The Environmental Consequences of Industrialization in Western European Core Countries and the Borsod Basin of Hungary, 1850–1945: A Comparative Outline

Viktor PÁL

The Borsod Basin in a comparative European perspective in the late 18th and early 19th centuries

Coal and iron ore were widely available in eighteenth century Britain; hence, steam power could be utilized. There was a fairly reliable infrastructure and stable government, which created the background for business and stressed the pivotal role of private initiative.[1] Industrialization and urbanization rapidly transformed Great Britain. By the mid-19th century there were nine British cities that had more than 100,000 inhabitants.[2] Industry was an important user of coal, and source of smoke pollution. In large cities a great number of homes were heated with coal during the winter months which worsened all-year around pollution from industrial chimneys. Smoke and pollution control did not go usually together, and it took decades of industrialization and pollution until the first effective pollution control laws were legislated and exercised in Britain. Business interests were normally in controversy with the environmental and public health interests of the local communities. Even though the efficiency of steam engines improved, their numbers were growing faster, hence they produced more pollution. [3]

In the 19th century in East-Central Europe, Maria Theresa and Joseph II facilitated industry and commerce, especially in the Bohemian and Moravian provinces of the Habsburg Empire. This "economic development facilitated from above" was in a sense different from the British way, because it was not initiated by private entrepreneurs. However, the outcome was similar, albeit smaller in scale.[4] As a result of this process, Bohemia took a leading position in the modernization of the empire. By the 1780s, there were over 200,000 workers employed at textiles manufactures northeast of Prague and in and around Brno.[5]

During the same period, Hungary was a dominantly agricultural land. Modest industrial establishments concentrated in the mountainous regions of Transylvania and the Uplands. In the Borsod Basin, for example, industrial potentials were rooted in local forests (timber and charcoal), brown coal and iron ore deposits. One of the first entrepreneurs who settled as a result of the court's progressive economic policies was Henrik Fazola, a German-born iron master from Würzburg. After 1765, Fazola established a small number of iron manufacturing workshops in the Garadna and Szinva valleys.[6] In the 1820s, forges sought more water power and space, and operations moved a few kilometers downstream in the Garadna Valley.

The overall annual production of the Fazola works remained low and never exceeded 1,000 tons annually. Despite the financial and administrative support of the Vienna court, the Garadna forges did not prove to be financially stable. Local iron ore was of poor quality and large markets were hard to access from this remote location on unpaved roads. The overall scale of industry in the Borsod Basin was not comparable to the business activity of the Czech lands. However, the modest resources and industrial beginnings of Borsod meant a grounding for future industrial development after the end of the 19th century.[7]

---

[1] HOBSBAWM 1989, 14.
[2] MOSLEY 2008, 2.
[3] CLAPP 1994, 16.
[4] MAŁOWIST 2009, 226.
[5] EVANS 2006, 92.
[6] The Garadna and Szinva valleys are incorporated in city of Miskolc and are popular leisure destinations.
[7] *Diósgyőr 1765–1910*, 2.

Germany possessed the advantage of being a “late comer” to industrialization, which meant that German industrialists adopted modern production technologies faster than already established producers in Britain and Belgium. The main pillars of German industrial development were typical of late 19th century Europe: coal, iron, and steel. Between the 1830s and 1870s, German industries grew at an enormous rate.[8] Similarly to Britain and Belgium, one of the facilitators of the German industrial “revolution” was the growing rail network. The construction of the first line in 1833 was followed by the expansion of the rail network, reaching 6,500 km in 1852, 50,000 km in 1873, and 61,000 kilometers by 1910.[9] Prussia had substantial indirect state investments in the growing rail network. Several other plants and mines were state-run as well. The German chambers of commerce were “semi-public, semi-private” institutions. The German type of industrialization included strong state intervention and therefore was different than the Anglo-Saxon deregulated market of the private initiative.[10]

Industrial Development and its Environmental Consequences in the Ruhr and in the Borsod Basin, 1850–1914

During the second half of the 19th century, Germans witnessed a rapid population growth and urbanization trend. Between 1850 and 1910, Berlin grew from a city of 412,000 to a metropolis of over 2 million inhabitants. Hamburg’s population was close to 1 million by the end of the same period, and Munich surpassed half a million inhabitants.[11]

As a result of industrialization and urbanization, contemporaries noticed that pollution caused by Germany’s booming industries began to have a negative impact on communities. It was along the Ruhr, the Lippe, and the Emscher rivers, and in Saxony, where industrial and urban wastewaters took their tolls first and coal mining, iron, and steel manufacturing were to become the most important employers.[12] One of Europe’s largest bituminous coal and lignite fields is located in Rhineland-Westphalia. The Rhine, Western Europe’s international transport route, provided easy transportation access for the region.[13] As Ruhr mines and factories multiplied, small settlements grew into “sporadic industrial towns” and eventually into a “continuous industrial belt”. Simultaneously with the spread of the industry, water supply became a pressing issue. Traditional water sources proved to be inadequate or contaminated for the rapidly developing area.

