

## **A DEEP DIVE INTO THE CHRONIC AIR POLLUTION REALITY IN BAIA MARE. PART III: AIR POLLUTION EFFECTS ON THE LOCAL POPULATION BETWEEN 1980 AND 2006**

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### **Abstract**

Baia Mare, with its long-lasting mining and metallurgical tradition, is one of the country's most problematic cities in terms of historical pollution and resulting consequences. This paper is the final chapter of a complex three-part work and aims to present a series of air pollution effects on public health in Baia Mare between 1980 and 2006. The first part focused on an overall view of historical air pollution sources in Baia Mare. The second part presented the evolution of air quality in Baia Mare and highlighted the chronic air pollution, consisting of sulphur dioxide, nitrogen dioxide, ammonia, particulate matter, and heavy metals between 1995 and 2006. The historical environmental (including air) pollution in Baia Mare had 3 main sources: National Company of Precious and Nonferrous Metals (NCPNM) - Remin Corporation; Cuprom Corporation; Romplumb Corporation. The three companies were active for decades and, until the early 2000s, environmental protection was not a priority of their technological process management. After the year 2000, investments in ecological technologies were undersized, and the 2008 economic crisis affected the companies' activity. Air quality in Baia Mare between 1995 and 2006, as well as prior to this period, was particularly critical due to high concentrations in particulate matter with high lead and cadmium content, but also due to high sulphur dioxide concentrations between 1995 and 2000. A direct consequence of inadequate air quality was the deterioration of the city inhabitants' health. The paper is based on data provided by the Maramureş Public Health Directorate, World Health Organization reports, Cluj Napoca Hygiene and Public Health Institute reports, as well as Romanian and foreign experts who conducted investigations on air pollution-related illnesses in the study area. Our historical analytical approach mainly aims to address the effects of the technological processes of the Cuprom and Romplumb companies on the health of their employees and of the local population. One of the main causes for the high incidence of respiratory diseases in the local population was the historical pollution in the analyzed area, which had cumulative effects over time. In addition to these illnesses, it was found that in the study area, between 1980 and 2006, a more notable deterioration of public health occurred compared to other settlements (lower life expectancy, higher overall mortality index, more frequent D<sub>2</sub> avitaminosis and metabolic conditions linked to lead pollution, etc.), and one of the main reasons was the city's chronic air pollution. Morbidity reports were generally dominated by acute and chronic respiratory diseases, and digestive and cardiovascular disorders. National Company of Precious and Nonferrous Metals (NCPNM) - Remin and Romplumb Corporations are currently in a state of insolvency, and Cuprom Corporation is bankrupt, which resulted in an improvement of air quality in the study area.

**Keywords:** Baia Mare, historical pollution, air pollution, public health, illness incidence, morbidity

## 1 PURPOSE OF THE STUDY AND BACKGROUND

Baia Mare City, the former mining and metallurgical industry “capital” of Romania, is one of the country’s most problematic areas in terms of historical pollution and related effects. In Baia Mare, pollution is chronic and is derived from multiple sources (Manoiu and Spiridon, 2017).

This paper, the final part of a complex three-part work, aims to present the consequences of air pollution on public health in Baia Mare between 1980 and 2006. Our work brings up to date and enlarges the bulk of information provided by the very few papers that cover the subject of air pollution effects on public health in Baia Mare (Lacatusu et al., 1996; Dobra and Viman, 2006; Nadisan, 2006; Jelea and Jelea, 2007; Oroian, 2010; Roba et al., 2016; Smical, Muntean and Torok, 2016). In a previous paper, the first of this series, we presented an overview of historical air pollution sources in Baia Mare (Manoiu and Spiridon, 2017). In the second part of the series, we presented the evolution of air quality in Baia Mare, while highlighting chronic air pollution with sulphur dioxide, nitrogen dioxide, ammonia, particulate matter, and with the heavy metals contained therein, between 1995 and 2006 (Manoiu, Spiridon, Antonescu, 2017).

The historical environmental pollution (including air) in Baia Mare had 3 main sources, i.e. three large companies: NCPNM (National Company of Precious and Nonferrous Metals) Remin Corporation; Cuprom [*cupru (Rom)* = copper] Corporation; Romplumb [*plumb (Rom)* = lead] Corporation. All three companies were active for decades and, until the early 2000s, environmental protection was not a priority of technological process management at the three metallurgical centres. After the year 2000, investments in green technologies were undersized and, starting with 2008, the economic crisis affected the companies’ activity. Air quality in Baia Mare between 1995 and 2006, as well as before this period, was critical due to high concentrations of lead- and cadmium-rich suspended particulate matter, and sulphur dioxide. The direct consequence of the inadequate air quality was the deterioration of the city inhabitants’ health.

