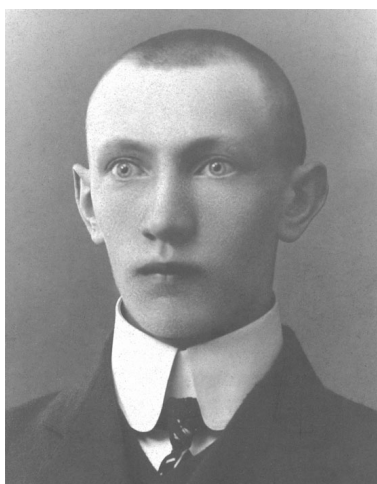


in memoriam

Professor Paul Nikolai Kogerman and the success story of Estonian kukersite



Estonia is a small country on the Eastern border of the European Union. Kukersite oil shale has been an engine of its economy for a long time. The local people have had many rulers from Swedes and Danes to Germans and Russians. Estonia achieved national independence for the first time during the turmoil of World War I and the following War of Independence, also known as the Estonian Liberation War. It was a hard fight but it was even harder to develop the economic base for the newly independent country.

In addition to agriculture it was important to develop national industry and energy production. The Swedish king Gustavus Adolphus had founded the University of Tartu in 1632, which became internationally well-known and developed strong scientific traditions. Foreign professors and scientists left because of the war while there weren't almost any professors or scientists of Estonian nationality. The university had to quickly develop a national group of technical scientists to restart the studies on oil shale. The main prospective natural resource for Estonia at that time was kukersite oil shale. However, oil shale studies were in their beginning stages not only in Estonia but also worldwide. The use of local oil shale in energy production and chemical industry began in 1916, when oil shale mined in Kukruse was taken to St. Petersburg Gas Factory and oil shale gas was used to light the city.

Most important for building the country is its educated people. Inspired by the results of the War of Independence, many engineers of Estonian nationality moved to Estonia from Russia, mainly from St. Petersburg. These people became enthusiastically involved in the development of the country. Young people were sent to study in Western European universities directly from the fronts of the War for Independence.

Three men played pivotal role in starting the oil shale studies in Estonia. One of them was Paul Nikolai Kogerman; this story has been written on the occasion of his 120th anniversary. The other two men were construction engineer Märt Raud (1878–1952) and chemist Karl Luts (1883–1941) who had studied and worked in St. Petersburg. When they returned to Estonia, they brought with them the results of the geological studies of Estonian mineral resources and the recommendation from geologist Nikolai Pogrebov to implement kukersite for energy production in the newly independent country. The development of Estonian national oil shale industry was initiated. In 1921, the first experimental generator was completed, the design of which was based on the “oil generators” of Julius Pintsch. The first oil plant went into operation in 1924. The work was continued at a great pace and by 1939 State Oil Shale Industry by itself produced 60000 tonnes of heating oil in addition to engine fuel, bitumen and other products of oil shale chemistry. Simultaneously with State Oil Shale Industry, several shale oil factories were started by foreign companies: Kohtla-Nõmme oil factory was developed by British capital, Kiviõli oil factory was started by the Germans and Sillamäe oil factory by the Swedes. The total production of shale oil and engine fuel in Estonia reached 179 000 tonnes of heating oil and 22 000 tonnes of engine fuel by 1939. Half of the production was exported. Scientists have a great impact on the development of oil shale industry. “Oil Shale Research Laboratory” started its work at the University of Tartu in 1925 under the direction of professor Kogerman. The chemistry laboratory of the State Oil Shale Industry under direction of Karl Luts also developed into high-level scientific oil shale research laboratory. The oil shale chemical industry of Estonia developed successfully and provided energy independence for the country. The development of oil shale industry was supported by local mechanical engineering industry. The Franz Krull factory developed under the guidance of Dr. Tech. P. Shemoulov into an internationally known designer and producer of oil shale industrial machinery. The tunnel furnaces for Kiviõli oil shale factory were constructed together with German Lurgi AG. Similar furnaces were ordered from Estonia for Australian Glenn David oil factory and were used there with success until the end of Australian oil industry in 1952 satisfying 3% of country's oil needs during the wartime.

The occupation of Estonia by the Soviet Union changed the situation in the area of thechnology as well. New people came to lead the oil shale industry. The leader of Estonian oil shale industry M. Raud was removed from the factory. In 1949, the engineer, by then almost 80 years old, was deported to Russia together with his wife where both died soon. The chemist

Karl Luts was last seen in 1941 when he was being transported under the NKVD escort to a Russian ship leaving the port of Tallinn. The time and place of his death are unknown. Professor Kogerman fared a little better: he was deported to Russia together with his family in 1941 where he spent the wartime in a concentration camp. After the war he was freed and in 1945 sent back to Estonia as a scientist important for the oil shale industry. He was able to continue his earlier organizational and scientific work but under continuous pressure from the KGB his life remained short. P. Shemoulov was also deported to Russia in 1941. He was teaching chemical engineers in the Moscow Institute of Chemical Engineering after the war. His students Stelmakh, Markov and others in collaboration with Estonian engineers and scientists developed the ideas of Shemoulov further in the area of designing oil shale distillation machinery and its testing in Estonian oil shale industry.

