That's oil!...The Apothecary and the Blood of the Earth

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Abstract: Petroleum was of little interest to analytical chemistry scholars until the mid-19th century, as they considered it unhelpful to experiment with an explosive chemical compound with niche utility value. The discovery of oil's potential is credited to Polish pharmacists Ignacy Łukasiewicz and Jan Zeh, who performed the chemical separation of oil in a pharmacy laboratory using the scientific method of fractional distillation. The isolation of the kerosene fraction from oil was exploited by Ignacy Łukasiewicz, who created an innovative design for a lamp. Lighting with cheap kerosene became the idea of the explorer, who, with the help of Polish investors, organised the first oil mine and refinery in 1854, laying the foundation for the oil mining and petrochemical industry. Łukasiewicz's lamp, entering mass use, initiated global demand for oil. The accounts of Polish and Austrian historians on the pioneering role of Łukasiewicz in this regard support the arguments from the field of physics and analytical chemistry developed by Wojciech Roeske, who demystifies the amateurish, intuitive methods of oil purification of Łukasiewicz's predecessors, documents the merits of the Pole as a pioneer – an ancestor of the oil industry derived from the tradition of Polish pharmacy.

Keywords: Ignacy Łukasiewicz, kerosene lamp, kerosene, fractional distillation, oil mining, petrochemicals

Introduction

In 1882, the year at the beginning of which Ignacy Łukasiewicz (8.03.1822 - 7.01.1882) died, Thomas Edison lit up California's Menlo Park with hundreds of light bulbs on September 4. This was a harbinger of the inevitable arrival of electric light, although Łukasiewicz's kerosene lamp still served people until the middle of the 20th century, when about a century had passed since July 31, 1853, when Ignacy Łukasiewicz, a pharmacy graduate from the "Pharmacy under the Golden Star," delivered lamps for the new petroleum fuel to the Lviv hospital (Tomanek 1928; 22-24). And today you can still meet people who spent their evenings by a kerosene lamp. This date of Łukasiewicz's public lamp exodus – "lighting the first kerosene lamp" – is sometimes celebrated in Poland as a symbolic day for the birth of a new industry (Tomanek 1928; 73-75). Thanks to the lamp, the world entered the era of oil civilisation, as within ten years of 1853, the oil mining that Łukasiewicz inaugurated had already transformed into a professional oil mining

and refining industry. The Polish kerosene industry infected the world with oil fever. It was a world power for several decades in the 19th century, and made Vienna an oil hub and stock exchange headquarters.

The state of oil research in the 19th century

Before Łukasiewicz, oil remained outside the circle of interest of European earth sciences of the 19th century (Szajnocha 1881; 3), although its occurrence was reported by physiographers. Surface oil seeps in Poland are evidenced by geographical names like Ropa, Ropianka, Ropica, Ropka. It was of interest to tanners, wheelwrights and quacks. The ancients wrote about oil. Egyptians prepared mummies with it.

In Poland, in the 16th century, Stefan Falimirz recommended the healing properties of oil. He explained that "*petroleum"*, is *"an oile which comes from stone"* (Falimirz 1534; 231)**.** Oil and its forms were described by Polish scholars of the past centuries – Gabriel Rzączyński (1721), Krzysztof Kluk (1781; 196-208), and Stanisław Staszic (1815; 277-283).

Pharmacists played a special role in the development of Earth sciences in the 19th century. With pharmacy laboratories at their disposal, they had a chance to join the trend of scientific discoveries in physics and chemistry that accounted for the technical leap of the century of "steam and electricity". Independent chairs of scientific pharmacy, which were separated from medical departments, were established in Polish universities as early as the 18th century in Warsaw, Cracow and Vilnius, and their tradition was carried on by generations of scholars in the 19th century (Rembieliński, Kuźnicka 1987; 100-122). The Department of Pharmacy at the Jagiellonian University was established during the reign of the last Polish king in 1783. Its first university professor was Jan Szaster, whose most prominent continuators were Józef Sawiczewski, and during Łukasiewicz's studies, Florian Sawiczewski, Rafał Czerwiakowski and Ludwik Zejszner (Roeske 1974; 31-35).

