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CHEMICAL IDEAS AND THE DEVELOPMENT OF CHEMICAL AND PETROLEUM INDUSTRY ON THE POLISH TERRITORY SINCE 1850 TO 1920

POJĘCIA CHEMICZNE I ROZWÓJ PRZEMYSŁU CHEMICZNEGO I NAFTOWEGO NA TERENACH POLSKICH W LATACH 1850–1920

Abstract

The information about: 1) the liquefaction of oxygen and nitrogen in 1883 in Kraków, 2) the formulation in Lwow of the hypothesis of vegetal origin of crude oil, 3) the discovery of chromatography in 1903 in Warsaw, is given. The situation of chemical industry in the three parts of Poland partitioned among Russia, Germany and Austria is reported. A special attention is paid to the activity of Ignacy Łukasiewicz, who received for the first time in the world the kerosene from the crude oil, constructed and lighted in Lwow pharmacy in March 1853 the kerosene lamp. In 1854 he excavated petroleum shaft in Bóbrka and in 1856 he built a petroleum refinery in Ulaszowice near Jasło, getting ahead of USA, where the first petroleum refinery at Oil Creek was built five years later, in 1861.

Keywords: *the chemical industry*, *the petroleum industry*, *Poland*, *1850–1920*

Streszczenie

W artykule poinformowano o: 1) otrzymaniu w Krakowie w 1883 r. ciekłego tlenu i azotu, 2) sformułowaniu we Lwowie hipotezy roślinnego pochodzenia ropy naftowej, 3) odkryciu w 1903 r. w Warszawie chromatografii. Omówiono sytuację przemysłu chemicznego w trzech częściach Polski podzielonej między Rosję, Niemcy i Austrię. Szczególną uwagę zwrócono na działalność Ignacego Łukasiewicza, który otrzymał naftę z ropy naftowej, skonstruował i zapalił w marcu 1853 r. w lwowskiej aptece pierwszą w świecie lampę naftową; w 1854 r. wykopał szyb naftowy w Bóbrce, a w 1856 r. zbudował rafinerię ropy naftowej w Ulaszowicach, uprzedzając o pięć lat USA, gdzie pierwsza rafineria w Oil Creek została wybudowana w 1861 r.

Słowa kluczowe: *przemysł chemiczny*, *przemysł naftowy*, *Polska*, *1850–1920*

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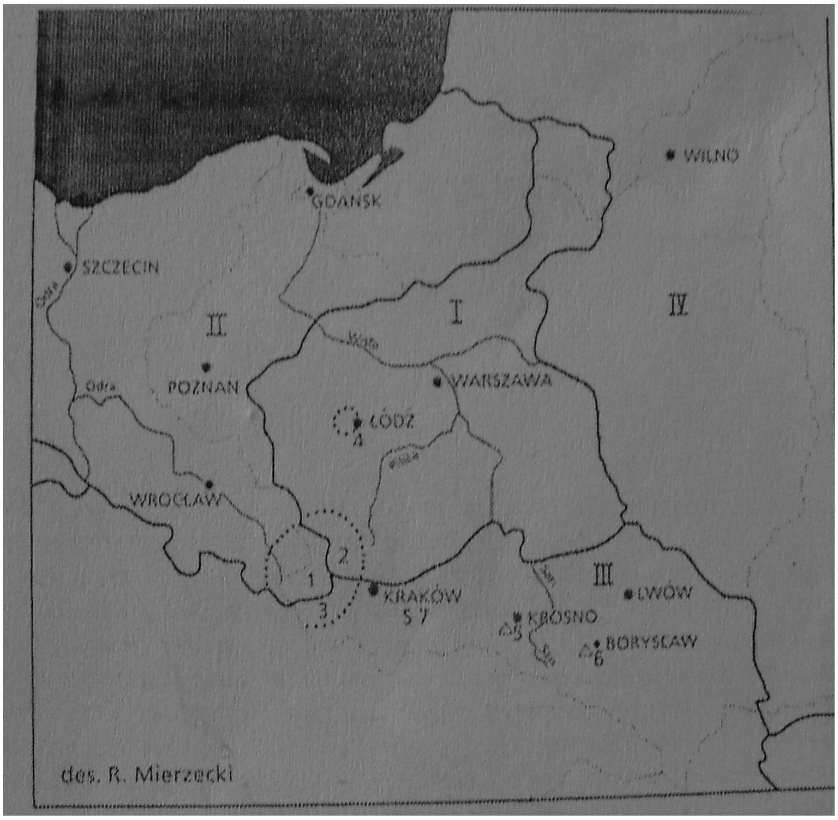
1. The historical background

