period represents the beginning of today's occupational medicine (5, 15).

Idria

During 15th century the Idria region became a part of the province «terre ferma», a direct hinterland of Venice. In 1508 czar Maximilian I conquered this land for the first time. After long lasting battles with Venice (1508-1517) this region, rich in cinnabar (HgS), was annexed to the hereditary provinces of the Habsbourg dynasty; at first to the county of Gorizia and later to the duchy of Carniola (16). The beginning of mercury mining goes backto the Venetian period in the year 1493. At that time miners were independent, among them we find also noblemen and citizens from Habsburgian provinces, from duchies of Carinthia and Carniola. In 1745 the empress Mary Theresa founded the independent royal office for coinage and mining (Camera Aulica in monetariis et montanisticis), where the records of the Idria mercury mine are still preserved (there are 73 fascicles with data on mine personnel, salaries, office management, regular and premature retirements, grants, compensation money... covering the period from 1765 to 1804) (6). These records contain much valuable information on the general health condition of miners of that time. The Idria mine remained under Austrian government to the end of World War I (1918), with the exception of a short period from 1809 to 1813, when Napoleon proclaimed this region as a part of the Illyrian provinces.

The Idria Mine

The mercury mine in Idria is the second oldest and the second largest of its kind in

Europe, while the mercury mine in Almaden (Spain), which is still in operation, is the oldest in the world; it had already been exploited by the Ancient Greeks and Romans. In 17th and 18th century the Almaden mine suffered much damage because of many fires. When production was temporarily stopped, the mercury mine in Idria increased its production three to five times and fully covered the loss of the supply of Spanish mercury. In the Idria mine we find mercury of two different types: mercury ore, the so called cinnabar and native mercury. While the cinnabar has to be melted in order to obtain the mercury, the native mercury is already liquid. An Englishman Edward Brown who, in 1672 during his journey across Europe, visited Idria, described the native mercury he had seen (2). The cinnabar in the Idria mines was very rich in mercury, containing 50-70%. At the same time a great deal of native mercury was available, which also ran into the nearby brook Nikove and was by chance discovered by a peasant in 1490. Until the middle of 17th century the cinnabar was melted in clay pots. Later on furnaces were introduced and the new method gave much better results.

For the 34 years between 1539 and 1573, 1.900.000 kg of mercury was sold (18). Mercury was a typical export. At first it was sent to the commercial seaport of Venice and later on to Trieste from where it was transported to the south of Germany, Holland, Spain and further on to South America where it was used to amalgamate silver and gold. Surface transport was also used through Upper Carniola to Villach or across Leublpass to Klagenfurt. Until the second part of 19th century Idria had no road connections, so the mercury was carried along narrow rocky paths by horses.

Let me describe the work in the mine to get a better idea of miners' lives, as well as their problems. Upper ore deposits were soon worked out; miners had to dig deeper and deeper. The first vertical pit, called Ahacij's pit, opened in

1536, was 68,5m deep. It was closed in 1746. By that time it had reached the depth of 133m. Anothervertical pit, Barbara's pit, which reached an approximate depth of 200m was the deepest pit of its kind. In spite of a permanent fresh air supply, the lowest parts of the pits remained badly ventilated. There were toxic and inflammable gases. Therefore it was not permitted to use lanterns in order to avoid fires. In 1550, 30 miners died because of methane explosions. There was also a constant threat of water breaking in. Working conditions in the Idria mine were so bad that the miners were able to work only 8 hours per day, when, at that time a normal working day was 10 hours. The miners descended the pits by ropes and to get out they used free-hanging rope-ladders. When they were too weak to climb, or if they suffered from chronic mercurialism, they were lifted by special baskets. They also had to extract the ore and remove water, as well as, sinking the wooden beams to support the shafts. They used a lifting lack-Haspel in German-which has been mentioned by Georg Bauer in his book De re metallica libri duodecim (7, p8). In pits deeper than 40m they had to use a special device, called a gepelj, which was driven by horses. The most difficult task was to pump water out of the pit. Only young and healthy men were able to do it. The ore layers needed to be properly dried up before the miners could start digging.

