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# Mendeleev and the Petroleum Industry

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## MENDELEEV AND THE PETROLEUM INDUSTRY

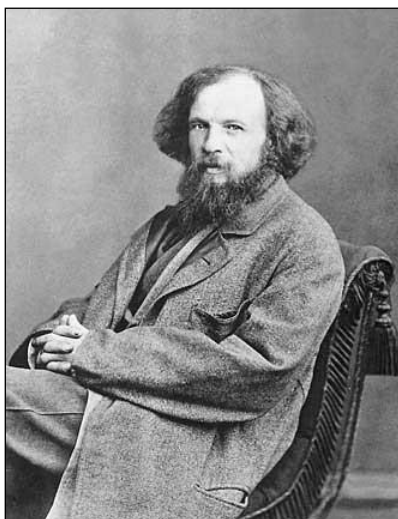
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### Introduction

The discovery of the Periodic Table in 1869 by Dmitri Ivanovich Mendeleev (1834 – 1907) (**Figure 1**) is only one of his professional achievements. His work on petroleum was his major occupation. He wrote many articles on the subject and supported the theory that the origin of petroleum was the result of the reaction of carbides with water — a theory that is dismissed today in favour of the organic theory. He went to Baku in Azerbaijan many times to consult on oil production. Azerbaijan at that time was part of Imperial Russia and an oil well was drilled using primitive methods more than a decade before an oil well was drilled in North America. In 1901, it produced more than half of the world's oil. Today, it produces a small amount as compared with other producing countries.

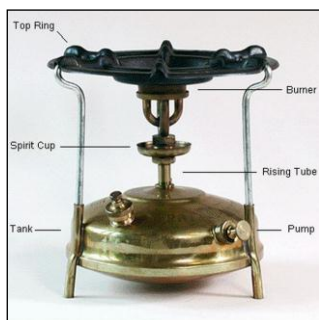


**Figure 1.** Dmitri Ivanovich Mendeleev (1834 – 1907).

### Kerosene

In 1846 a small kerosene factory was built. Barrels were used to collect and store the oil that is why today oil is measured and sold per barrel. Kerosene is a clear liquid obtained from the fractional distillation of petroleum between 150 and 275 °C. In the second half of the 19th century Baku turned into the biggest oil region of Russia. Kerosene was widely used in households cooking in Primus stoves invented in 1892 (**Figure 2**) and lighting fuel in lamps and

lanterns (**Figures 3** and **4**) before electrical distribution became available. Its name is derived from Greek meaning wax, which was registered as a trademark in 1854. Kerosene burned longer and with a brighter light than other oils.



**Figure 2.** Kerosene cooking in portable stoves.



**Figure 3.** Kerosene lamps.



**Figure 4.** Kerosene lantern.

The widespread availability of cheaper kerosene was the principal factor in the decline in the whaling industry in the late 19th century, as the leading product of whaling was oil for lamps. Kerosene also replaced turpentine obtained from the distillation of wood as a fuel. Kerosene stoves have replaced traditional wood-based cooking appliances. Kerosene was sold in some filling stations or in tank cars (**Figure 5**). The vast Russian empire needed more of the new light than anyone else as St. Petersburg, the capital, barely had six hours of daylight in the winter. Interestingly, after crude oil was processed, one of the by-products (gasoline) at that time was simply dumped or used as solvent.



**Figure 5.** Selling kerosene from a tank cars.

Today, kerosene is mainly used in fuel for jet engines in several grades. One form is burned with liquid oxygen as rocket fuel. Kerosene is used to store active metals that react with air or water such as potassium, sodium, lithium, etc. It also used a pesticide.

### Mendeleev in Baku

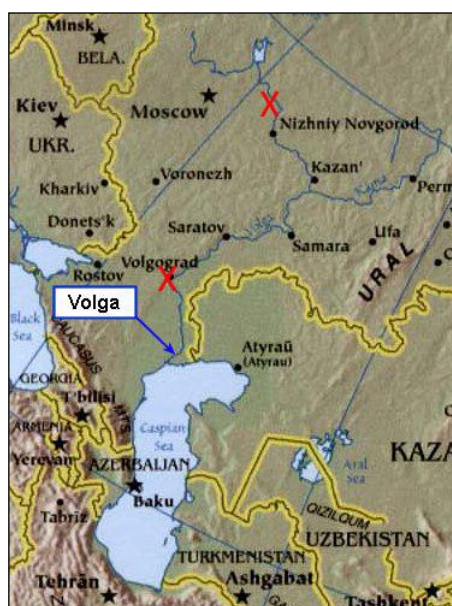
Mendeleev was 29 years old when he was invited by the Russian oil businessman Vasily Alexandrovich Kokorev (1817 – 1889) (**Figure 6**) to visit his oil refinery in Baku constructed in the 1850s and make recommendation since it had become less profitable. Mendeleev at that time was professor at Saint Petersburg University, just returned from Heidelberg in Germany where he was sent by the Russian Government in 1859 to 1861 to study. Apparently he became