However, in the analysed period, there was a decreasing pollutant evolution trend in the local atmosphere, both for heavy metals and SO<sub>2</sub>, which can be linked to the decline in the activity of the large polluting companies, the green investments of which proved ineffective and did not generate significant changes in urban air quality. Romplumb and Cuprom had pollutant dispersion stacks equipped with self-monitoring and online transmission systems that continuously transmitted the recorded data to EPA Maramureş. At present, NCPNM Remin and Romplumb are insolvent, and Cuprom has filed for bankruptcy. Air quality in the studied area has improved.

The paper is based on data provided by the Maramureş Public Health Directorate and the Institute of Hygiene and Public Health in Cluj Napoca, World Health Organization reports, as well as on studies conducted by Romanian and foreign experts who have analysed air pollution-related health risks in the Baia Mare area. Our historical and analytical research mainly focuses on the technological processes of Cuprom and Romplumb, more specifically on two main issues: 1) the effects of the pollutants emitted by the two companies on the city inhabitants’ health and 2) the effects of the same pollutants on the health of the companies’ employees.

## 2 EFFECTS OF BAI A MARE CITY ATMOSPHERIC POLLUTANTS ON PUBLIC HEALTH

### 2.1 General Aspects

The population of Baia Mare City and of the surrounding area was, in the second half of the 20th century and in the beginning of the 21st century, strongly affected by SO<sub>2</sub> and lead-containing particulate matter emissions, as well as by other pollutants: Cd, As, Cu, Zn, Mn, etc.

The few reports completed throughout the years based on studies conducted on the consequences of air pollution in Baia Mare on public health indicate that “a more significant deterioration of public health occurred in this region compared to other settlements” (Coman, 2006). In essence, the studies’ results showed that (Coman, 2006):

- life expectancy was reduced by 2.2 years;
- the overall mortality index was 10-15% higher;
- D<sub>2</sub> avitaminosis frequency was 65-95% higher;
- the frequency of metabolic diseases caused by lead was 40-60% higher.

Lead was considered the main pollutant in the Baia Mare area. The most notorious disease caused by this heavy metal is lead poisoning, the symptoms of which include colic and abdominal pain, vomiting,

constipation, inattentiveness, multiple joint pain, irritability, balance disorder, weight loss, fatigue, insomnia, anaemia, encephalopathy, etc.

In 2006, in 10 days alone, 5 Romplumb workers were hospitalized in the Occupational Diseases Unit and diagnosed with chronic lead poisoning or lead-induced colic.

The state of apathy, drowsiness or fatigue, and the unjustified exhaustion of Baia Mare residents were caused by the diminished amount of oxygen that reached the tissues and especially the brain, due to the partial replacement of iron ions in haemoglobin molecules with lead ions (Nadisan, 2006). It must also be noted that, during the analysed period, Baia Mare was almost devoid of elderly people (Nadisan, 2006).

In addition to lead and SO<sub>2</sub>, in Baia Mare there were also other active pollutants, such as cadmium, arsenic, copper, zinc, manganese, etc, which entered the human body as particulate matter via airways and caused various symptoms and diseases.

## **2.2 Effects of Atmospheric Pollutant Emissions on Baia Mare Residents**

In this section we will present a series of results regarding the effects of air pollutants, especially particulate matter containing lead and other heavy metals, as well as SO<sub>2</sub>, on Baia Mare residents, based on the analysis of information provided by specialized international bodies, but also by committees of foreign and national experts who conducted various studies in the area.

a). Between 1980 and 1990, air pollution in Baia Mare routinely exceeded accepted limits and was at times highly toxic. This high, permanent pollution had an unquestionable effect on public health locally, especially since certain pollutants, such as lead, have a cumulative effect (Jacomet, 1992). A high number of illnesses were recorded in this period: 759 cases of chronic lead poisoning, 163 severe lead intoxications, 2 cases of professional lead-induced encephalopathy, and 2 chronic arsenic intoxications (Maramures Sanitary Department, 1992). Rural workers proved less resistant to pollution, as there were numerous deaths around the age of 40-50 (Jacomet, 1992). Two categories of inhabitants were particularly strongly affected by pollution: workers who did not comply with sanitation regulation, especially Romplumb employees, and Ferneziu neighbourhood residents, who are geographically located between the two large polluters (Phoenix /Cuprom and Romplumb) (Maramures Sanitary Department, 1992; Jacomet, 1992).