In order to understand the situation of Polish science and industry during the second half of the nineteenth century and two first decades of the twentieth century some historical background is necessary. Poland and Lithuania constituted one entity in the eighteen century and this "Commonwealth of Both Nations" was the largest, although not the strongest, country in Europe. From an economic point of view the raw materials found in different part of this vast country were complimentary and formed a good basis for development of chemical industry. However the partitioning of Poland among Russia, Prussia and Austria



Legenda:

_____ Frontiers 1815–1924
Frontiers 1923–1939

I Polish Congress Kingdom
II Duchy of Poznan
III Galicia
IV Russian Empire

1. High Silesia Basin
2. Dąbrowa Basin
3. Kraków Basin
4. Łódź Basin
5. Krosno Petroleum Basin
6. Borysław Petroleum Basin
7. Salt mines

Fig. 1. The Polish Territory after 1815

at the end of eighteenth century put an end to this unity. The three regions that resulted, fragmented and put apart by the state frontiers, constructed peripheral economic districts of the occupying empires. The three regions inhabited at that time by Poles were:

1) the so-called Polish Congress Kingdom with Warsaw as capital incorporated into the Russian Empire as "Vistula District",
2) Grand Duchy of Posen (Poznań), East Pomerania and Upper Silesia in 1871 incorporated into the German Empire after an earlier annexation by Prussia,
3) the part annexed by the Austrian Empire, called Galicia, with the capital in Lwów (now Lviv in Ukraine), which after 1872 achieved some measure of autonomy and was governed by Poles (see Fig. 1)[1].

Poland regained independence in November 1918.

2. The Chemical Ideas

Only, in Galicia did Poles have a possibility to develop chemical ideas. In Iagellonian University in Kraków (Cracow) in 1883 the physicist Zygmunt Wróblewski (1845–1888) and the chemist Karol Olszewski (1846–1915) for the first time in the world liquefied oxygen and nitrogen in a stable form. In 1884 Olszewski also liquefied hydrogen, but only in a dynamic state. At the end of the nineteenth century the lowest temperature in the world (–263,9°C) was achieved in the chemical laboratory of the Cracow University. In 1895 Olszewski liquefied and solidified gaseous argon sent to him by William Ramsey, the discoverer of this element[2].

In eighties of the nineteenth century Bronisław Radziszewski (1838–1914), professor of the organic chemistry at the Lwów University developed the idea on the origin of the crude oil, which according to him was to be the result of the fermentation of vegetable remains[3]. He refuted Mendeleiev's proposition that the crude oil originated from inorganic remains.

In 1903 Mikhail Semenovich Tswiet [Михаил Семенович Цвет] (1872–1919) professor of botany and agronomy at the Russian Imperial University in Warsaw invented chromatography, one of the most important method of chemical analysis.

In 1916 Ignacy Mościcki, at that time professor of the Lwow Polytechnic School, organized in Lwow a society called METAN to promote the chemical industry. It is active to-day in Warsaw as the Ignacy Mościcki Institute of Industrial Chemistry. Ignacy Mościcki was 1926-1939 the President of the Polish Republic.

In 1919 the Polish Chemical Society was organized to unite all people working in Poland with the chemical matters.

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[1] Roman Mierzecki, *The Polish Chemical Industry; Isolated Developments in a Divided Country*, [in] Ernst Homburg, Anthony S. Travis, Harm G. Schröter, ed., *The Chemical Industry in Europe,1850–1914: Industrial Growth, Pollution, and Professionalization,* Kluwer Academic Publishers, 1998, p. 60.

[2] Zdzisław Wojtaszek, Halina Kuzyk, Alojzy Modrzyniec, Jerzy Dubowy, Krystyna Łopata, *Karol Olszewski*, PWN, Warszawa, Kraków 1990.

[3] Ignacy Z. Siemion, *Bronisław Radziszewski i lwowska szkoła chemii organicznej*, Wrocław 1999, 108-122.

