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SHORT COMMUNICATIONS

The Role of State Central Laboratory and National Testing Centre in Advancing Technology Studies in the Republic of Estonia

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By the beginning of the 20th century, a significant imbalance had emerged in Estonia's industrial capacity and creative engineering power. While the majority of the manufacturing industry had so far been based in Narva, northeast Estonia, with the Narva falls providing a cheap source of energy, in the given period industry began to appear elsewhere as well, especially in Tallinn. Within a couple of decades, the country was covered with a dense rail network. Advances in shipping had a direct effect on industrial development. Estonia was rapidly moving towards becoming an industrial society. Small workshops and big machine-building factories were established.

The primary trigger for searching new solutions in power industry was the scarcity of energy gripping the world during the First World War. The Republic of Estonia was born during an acute energy crisis. The war had put an end to coal import. The principal fuel used in industry, railway transport and households was firewood, but demand for it exceeded the supply. The rapid disappearance of forests available for cutting forced people to use less firewood and partially replace it with peat and oil shale.

There was, however, neither enough equipment nor labour force to sharply increase peat production. At the same time, oil shale was considered a novel type of fuel. Gregor von Helmersen tested the process of thermal disintegration of oil shale, which produced oil and gas. The chemical composition of oil shale was first analysed by Georg Petzholdt and Alexander Schamarin in Tartu (Mägi, 2012). There was no experience whatsoever of using it as a fuel. Knowledge obtained from processing other types of fuel was of little use, since it could not be directly applied to oil shale processing due to its specific character of producing large amounts of ash residue and its specific thermal decomposition. Moreover, it differed from any other known fuel in terms of its characteristics. The very first experiments proved that one needs very different conditions and furnace construction to burn oil shale. Overcoming the difficulties proved much more problematic than expected. The industry's leaders agreed to reconstruct furnaces only on the condition that they be offered ready-made constructions. Therefore, oil shale as a fuel was initially not widely used. Under the circumstances an effort was made to increase peat production.

The industrial exploitation of Estonian oil shale resources began in the 1920s. The pioneering institution to commence research into the combustible properties of oil shale was the State Central Laboratory in Tallinn (Dreyer, 1922). The laboratory was staffed by chemists and chemical engineers who had obtained their diplomas in Tartu and Riga. Their main assignment was to perform analyses while, less frequently, some research-oriented tasks were undertaken as well, such as establishing the properties of local fuels, finding options for chemical processing of oil shale, and analysing the radioactive content of curative mud. Comparative testing of oil shale formed a major part of their activities. This line of work was continued by the National Testing Centre at the Tallinn Technical College (Maddison, 1925; Mägi, 1985).

To satisfy the huge demand for fuel, oil shale mining was started in Kohtla in 1919. The following year, a mine was opened in Kukruse. In 1919, Tallinn Gas Company was the first to start using oil shale (Kogel, 1919), and shipyard plants followed its lead. Oil shale was tried out as replacement of coke in railway workshops. Ships made trial runs using oil shale as a fuel. The State Central Laboratory began carrying out research into oil shale as a fuel by comparing its calorific value with that of peat (Pezold, 1922). Later, the National Testing Centre continued research into oil shale. Research on the technological employment of oil shale in cement industry was pursued. To achieve satisfactory results, it was considered necessary to improve techniques of mining oil shale. The cement factory in Kunda was the pioneering industrial enterprise to start using oil shale for heating (Raud, 1919).

Engineers believed that the large-scale employment of electricity could be the solution to the difficult situation in power engineering. They recommended using water and peat to produce electricity. Initially, their recommendations did not include oil shale which was considered a suitable raw material for chemical and cement industries. The priority in terms of electricity consumption was to provide the agricultural sector and small industries with electricity. The towns, big industry and transport followed on the priority list.

