

THE STORY OF OIL SHALE DISCOVERY IN ESTONIA

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***Abstract.** There is a traditional narrative in Estonia on how oil shale was first mentioned by A. W. Hupel in 1777 and how supposedly, A. J. Güldenstädt stated in his books that oil shale was discovered near Jõhvi in 1725. However, from historical literature and archival documents the authors of the present research found no evidence to prove these statements of the narrative. In this study, it will be specified how oil shale was actually discovered on the Kohala estate and first described in 1791.*

***Keywords:** history, Hupel, Güldenstädt, Georgi, Kohala.*

1. Introduction

Despite the fact that oil shale is Estonia's most important source of energy and serves as a basis for its chemical industry, the early history of oil shale research in the country has not been sufficiently studied. However, there has developed a certain traditional narrative concerning the history of the first oil shale research in Estonia. On the one hand, that story is generally unknown for the international public, on the other hand, as is revealed in the present study, it contains mistakes and misinterpretations.

The aim of this investigation is to clarify on the basis of historical literature and archival documents how oil shale was discovered and first described in Estonia, but also to disseminate the historically correct version.

2. August Wilhelm Hupel

Traditionally, it is believed [1–5] that Estonian oil shale was first mentioned by August Wilhelm Hupel (1738–1819), a pastor from Põltsamaa. Pastor Hupel was the first to prepare a general overview of the economic and natural conditions in Estonia and Livonia in the second half of the 18th

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century. In order to collect data for his book, Hupel established a network of correspondents to send him relevant information [6].

In “Earth Resin” (in German *Reine Erdharze*), the second volume of his four-volume book “Topographic Messages from Livonia and Estonia” (in German *Topographische Nachrichten von Lief- und Ehstland*), it is written on page 532: “According to a man’s confirmation, stone oil can be found under a small Estonian manor; ...” (in German *Steinöhl, welches man nach eines Mannes Versicherung unter einem kleinen ehstländischen Gut soll gefunden haben; ...*) [7]. Nothing else is said about oil shale in the book but usage of the word *Steinöhl* (shale oil) in that particular sentence is traditionally regarded as the first time Estonian oil shale was mentioned.

There are several contradictions regarding this reference in Hupel’s book. First, the afore-mentioned and often-cited phrase is torn out of context. Looking at the whole paragraph, Hupel has written the following: “Similarly to sulphur, I lack reliable data on stone oil, which, according to a man, can be located near an Estonian small manor, as well as coal that I have not yet seen.” [7]. There is indeed neither sulphur nor coal in Estonia. In order to understand Hupel’s writings, we must delve into the German scientific world of the 18th century, including knowledge of the geology of the Earth (i.e. mineralogy). Comparing Hupel’s text with the works of predecessors of modern geologists [8–11], it can be concluded that Hupel had general knowledge about combustible substances and the classifications that existed then. At the same time, having probably not read the respective studies, he classified sulphur with substances that were mainly related to petroleum (amber, shale oil) [7]. However, this categorisation was not used by any other mineralogist of his time.

The second question is: “What does *Steinöhl* actually mean?” As is known, German words for oil shale are *Brandschiefer* or *Brennschiefer*. But if we look again into the scientific books of the 18th century, we can see that stone oil was usually categorized in the same class with petroleum. By the understanding of that time, this class contained oils that naturally oozed from the Earth as it is common in Tyrolean oil shale deposits. But in case of Estonian oil shale, oil can be released only by heating, yet Hupel’s writing includes no reference to such a possibility whatsoever.

It is quite certain that for Hupel, who had studied medicine at Jena University in his youth [6], *Steinöhl* did not signify oil shale as stone in the geological sense, but oil flowing out from stone or earth, which was in those days often used in alchemy and medicaments. In a medical book [12] edited and translated into Estonian by Hupel and published in 1771, German word *Steinöhl* is used in parallel with Estonian word *kiviõli* (then *Kiwwi ölli*; stone oil) and specified by the word petroleum. Thus, Hupel’s vague reference to *Steinöhl* in the book “Topographic Messages from Livonia and Estonia” cannot be considered as the first mentioning of oil shale in Estonia.