3. The Chemical Industry

The development of chemical industry in each of the three segments of partitioned Poland was different. It was determined by the availability of raw materials in those regions and by political conditions. The invaders were not interested in stimulating the local industry; foreign companies were the owners of most raw materials and plants in Polish territories[4]. The Upper Silesia Basin the most industrialized was rich in coal (the largest deposits in Europe of coking coal) beside the iron ores, large quantities of the zinc ores: calamine and blende[5]. The development of this region was hindered due to proximity to frontiers[6]. Together with the neighboring Basins under Austrian and Russian rules (Cracow and Dąbrowa Basins) the Upper Silesia formed one of the largest industrial regions in Europe. In 1883 the first Thomas converter in Silesia was installed in Friedenshütte (now Huta Pokój). Large amounts of the fertilizer thomasine were produced as byproduct[7]. In nineteenth century the zinc production in Upper Silesia based on calamine and blende exceeded the production in all other regions of Europe[8]. Nevertheless, the chemical industry in Silesia remained underdeveloped, though tar distilling and preparation of raw materials for the dyestuffs industry became an important activity[9]. Not before 1916 did the war situation make it possible to construct there, in Königshütte (now Chorzów), a massive ammonia factory, where nitric acid and nitrogen fertilizers were produced from 1917 onwards. In 1919, after Chorzów had been assigned to Poland, the Germans dismantled much of the equipment and removed the construction plans. In 1922, Polish engineers led by professor Ignacy Mościcki restored the factory to full production[10].

The Duchy of Poznań was considered by the Germans an agricultural region, nevertheless they did not erect there any fertilizers plants. 80 per cent of fertilizers were imported from other parts of the German Empire[11]. By contrast, the sugar industry was substantial for this region. In 1882 a German company constructed a sugar mill in Chełmża (Pomerania), the largest in Europe at that time[12]. However the Poznań and Pomerania sugar factories produced mainly the raw sugar, which was sent for purification to central German countries[13]. In 1882 in Mątwy near Inowrocław the first on Polish territory factory for calcite and crystallized soda was built. In 1890 it produced 30 tons of soda daily[14].

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[4] J. Łukaszewicz, *Przewrót techniczny w przemyśle Królestwa Polskiego 1852–1896*, Warszawa 1963.
[5] A. Mączak ed., *Encyklopedia historii gospodarczej Polski do roku 1945*, vol. II, Warszawa 1981, p. 130.
[6] *Ibidem*, vol. II, 520.
[7] *Ibidem*, vol. I, 297.
[8] J. Dębicki, *Przemysł cynkowy*, Warszawa 1927.
[9] L.F. Haber, *The Chemical Industry during the Nineteenth Century: A study of the Economic Aspects of applied Chemistry in Europe and North America*, Oxford 1971, 127.
[10] E. Kwiatkowski, *W takim żyliśmy świecie*, Kraków 1990, 69-86.
[11] A. Mączak ed. *op.cit*, vol. II, 470.
[12] *Ibidem*, vol. I, 106.
[13] J. Iwaszkiewicz, *Przemysł cukrowniczy w Polsce dawniej i dziś*, Warszawa 1938.
[14] Florian Kruszka, Adam Wartalski, *Historia polskiego przemysłu nieorganicznego*, Warszawa 1996, 62.

The Congress Kingdom of Poland was from 1850 a part of Russian economic sphere when the custom frontier between the Kingdom and the rest of Russia was removed. Russian customs duties on raw materials and finished products were high, whereas those for intermediate products were low. Many foreign companies built then in the Kingdom their factories in which their intermediate products were converted into final products, exported without any tax to the whole Russian Empire. It was a reason of rapid progress of production in the Kingdom, greater than in other parts of the Empire[15]. In 1833 a French entrepreneur Philip de Girard constructed a linen factory, the largest in Europe, in a small town (named afterwards Żyrardów) 50 km south-west from Warsaw. The textile industry was developing also in the Łódź region, where in 1889 the first small dye-making factory was set up by Jan Smiechocki. Some years later with the help of Ignacy Hordliczka he increased the dye production, invented a process for fabrication of a sulphur black dye, and built a new much larger dyestuff plant in Zgierz. In the same year1889 in Pabianice near Łódź the firm Schweikert & Fröhlich built a substantial chemical and dye factory. In 1900 the dyestuff production in the Kingdom was as great as 2000 tons and it represented 28 percent of total Russian production[16]. In Warsaw medicines were prepared in several pharmaceutical factories and pharmacies[17]. The sugar industry was active in the Kingdom as well. In 1849–1850 some 33 sugar mills produced 3.500 tons of refined sugar from 50.000 tons of sugar-beets[18]. In 1871 37 sugar mills were active in which 11.654 workers were employed[19]. In 1870 Warsaw and Radom became the centers of the Polish tanning industry[20].