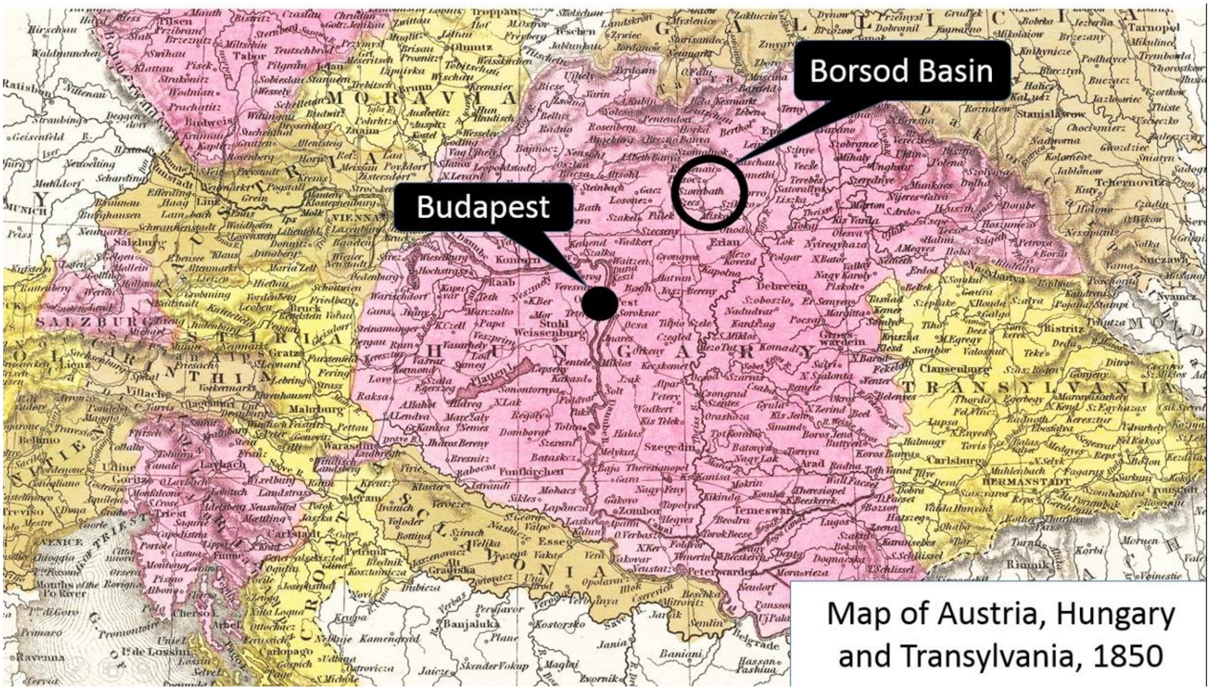
In Hungary, industrial and urban development boomed after 1867, when Magyars gained independence from Vienna in domestic economic matters. Soon Pest-Buda began to support Hungarian industry with tax reliefs, aid for investment, loans and the development of transport.[14] Between 1867 and 1873, 4,100 km of new railroads were constructed. After the economic depression of 1873, the boom continued (1882-90), and added 4,000 km of new railways to the existing system.[15] Initially, most rails and carriages were imported. However, from the 1880s, a growing number of items of the Hungarian railway infrastructure were supplied by domestic producers. Additional rail infrastructure, for example bridges, also required a great number of domestic products. Simultaneously with the railway boom, major Hungarian river flows were regulated and large areas of agricultural land were reclaimed. Railway construction and river regulation were both part of Hungary’s epic modernization project during the second part of the 19th century. As a result of industrialization, the number of factory workers nationally grew from around 660,000 (10 percent of total workforce) to 862,000 between 1869 and 1890.[16]

---

[8] Blackbourn 1997, 178–180.
[9] Ibid., 362–370.
[10] Ibid., 185.
[11] Berghahn 2001, 185–186.
[12] Blackbourn 2007, 180.
[13] Cioc 2002, pages between 21 and 24.
[14] Katus 1979, 943.
[15] Railroad construction provided opportunity for widespread corruption in Hungary. Despite the tumultuous economic and social history of railroad construction in Hungary the presence of an extensive rail network brought economic development to Hungary eventually.
[16] Katus 1979, 1010–1012.