Nevertheless, it is interesting to follow how the name of Pastor Hupel got into the oil shale literature. Pastor Hupel was first mentioned by the Baltic

German scientist Henry von Winkler¹ in his book about Estonian geology published in 1922 [13]. A few years later, in 1928, the story about Hupel was published in a book [14], which, according to archival data², was written by Märt Raud (1878–1952), the famous Estonian oil shale scientist and engineer. After that it began to spread to other scientific and popular science works. It is hard to understand why Winkler, who was a recognized specialist of oil shale chemistry and an author of several books on oil shale, had to include such a dubious reference to Hupel's work in his book. A plausible key to this mess-up is the fact that Winkler worked between 1922 and 1944 at a company named *Die Estnische Steinöl AG* located in Kiviõli, suggesting that in some contexts the word *Steinö(h)l* has been understood as a synonym of oil shale.

3. Johann Anton Güldenstädt

The most arcane scientist in the history of Estonian oil shale research is Johann Anton Güldenstädt (1745–1781). Henry von Winkler wrote on the first page of a book he edited [15] in 1930: “Oil shale [that was found] near Jõhvi in 1725 has been reported in Güldenstädt's two-volume travelogue of a journey through Russia.” Since then, Güldenstädt's name has been often mentioned with regard to Estonian oil shale history. While some authors merely refer to 1725 as the date of the first mentioning of oil shale found in Estonia as a wide-known fact [16–18], it may follow from the misleading wording of some other works [1, 2, 19–21] as if Güldenstädt had personally visited Jõhvi 20 years before he was born. Yet there are also publications [3, 4] that contain a faulty reference to Güldenstädt's only travelogue “Traveling through Russia and in Caucasian Mountains” (in German *Reisen durch Rußland und im Caucasischen Gebürge*). Peter Simon Pallas (1741–1811), the well-known German zoologist, geographer and Russologist, published the first part of these travel notes in 1787, shortly after Güldenstädt's early death. The second part of the travelogue was published in 1791. Güldenstädt's journey to Caucasia (1768–1775) was an extremely significant expedition from the standpoint of the 18th century's Russian empire. Güldenstädt's book is especially important to many ethnic groups of Caucasia, since it is the first time ever they are mentioned in the printed medium [22]. Regrettably, neither part of the book by Güldenstädt [23] contains a reference to Estonia, let alone oil shale. The reason is fairly

¹ Henry von Winkler was born in 1870 to the Ulvi manor owner not far from Rakvere in Estonia. He studied chemistry at Royal Saxon Polytechnic Institute in Dresden. In 1900, he established the first Estonian chemistry laboratory in Tallinn. In 1905, he started working at the Tallinn bacteriology laboratory, which he also directed during the First World War. He was the author of several geography and geology textbooks. Winkler was one of those that performed chemical analysis of oil shale and studied the application issues of oil shale as fuel in Estonia during World War I. He died in 1947 in Berlin.

² Compare Estonian State Archives, 2491-1-89, s 1–69.

simple – the expedition did not cover the modern area of Estonia. In addition, there is no reference to Estonia or oil shale in the other works by Gldenstdt [24, 25] edited by Pallas either. Furthermore, there are no references to a connection between Estonia and Gldenstdt in his complete biography [22]. Thus, the current knowledge provides us no reason to believe that Gldenstdt was in any way connected with oil shale.