Estonian oil shale production gained new momentum with the arrival of German troops in 1941. The specialists of Baltöl GMBH came to Kohtla-Järve to jump-start oil production for the war machines. The shale oil as cold-resistant and heavier than water was especially important for the submarines. But the grand plans of the Germans did not succeed. When the Russian troops reconquered Estonia in 1944, about 200 people from Estonian oil shale industry evacuated with the German forces and temporarily started quite primitive oil production (distillation in a mound) in Schömberg, Germany. This ended in 1945 together with the end of the war and the evacuated specialists were dispersed all over the world as displaced persons.

The Soviet forces in Estonia were followed by grand plans of Russian engineers to develop local oil shale industry and to produce uranium from it. A factory for oil shale gas was built in Kohtla-Järve to supply Leningrad and later also Tallinn with household gas. Large oil shale power plants were built in Narva. Oil production in generators and tunnel furnaces was developed. Oil shale research was broadened in Tallinn Polytechnical Institute and the Institute of Chemistry of the Estonian Academy of Sciences; Institute for the scientific study of oil shale was founded in 1958 in Kohtla-Järve. The first 200-tonne generators in Kohtla-Järve were as a result of the work by V. Jefimov developed into improved 1000-tonne generators for distillation of oil shale. The systems with solid-state carrier UTT200, UTT500 and UTT3000, developed by Moscow ENIN scientists and tested in Estonia for a long time, were not particularly reliable nor environmentally friendly. The time has passed and at the present time original 6000 tonne solid-state heat carrier distillation system Enefit 280 is being built with plans to enter the foreign markets. While a hundred years ago foreign countries came to Estonia to install their oil production machinery, in the 21st century Estonian engineers are going to install their Enefit equipment to Jordan and to the Utah Green River oil shale fields in the US.

The studies on Estonian oil shale were significantly broadened after World War II. The formation of oil shales was studied, the oil shales from

different places of the world were compared and new ways of usage for oil shale products were developed.

Local high level technical staff, necessary for the development of science and technology, existed thanks to the educational program for engineers, started in Tallinn Technical University in 1936. Therefore, little Estonian SSR developed into the center of oil shale studies for the big Soviet Union. Since 1984 a special international scientific-technical journal about oil shale research called OIL SHALE has been published in Tallinn. Estonian oil shale researchers – chemists and power engineers – academicians and professors A. Aarna, I. Õpik, A. Ots, V. Jefimov, I. Rooks, L. Mölder, T. Purre, K. Urov, I. Kleesment, A. Fomina, geologists A. Raukas, V. Puura and others became known not only behind the iron curtain of the Soviet Union but all over the world. A big international congress of oil shale researchers was held in Tallinn in 1967. For over 60 years doctor of technical sciences A. Elenurm (born in 1922) has been working at the oil shale research laboratory of the Tallinn University of Technology, and has during that time studied the products from all the solid-state heat carrier distillation systems (from the first laboratory test system from Ilmarine, the former Franz Krull factory to the industrial-scale Enefit 140 system).

However, the ambitious development of Estonian oil shale industry resulted in very big damage to the beautiful nature of Northern Estonia. A whole cascade of artificial hills were erected, the rivers and the ground were polluted. After the restoration of independence, Estonia has spent huge sums to clean up the nature and luckily experience has been gained in detoxification of oil shale waste.

Let's come back to the beginning

P. N. Kogerman was the engine for all this development. In 2000, fifty years after his death, the people of Estonia elected him as one of the greatest figures of the century.

Paul Kogerman was born on December 5, 1891, in Tallinn in the family of a gas factory worker. The family with seagoing traditions came to Tallinn from the island of Hiiumaa after his father ended his career as a seaman. He got his elementary education from an elementary school (1901–1904) and a four-year town school (1904–1908). The lack of money prevented him from going on to the high school and he had to make his living as a teacher in church manors close to Tallinn. He passed his high school examinations as an extern at the Tallinn Alexander Gymnasium in 1913. He studied chemistry at the University of Tartu from 1913 to 1918. From the well-known scientists of that time his teachers included professor M. Tsvet, known as the developer of chromatography and I. Kondakov who studied polymerization of dienes. He started his studies on oil shale in 1917 under the direction of professor A. Bogojavlenski. Unfortunately these Russian scientists left Tartu after the War of Independence.