Toxicity of Mercury

Mercury has been known as a toxic substance since ancient times. Plinius and Dioscorides described an acute poisoning caused by mercury. The medieval Arab doctors were familiar with similar cases. Whilst mercury was used to treat syphilis acute poisoning became ever more frequent. However, until the 16th century we lack data on chronic diseases caused by mercury. When Paracelsus visited Idria (around 1527) he was shocked. In his essay *Von der franzosischen Krankheit,* published in 1529, he stated the case of Idria where people were paralyzed, deformed, asthmatic, trembling and with no prospect of becoming healthy again. He described it in these words: *«secht ein exempel in Nidria, alle die umb da wonendt, seindt krumb und lam, leichtlich erstickt, leichtlich erfrorn, nimermehr keinen rechten gesundheit wartend».* (7, p 8). This statement is one of the oldest descriptions of chronic mercurialism and is one of the oldest documents on Idria. Paracelsus wrote it under the strong, unfavorable impression that the sick and injured inhabitants of Idria had made on him.

Paracelsus and others

In his work on miners' diseases Von der Bergsucht und andern Berkrankheiten (1533) Paracelsus gave a more detailed decription of mercurialism. In the third chapter, on diseases caused only by mercury, he described the symptoms of chronic poisoning with mercury such as tremor, teeth loss, diseases of digestive organs, skin and kidney... (1). He suggested the use of some primitive prophylactic respirator to protect miners from inhaling toxic mercury vapors. Paracelsus thought that mercury was deposited in joint cavities, mostly in the legs. He suggested treatment of the affected joints with strong caustic substances in order to make holes so that mercury could drip out. With this work Paracelsus paved the way for a new branch of medicine as occupational medicine or industrial hygiene and medical toxicology.

Among the pioneers of occupational medicne are also the German doctor Ulrich Ellenbog (1440-1499) with his essay *Von den gifftigen besen Tempffen undReuchen*, which was written in 1473 and printed in 1524; and Georg Bauer (Agricola, 1490-1555) with his early work on miners diseases *De re metallica libri duodecim* (Basel, 1561). Pier Andrea Mattioli (1500-1577), a well known botanist from Siena, worked as a doctor in Gorizia close to Idria, visited the Idria mine and wrote about it. He also realized the side effects of mercury vapors and wrote that even the strongest and the most healthy miners could not stay atthe mine longerthanfouryears, because of the onset of trembling (3).

In the first Topography of Carniola, *Die Ehre des Herzogthums* Crain Johann Weichard Valvasor (Laybach, 1689) described Idria:

« Das Bergwerk Ydria... ist vor vielen anderen in grossem und wohlverdientem Ruhm und eine rechte Schatz-Grube oder fruchtbare Mutter des Quecksilbers. Ligt... Zwischen hohem Gebirge in einem Graben drey starker Meilwegs von Ober-Laybach gleich anden Crainerischen wohlgemauerten wohn-Hausem.» (17), (7, p 6).

Idria had in 18th century about 300 houses, there were some 3000 inhabitants and from 365 to 900 miners. Valvasor described also the sick miners, theirtrembling and invalidity. They even had certificates, issued by the government, stating that they were not capable of working, so they were allowed to beg and ask for charity.

The German Hoffman wrote an interesting essay on diseases of miners and workers in smelting houses; it was published in Halle in 1705. Similar monographs were published in 18th century by Michael Alberti (Halle, 1721), and Johan Friedrich Henkel (Dresden, 1745), but the fundamental work on occupational medicine *De morbis arificum diatriba*, written by Bernardino Ramazzini (1633-1714) was printed in 1700 in Modena. It is a systematical tractate on the whole of occupational medicine.