Professor of pharmacognosy, history of pharmacy and long-time director of the Museum of Pharmacy at the Jagiellonian University in Cracow Wojciech Roeske saw Łukasiewicz's work, unlike the other contenders for his pioneering position, not as the result of spontaneous chance, but the success of a well-educated pharmacist, the culmination of the tradition of Polish scientific pharmacy – the "*primus inter pares*" of the 19th-century oil industry. He evidenced this thought and expressed it in the words:

"The mother of petrochemistry and the oil industry is the Polish pharmacy, the cradle is the pharmacy laboratory" (Roeske 1991; 84).

First fractional distillation of crude oil in 1853

After graduating from the fourth grade of the Rzeszów Gymnasium, fourteen-year-old Ignacy Łukasiewicz, as a pharmacist's apprentice, began his path to becoming a pharmacist. These were years of laboratory work from dawn to dusk,

studying and taking exams in physics, chemistry, drug preparation, pharmacognosy, medicine, toxicology, geology, zoology, dendrology, herbal medicine, and materials science. By the time he earned his master's degree, Łukasiewicz had completed fourteen years of pharmacy work and study, as well as a year and a half of university study in Cracow and a diploma semester in Vienna. The pharmacy of his time produced a great number of medical, perfume, food, and household preparations, which required comprehensive knowledge of and acquaintance with laboratory techniques.

Ignacy first saw crude oil only as a thirty-year-old master pharmacist in June 1852. Years later, he recounted in an interview the day that the village innkeeper Abraham Schreiner showed up at his pharmacy *"with a flask of liquid red like blood"* (Morawski 1871; 50) – as Łukasiewicz was the first to compare oil to blood (Krajewski 2018, Klare 2006). The compound with the Latin name *petroleum* was already known to him. He heard about it during his studies in Cracow from Professor Zejszner (Morawski 1871; 50), and purified oil from Italy was a luxury drug known to apothecaries. What was new to him was that rock oil could be obtained in close proximity.

With the approval of the pharmacy's principal Mikolasch, Łukasiewicz set about experimenting on the hitherto scientifically unexplored compound with his senior colleague Jan Zeh. The masters used the fractional distillation method and fairly quickly "decomposed" the crude oil into light gasoline fractions, medium fractions and heavy hydrocarbon fractions from the group of technical oils and asphaltenes. When testing their properties, it was found that the fraction isolated between 250 and 350 degrees Celsius burnt with a bright, even, non-explosive flame. It was also called kerosene. This was a pioneering success and a testament to the highest professional qualifications of the two pharmacists. A patent for a method of laboratory distillation of crude oil was issued to them at the Vienna patent office with a date of December 2, 1853. Its essential passage was: *"Zeh Johann und Mag. Der Pharmazie Ignatz Lukasiewicz Erfindung die naturliche Bergnaphte auf chemische Wege so zu lautern dass Sie dadurch zur technischen Zwecken unmittelbar verwendbar werde. Provilegium Urkunde 2 Dezember 1853. Civil. Dauer 2 Jahre Geheim.*" (Roeske, 1974;. 85).

Based on Anczyc's description of the method used by the masters (Anczyc; "Kłosy "1882, 885), Roeske was able to conclude that this procedure *"in principle is still in use today"* (Roeske: 1974; 42). Commenting as a specialist in analytical chemistry on the complex process of fractional distillation, Roeske argues that news of all discoveries guided by intuitive empiricism must be mystifications.