The center of commerce in Hungary was Budapest. Railroads and commercial and financial ties met there. Budapest became a rising metropolis, home to large commerce warehouses, pig markets, railway head stations, and credit and commercial banks. The city also hosted many large-scale industrial establishments. Grain mills became lucrative business opportunities, and by 1895 they employed about 3,600 workers and the total capacity of their machinery was over 15,000 horsepower.[17]

The Ganz, Schlick, Láng, Vulkán, MÁVAG and Hunnia companies represented the heavy industry in Budapest. Most of these factories grew large to supply the demands of railway construction and the mechanization of agriculture. After the 1890s electrical engineering, war industries (*Weiss Manfréd Művek*), and the chemical industry grew at a high rate.[18]



Map of Austria, Hungary and Transylvania, 1850

From the second half of the 19th century, growing industries and urban population in the Ruhr needed unprecedented amounts of water. The forested drainage basin of the Ruhr and the hilly slate mountains nearby were less suitable for the filtration and storage of groundwater. Ruhr tributaries of the Rhine had limited discharge capacities, and when industrial plants and towns began to discharge a growing amount of pollution to the Rhine and its tributaries, water supply became a significant issue. Eventually, water for municipal and industrial use was mostly stored in reservoirs in the Ruhr area upstream to users. Water was not directly taken from large upstream reservoirs because industrial and municipal users were located further down, at the medium and downstream reach of the river, so it would have been very costly to construct an artificial water supply system. Also in the Ruhr, runoff from the Ruhr basin was able to supply users with water normally, except in dry periods. Then water was discharged from reservoirs to the river Ruhr to maintain adequate flow. The complex water management system aimed to supply industries and municipalities with adequate amount of water all year long.[19]

The self-cleaning capacity of the Rhine, which served both as a source of industrial water and an industrial waste-water canal, were limited. Industrial pollutants accumulated in rivers of the *Ruhrgebiet* and their self-cleaning capacity was soon exhausted. Phenols were some of the most notorious pollutants in the Ruhr area because they were bound to the coking process. Therefore, phenols re-

---

[17] Vörös 1978, 350.
[18] Ibid., 353. A detailed list of factories.
[19] Renz 1983, no. 147., 638–639.

mained present in the Rhine until the middle of the twentieth century when oil and natural gas replaced coal as fuel for the industry. Phenols also smelled very unpleasant and were considered a threat by non-chemist local residents as well. Debates soon escalated to a point where steps needed to be taken.[20]

By 1910, half of the Emscher's flow was of municipal and industrial effluent. This was because over 1.5 million residents, 150 mines, and 100 other industrial plants used the Emscher as a sewer. Another contributing factor was that the Emscher was the shortest and had the smallest watershed among the main Rhine tributaries in the Ruhr area. After a while, the river hardly had enough water in its riverbed to wash off the pollution effectively. Also, the river had a low gradient, which meant that during dry seasons, waste-water hardly flowed and caused environmental degradation of the riverbed. This was also a threat to public health. The river had a legendary stench due to the high phenol content. Waterborne diseases such as typhoid and cholera took their painful tolls in local communities, but industrial interests prevailed and the Emscher remained an open-air dump. After the inauguration of the Emscher Association (1899), engineers sought practical solutions and altered the Emscher effectively. The river's length was reduced to make it steeper and cement was employed in the riverbed to transform what remained of the river into an efficient wastewater canal, which led wastewater to the Rhine more quickly.[21]