In 1719, the French doctor and botanist Bernard de Jussieu described bad working conditions in the Spanish mercury mine at Almaden (4, 13). The case in Idria was not any better. However, in the period of enlightenment some efforts were made to solve certain social and medical problems. In 1736 Anton Hauptmann was sent to Idria to make some technological and organizational changes to modernize the mine. The same year the surgeon Philipp Eckhardt who had alreadytreated miners in Idria received an additional state salary to keep an accurate record of his patients, to give free treatment as well as free medicaments to miners and to find himself an assistant (10). Besides this, for the first time in history the sick miners were entitled to receive money for food (*«Krankengeld»* -75% of their salary) from the state treasury; Thus the state entered into an engagement of a fraternity fund (sick fund).

Later on the miners' surgeon was given another difficult task. He had to decide who was sick and for how long the sick person was entitled to receive money for food. The surgeon could no longer cope with all these responsibilities, and therefore in 1740 a special commission of the Austrian government sent to Idria a trained surgeon, Joseph Gutt (also Gueth, Guth). His main task was to prevent and to treat occupational diseases caused by intoxication with mercury and to intervene in accidents that happened in the mine. After many requests the then director of Idria mine, Anton Hauptman, in 1754 succeded to get the first doctor to Idria.

Jovanni Antonio Scopoli

In 1754 Idria apppointed its first doctor, Jovanni Antonio Scopoli (1723-1788) (19). From that time on not only miners but also theirfamilies were entitled to free medical care. Scopoli stayed in Idria for 15 years. During that period he set up his well known entomological and botanical works (the botanical species *Scopolia* and the alkaloid scopolamine are named after him) (9) and wrote a mineralogical and medical essay on mercury miners and mercurialism *De Hydrargyro Idriensi, Tentamina Physico-Chymico-Medica* (Venice, 1761) (14). He thought that in the existing working conditions miners should not work more than 6 hours per day.

Scopoli listed the most frequent symptoms he noticed among Idria miners: tremor, salivation, cough, breathing problems, diarrhoea, in-



termittent fever and parasites. Based on his personal experiences, he perfectly described some clinical examples of occupational poisoning with mercury and confirmed Jussieu's observations that alcohol could greatly intensify the risk of intoxication with mercury. He asserted that alcoholism is also an occupational risk for Idria miners, resulting from bad social conditions.

Under the name of Miner's Asthma, Scopoli described a pneumoconiosis, with features suggestive of tuberculosis, including its etiology and autopsy findings. As a protection against mercury dust, he suggested humidifying the air and the use of wet linen cloths in front of the mouth and nose.

Intoxication was much more frequent amongst the miners who were working in front of furnaces. In 1750 the Spanish melting procedure was introduced to Idria. The Aludel furnace. Joannes Antonio Scopoli (1723 - 1788)

developed in 1606 by Alfonso Bustamente from Almaden, offered a much better protection to workers as the mercury fumes circulated in a closed system. However, the pipes cracked quite often, in which case the intoxication was even more acute! Scopoli described the symptoms of such an acute intoxication: sweet taste, salivation, teeth loss, sores in the mouth, headaches and pains in the legs at night time, tremor and strong psychic retlessness.

Another well known doctor from 18th century was Baltazar Hacquet (1739-1815) (11, 8). He managed to introduce the practice allowing miners to take a bath after work. His idea to serve milk to miners after work was never realized; it was too expensive. Both Scopoli and Hacquet had many problems with the authorities as they claimed that the administrators of the Idria mine did not care enough for the miners, and that on the contrary, they cruelly exploited them (4, p 140-141).

Detailed review of Scopoli's work *De Hydrargyro Idhensi, Tentamima Physico-Chymico-Medica.*

In this article major attention is given below to Scopoli's work, *De Hydrargyro Idriensi*, in which chronic mercurialism, its signs and symptoms, preventive and curative measures are perfectly described.