Ignacy Łukasiewicz's first kerosene lamps

The initial success of obtaining light kerosene, shared with his colleague, could only be multiplied by Łukasiewicz. He mentioned:*"I'm trying to shine, of course, with the oil lamps. The tank ignites inside, bursts it and almost burned me*

(...). I'm going to the famous tinsmith Bratkowski. (...)We try, we improve..." (Morawski 1871; 52)

The thing was to harmonise the design of the lamp with the physicochemical peculiarities of kerosene. For Roeske, this meant definitively resolving the pioneering position of Łukasiewicz's prototype through his proprietary solutions for the air supply to the holed burner, the features of the wick and its adjustment, the kerosene container, the shielded flame, the polished mica part, and the method of drawing out exhaust. (Roeske 1974; 47).

Roeske contrasts Łukasiewicz's lamp with the features of Sambor's lighting from the beginning of the century. On the basis of Höfer and Engler's description of the Samborian lamps in the rock oil monograph, Roeske shows that the product used in them was not kerosene, but a random mixture of light gasoline fractions obtained at 70-120 degrees Celsius without a scientific theoretical basis or appropriate method. The compound was volatile and required an air supply *"smaller than the smallest pin* (Roeske 1974; 47), because it burned with a living flame, which precluded the use of a wick and the regulation of light and was a dangerous experiment. Understanding among specialists in analytical chemistry and laboratory technology of the principle of the appropriateness of the properties of kerosene for the construction of the Łukasiewicz lamp, Roeske found in almost all of Europe. At numerous scientific conferences, the Cracow professor presented this problem and handed out replicas of Łukasiewicz's lamps, which he described in his diary of these sojourns (Roeske 1991).

Guided by scientific rationale, Roeske also contradicted the view that American Benjamin Silliman obtained combustible distillate from oil in 1855. His opinion is confirmed by the fact that Yale University, at the hands of Professor of Technical Sciences Jerzy Hołubiec, submitted a written statement that Silliman had never constructed a lamp (Roeske, 1974; 48-49). Łukasiewicz's pioneering position is also described by historians and Austrian officials of his time, who were not necessarily positive about Polish successes. Industrial inspector Navratil testifies: *the first public edifice on the entire globe lit by petrol was the general hospital in Lviv. It was illuminated by Łukasiewicz's petrol."* (Roeske: 1974; 47). This fact is confirmed by geologist, author of works on kerosene Hans von Höfer (Roeske 1974; 84).

Although the first designs of Łukasiewicz's lamps could hardly be called exclusive, their creator was not so much interested in their fabrication as in perfecting the quality of kerosene as part of the "living room" genre, without unpleasant odour or smoke. He confessed:*"Then they proclaim the new illumination: pinolin, camphine! I can't sleep for jealousy* (Morawski 1871; 52). So, for encouragement, he also called kerosene the *"new camphine.* He purchased oil from village gatherers, distilled it, and sent offers to Germany, France, and Vienna. Twenty years later, this was described by the Austrian Gintl, who personally encountered Łukasiewicz: *"Es war in den Jaren 1853/4 als Herr J.B.Heindl gegenwärtig Besitzer der chemischen Fabrik zu Ottakring, vom Hernn Łukasiewicz in Lemberg*

Proben von Destillaten sammt Lampen erhielt, um diesen Leuchtstoff in Wien bekannt zu machen und ein Kapital zur Ausbeute dieses Mineral-Oelszu acquiriren nachdem hierfür weder in Lemberg noch in andern Orten Galiziens ein Interesse erweckt werden konnte. Zu gleicher Zeit sandte Łukasiewicz solche Oelprobe durch den gegenwärtigen Central-Direktor der Carl-Ludwig Bahn Herrn Louis de Lens nach Paris und an den Prof. Redtenbacher in Wien, um die Aufmerksamkeit der wissenschaftlichen Welt aud diese Stoffe zu lenken und ihnen praktischen Eingang zu verschaffen. (...) „Doch bleiben diesen Bemühungen ohne ersehnten Erfolg." (Gintl 1873; 5). Łukasiewicz patiently invested, experimented with oil and made a living in pharmacy (Brzozowski, 1974; 64).