known to Kokorev through Germans who supplied him with some equipment. Mendeleev left for Baku on September 6, 1863, stayed in Moscow at Kokorev's mansion across the Moscow River from the Kremlin. He then left to Nizhniy Novgorod and onwards aboard a ship along the Volga then to Baku. He returned on October 8.



**Figure 6.** Vasily Alexandrovich Kokorev (1817 – 1889).

After the visit, Mendeleev proposed building a pipeline for oil transportation from wells to the sea, where oil was to be stored in reservoirs then transported across the Caspian Sea by tanker till Volga and from there till Nizhniy Novgorod where a factory for processing oil to various products should be built (**Figure 7**). He argued further that Cheleken, then part of Turkmenistan – now known as Hazar (**Figure 8**), would be occupied by the Russian military for exploitation of its oil resources. The project did not appear to have gone ahead. Incidentally Turkmenistan was annexed by Russia in 1881 but became independent in 1991.



**Figure 7.** Map showing Baku on the Caspian Sea and Nizhniy Novgorod and Volgograd, formerly Tsaritsyn (1589 – 1925), And Stalingrad (1925 – 1991) on the Volga, X.



**Figure 8 .** Map showing Baku and Cheleken, X.

Kokorev suggested that Mendeleev become technical director of the new refinery to be built near Nizhniy Novgorod. Mendeleev tempted to give up his low-paying academic position in order to work full-time in the oil industry for much more money but he declined the offer because his wife did not like the idea. He was even offered later to become a co-owner of the refinery but after much thought he declined. Six years later in 1869 Mendeleev became famous for formulating the Periodic Table.

The refineries around Baku moved their oil from the wells to Baku in wooden barrels on carts, which was inefficient. Manufacturing barrels was made worse by the lack of wood in the region. The barrels were prone to leaking. Oil was shipped by boat up the Volga. In order to improve efficiency, refiners asked the Caucasus and Mercury Shipping Company owned by Kokorev to install cisterns so that oil could be shipped along the Volga in bulk but the company refused.

### Mendeleev and the oil industry

Mendeleev took part with the Russian delegation for the Paris World Fair in 1867 as an expert on chemistry. In 1868, two government commissions were formed — one in Tbilisi and one in St. Petersburg. The Tbilisi commission noted that the United States, which was not tied by a leasing system, experienced growth. In Russia the oilmen did not open up new wells because of the leasing system. As a result it was impossible for modernization. The St. Petersburg commission found the need to end the leasing system. In 1875, America made some huge oil discoveries and in the absence of any taxes, the price of oil fell. The threat of the influx of cheap American kerosene was taken seriously and a commission was created to examine the question of taxes on oil. As a result the Russian Government decided to send Mendeleev to examine the American system.

Mendeleev departed from St. Petersburg on May 30, 1876 with his English speaking assistant, and returned September 11. The trip was sponsored by the Minister of Finance to understand the modern technology of the oil business in America, the tax policy on oil, and to understand the reasons for the lowering of kerosene prices. Mendeleev visited the oil fields in Pennsylvania and the Philadelphia World Fair to examine the oil display. He took a trip to Niagara Falls and visited the meteorological centre in Washington. Meteorology was a subject which he would later study for the Russian Government. On his return, Mendeleev wrote to the Minister of Finance, *Memorandum regarding the abolition of lighting oil taxes*.