b). In 1992, blood samples for lead and cadmium analyses, and urine samples for arsenic analyses were collected from Romplumb and Phoenix/Cuprom employees, as well as from 3-6-year olds from the Ferneziu neighbourhood. The sample group also included an equal number of children who lived within a 30 km radius of Baia Mare, which brought the total number of study subjects to 126 (Faculty of Medicine, University of Amsterdam, 1992). 8 of 15 employees who worked on lead-containing suspended particulate matter installations had more than 70 µg Pb/decilitre of blood, which exceeded the OMS-accepted limit 7 times over (10 µg Pb/decilitre of blood) (Faculty of Medicine, University of Amsterdam, 1992). The accepted levels of lead in blood were 7 times higher with 12 out of the 32 children (Faculty of Medicine, University of Amsterdam, 1992). WHO states that lead can have serious consequences for the health of children (WHO, 2009; WHO, 2010; WHO, 2017). According to WHO, there is no known safe blood lead concentration. But it is known that, as lead exposure increases, the range and severity of symptoms and effects also increase. Even blood lead concentrations as low as 5 µg/dL, once thought to be a "safe level", may be associated with decreased intelligence in children, behavioural difficulties, and learning problems (WHO, 2009; WHO, 2010; WHO, 2017). 13 out of 32 children had more than 40 µg As/litre of urine (Faculty of Medicine, University of Amsterdam, 1992). According to WHO, a urine sample showing more than 50 µg/litre may be taken as evidence of recent exposure, provided the subject has not consumed sea food during the previous four days, which was not our case (WHO, 2005).

c). In 1999, lead levels of children from Primary School No. 16 in Ferneziu were 6 times higher than those of children from Primary School No. 1 in Baia Mare (Cluj Medicine and Health Centre, Bucharest Public Health Institute, 1999). Prolonged exposure to lead and arsenic had a negative influence on somatic development, affected the children's visual and hearing acuity. Lead reduced their intelligence coefficient and weight indicators, and caused growth disorders; this pollutant affected the subjects' circulatory system, liver and nervous system, and increased their irritability and fatigability. Lead also had an impact on the inner coat of blood vessels, which resulted in endarteritis (Cluj Medicine and Health Centre, Bucharest Public Health Institute, 1999). That same year, the number of professional diseases in Maramures County was 2 times higher than the national average. Out of the total of 248 professional lead intoxications recorded countrywide in one year, half occurred in Maramures County mainly in Baia Mare (Cluj Medicine and Health Centre, Bucharest Public Health Institute, 1999).

d). In 1999, air lead levels in Baia Mare schools were 9 times higher than the accepted limit. Pneumonia and

asthma levels in Baia Mare children were higher than those recorded in Ploiesti and Targu-Mures, which were industrialized cities as well. Sulphur dioxide pollution, especially in the cold season, was a major risk factor for acute and chronic respiratory diseases (Cluj-Napoca Public Health Institute, 1999).

e). In 2000, this region had one of the country's highest levels of exposure to lead. With some children, the level of lead in blood was 6 times higher than the safety margin, while with adults it was 2.5 times higher (WHO, 2000).

f). In 2003, upon analysis of blood samples taken from ~150 13-year-old (on average) children from 15 schools citywide, the conclusions of the 2000 WHO report, which noted that lead levels in certain samples were 6 times higher than the accepted limit, were restated for the Nicolae Balcescu Primary School (nr.16) in Ferneziu (Maramures Nature Protection Commission, Maramures Public Health Department, 2003). With no exceptions, all blood samples showed various levels of lead, 75% of which exceeded the safety limit set by WHO – 10 µg/decilitre of blood. The Ferneziu children's mean lead level was 33.4 µg/decilitre of blood, and only 3% of them, who were born outside city limits, had below 5 µg/decilitre of blood. The variation of lead levels was the result of multiple factors, such as proximity to source, social status, living conditions, nutrition, general health state, hygiene, and other individual physiological specificities (Maramures Nature Protection Commission, Maramures Public Health Department, 2003). More severe cases were hospitalized, while the others were granted free outpatient treatment. Schools were instructed to apply special hygiene measures in order to prevent and mitigate lead contamination. High heavy metal values have extremely serious effects on children, as they affect their physical and intellectual development, and nervous systems. Ferneziu students could not tolerate classes longer than 35 minutes due to their low IQs.