The sulphuric acid needed for dye production was produced from sulphur imported from Sicily. In 1909 some 13.200 tons of this acid were produced that formed 10 per cent of the whole Russian production[21]. In the Dąbrowa Basin the largest ironwork on Polish territory was established as early as 1834[22]. From 1878 local ores and those from other Russian regions were proceeded in open-hearth steel furnaces. At Ząbkowice an electrochemical factory built in 1898 produced chlorine from imported Galician salt. It was converted into chlorinated lime. In 1900 its amount 2.524 tons formed 21 per cent of the production of the whole Russian Empire. In the same electrochemical process, caustic soda was obtained[23].

Galicia was in the worst economical situation. Local raw materials such as sulphur layers in Swoszowice, and phosphate and potassium salts in eastern Galicia were exploited to a very small degree. Only in Cracow Basin the soda plant constructed in 1883

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[15] E. Kwiatkowski, *Dzieje chemii i przemysłu chemicznego*, Warszawa 1962, 97.

[16] K. Smoleński, E. Trepka, *Historia przemysłu chemicznego i widoki jego rozwoju w Polsce*, Warszawa 1919; Die chemische Industrie, 1905, **28**, 375-408; *A History of Chemists, Companies, Products and Changes*, Manchester 1987, 79.

[17] I. Kikta, *Przemysł farmaceutyczny w Polsce 1829–1939*, Warszawa 1972.

[18] S.B. Książkiewicz, *Historia polskiego przemysłu chemicznego w latach 1815–1918*, Warszawa 1995, 44.

[19] Z. Przerębel, *Historia cukrownictwa*, Warszawa 1927.

[20] A. Mączak, *op. cit*., vol. I, 283.

[21] F. Kruszka, A. Wartalski, *op. cit*., 9.

[22] A. Mączak, *op. cit*., vol. I, 265.

[23] F. Kruszka, A. Wartalski, *op. cit*., 76.

in Szczakowa did produce 50 tons of calcined soda daily. An important raw material appeared to be the crude oil used for a long time for lubrication purposes.

4. Ignacy Łukasiewicz and the Oil Industry

The crude oil was in the second half of the nineteenth century the greatest raw material resource in the Carpatian region of the Polish territory. 16 liters of petroleum were daily drawn from 30 wells in Borysław[24]. In 1837 in Lwów two dispensing chemists, Joseph Schopf and Gabriel Muling, heated in a retort a mixture of dense and light crude oils and obtained some quantities of gaseous hydrocarbons. These were conveyed by pipes into different parts of their pharmacy and domestic rooms and used for illumination. This cracking process, the first in the world, was rather tedious and found no imitators[25].

Fig. 2. Ignacy Łukasiewicz (1822–1882) painted by Andrzej Grabowski, 1884 (source: chomikuj.pl/Lukasowi/Galeria/Prezentacje+Word.Ignacy+*c5*8lukasiewicz,122899607.docx)

Very important was another attempt at crude oil utilization in 1853. It led to the development of the petroleum industry in south Poland and else where. The individual responsible for this attempt was Ignacy Łukasiewicz (1822–1882) born near Mielec in northern part of Galicia[26]. As a young man he took part in the Polish liberation movement and spent 1847–1849 in an Austrian jail. Such difficult conditions prevented him from undertaking regular studies in science. He began his work in an pharmacy in Rzeszów as an assistant and after for

[24] A. Mączak, *op. cit*., vol. I, 48.

[25] Z. Ruziewicz, *Początki przerobu galicyjskiej ropy naftowej i pierwsze gazowe oświetlenie we Lwowie*, Wiadomości Chemiczne, 1993, **47**, 681-695.