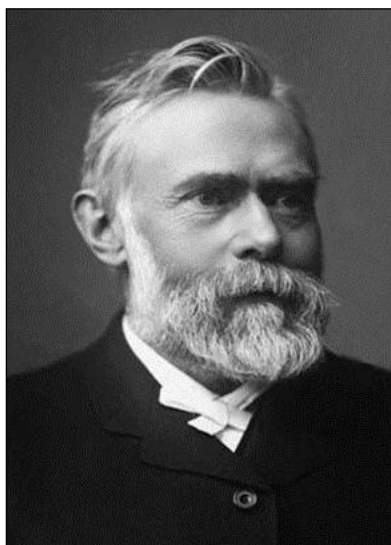
Mendeleev mentioned the necessity of cancelling the petroleum tax. American oil started to decrease when taxes on crude oil and its refining were abolished. The result was an increase in use. Mendeleev discussed fire hazards and kerosene, dangers of its transportation and storage, refining of oil by-products, oil pipelines, how to attract capital to the Russian oil industry, and how to encourage its growth. Furthermore, because there was insufficient technical information on Russian oil, it was necessary that a study of the industry be undertaken including the heavy oil, its uses and its marketing. He argued that the refineries should not only be in Baku but along the Volga and in the centre of use, close to those places where barrels are cheap. Mendeleev wrote that it was necessary that different people do the construction, sales, give technical advice, drilling, construction of reservoirs and other apparatus. He also commented on the state of the bureaucracy and the employment of women in America, and the arrival of the first gas piston engine in America.



Mendeleev noted that only half of America's kerosene was consumed at home while the rest was exported. He observed that America used three times kerosene per capita as Europe while Russia was using less than Europe. America's economic strengths, was the result of the quality of their oil, which produced much greater quantities of kerosene than Russia's. Mendeleev believed that the Baku oil fields could compete with the American product if the Russian government similarly abolished the taxes it assessed on the industry. Once Russian kerosene was plentiful and reached a low price then Russia, should export to Europe by using pipelines, special barges, and wagons.

### Nobels in Baku

The Petroleum Production Company Nobel Brothers was set up by Ludvig Nobel (1831 – 1888) (**Figure 9**) and Baron Peter von Bilderling (1844 – 1900) in 1876 in Baku. It was headquartered in St. Petersburg and became one of the largest oil companies in the world producing 50 % of the world's oil. Ludvig Nobel was an engineer and a businessman. The Nobel family was from Sweden but lived many years in Saint Petersburg. The company had been facing financial difficulties since the end of the Crimean War in 1856 due to a severe cut in the military budget ordered by the new Tsar Alexander II, and eventually, in 1862, the firm was sold.



**Figure 9.** Ludvig Nobel (1831 – 1888).



**Figure 10.** Robert Nobel (1829 – 1896).



**Figure 11.** Alfred Nobel (1833 – 1896).

With some funds he had managed to save, Ludvig opened a new firm, the Machine-Building Factory. Initially producing cast-iron shells, the factory became in a few years one of the largest producers of gun carriages of Russia. When his brother Robert (1829 – 1896) (**Figure 10**) bought a refinery in Baku, Ludvig invested in refinery modernization. He established technical chemical research labs employing dozens of scientists, finding ways to treat oil, developing new uses for oil, and developing new products derived from oil.

By 1876, the Nobel brothers established themselves as the most competent refiner in Baku and sent the first shipment of illuminating oil to St. Petersburg. By 1879, Ludvig turned the business into a shareholding company, Branobel, with brothers Robert and Alfred (1833 – 1896) (**Figure 11**) and others.

### Improvement in the Azerbaijan oil industry

Great changes were introduced in the area of oil storage, for example, iron reservoirs were used. In 1877, construction of the first oil pipeline linking Surakhany oil field and refinery in Baku was completed. By 1890, there were more than 25 pipelines. The Nobel Brothers were the first to introduce railway tanks (cisterns) for oil transportation in 1883. In 1884, the oil producers in Baku established the Oil Extractors Congress Council under the direction of Ludvig Nobel. They created the magazine, *Neftyanoe Delo* (Oil Business). Ludvig and Robert Nobel built Villa Petrolea which received on October 9, 1888 Emperor Alexander III of Russia with his family; currently functions as a museum. Ludvig Nobel invented oil tankers; the world's first tanker was *Zoroaster* (**Figure 12**) designed in Sweden in 1878 and made its first trip from Baku to Astrakhan.