g). In 2004, a public health study was conducted in Baia Mare (Nita, 2004) on 89,512 subjects, with ages ranging between 15 and 64. The study also included people from the same age group living in the area around the city: Grosi – 1,648 subjects, Sacalaseeni – 3,650 subjects (located south of Baia Mare), Recea – 3,263 subjects (located to the south-west of Baia Mare, in an area with lower levels of pollution) and Baia Sprie – 9,950 subjects, located to the east of Baia Mare. Considering that pollution in Baia Mare was not uniform, the areas to the north-east, located in the immediate vicinity of pollution sources (Romplumb and Cuprom), were analysed separately in terms of morbidity indices. The study showed that the incidence of pulmonary tuberculosis in Baia Mare was 0.078‰, with a higher value in the centre – 0.243‰ and in Baia Sprie – 1.407‰ (Nita, 2004). Overall morbidity was dominated by acute and chronic respiratory conditions, and digestive and cardiovascular disorders. With regard to respiratory tract pathology, as an effect of atmospheric pollution, acute upper respiratory tract infections were ranked first with an incidence of 115.549‰ citywide, which peaked in the Cuprom platform area (387.490‰), followed by Ferneziu neighbourhood with 286.304‰ and Sacalaseeni, with 156.711‰ (Nita, 2004). Acute lower respiratory tract infections (acute bronchitis, acute bronchiolitis, etc) also had high incidence rates citywide (41.937‰), which peaked in the eastern part of the city, the Cuprom platform area (105.157‰) and in Baia Sprie (48.944‰). Chronic upper respiratory tract conditions have a 16.443‰ incidence citywide. Morbidity numbers show a high rate of infectious respiratory conditions, in which a major role is played by pollution with non-ferrous metals.

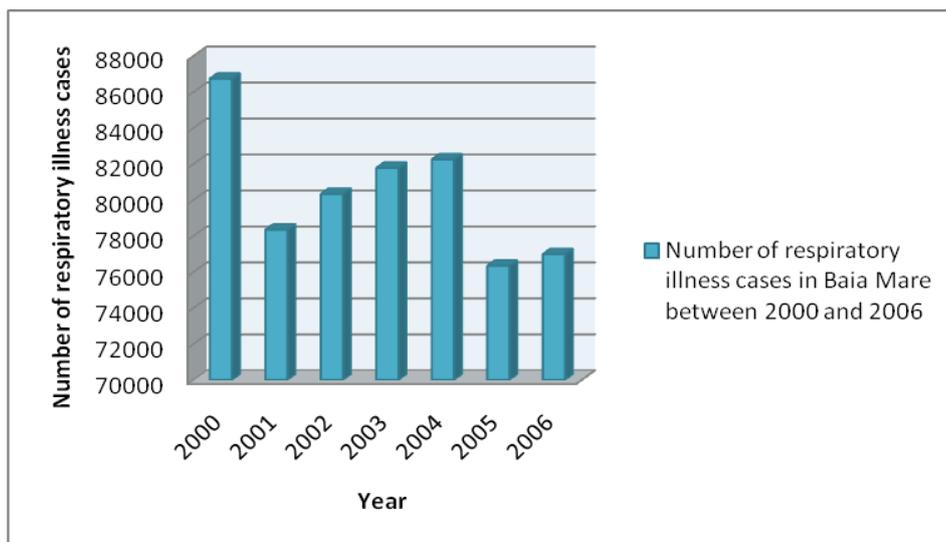
h). In 2006, in Baia Mare, there were 76,994 respiratory system illnesses and 144 tumour cases. Table no. 1 presents the evolution in respiratory system illness and tumour cases in the local population, between 2000 and 2006 (Maramures Public Health Authority, 2007).

In Table 1 and Fig. 1, there is an oscillating evolution of the number of respiratory conditions, which peaked in 2000. However, in the last year of the analysis (2006), the number of respiratory conditions decreased and was lower than that of the year 2000 by 9,754 cases. A significant decrease occurred in 2000-2001, when the number of cases went down by 8,400 (Table 1, Fig. 1). This can be explained by the fact that, in 2000, Cuprom halted its main polluting technological processes, and Romplumb underwent an upgrade process (budgetary funds) that aimed to increase atmospheric protection, which consisted of the construction of a pollutant dispersion metal stack.

**Table 1. Morbidity in Baia Mare between 2000 and 2006 (Maramures Public Health Authority, 2007)**

Respiratory system illnesses	2000	2001	2002	2003	2004	2005	2006
Pharyngitis/tonsillitis	25,850	24,821	25,707	24,688	24,594	23,809	22,170
Laryngitis/tracheitis	2,816	6,908	7,836	8,375	9,516	9,096	9,157

Other upper respiratory tract infections	26,070	25,786	26,686	26,659	24,323	20,680	23,025
Pneumonia	3,420	3,588	3,801	3,728	3,543	3,569	3,068
Acute bronchitis	5,007	9,850	9,694	10,914	11,905	12,093	12,689
Other lower respiratory tract infection	418	398	289	478	824	350	413
Acute rhinitis/pharyngitis	1,511	3,095	2,944	3,023	3,691	3,842	3,156
Nonspecific bronchitis	139	186	368	414	156	85	256
Chronic bronchitis	392	407	253	267	222	186	346
Emphysema	29	31	19	38	22	28	40
Other obstructive diseases	263	77	58	67	89	91	94
Asthma	269	318	267	185	267	208	282
Other pleura disorders	40	13	51	10	16	7	15
<b>TOTAL respiratory illnesses</b>	<b>86,748</b>	<b>78,348</b>	<b>80,343</b>	<b>81,784</b>	<b>82,263</b>	<b>76,345</b>	<b>76,994</b>
<b>Tumours</b>							
Oesophagus/stomach	46	34	32	30	18	28	29
Trachea/bronchial tubes	82	54	61	49	65	67	80
Other respiratory system tumours	1	7	13	10	15	9	13
Malignant tumours of mesothelial tissue	3	5	9	15	5	7	14
Malignant melanoma	24	30	23	21	22	17	8
<b>TOTAL tumours</b>	<b>156</b>	<b>130</b>	<b>138</b>	<b>125</b>	<b>125</b>	<b>128</b>	<b>144</b>