[26] W. Kisielow, *Chemia i technologia chemiczna ropy naftowej w Polsce 1816–1988*, Gliwice 1992.

a brief period of study of mineralogy at the Iagiellonian University in Cracow he qualified in 1852 at Vienna University with a thesis on *Baryta and Anilinum* under the professor of chemistry Joseph Redtenbacher. In the same year he began to work in the large pharmacy "Pod Gwiazdą" (Under the Star) of Piotr Mikolasch in Lwów. There he became interested in petroleum, having some knowledge about this substance from the lectures on mineralogy in Cracow. In 1852 he was asked by the two merchants from Borysław to thicken the crude oil to improve its lubricating properties. Applying the method of fractional distillation, he observed one fraction of a clear liquid. It was kerosene, not known at this time. The merchants wondered if vodka could be extracted from this fraction. Łukasiewicz tried to used kerosene in oil lamps, but it caused an explosion. To overcome this, a tinsmith, Bratkowski, and Łukasiewicz constructed a new lamp with a porous wick, a mica chimney, and air entrance from the bottom (Fig. 3)[27]. This new lamp operated safely when filled with kerosene. The first kerosene lamp lighted in March 1853 in the window of Piotr Mikolasch' pharmacy at the Large Street (now Kopernik Street) in Lwów. Piotr Mikolasch, Ignacy Łukasiewicz and their collaborator Jan Zeh organized a company for production of kerosene.

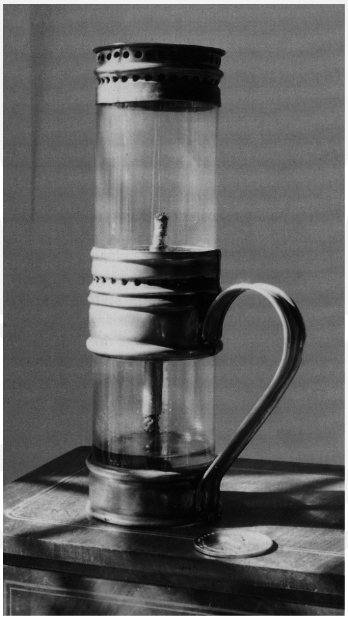

Fig. 3. The reconstruction of the first kerosene lamp (1853) after proposition of I. Łukasiewicz and A. Bratkowski

On the night of 31 July the surgeon Zaorski operated on Władysław Cholecki in a Lwów hospital under light of kerosene lamps. This date is considered as the begin of the world petroleum industry (In USA 29 August 1859 is considered to be such a date, as on this date

[27] *Lampy naftowe ze zbiorów Muzeum Okręgowego w Krośnie i Muzeum-Skansenu Przemysłu Naftowego im. Ignacego Łuksiewicza w Bóbrce*, Krosno 1996, 5.

E.L. Drake sank a 22-meter petroleum well by means of a steam-engine in the farm Willard near Titusville in Pennsylvania). Soon after, the Lwów hospital purchased 500 kg of kerosene for illumination. On the 2-nd December 1853 a patent for "the discovery that the crude oil purified in the chemical way is adapted for the immediate use for technical purposes" was awarded by the Austrian Patent Office to Łukasiewicz and Zeh[28] The Łukasiewicz's kerosene lamps were used on the Austrian Northern Railway. Łukasiewicz's kerosene lamps preceded the American construction of B. Silliman by two years.

Since 1853 Łukasiewicz sought out petroleum reserves in the Carpatian region. In 1854 he drove the first in the world petroleum shaft in Bóbrka near Krosno (now a Museum of Petroleum Industry). In 1856 he built in Ulaszowice near Jasło the first in the world petroleum refinery. The first American petroleum refinery at Oil Creek, Pennsylvania was built five years later, in 1861. In 1862 Łukasiewicz came into contact with American crude oil manufacturers. He adopted their well-sinking method invented in 1859 by E.L. Drake and constructed some new refineries, the largest in 1865 at Chorkówka. The representatives of US-based Standard Oil Company visited Łukasiewicz, studied his constructions, and tried to find in Łukasiewicz's refineries methods to avoid their own difficulties. They offered Łukasiewicz an 20 per cent profit agreement. Łukasiewicz rejected their offer, declaring: 'I have enough of my own money'. Without charge he supplied with kerosene the religious organizations of different creeds and was active in several industry-based social organizations. Łukasiewicz was also active on the social field, he was elected to local self-government organizations and to the Galician Parliament as well.

In 1909, all Carpatians petroleum wells produced 2.700.000 tons of oil; this was equal to 5.22 per cent of the world production of petroleum. After 1909 the production decreased, because of the exhaustion of some oil wells.

[28] Kwaśnicki.prawo.uni.wroc.pl/pliki/Drozen%20o%20Lukasiewicz.pdf