**Figure 12.** The world's first oil tanker Zoroaster, 1878.

By 1890, 345 tankers, including 133 steam vessels and 212 sailing vessels were sailing on the Caspian Sea. The oil-saturated earth in Baku was covered by fertile soil and fresh water was imported from the Volga on ships travelling from Astrakhan which used it as ballast instead of sacks of sand. Large companies started to employ geologists to describe and map prospective structures. By early 20th century, innovation started to improve the backward well drilling practices. Tankers played an important role in shipping fuel. For example, on July 22, 1892 the first tanker sailed from Britain to Batum to be filled with kerosene, subsequently passed through the Suez Canal [opened in 1869] on August 23 for the Far East.

### Mendeleev's other trips to Baku

Mendeleev made a second trip to Caucasus in 1880 and was befriended with Azerbaijani oil industrialist Haji Zeynalabdin Taghiyev (1821? – 1924) (**Figure 13**). In 1884 (October 26 – November 8) he took an active part in the Congress of Baku Oil Industrialists. In May 1886 he made another trip to Baku and gave speeches about the conditions of development of oil business. On March 1887 he presented a report to the minister of state properties about the issue of oil and kerosene pipelines.



**Figure 13.** Haji Zeynalabdin Taghiyev (1821? – 1924).

In 1880, Mendeleev proposed the construction of Baku–Batum pipeline to transport oil to the world market (**Figure 14**). The project was postponed as premature, and the construction started only in 1896 and finished in 1906. The first pipeline was kerosene pipeline. It was at that time the longest pipeline in the world. It was Alfred Nobel's dynamite that helped build the pipeline through the mountains. Other pipelines were later constructed.



**Figure 14.** Baku – Batum pipeline (Sangachal – Supsa), 1906.



### Rothschild brothers in Baku

In 1883 the Caspian – Black Sea Oil Industry & Trade Society was established by Alphonse Rothschild (1827 – 1905) (**Figure 15**) the son of Paris banker James Rothschild (1792 – 1868). After his father's death, Alphonse took on the management of the Paris banking business. Alphonse Rothschild opened branches of his company in many cities in the Volga area, in the Baltic States, in Belorussia, and in and Poland. After his death his younger brother Baron Edmond Rothschild (1845 – 1934) (**Figure 16**) took over. The construction of the Transcaucasia railway (**Figure 17**) connecting Baku and Batumi was finished in 1883 thanks to a Rothschild loan. In the early 1900s, the Nobel Brothers and the Rothschilds concluded an agreement to prevent the American Standard Oil from entering the Caucasus.



**Figure 15.** Baron Alphonse Rothschild (1827 – 1905).



**Figure 16.** Baron Edmond Rothschild (1845 – 1934).



**Figure 17.** Transcaucasia railway connecting Baku and Batumi.

## World Wars

On the eve of the World War I, the Russian General Oil Company, Royal Dutch Shell, and Partnership of Nobel Brothers controlled 60 % of oil production. In 1912, Anglo – Dutch firm Shell obtained 80 % shares of Caspian – Black Sea Society Mazut, which had belonged to Rothschilds.

After the Russian Revolution, nationalization of the industry was decreed by the Baku commune in June 1918. As a result of World War I no oil export was possible, oil storage facilities were damaged, and wells were idle. The government of Democratic Republic of Azerbaijan was unable to restore the damage done to the oil industry.

On 28 April 1920, the Bolsheviks seized power in Baku and confiscated and nationalized the industry. They formed Azneft State Company. Scientific exchange started with the USA and engineers from Baku visited the oil fields in Pennsylvania, Oklahoma, California, and Texas. The Azerbaijan State Oil Academy was established in 1920 to train oil specialists.

By World War II, the Nazis were determined to capture the oil fields of the Caucasus. Their defeat at Stalingrad forced a retreat. Oil production from the existing fields started to decline after World War II, as a result of over-production.

In the early 1930s, engineers constructed the first offshore wells and in 1949 important discoveries were made. In 1957 several large oil and gas fields were discovered and put into production.



**Figure 18.** Baku – Tbilisi – Ceyhan pipeline, 2006

After gaining independence Azerbaijan the Baku – Tbilisi – Ceyhan pipeline was opened in 2006 to transport crude oil (**Figure 18**). It is the second longest oil pipeline in the world — the longest being the Druzhba pipeline from Russia to central Europe.

*Extensive references to the original literature is in Ph.D. Thesis of Mark Butorac, "Mendeleev, the West and the Russian Oil Industry", presented at the Faculty of Graduate Studies and Research, McGill University, Montreal, 2001 (252 pages).*

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# Nano Studies

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