But even more interesting is to track how this misinforming reference entered the oil shale literature. It can be deduced from the list of references in Winkler’s book [15] that Gldenstdt’s travelogue had been referred to via another source. The book’s list of references contains an unusual entry: “Oil shale that was sighted near Jhvi in 1725 has been mentioned in Gldenstdt’s two-volume travelogue of a journey through Russia”, as well as a reference to the journal *Livlndische Jahrbcher d. Landwirtschaft*, 1867, 14th issue. Also, there is an additional acknowledgment which claims the publication to be probably the earliest report on oil shale [15]. This reference has two flaws. Firstly, the mentioned journal was not published after 1866. Secondly, the pages referred to in the issue of 1861, which was actually the 14th issue, contain a chapter of a longer article [26] discussing phosphate rock discovered near the Luga River and include no information on oil shale whatsoever.

Again, it is difficult to understand how such an error could occur. It is important to emphasize that the wrongly dated reference to the above-mentioned article [26] first appeared in the list of references of a book discussing the matters of phosphate rock by the Baltic German applied geologists Franz Beyschlag (1856–1935) and Leo von zur Mhlen (1888–1953) in 1918 [27]. Based on circumstantial evidences we may only speculate that the roots of Winkler’s mistake somehow originate from von zur Mhlen who corresponded with Winkler personally [28], and like Gldenstdt travelled in Caucasia in 1910 as a geology student of the University of Tartu [29].

4. Johann Gottlieb Georgi

Overviews of the history of Estonian oil shale chemistry often start with introducing Johann Gottlieb Georgi (1729–1802), as well as with an article [30], which is considered the first scientific piece of writing on Estonian oil shale [2, 4, 16, 31, 32]. At first, it should be paid attention to that the article in question [30] is actually anonymous, i.e. the author’s name is not indicated. But as the authorship is traditionally attributed to Georgi, we will follow the custom.

Regrettably, references to Georgi’s work are a typical example of how mistakes tend to travel in later texts. In this particular case, the sequence of misinterpretations starts from the writing by the prominent oil shale scientist

Nikolai Pogrebov³. In a footnote of his publication [33], N. Pogrebov vividly describes how he learned from Aleksandr Karpinski (1847–1936), a geologist and a member of the Saint Petersburg Academy of Sciences, and later Academy of Sciences of the USSR, that Georgi was the first to deal with oil shale at the end of the 18th century. Pogrebov admits that he has not seen the original articles and is describing Georgi's results via Doss [34]. Pogrebov's text about Georgi is clearly recognisable in several later works [14, 31], whence it travelled to other oil shale publications and slowly started to mutate. Therefore, the printed medium contains a fair amount of confusion with the basic matter, for example, who was the first person to discover oil shale in Estonia, to transport it to Saint Petersburg and to test it. In this context, some studies [1, 3, 33] mention Anton Johann von Engelhardt (1729–1808) as the first scientist who investigated oil shale.

The true story of how oil shale was first described starts with the fact that since the growing stock of trees in the European part of Russia was decreasing, the oldest Russian scholarly society – the Free Economic Society of Saint Petersburg (established in 1765) – began to look for information from its members about combustible minerals that could replace wood. This request got several responses, mainly from inner Russia, which were published in the Proceedings of the Society⁴. Documents from the Free Economic Society archives that are preserved in Saint Petersburg evidence that the request launched a chain of events, which led to the publishing of the article [30] in 1791. It is unknown how and through whom the information about a kind of combustible mineral found near the Kohala estate (*Tolks* in German) in Estonia reached the Society. The estate is located about 10 km north-east of Rakvere. But documents show that the Society gave Georgi a task to prepare a questionnaire for obtaining more information⁵. In reality, the questionnaire was drawn up by Eberhard Johann Schröter (1725–?)⁶, an archivist of the Society, who was probably the first person to receive any information about the combustible mineral found in Kohala. The questionnaire was sent to Baron Fabian Reinhold Ungern-Sternberg (1738–1795), the landlord of Kohala estate. The response of the estate owner is preserved in the archives of the Society⁷. First, there was a question about the extent of the site. The landlord guessed that a 4–5-fathom-high (ca 8–10 m)

³ Nikolai Pogrebov (1860–1942) was a Russian and Soviet hydrogeologist and an engineering geologist, as well as a professor at Leningrad Mining Institute from 1931 to 1936. In 1887 he graduated from the Saint Petersburg Mining Institute. From 1897 to 1919 he worked as the librarian and archivist of the St. Petersburg Geology Committee. In 1902, he described the Baltic oil shale basin and was actively involved in studying oil shale and its application issues up to the 1920s. Works at the Estonian first oil shale quarry were initiated under Pogrebov's personal direction in 1916. He passed away during the Leningrad Blockade.