In his work *Tentamina*, Scopoli describes different illnesses of the Idria miners. He believes that all heavy metals are toxic, mercury in particular. In the introduction he points out the fact that, miners should not work more than six hours per day and that, they should be paid enough to make their living so that they would not have to work after hours. Two hundred and fifty years ago Scopoli had already envisaged 'sick leave' as we know it today, requiring absence from work and financial support until the slightest symptoms of hydrargyrosis had disappeared. The following symptoms were to Title page of Scopoli's dissertation on mercury from 1771.



be found among the miners: tremor, salivation, cough, asthma, dysentery, intermittent fever and parasites (14, 12).

Tremor

He writes that tremor is accompanied by general weakness, fatigue and anemia, all caused by inhaling mercury fumes and dust. The severity of the symptoms depends on the intensity and duration of the exposure to mercury. Although mercury fumes could not be avoided, the miners working in the shafts with better ventilation rarely became sick and suffered tremor much later than those working in either a dusty and stuffy environment or near furnaces. The only treatment he advises is fresh air, meaning absence from work. He thinks that miners do not need any medicine: yet the empress Maria Theresa had passed an order that the miners be given prescriptions free of charge. Scopoli comments that it will do them no good! As long as they have to work long hours to earn enough to survive, they will descend pits with tremor. The administration should reduce working hours and offer financial support to sick miners.

In addition to fresh air Scopoli advises sweating and hot baths. He gives miners *decocti guajaki*. He stresses the importance of hygiene. After work miners' skin and clothes were covered with dust, full of mercury, which caused a permanent intoxication. Besides, miners used to take food to work and they ate with dirty hands. In serious cases of hydrargyrosis Scopoli advises purgatives (rheum, manna, senna, tamarindus) and less often ipecacuana, as an emetic.

Salivation

Salivation is accompanied with gingivitis, stomatitis and tooth loss followed by ulcers and facial necrosis. Scopoli considers these symptoms as signs of local intoxication with mercury. He thinks that the organism mostly excretes mercury in places exposed to the outside air. Miners having salivation generally do not get tremor and vice versa. Sick workers in the mercury foundries mainly exhibit salivation (the ore was melted in clay retorts). Scopoli advises rinsing the mouth with a decoction of barley with some honey and warns against drinking alcohol.

The modern explanation of symptoms of acute and chronic intoxication is quite different: chronic intoxication progresses slower in people working in the shafts than in those working at the furnaces; thus stomatitis is observed earlier than neurological symptoms.

Scopoli believes that any organ already affected by some other disease, is more

vulnerable to mercury intoxication. He gives an example of an eye patient who became deaf, but he does not make any specific diagnosis.

Pneumoconiosis

While crushing ore or cleaning furnaces, miners find themselves in a very dusty environment. Scopoli thinks that dust causes a constant cough which later develops into a consumptive cough. In his time nobody understood the real cause of tuberculosis, however, Scopoli's statements were undeniable, clear and correct. His advice to use a wet cloth in front of the mouth and nose, the same preventive method as already described by and most probably, the miners Mattioli, themselves had already thought of such a simple protection against dust. And what was the treatment ? Scopoli prescribes species perforates, small doses of opium and eventually venesection (bleeding). He repeats his warning against alcohol. Scopoli believes that work in front of furnaces and excessive alcohol drinking cause asthma. His description of the disease corresponds mainly with the symptoms of tuberculosis. Also in this case he prescribes some decoctions and small doses of opium.

Enteritis

In regard to diarrhoea, he mentions that the enteritis, as well as enteritis with ulceration, might each result from hydrargyrismus. His description seems rather vague; however, it is obvious that he is not discussing 'the bloody flux'.

He regards different types of enteritis as having a common cause, which was not unusual in the prebacteriological era. It is possible that he treated leptospirosis as enteritis, too. Scopoli states that the cases of enteritis were more frequent in August and September than during the rest of the year, which suggests that the infections were not always caused by mercury. He disputes with some doctors who think that enteritis is caused by eating over-ripe fruit and even quotes Sydenham's opinion on fruit. He recommends a diet (slimy rice or grits) and prescribes ipecacuana as an emetic and rhubarb as a laxative. Scopoli is also concerned about water loss and advises drinking a beverage made of five parts of water and one part of wine.