The world's first oilman

In 1854, Łukasiewicz left Lviv to run his own pharmacies in Gorlice, Krosno and Brzostek. Luckily, he met investors there who entrusted him with an oil-bearing site in the Bóbrka estate for the world's first mine.

"*If I am not mistaken, this is oil, in mercantile terms – kerosene!"* (Morawski 1871: 55), Łukasiewicz exclaimed enthusiastically at the sight of a sample brought by future investor Tytus Trzecieski (Brzozowski 1974; 84-87). The mine was in operation in 1854, even though the owner of Bóbrka, Karol Klobassa already had an expert report on his oil from the Liebieg Institute in Munich. *"This is fat without value"* – ruled the German scholars (Morawski 1871; 56) and this fact, too, verifies the information about Łukasiewicz's predecessors typified even from ignorant scientists, such as the kerosene merchant Schreiner (Brzozowski 1974; 85-87). Quite quickly, Łukasiewicz abandoned the idea of lamp production without regret. Coming across a rich oil deposit in 1861 eventually prevented him from managing pharmacies as well (Brzozowski 1974; 118).

It was not until five years later, in 1859, artesian well digging expert Colonel Drake came across an oil deposit in Pennsylvania, and so the first oil well on American soil was established (Brzozowski 1974; 72-73). Meanwhile, the Regional Museum in Jasło has in its collection Łukasiewicz's diploma from an industrial fair for petrochemicals and light kerosene from 1858. (Bonusiak 2018; 115). At the time of his death, Łukasiewicz, in addition to being a shareholder in the Bóbrka mine and owner of a refinery, was co-owner of more than a hundred shafts in mines in Ropianka, Smereczna, Nowosielce, Uherce Mineralne and Solina. (Bonusiak 2018; 126).

Thanks to the fortune made in kerosene, he was a sponsor, lender and donor to countless people and public institutions, and was tireless in social activities. He was a member of the national parliament, creator of the world's first workers' insurance and "fraternal funds", builder of schools, and educator of the people, who called him "father". He initiated the oilmen's association and the trade newspaper "Górnik" (1882).

Łukasiewicz world pioneer of petroleum science and ambassador of Polish pharmacy – summary

Informed by Schreiner of Łukasiewicz's discoveries, the Viennese factory of the Ditmar brothers switched from oil to kerosene lamp production within a few years. In 1864, without an agreement with the Polish inventor, they patented the design of the burner, an essential component of Łukasiewicz's lamp (Roeske 1974; 49), which became known worldwide as the "Ditmar lamp." In Bóbrka, Łukasiewicz trained oil mining personnel – miners, technical personnel, and engineers. Polish and foreign investors were hired to study, come as guests, copy equipment, inventions. (Franaszek 1991). Kerosene from under Łukasiewicz's supervision and logistics to the end of his life topped the rankings of quality exchanges, at national exhibitions and in Vienna (Tomanek 1928; 39-43). John Rockefeller also sent his engineers to him from the US for know-how (Brzozowski 1974; 141). Łukasiewicz's students and employees dispersed over time as sought-after petroleum professionals across the continents.

Feted by the elite, Łukasiewicz was decorated by the Pope with the order and dignity of papal chamberlain (Tomanek 1928; 71-72) and by Emperor Franz Joseph with a medal and the title of baron (Tomanek 1928; 73-75). He received these honours with exasperation. To the end, he treated people for free and, although he was a Polish nobleman of the Łada coat of arms, did not allow people to call him anything other than "Mr. Pharmacist".

The end of his century brought a global crisis of oil overproduction, but soon the role of the lamp that started and unleashed the race for oil was taken over by internal combustion engines. Oil took over completely in the twentieth century and rules until now. The era of Łukasiewicz – the apothecary, ambassador of Polish pharmacy, who deciphered the mystery of oil, recognised its power and personally implanted it in the bloodstream of civilisation – continues.

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