Because the Emscher was designated to be the "toilet" of the *Rurhgebite*, the more water-abundant Ruhr River was preserved to supply industrial plants with clean water.[22] By 1900, water intakes were soaring along the River Ruhr, at around 150 million cubic meters annually, and within another 10 years, water intake reached 200 million cubic meters annually.[23] As a result, there was less water in the riverbed and its velocity and self-cleaning capacity deteriorated. Water loss occurred because of the share of functions between the Emscher and the Ruhr and wastewater was taken out from the Ruhr, and wastewater was pumped back into the Emscher. By the end of the 19th century, water shortages were frequent and disputes began among factory users to secure adequate water supply. New water engineering projects were created by the Ruhr Dam Association (1899) and the 1901 Ruhr Dam Act. Based on experiences with water reservoirs in Great Britain and the USA, six large dams were constructed in Rhineland-Westphalia between 1899 and 1965. Their capacity was enough to hold 469 million cubic meters of water. Water quality in the river Ruhr and its tributaries was guaranteed by the Ruhr River Association (*Ruhrverband*), founded in 1913, and water quantity in the Ruhr reservoirs was overseen by the Ruhr Reservoirs Association (*Ruhrtalsperrenverein*), founded in 1899. The total storage capacity in the Ruhr Basin is 410 million cubic meters, of which more than half is stored in two large reservoirs, the *Möhne* (127.8 million cubic meters effective capacity), and the Bigge reservoir (160.2 million cubic meter effective capacity). The three smaller reservoirs, the Henne, Sorpe and Verse, stored 36.4, 66, and 18.5 million cubic meters of water respectively.[24]

---

[20] „Phenol is both a manufactured chemical and a natural substance. It is a colorless-to-white solid when pure. The commercial product is a liquid. Phenol has a distinct odor that is sickeningly sweet and tarry. You can taste and smell phenol at levels lower than those that are associated with harmful effects. Phenol evaporates more slowly than water, and a moderate amount can form a solution with water. Phenol can catch fire. Phenol is used primarily in the production of phenolic resins and in the manufacture of nylon and other synthetic fibers. It is also used in slimicides (chemicals that kill bacteria and fungi in slimes), as a disinfectant and antiseptic, and in medicinal preparations such as mouthwash and sore throat lozenges." Agency for Toxic Substances and Disease Registry's website, http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=27 (accessed July 14, 2013).

[21] Cioc 2002, 89.

[22] The notion of „tap and toilet" originally used by Cioc 2002.

[23] Cioc 2002, 89.

[24] Renz 1983, 639-640.

Between 1904 and 1958, a total of eight water associations (*Genossenschaften*) were established in the Ruhr area by special laws (*Sondergesetzen*). These associations in the Ruhr area carried out extensive planning and construction for waste disposal, water supply, flood damage reduction, and land drainage, which caused significant problems, especially in former mining areas. Membership in the *Genossenschaften* was compulsory and voting power was distributed "*in accordance with the size of contribution to an association's expenses."* As a result, *Genossenschaften* were controlled by their largest and most affluent industrialist members.[25]

Despite the evident priority given to industrial needs, the *Ruhrverband, Emschergenossenschaft*, the *Rurhtalsperrenverein*, the *Lipperverband*, the *Wupperverband*, the *Niersverband*, the *Lineg*, and the *Erftverband* were "*the only organizations in the world that have designed, built, and operated regional systems for waste disposal and water supply*" as recently as the 1960s, according to the Kneese and Bower.[26]

From the early 1900s, the Ruhr Dam Association also facilitated the installation of mechanical treatment facilities such as the Imhoff tanks, to reduce the quantity and improve the quality of industrial effluent. These sedimentation tanks were promoted by Karl Imhoff, a water engineer. They functioned just like any other primitive sedimentation tanks. Water was rested in tanks to let solid particles sink to the bottom, and then the somewhat cleaned top layer of water was discharged to the Emscher. Mark Cioc notes that the high metal ore content sediment sludge was dried and sold as a low-grade nitrogen fertilizer, causing further environmental and health damage. All together, 138 Imhoff tanks were installed along the river between 1907 and 1914.[27]

Another initiative to reduce water pollution along the river Ruhr was the Cooperative for a Clean Ruhr (1911). This association targeted the notorious phenol pollution of the coke and coal industry. By 1910, over 6,000 cubic meters of phenols were discharged in the Ruhr area, mostly to the Emscher, annually. Phenols could not become sediment in Imhoff tanks, and recycling was capital-intensive and not profitable. Phenols, however, were apparent and dangerous. They produced an undesired odor, contributed to the outbreak of waterborne diseases, and when built up in fish fat, they made caught fish inedible. Still, it took quite a while until the first phenol removal plants appeared in 1926. Even as late as 1956, there were only twenty such plants in operation, removing only about half of the Emscher's phenol pollution.