Initially, the developments in the field did not extend to education. However, a noticeable change emerged in professional preferences as interest towards sciences increased. Riga became the closest centre to study engineering. In previous years, very few Estonians had gone to study there; their numbers, however, increased dramatically when the Riga Polytechnicum acquired the status of a state technical university. This was the place where the subsequent generation of educated men of action appeared, who, in economic and technological terms, started to build independent Estonia.

Engineers founded the Estonian Technical Society in 1917, even before Estonia's independence was declared. The society aimed to facilitate cooperation among engineering circles, the development of engineering education and industry as well as to explore our natural resources. The society's most significant achievement was the establishment of the Tallinn Technical College, the first school of engineering in Estonia. The Estonian engineers' organisations demonstrated remarkable initiative in advancing the ideas of power engineering. The three main areas of activity of the Estonian Technical Society concerned power engineering: oil shale studies, mapping peat deposits, and using peat and the Narva waterfall in power production. The Estonian Institute of Engineers stated a similar objective. Besides safeguarding the engineers' professional rights and supporting the local engineering education, they stated a well-functioning energy system as their principal objective. Engineers cannot limit themselves to working only in their chosen speciality, they have to explore other cultural expressions and by doing that contribute to the general progress.

Estonia followed the example of other countries, especially Sweden and Germany, when organising its energy system. Sweden had achieved success in using waterpower and Germany was of interest because of skilful usage of peat for electricity production (Hacker, 1919). The first large Estonian power stations were peat-fired. The central technical board of the Ministry of Agriculture supported the position that the state should maintain the right to use the Narva waterfall. A department was established at the Ministry of Commerce and Industry to study the possibilities of extracting energy from Estonian rivers (Mastberg, 1919). A committee responsible for the construction of a hydroelectric power station on the waterfall was established.

The waterfall near Narva was considered powerful enough to produce approximately one-third of the electricity the country needed (Tiltsen, 1922). The rest was to be generated by peat-fired thermal power stations that were to be built near large deposits of peat in West and Central Estonia. The sub-committee of economic policy of the Financial Committee of Constituent Assembly was assigned the task of collecting data on industry employing natural resources such as peat, timber and oil shale. The sub-committee was also responsible for organising the establishment of the nationwide electricity supply network.

The overall fuel shortage led the local specialists to explore ways of using oil shale as fuel. The principal problem was the lack of a suitable furnace construction. The competition staged by the Chamber of Commerce and Industry produced non-descript results. Judges of the competition were of the opinion that although there were a few interesting solutions, the designers had not been able to take into consideration the characteristics and peculiarities of oil shale, especially its high percentage of ashes and relatively low calorific value. Better results were achieved by using step grates, the production of which was started at the Tallinn machine works.

In 1923, new boilers were purchased from Babcock & Wilcox in the United Kingdom for the expanded Tallinn power station. Tests were conducted prior to transition from use of firewood to that of oil shale. The tests proved that when oil shale was used the production costs of electricity decreased approximately by 50 per cent. It appeared that the furnaces of the French company L'atomiseur Rex belied expectations when oil shale was used and they were replaced by grate furnaces made by the local machine works Ilmarine. The grate furnaces made by the latter proved to be the best and most reliable for oil shale once the changes and amendments to the furnace structure had been made. The machine works were entrusted with the construction of furnaces also during the subsequent stages of expanding the power station.

In the mid-1920s, employment of oil shale became widespread in all branches of industry. The railway became the largest consumer of oil shale ('Põlevkivi…', 1925). Although a rather good engine furnace structure suitable for burning oil shale was designed, oil shale did have considerable shortcomings such as generating a lot of residue ash and smoke. The fast developing shale oil industry opened up new possibilities. Solid research was also pursued by the oil shale industry (Luts, 1922). The Oil Shale Laboratory was established in Tartu with an aim to theoretically study the chemical composition of oil shale. The laboratory was later transferred to the Tallinn University of Technology.