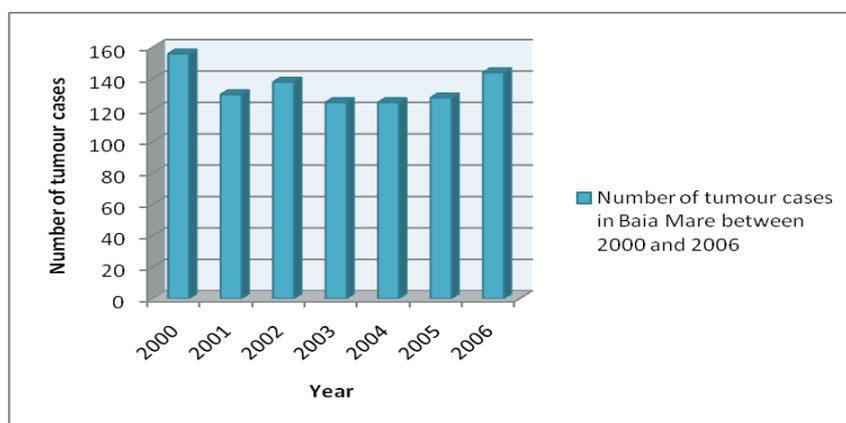
**Fig. 1. Number of respiratory illness cases in Baia Mare (2000-2006) (Maramures Public Health Authority, 2007)**

After the year 2001, a slight increase in respiratory conditions can be noticed up to 2004. In 2005, there were

fewer cases than the previous year and this was, in fact, the lowest number of respiratory illnesses throughout the analysed period (76,345). In 2006, there were 649 more cases than in 2005 (Table 1, Fig. 1).

Most cases consist of upper respiratory tract infections (Table 1), which had oscillating numbers between 2000 and 2006, peaked in 2002 (26,686 cases), and went down towards the end of the analysed period. They are followed by pharyngitis/tonsillitis cases, which had a decreasing trend between 2002 and 2006, when the number went from 25,707 to 22,170 (Table 1), and which peaked in 2000 (25,850 cases). There were also numerous cases of acute bronchitis (Table 1), and there is a significant discrepancy between the first and last years of the interval, as the number of cases more than doubled by the end of the analysed period (5,007 cases in 2000, and 12,689 cases in 2006) – from 2002 to 2006 the number increased constantly. Pneumonia cases had a decreasing trend (Table 1) from 3,420 to 3,068 (2000-2006), and peaked in 2002 (3,801 cases). There were also increases in the number of laryngitis/tracheitis (2,816 cases in 2000, 9,157 cases in 2006), acute rhinitis/pharyngitis (1,511 cases in 2000, 3,156 cases in 2006), non-specific bronchitis (139 cases in 2000, 256 cases in 2006), emphysema (29 cases in 2000, 40 cases in 2006) and asthma (269 cases in 2000, 282 cases in 2006). All the other respiratory conditions (lower respiratory tract infections, chronic bronchitis, other obstructive illnesses, other pleura conditions) had a lower number of cases in 2006 than in 2000 (Table 1).

The evolution of tumour cases was inconsistent (Table 1, Fig. 2), ranging from 125 to 156 per year, with the lowest number in 2003 and 2004 (125), and the highest in the first analysed year (156). In 2006, there were 144 tumour cases in Baia Mare.



**Figure 2. Number of tumour cases in Baia Mare (2000-2006) (Maramures Public Health Authority, 2007)**

The number of malignant mesothelial tissue tumour cases increased from 3 (in 2000) to 14 (Table 1), and generally had an upward trend. The highest number of cases (15) was recorded in 2003.

Oesophagus and stomach tumour cases decreased between 2000 and 2004 from 46 to 18 (Table 1), after which increased to 29 in 2006.

Tracheae/bronchial tube tumour cases oscillated between 49 (2003) and 82 (2000); starting with 2004, the category had an upward trend and peaked in 2006, when it reached 80 cases (Table 1).

The number of malignant melanoma cases decreased from 24, in the first analysed year, to 8 in 2006 (Table 1); 2001 had the most recorded cases (30).