The final stop for waste discharged by Swiss, French, and German industry to the Rhine and her tributaries was the Netherlands and Dutch cities. Here, the international pollution of the Rhine limited possibilities for the Netherlands' growing urban population to extract drinking water after the 1870s. Water problems were especially pressing in Amsterdam, according to Cornelius Disco. The Dutch capital city acquired water from a Dune Catchment Area, and following chronic water shortages in dry summers, in 1885 the Dune Water Company was granted a concession to serve Amsterdam with water from the river Vecht, a river in the Rhine delta. Unfortunately, this plan did not provide solution after all, because water from the Vecht was very polluted, and the city commission forbade its use for drinking purposes.[28]

While the Ruhr and Dutch urban areas struggled with water pollution and new industries thrived in Budapest. In some areas of Hungary where industrial potentials were left unexploited by private entrepreneurs because of the high financial risks involved, the Hungarian state intervened. In 1867, the Ministry of Finance initiated the construction of a state owned rail and rail wheel factory in Diósgyőr. Two civil servants, János Gombosy and Miksa Glanzer, were appointed to manage the construction works.

---

[25] Kneese 1985, 238.
[26] Ibid., 237.
[27] Cioc 2002, 95.
[28] Disco 2007, 386.

The Royal Diósgyőr Iron and Steel Factory received large state orders. The environs of the factory were not the narrow and dark upper valleys of the Szinva and Garadna anymore. Diósgyőr mills needed more space and were built in the lower plain of the Szinva Creek, between the provincial towns of Diósgyőr and Miskolc. Within less than a century, these two towns and a handful of other smaller communities grew into an industrial center of over 225,000 people called “Greater Miskolc.”

The Diósgyőr factory on a postcard, around 1900.
Zempléni Múzeum [Museum of Zemplén], Szerencs (0129761)

The Diósgyőr factory was donated by the state with a number of coal and iron mines in the immediate surroundings of the factory, and also further away in the Rosenau (Rozsnyó, today: Rožňava, Szlovákia) and Rudabánya area. Local iron deposits around Diósgyőr were insignificant and could only be used as added materials. Therefore, iron ore was chiefly transported to Diósgyőr from the mines of Rudabánya and Telekes. Contrary to iron, local coal deposits in Pereces had substantial potential and were already extracted by the 1880s. In Pereces, a vital mining community had developed and the geographical range of mining had been extended to valleys north of the village by a 2,300 m coal and workforce rail tunnel. The upper layer of the Pereces coalfield consisted of poor quality brown coal, but coal from deeper layers was suitable for fueling Diósgyőr’s steam engines.[29] Having its own brown coal was an advantage and made Diósgyőr more competitive on the domestic market. Further advantage was taken when the new Rožňava–Miskolc and Miskolc–Diósgyőr rail line was built. By rail, iron ore was easily transported to Diósgyőr, and the factory’s steel products were linked to their markets in Hungary and abroad by rail when preconditions grew favorable and Diósgyőr began operation in 1870. First, furnaces and rolling plants were installed, but technological setbacks halted production. When production lines were finally running smoothly, it was difficult for the factory to gain a niche on the market, because it was already dominated by more established Western competitors. After years of struggles, the 1873 economic depression hit Diósgyőr especially hard. It took the plant over a decade to recover and it was able to fulfill its annual 11,000-ton rail production capacity for the first time only in the early 1880s.[30]

[29] PÉCH 1873, 70.

[30] “d) Súlymértékek: 1 bécsi mázsa annyi mint 56.006: ötvenhat egész, hat ezredrész kilogr. [d) Weight, 1 Wiener Zentner (Viennese Centner) equals to 56.006 kilograms.]” Therefore 200,000 Zentner of iron equals to roughly with 112,000.tons. 1874. évi VIII. törvénycikk a métermérték behozataláról, [Act VIII/1874 on the Implementation of Metric Standard] Enacted in Budapest, Hungary.