Solid fuel refining subsequently proved to be an essential focus of activity for the oil shale industry: low-quality oil shale was converted to high-quality liquid fuel. Also, experiments in oil shale distillation began at the time with the purpose of finding a replacement for lubricating oil, which had become scarce during the war, making the situation especially complicated for railway transport (Mägi, 2008). The Rolle retort which had become well known in Germany as a furnace employed in lignite distillation was taken as an example when choosing the distillation retort. French and Scottish knowhow was employed to develop the technology (Kogerman, 1919) and Estonian chemists visited oil mills in Scotland.

By 1930, the oil shale industry was fully operational in Estonia. The first experimental industrial distillation unit, designed and constructed by the Berlin company Julius Pinsch AG, was opened in 1921 (Mägi, 2004). Then the construction of a large mill was started in Kohtla. It took four years to develop the technology and in 1925 the first big oil mill was launched (Mägi, 2005). The first attempt to heat an engine with shale oil in Estonia was made in the Kohtla mine. The main investor was the Estonian state who owned the First Estonian Oil-Shale Company, the largest company within the whole industry. The company aimed at poly-production, being involved in both mining and shale oil production. Lump oil shale was sold to railway companies; other goods available included shale oil and other chemical products made of shale oil such as varnish, steep, and pesticides. In the late 1930s, oil factories in Estonia produced 200,000 tons of crude oil and two million tons of oil shale was mined. Three methods of thermal processing were employed to extract oil: the internally heated vertical retort, the externally heated rotary retort and the original internally heated horizontal tunnel oven designed by Estonian engineers. The local shipyard plants and the machine works Ilmarine and Franz Krull produced the necessary equipment for the oil mills. Distilling furnaces developed in Estonia received international recognition. Australia was the first country to commence production of shale oil by adopting the Estonian technology (Öpik, 1983). The Estonian company Franz Krull designed an oil mill with two tunnel kilns for the Australian company National Oil Property Ltd. The oil mill was constructed in Glen Davis near Newnes in New South Wales.

Studies on oil shale and its products formed an essential part of the day-to-day work of the Chemistry Department at the National Testing Centre. Shale oil was the cornerstone of the success in oil shale industry. Approximately half of the shale oil production was exported. The principal consumers of Estonian shale oil were Finland, Sweden, Norway and Germany. The Heat Engineering Department was engaged with studying the possibilities for using shale oil as a motor fuel and conducted comparisons between petrol from oil shale and imported petrol. The Engineering Department of the Centre was involved in exploration of construction materials (Maddison, 1934). The expanding use of oil shale heating in the industry and power plants brought along a new complication pertaining to ash utilisation. As the ash had been detected to possess certain properties of cementing agents it came to be used for the production of building stone.

Having overcome the difficulties, the industry started to grow. The principal issues the local engineering culture had to face were engineering education, the level of knowledge of engineers, the responsibilities and vocational rights of engineers, participation in the life of the state and society, and development of culture, especially technical culture and the corresponding frame of mind. It was left to the engineers to introduce engineering thought into the society, it was especially expected in the industry (Leppik, 1931). The economic situation seemed to offer fairly good prospects for the development of energy management. Industry required more and more power, and certain increase in energy consumption was noticeable in agriculture. Modernisation of the industry started, first and foremost, with supplying factories and plants with modern machinery and other equipment. Investing was particularly heavy in shale oil, construction materials and peat industries.

Expanded and modernised production was much more effective in employing labour force. The advantages of the Estonian industry included the availability of domestic raw materials and relatively high-skilled labour. However, the shortage of people with technical education was rapidly becoming a problem. A new draft law on the establishment of a technical institute in Tallinn was prepared under pressure from the industrial circles. The Institute of Engineers was invited to participate in the preparation work, but was not satisfied with the draft law being focused solely on engineering studies, paying no attention to research. The institute claimed that a technical university cannot have less autonomy than a classical university, and this principle had to be applied equally to the study process and research. They considered it important that the opportunity to obtain academic degrees in engineering is available in Estonia. The engineering vocation is based on academic technology. Engineers as appliers of modern technology have to have as good knowledge, that is, education, as possible since technology plays an increasingly significant role in a state's development.

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