Tumour-related illnesses in other respiratory organs were recorded constantly between 2000 and 2006 (Table 1), with numbers ranging from 1 to 13. A peak (15) was noted in 2004.

The main cause for the high number of respiratory diseases and tumours among Baia Mare residents was the local historical pollution, with cumulative effects over time (Manoiu, Spiridon, Antonescu, 2017).

## **2.3 Effects of Particulate Matter Containing Lead and SO<sub>2</sub> on the Health of Phoenix (Cuprom) and Romplumb Employees**

### **2.3.1 Phoenix Company (Cuprom) Case**

In 1992, a study was conducted on the health state of employees of the Phoenix Company (Cuprom) who were exposed to various pollutants, mainly particulate matter containing heavy metals and SO<sub>2</sub> (Clinic no. 2 Baia Mare, 1992). Workers from nearby factories (METC – Mining Equipment and Technology Company,

EATC – Equipment, Accessories and Tools Company, CERAMICA) were also included in the study, as the pollutants emitted by technological processes at the Phoenix Company, under certain meteorological conditions, affected a wider perimeter around the platform. The study tested 538 Phoenix workers and 134 employees from nearby units (68 from METC, 33 from EATC, 33 from CERAMICA).

176 workers exposed to lead were examined in this study (Table 2).

**Table 2. Health state of Phoenix, METC, EATC, CERAMICA employees who were exposed to lead pollution, in 1992 (Clinic no. 2 Baia Mare, 1992)**

Department	Physiological Pb absorption (normal)	Increased Pb absorption	Chronic lead poisoning	TOTAL
Constructions workshop	20	4	1	25
Thermal mechanical workshop	5	6	-	11
Administrative	12	4	-	16
Oxygen	-	3	1	4
Winding	16	3	1	20
Xanthates	8	3	1	12
Melting	4	4	6	14
Laminates-oxides	16	7	6	29
Lead processing	-	1	-	1
Copper bars	1	-	-	1
Anticorrosive (warehouse, transport)	7	10	2	19
Auxiliary (supply, sales)	21	1	-	22
Medical unit	2	-	-	2
<b>TOTAL</b>	<b>112</b>	<b>46</b>	<b>18</b>	<b>176</b>
	<b>64%</b>	<b>26%</b>	<b>10%</b>	<b>100%</b>

112 workers (64%) exhibited physiological lead absorption (normal), for the professional exposure: blood lead levels of 40 µgPb/dL, and urine lead levels of 50-80 µgPb/L. 46 workers (26%) exhibited an increased lead absorption, i.e. blood lead levels of 40-80 µgPb/dL, and urine lead levels of 80-150 µgPb/L. 18 workers (10%) were suffering from chronic lead poisoning, and had blood lead levels of over 80 µgPb/dL, and urine lead levels of over 150 µgPb/L (Table 2). The employees suffering from chronic lead poisoning showed a series of symptoms, such as headaches, irritability, fatigue, sleep disturbances (somnia or insomnia), polyarticular pain (especially in the elbows and knees), loss of appetite, constipation, hepatomegaly, palpitations, dizziness, asthenia, etc. It must be noted that most cases of increased lead absorption were found in the Thermal mechanical workshop, Laminates-oxides and Anticorrosive departments, and most chronic lead poisoning cases in the Melting and Laminates-oxides departments (Table 2).

376 workers exposed to SO<sub>2</sub>, from both Phoenix and the other 3 nearby companies (METC, EATC, CERAMICA) were tested, of which 189 (50.26%) exhibited respiratory dysfunctions. Of the 242 Phoenix workers, 132 (54.54%) exhibited such conditions.

### 2.3.2 Romplumb Company Case

Upon analysis of the general morbidity at the Romplumb Company, in terms of temporary work incapacity, between 1983 and 1993, this unit had much higher values than the other metallurgical centres countrywide. During this period, the severity of over 75% of illnesses generated by the lead-polluted microclimate was either average or high, and patients required hospital- or clinic-based recovery treatment (Clinic no. 2 Baia Mare, 1994). The oscillation of cases of professional illnesses and acute intoxications at Romplumb is presented in Table 3, where lead-induced colic and chronic lead poisoning have the highest values (Clinic no.2 Baia Mare, 1994). It must be noted, however, that the number of chronic lead poisoning decreased by half in 1993, compared to 1983 (36 cases vs 71).