Success continued thereafter. Diósgyőr rose from dismal to boom in a few years, and the factory was the supplier of the majority of rails during the second wave of the Hungarian railway construction boom in the 1880s. Besides rails, Diósgyőr produced slightly more than 5,000 pairs of train wheels a year. The factory also produced steel parts for bridges and the gigantic drill heads for the construction works of the Iron Gate river regulation project on the Lower Danube. To deal with competition, Bessemer converters, a Martin furnace, and a new generator plant were introduced. By the late 1880s, Diósgyőr emerged as a relatively modern and large factory in European comparison with 1,600 employees.[31]

But by the end of the 1890s conjuncture was over, and during the last years of the 19th century Diósgyőr was mostly restricted to producing steel parts for bridges. The growing number of military orders did not counterbalance economic decline, and in 1901, 1,000 workers were laid off and hundreds more were forced on holiday. After 1906, war preparations and artillery production orders continued to employ the Diósgyőr plant, and the advance of World War I provided a steady supply of contracts. Even though the production scale and success of the Diósgyőr mills was dwarfed compared to the giants of the Ruhr and Silesia, Diósgyőr and factories like it in Hungary made a solid industrial base for further industrialization under Stalinist development plans in the latter half of the twentieth century.

During the 19th century, and especially after the Compromise of 1867, Miskolc's population rapidly grew, and the city emerged as a center for industry and commerce. By the end of the 19th century, Miskolc and Diósgyőr, a former royal domain, jointly formed an urban area. A sign of urban growth was that the two main parts of the city were connected by light rail in 1897. For the urban areas' growing population, a reliable and safe water supply was needed. Miskolc commissioned József Fodor in 1885, and János Wein in 1890 to conduct research on the urban water supply of the city. Both Fodor and Wein considered two major options for water supply. They researched the limestone cave system of the Bükk Mountains. Here, significant amount of karst waters were stored in the hollow mountains, which after purification sprung to the surface in a number of locations in close proximity of the town. Another option was water from the river Sajó. However, bank filtration experiments on the Sajó produced unsatisfactory results. Therefore, engineers favoured the abundant karst springs of Tapolca.[32]

The decision to supply Miskolc by the Tapolca springs was followed by lengthy negotiations with the Greek Catholic Bishop of Munkács (Mukachevo), the landlord of the area. The city council purchased the property in 1908 and the first version of the city's water supply and wastewater system was built between 1909 and 1913. This first system connected mostly wealthier residents to the water supply system. All together, 840 of the total 4,843 houses were on the gird by 1913.[33]

Before World War I pollution on high levels was unheard in Northern Hungary, excluding a few tiny spots of industrial development. In Budapest, however, the situation was different. Large production capacities concentrated in and around this city, along with a steadily growing population. Act XXVIII of 1885 discussed the water use of industrial plants, and stated that in case of user disputes over water resources, considerable priority should be given to industrial plants over agricultural users. Field users could access water only on weekends, between 9 pm Saturday and 3 am Monday. Excess water use for agricultural users was only possible if they paid compensation to industrial users.[34]

[31] *Diósgyőr 1765-1910.*
[32] Vincze 1965, 140.
[33] Vincze 1965, 140.
[34] 1885. évi XXIII. törvénycikk a vízjogról [Act. XXIII. in 1885 on Water Rights] Enacted in Budapest, Hungary. 30.§ and 31.§.

The "polluter pays" principle appeared in the 1885 Hungarian law. Owners of water infrastructures were obliged to pay compensation when "*they (owners of water infrastructures) changed the flow of water and that caused harm*" downstream. The 1885 law forbade any type and quantity of pollution in theory. The law did not establish a system of water pollution fines, rather pollution from "*factories, mines and other companies" were treated on an individual case basis. After the examination of each case "(state) authority decides what measures should be taken*."[35] For those who did not comply with state measures, polluter fines were set: "*Fines up to 100 forints can be set (on those) […] who pollute waters with harmful and infectious materials.*"[36]

The 1885 water law and its remarks on water pollution followed Western European principles over water rights and pollution. Priorities were given to industrial water use over agriculture both in Hungary and in Western Europe. Both Hungarian and Western European law established the "polluter pays" principles in water regulation. During the second half of the 19th century, industrial development and urban expansion multiplied the volume of discharged wastewaters both in Hungary and in Western Europe.

The Aftermath of Rapid Industrialization. Environmental Awareness before WWI in Western Europe and in Hungary

In 1913, Hungarian water laws grew stricter. Tighter regulations reacted to the increased discharge of water pollutants. New regulations complemented the 1885 law, and aimed to enforce the protection of public health. The 1885 and 1913 water protection legislation had a favorable impact on water research as well. Gábor Baross, Minister of Communal Works, established a ministerial Department of Hydrography, Hungary's professional government unit for water-related research. In 1952, this department evolved into the Institute for Water Management and Research (*Vízgazdálkodási Kutató Intézet,* VITUKI), and had considerable scientific authority over water supply and wastewater planning issues in Hungary.