⁴ Russian State Historical Archive (Saint Petersburg) (RSHA), 91(Free Economic Society) 1-414, s 59.

⁵ RSHA, 91-1-32, s 39v.

⁶ RSHA, 91-1-32, s 39v.

⁷ RSHA, 91-1-408, s 58-59.

sandy hill on his land might consist of the rock. He derived his opinion from the fact that the ‘burning rock’ (in German *brennbarer Stein*) was discovered both at a depth of four fathoms when a spring was opened at the slope of the sandy hump, as well as in a well that had been dug some years earlier a few hundred fathoms further at the same slope. The thickness of the rock layer was half a fathom (about 1 m). At the same time, the landlord claimed that the burning rock had not yet been discovered anywhere else.

When the baron was asked whether that burning rock had been used on the estate, Ungern-Sternberg answered: “Only the cowherds use these burning pieces on meadows at nights. Peasants do not use the rock due to the fact that it gives off a strong /.../ stench when burning. The estate has not conducted further tests on the rock either, because it is complicated to quarry it from that depth, and there is no lack of wood.” Ungern-Sternberg admitted that some tests had still been conducted, and a cauldron of water was made to boil with little effort. The landlord noted that the fire produced a lot of heat.

Archival documents do not reveal the role of Anton Johann von Engelhardt in this story. In Georgi’s paper [30] there is only a short sentence saying that a brownish, light and layered mineral, which contains fossils of tiny marine creatures and burns in fire, was found in Kohala. This paper was introduced to the Society by Actual State Councillor von Engelhardt in March 1789. The paper also says that the Society assigned Georgi a task to analyse that mineral.

Johann Gottlieb Georgi, who at that time was a chemist of the Free Economic Society, presented results of the analyses at the Society’s meeting on 28 March 1789⁸. Following a tradition, those results were first published in German in the Proceedings of the Society in 1791. A year later Georgi’s presentation was translated into and published in Russian [35]. Georgi found that when heated, the oil shale consisted of 40% of crude oil (in German *Bergharze*), the rest being water, clay and limestone. By distillation of ten ounces of stone he obtained one ounce of oil (in German *Bergöl*). In his presentation, Georgi classified the analysed mineral as clayish black-tar shale (*Terra bituminosa argillacea fissilis*).

5. Conclusions

The present research revealed that in Estonia oil shale was accidentally discovered in mid-1780s on the Kohala estate. The oil shale found in Kohala was scientifically analysed in 1789 by Johann Gottlieb Georgi, a chemist of the Free Economic Society of Saint Petersburg. Results of the analysis were published in the Proceedings of the Society in 1791 [30], and that paper can be considered as the first piece of writing on oil shale discovered in Estonia.

⁸ RSHA, 91-1-32, s 54.

Although A. W. Hupel's "topographic messages" are often referred to as notes containing the first mentioning of oil shale, it is not justified. Based on geological knowledge of that time, A. W. Hupel definitely ascribed the word *Steinöl* to something different than oil shale. Dating Estonia's oil shale history from the contribution by J. A. Güldenstädt and the early 18th century is not supported by any factual evidence either. We will probably never find out why Henry von Winkler included the names of Pastor Hupel and Johann Anton Güldenstädt and the year 1725 in the history of oil shale. The most plausible reason is that he just disregarded accuracy in handling historical facts.

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