**Table 3. Evolution of professional illnesses and acute intoxications at Romplumb Corporation, between 1983-1993 (Clinic no.2 Baia Mare, 1994)**

Year	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Lead-induced colic	-	6	20	34	20	22	41	4	18	26	12

Chronic lead poisoning	71	42	62	44	22	25	18	2	28	41	36
Lead-induced encephalopathy	-	-	-	-	2	-	-	-	-	-	-
Arsenic intoxication	-	1	1	-	-	-	-	-	-	-	3
<b>Total professional illnesses</b>	<b>71</b>	<b>49</b>	<b>83</b>	<b>78</b>	<b>44</b>	<b>47</b>	<b>59</b>	<b>6</b>	<b>46</b>	<b>87</b>	<b>51</b>

In 1994, a study was conducted on the health state of Romplumb employees. 450 workers were tested, from both lead oxide-generating units (Melting, Agglomeration) and other sectors (Electrical workshop, Mechanical workshop, Laboratory, Medical unit, Accounting, Security). The frequency of acute and chronic intoxications is presented in Table 4, where chronic lead poisoning and lead-induced colic are once more the most common. The number of cases increased compared to the year 1993 (Clinic no. 2 Baia Mare, 1994).

**Table 4. Frequency of acute and chronic lead intoxications at Romplumb Company, in 1994 (Clinic no.2 Baia Mare, 1994)**

Condition		No.of diagnosed people	% of the total number of tested employees
Declared chronic lead poisoning		48	10.66%
Lead-induced colic – once		10	2.22%
Lead-induced colic – twice		4	0.88%
Lead-induced colic – 3 times		6	1.33%
Lead-induced colic – 12 times		1	0.25%
Associated intoxications	Chronic lead poisoning and arsenic intoxication	2	0.44%
	Lead-induced colic and arsenic intoxication	2	0.44%

A low number of arsenic intoxications was recorded between 1983-1994, of which some were linked to chronic lead poisoning (Clinic no. 2 Baia Mare, 1994). Arsenic effects consist of: chronic irritation of upper airways; chronic rhinitis, nasal septal ulceration and perforation, chronic pharyngitis, chronic laryngitis, chronic tracheobronchitis, chronic obstructive bronchopneumonia; eye irritation, chronic conjunctivitis; palmoplantar hyperkeratosis; gastrointestinal disorders; cutaneous carcinogenesis; changes in EKG routes; sensory polyneuropathies.

For both Phoenix/Cuprom and Romplumb, studies conclusively show the cause and effect relationship between lead pollution and the high number of occupational diseases and intoxications.

## CONCLUSIONS

Between 1980-2006, public health in Baia Mare City deteriorated due to pollution with particulate matter containing lead and other metals (Cd, As, Cu, Zn, Mn), as well as SO<sub>2</sub>, emissions from the 3 local polluting sources. Lead was considered to be the main pollutant in the Baia Mare area.

In the analysed period, air pollution frequently exceeded the allowed limits, which was reflected in the residents' health, especially those in the Ferneziu neighbourhood, positioned between two polluting companies, but also in the health of the companies' employees. Children living in this neighbourhood were particularly seriously affected, as some had blood lead levels that were 7 times higher than the WHO-accepted limit, which affected their systems in multiple ways.

With Baia Mare residents, during the study period, respiratory disorders, tumours, chronic lead poisoning and lead-induced colic had the highest incidence rates.

With regard to Phoenix/Cuprom and Romplumb employees who were exposed to the aforementioned pollutants, it was found that a large share had high blood lead levels, chronic lead poisoning and lead-induced colic. Phoenix workers also had a high number of respiratory disorders.

To conclude, we note that industrial emissions unequivocally affected the health of most Baia Mare residents between 1980 and 2006, with numerous recorded cases of severe effects. Long-term effects of pollutants were found to have had a negative impact on the local quality of life. The general health state of Baia Mare

inhabitants was negatively impacted by air pollution, as shown by the clear link between morbidity data on respiratory disorders and the high blood lead levels, and the high illness incidence rate.