Febris intermittens

Scopoli did not know what caused the disease febris intermittens. Naturally, in the middle of the 18th century it was quite impossible to write anything precisely about the causative agent of such symptoms. However, Scopoli gives a detailed description of the disease which enables a retrospective diagnosis with a high level of probability. He writes that the disease occurs seasonally, in the Spring and Autumn; febris tertianals prevailing in Spring and febrisquartana in Autumn. Quite often the disease is followed by dropsy and is always accompanied by outbreaks of icterus. During paroxysms the skin is often covered with blisters filled with serous liquid. After intense sweating the blisters disappear. Quinine, most probably the only efficient antipyretic of that time, was rarely effective. The disease had also other accompanying symptoms - foetor ex ore, bitter taste, loss of appetite and nausea.

The patients, mostly men, often vomited and had diarrhoea. Most likely the disease was caused by *Leptospira icterohaemorrhagica*. Of course, a positive microbiological test would be necessary to confirm the diagnosis, but based on Scopoli's descriptions we cannot think of any other disease. Although, Scopoli uses the terms such as *«tertiana»* and *«quartana»* we can be certain that the disease in question was not malaria; there are no swamps in the Idria region and quinine did not work. Moreover, in his exact descriptions, Scopoli never mentions a swollen spleen, but he does mention *icterus* and quite often a fatal nephritis. As we now know, in chronic intoxication with heavy metals, febris intermittens occurs only in cases of intoxication with tin (theso called «Messingmalaria»). Scopoli treated *febris intermittens* with *«sal medium»* and *«tinctura aromatica»*, three hours before the paroxysm, if possible.

He mentions signs and symptoms such as spasms in the stomach, foetor ex ore, itchy nostrils, swollen belly, itchy gullet, nausea, vomiting, rejection of food and excretion of worms per os or per rectum. Vermes probably corresponds to askarids (worms), however, it is most unlikely that in this case Scopoli would have thought of Ankylostoma. Scopoli carries on his argument with those doctors who think that worms develop from the eggs of insects, mostly flies. He asks the sarcastic question about 'who has ever seen a monkey that developed from a louse egg?' He is not sure whether the earthworm and askaris belong to the same species and whether any modification results from the different environments in which they live. But he thinks that earth and dust are the main sources of infection with worms. He suggests taking salinic purgatives made from mercury alloy; most probably he has in mind calomel, though he does not specify.

He mentions anemia in almost every description of a disease, not only in the case of worms. In each case, the anaemic colour of the skin agrees well with the clinical picture of the disease. Finally, he says that miners from Idria also suffer from other diseases that exist elsewhere and are not specific to miners.

Scopoli on certain diseases related to miners

Scopoli was convinced that all this suffering could have been avoided. He realized that miners were forced to work for food, even when they were sick, without opportunity to take a bath, poorly dressed and sometimes even barefoot. Miners suffering from chronic mercurialism had to continue to work in pits full of mercury vapors. The mine administration seemed not concerned, though lower efficiency of sick miners meant lower production. Alcohol made matters worse.

Scopoli realized that it was necessary to take preventive measures, to introduce some social arrangements and to improve working hygiene. Atthattime his ideas were not accepted. Because of his criticism of the existing social order the mine administration opposed him. The mercury mine in Idria and the medical sophistry related to it have certainly contributed a great deal to the fact that occupational medicine was to become a branch of medicine with the longest tradition among Slovenians.

Almost three centuries have passed since the miners in Idria got their first surgeon: and nearly two centuries and a half since the first miners' doctor in Idria, Dr Scopoli introduced preventive and curative treatment for miners. Owing to the very high value of Idria mercury and the great demand for this particular metal, medical and social care developed much earlier in Idria than in any other Habsburg province inhabited by Slovenians. It is quite understandable that many authors of medical books have used the experiences from 18th and 19th century Idria as examples and that a rich archive of mining and medical material has been preserved which attracts many Slovene, German and Italian researchers.

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Biography

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