The future professor fought in the War of Independence in a unit of Tallinn teachers. But his talents were noticed and he was sent to study abroad while the war was still ongoing. He found an opportunity to work and study at the Imperial College of Science and Technology in London, in the laboratory of Dr. W. A. Bone. In the summer of 1919 he visited the shale mines and oil factories together with his colleague J. Kopvillem. Dr. W.A. Bone was a fuel chemist by specialization. The earlier oil shale studies in Tartu and work in London laid the foundation for the work of P. Kogerman as an oil shale researcher. His first task was to standardize and modernize the chemical study methods of oil shale in order to study the thermal decomposition of oil shale products and their composition as well as the effects of various solvents and chemicals on oil shale. His Master's thesis "The chemical composition of Kukersite, the Estonian oil-containing mineral of the Middle Ordovician" was completed in May 1921 and the author was given a qualification of chemical technologist by the University of London. He received the degree of Master of Sciences in 1922. His Master's thesis was published in 1922 and is still a cited and respectable study on the properties, origins and formation of Kukersite.

Paul Kogerman was elected an acting docent of the Chair of Organic Chemistry of the University of Tartu in 1921, an extraordinary professor in 1924 and full professor of organic chemistry in 1925. The Kohtla-Nõmme Goldfields oil factory and oil produced there became the basis of oil shale studies. Phenols, carbonic acids and nitrogen compounds were determined in the oil. Kogerman was also interested in unsaturated hydrocarbons and dienes and their auto-oxidation because of his interest in developing stable oil shale gasoline.

In 1925 Oil Shale Research Laboratory was started at the University of Tartu in order to study in detail the products of oil shale distillation and their industrial production but also to understand the properties of oil shale and the special features of its formation. In 1927 Kogerman had an opportunity to work at Harvard University, Cambridge, USA, in the laboratory of professor E. P. Kohler. He chose the synthesis of 1,4-pentadiene and the study of its properties as his research project. The synthesis was successful. He continued the study of dienes in the laboratory of organic chemistry of the University of Tartu in 1929 and 1930 and in autumn of 1933 in Zürich in the organic chemistry laboratory of professor U. Ruzicka. As a result of this work his doctoral dissertation was completed in 1933, which he defended in the end of 1934 receiving the degree of Doctor of Technical Sciences. The topic of the dissertation was 2,3-dimethyl butadiene, its synthesis and polymerization reactions. In parallel he studied the properties of isoprene. These two compounds were in the focus of intense research at that time, especially from the perspective of the synthesis of artificial rubber. There were many inconsistencies and contradicting results. Kogerman synthesized dimethyl butadiene and proved that the reason for the contradicting results was the existence of the hitherto unknown cis-trans isomers. These isomers

had been considered to be different compounds up to then. Kogerman separated the cis and trans isomers of dimethyl butadiene and determined their properties. Until then the researchers had dismissed these oligomers as unimportant ones. This research topic remained at the Faculty of Chemistry of the University of Tartu after Kogerman went to work at the newly established Tallinn Technical University in 1936. Kogerman returned to this topic only after the war at the Institute of Chemistry of the Academy of Sciences. After Kogerman's death this topic was continued by his student Doctor of Chemistry Koit Lääts.

Paul Kogerman was an open person and a good communicator, he spoke well several foreign languages. This was very useful for him in his broad-ranging activities of organizing Estonian higher education, coordinating oil shale studies in Estonia and developing international collaboration. Kogerman represented Estonian oil shale research in numerous international conferences: Paris 1922, Cambridge 1923, Copenhagen 1924, Berlin 1930, Milan 1932, London 1933, Paris 1937 etc. He was a visiting professor in Finland, Sweden and Germany. He was a chevalier of the French Legion, a foreign member of Finnish Chemical Society. In 1936 Kogerman was elected the rector and full professor of organic chemistry of the newly established Tallinn Technical University (TTU). The Oil Shale Research Laboratory was transferred to TTU and Kogerman became its head on November 12, 1936.

In addition to his scientific work, Paul Kogerman was also actively involved in public life of Estonia as a developer of science and engineering education. He became a member of the Estonian Academy of Sciences in 1938 and was the head of its natural sciences section in 1938–1940. He was a member of Estonian National Assembly in 1936–1937, a member of the National Council in 1938–1939 and the Estonian Minister of Education in 1939–1940. From 1945–1951 he was the chairman of the Estonian Chemical Society, professor and Head of the Department of Organic Chemistry and Pyrogenic Processes in Tallinn Polytechnical Institute. He was the director of the Institute of Chemistry, Estonian Academy of Sciences in 1947–1950.

His published works are comprised of 187 items and he left behind 63 manuscripts. Paul Kogerman was lucky to come back alive from the prison camps of Siberia, and to work as a leading scientist and professor also in the Estonian SSR. However, his health was ruined by the difficult years in the prison and by constant surveillance by the KGB as the oil shale studies were naturally objects of technical intelligence. This led to the premature death of the professor (on July 27, 1951), being still in his fully productive years.

Aili Kogerman