## REFERENCE LIST

- Clinic no. 2 Baia Mare/Policlinica nr.2 Baia Mare (1992), Studiu asupra starii de sanatate a muncitorilor Companiei Phoenix/Cuprom/Study on the health status of Phoenix/Cuprom workers
- Clinic no. 2 Baia Mare/Policlinica nr.2 Baia Mare (1994), Actiunea plumbului asupra organismului salariatilor Romplumb Corporation/ Lead action on the employees of the Romplumb Corporation
- Cluj-Napoca Public Health Institute/Institutul de Sanatate Publica Cluj-Napoca (1999), Raport Proiect PHARE/PHARE Project Report
- Cluj Medicine and Health Centre and Bucharest Public Health Institute/Centrul de Medicina si Sanatate Cluj si Institutul de Sanatate Publica Bucuresti (1999), Evaluarea riscului la plumb si arsenic a copiilor din zona de influenta a Companiei Phoenix Baia Mare/Assessing the lead and arsenic risk of children in the influence zone of Phoenix Company
- Coman M. (2006), Depresiunea Baia Mare – protectia mediului din perspectiva dezvoltarii durabile/Baia Mare Depression - environmental protection from the perspective of sustainable development, Editura Risoprint, Cluj-Napoca.
- Dobra M., Viman V. (2006), Determination of concentration of air and soil pollutant heavy metals by ICP-AES, *Revista de Chimie*, 57:12, p.1283-1286.
- Faculty of Medicine, University of Amsterdam/Facultatea de Medicina, Universitatea din Amsterdam (1992), Studiu privind riscurile bolilor cauzate de poluarea cu metale grele in zona Ferneziu/Study on the risks of diseases caused by heavy metal pollution in the Ferneziu area
- Jacomet E. (1992), La Pollution a Baia Mare: Stage du 10 aout au 20 septembre 1992 aupres de la Romsilva R.A. Filiala Teritoriala Baia Mare
- Jelea S., Jelea M. (2007), Effects of polluting substances on risk category molten and agglomeration workers from Romplumb Society Baia Mare, *Carpathian Journal of Earth and Environmental Sciences* 2(1):51-57.
- Lacatusu R., Rauta C., Carstea S., Ghelase I. (1996), Soil-plant-man relationships in heavy metal polluted areas in Romania, *Applied Geochemistry*, 11:1-2, p.105-107, Elsevier Science Ltd, England.
- Manoiu V.-M., Spiridon R.M. (2017), A deep dive into the chronic air pollution reality in Baia Mare. Part I: Sources of historical environmental pollution in Baia Mare and their contribution to air pollution, *Proceedings of ADVED 2017-3rd International Conference on Advances in Education and Social Sciences*, October 9-11, 2017, Istanbul, Turkey.
- Manoiu V.-M., Spiridon R.M., Antonescu M. (2017), A deep dive into the chronic air pollution reality in Baia Mare. Part II: Air quality evolution between 1995-2006, *Proceedings of ADVED 2017-3rd International Conference on Advances in Education and Social Sciences*, October 9-11, 2017, Istanbul, Turkey.
- Maramures Nature Protection Commission and Maramures Public Health Department/Comisia Maramures de Ocrotire a Naturii si Directia de Sanatate Publica Maramures (2003), Raport determinare plumbemie la copii/Report on blood lead level determination of children in Baia Mare
- Maramures Public Health Authority/Autoritatea de Sanatate Publica Maramures (2007), Morbiditatea specifica in orasul Baia Mare in perioada 2000-2006/Specific morbidity in Baia Mare during 2000-2006
- Maramures Sanitary Department /Directia Sanitara Maramures (1992), Raport 1980-1990/Report 1980-1990
- Nadisan I. (2006), Caleidoscop ecologic/Ecological Kaleidoscope, Editura Universitatii de Nord, Baia Mare
- Nita S.-S. (2004), Poluarea aerului si riscul produs de activitatile societatii Phoenix in Depresiunea Baia Mare/Air pollution and the risk of Phoenix Corporation's activities in the Baia Mare Depression,

Comunicari de Geografie, Vol. VIII, Editura Universitatii din Bucuresti.

Oroian IG (2010), Assessment of industrial sources heavy metals contamination in Baia Mare area, *Metalurgia International*, 15:10, p.103-106.

Roba C., Rosu C., Pisteu I., Ozunu A., Baciu C. (2016), Heavy metal content in vegetables and fruits cultivated in Baia Mare mining area (Romania) and health risk assessment, *Environmental Science and Pollution Research*, 23:7, p.6062-6073, DOI: 10.1007/s11356-015-4799-6

Smical I., Muntean A., Torok Z. (2016), Human health risk associated with the transfer of heavy metals into the trophic chain by cattle grazing on the area in the vicinity of the tailing ponds in the east of Baia Mare city, Romania, *Studia Universitatis Babes-Bolyai Chemia*, 61:2, p.89-102.

World Health Organization (2000), Annual Report

World Health Organization (2005), A Field Guide for Detection, Management and Surveillance of Arsenicosis Cases, [http://apps.searo.who.int/PDS\\_DOCS/B0301.pdf](http://apps.searo.who.int/PDS_DOCS/B0301.pdf)

World Health Organization (2009), Levels of lead in children's blood, [http://www.euro.who.int/\\_data/assets/pdf\\_file/0003/97050/4.5.-Levels-of-lead-in-childrens-blood-EDITING\\_layouted.pdf](http://www.euro.who.int/_data/assets/pdf_file/0003/97050/4.5.-Levels-of-lead-in-childrens-blood-EDITING_layouted.pdf)

World Health Organization (2010), Childhood lead poisoning, <http://www.who.int/ceh/publications/leadguidance.pdf>

World Health Organization (2017), Lead poisoning and health, <http://www.who.int/mediacentre/factsheets/fs379/en/>