To manage flood control, river channelization and the management of water resources, the Engineer Service (*Kultúrmérnöki Szolgálat*) was established with the leadership of Jenő Kvassay in the Ministry of Agriculture (*Földművelésügyi Minisztérium*) in 1879.

Water quality protection changed in the latter part of the 19th century in the United Kingdom. At that time, organic content of river flows generally determined the degree of pollution for authorities. By the beginning of the twentieth century, a growing number of engineers argued that relying solely on organic compounds was insufficient and the absorption of dissolved oxygen should be included in water quality monitoring. To make water quality monitoring more reliable, the November 1912 report of the Royal Commission supported the inclusion of oxygen absorption into the water quality monitoring process. It was, however, not until the interwar era when the professionalization of wastewater issues reached a higher level of complexity on a local level. For example, in response to the central government's aim to control pollution with greater efficiency, the Nottinghamshire County Council's Public Health and Housing Committee set up a Rivers Pollution Prevention Subcommittee in July 1923. This subcommittee was responsible for any pollution of watercourses county-wide, and received its first full time "Rivers Pollution Officer" in May 1927.[37]

---

[35] Ibid., B) A hatósági rendelkezés alatt álló vizekről [B) About Waters Controlled by State Authorities], 24. § "A vizeknek ártalmas anyagokkal való megfertőztetése tilos. Hogy mily intézkedések szükségesek arra nézve, hogy gyárakból, bányákból és más vállalatokból hulladékok és megfertőztetett vizek más vizekbe bebocsáthatók legyenek: az iránt a közegészségügy követelményei és a fennálló használatok tekintetbe vételével a hatóság intézkedik."

[36] Ibid., VII. Fejezet Büntető határozatok [Chapter VII. Punitive Decisions], 185. § Száz forintig terjedhető pénzbüntetéssel büntetendő: 1. a ki vizeket ártalmas anyagokkal megfertőztet (24. §), a mennyiben az az 1879:XL. tc. 105. §-ba nem ütközik."

[37] SHEAIL 2002, 51.

In the United Kingdom in the latter part of the 19th century, sanitary engineers *"emphasized, the most important, in any case, was the state of the river, once the discharge had been mixed with its water."* The British system inspired other dilution and dilution-based wastewater discharge fines.[38]

After the war, defeated Gemany suffered under war reparations and the discharge of pollutants decreased for a brief period. In the weak and slowly stabilizing Weimar Republic, industrial production began to rise steadily after 1924 and it surpassed pre-war levels by 1928.[39]

On the lower section of the Rhine, excessive pollution once again provoked growing concern over the water quality of Dutch rivers and water supply in the Netherlands. In 1927, the Dutch Ministry of the Interior and Agriculture established an interdepartmental commission for the "Taste and Smell of River Water" to investigate and analyze the condition of the lower Rhine in the Netherlands. Investigators were particularly concerned about phenol, saline, and chloride in water. Between 1927 and 1931, monitoring in the Nederrijn at Rhenen found an average 441 mg/l of electrical conductivity (*geleidingsvermorgen*), 332 mg/l of solid materials (*vaste stoffen*), 61.9 mg/l of chloride, 3.2 mg/l of nitrate, 45.1 mg/l of sulfuric acid, 0.32 mg/l of ammonium, 29.3 mg/l of alkali metals such as Na+.[40]

Even though the Rhine was very depleted, it was a straightforward choice as a source of water for Rotterdam, and the city's first waterworks were established on the Rhine. Following the excessive international pollution of the Rhine upstream, typhoid epidemics threatened users, and several complaints were filed in Rotterdam about the phenol taste of drinking water from the Rhine. Phenol pollution continued episodically and in 1929 Rotterdam was forced to install new sand filters and in 1931 the city waterworks introduced chlorination to prevent epidemics.[41]

Bibliography

Diósgyőr 1765–1910

A Diósgyőri M. Kir. Vas- és Aczélgyár története 1765–1910 [The History of the Royal Hungarian Diósgyőr Iron- and Steel Factory 1765-1910]. Miskolcz: Szelenyi És Társa Könyvnyomdája, 1910.

BERGHAHN 2001

BERGHAHN, Volker. "Demographic Growth, Industrialization and Social Change." In *19th century Germany. Politics, Culture and Society 1780–1918,* ed. by John BREUILLY, London: Arnold, 2001. 185-–8.

BLACKBOURN 1997

BLACKBOURN, David. *Fontana History of Germany, 1780–1918: the Long 19th Century.* London: Fontana, 1997.

BLACKBOURN 2007

BLACKBOURN, David. *The Conquest of Nature, Water, Landscape, and the Making of Modern Germany.* New York–London: W.W. Norton, 2007.

BRAUN 1990

BRAUN, Hans-Joachim. *The German Economy in the Twentieth Century.* London–New York: Routledge, 1990.

CIOC 2002

CIOC, Mark: *The Rhine: An Eco-Biography, 1815–2000.* University of Washington Press, 2002

CLAPP 1994

CLAPP, W. Brian. *An Environmental History of Britain since the Industrial Revolution.* London–New York: Longman, 1994.

[38] Ibid., 48.

[39] BRAUN 1990, 48.

[40] DISCO, 392-394. Figures from the Table on 394.

[41] Ibid., 388–390.

CORNELIUS 2011

CORNELIUS, S. Deborah. *Hungary in World War II. Caught in the Cauldron.* New York: Fordham University Press, 2011.

DISCO 2007

DISCO, Cornelis. “Accepting Father Rhine? Technological Fixes, Vigilance, and Transnational Lobbies as „European” Strategies of Dutch Municipal Water Supplies 1900-1975.” *Environment and History* 13, No. 4 (2007): 381–411.

EVANS 2006

EVANS, J. W. Robert, *Austria, Hungary and the Habsburgs, Essays on Central Europe, c. 1863-1867*. Oxford: Oxford University Press, 2006.

HOBSBAWM 1989

HOBSBAWM, Eric J. *Industry and Empire, An Economic History of Britain since 1750*, Weidenfeld and Nicolson: London, 1989[6]

KATUS 1979

KATUS, László. “A Gazdasági fejlődés politikai feltételei [The Political Preconditions of Economic Development].” In *Magyarország története 1848–1890 [A History of Hungary 1848–1890],* ed. by László KATUS,, 933–1038. Budapest: Akadémiai Kiadó, 1979.

KNEESE–BOWER 1985

KNEESE, V. Allen, and BOWER, T. Blair. *Managing Water Quality, Economics, Technology, Institutions*. Washington D.C: Resources for the Future and the John Hopkins University Press, 1985.

MAŁOWIST 2009

MAŁOWIST, Marian. “East and West Europe in the 13th-16th centuries. Confrontation of social and economic structures.” In: *Eastern Europe and World Development 13th – 18th centuries. Collection of Essays of Marian Małowist*, ed. by Jean BATOU and Henryk SZLAJFER. Leiden-Boston: Brill, 2009. 215–227.

MOSLEY 2008

MOSLEY, Stephen. *The Chimney of the World. A history of Smoke Pollution in Victorian and Edwardian Manchester*. London-New York: Routledge, 2008.

PÉCH 1873

PÉCH, Antal. *Jelentése a selmeczi és diósgyőri kerületben és Rézbánya vidékén létező állami bányák és kohók állapotáról [His report on the condition of mines and furnaces in the Selmecz, Diósgyőr and Rézbánya areas]*. Budapest: Magyar Királyi Állami Nyomda, 1873.

RENZ 1983

RENZ, F. W. “Goals and management of the Ruhr Reservoir System since the Beginning of our Century”. *Scientific, Procedures Applied to the Planning, Design and Management of Water, Resources Systems. Proceedings of the Hamburg Symposium of IAHS, August 1983.* Hamburg: IAHSPubi, 1983. 637–647.

ROMSICS 1999

ROMSICS, Ignác. *Hungary in the Twentieth Century.* Budapest: Corvina–Osiris, 1999.

SHEAIL 2002

SHEAIL, John. *An Environmental History of Twentieth-Century Britain.* Basingstroke: Palgrave, 2002.

UEKÖTTER 2005

UEKÖTTER, Frank. “Polycentrism in Full Swing, Air Pollution Control in Nazi Germany.” In: *How Green were the Nazis?, Nature, Environment and Nation in the Third Reich*, ed. by Franz-Joseph BRÜGGEMEIEr, Mark CIOC, and Thomas ZELLER. Athens: Ohio University Press, 2005. 101–128.

VINCZE 1965

VINCZE, Oszkár. ”A miskolci vízmű (Miskolc Waterworks).” *Vízgazdálkodás* 5, No. 5 (1965): 140–144.