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SCIENTIFIC ACTIVITY AND CONTRIBUTION OF VOLDEMĀRS DĀLE (1922–2008), HONORARY DOCTOR OF THE LATVIAN ACADEMY OF SCIENCES, TO THE DEVELOPMENT OF POWER ENGINEERING

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Summary. Honorary Doctor *(Dr. h. c.*) of the Latvian Academy of Sciences (LAS), long-time leading researcher of the Institute of Physical Energetics, Professor *Voldemārs Dāle* (1922–2008) devoted his entire working life to science. The most important field of *V. Dāle's* research was the use of mathematical methods and computer technology in the dynamic optimization of power engineering development. The main areas of his scientific work include planning and forecasting methods of power system development; research on development problems of the Latvian and Baltic energy systems; methods of mathematical modelling of power systems considering the environmental factors. A monograph on research results in the optimization of electrical network development published in 1964 written by a group of three scientists, including *V. Dāle*, received the State Prize of the Latvian Soviet Socialist Republic (LSSR), which was awarded in 1965.

Keywords: *Voldemārs Dāle*, power engineering, power systems, dynamic programming, Institute of Physical Energetics.

Childhood and Youth of *V. Dāle* (1922–1950)

V. Dāle was born in Riga on 20 October 1922 [1]. When he renewed his documents in 1949, an error occurred, and from then on (from 28 March 1945, when the passport was issued), it was indicated in the official documents and passport that he was born on 10 October [2]. He was

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raised by his mother *Irma Dāle* (1900–1974), who was a newspaper dispatch worker.

In 1930, he graduated from Riga 12th Elementary School. As a child, he lived at 15/17 *Valguma* Street. From 22 March 1939, he lived at 5 *Dandāles* Street with a break from 26 June to 17 September 1942, when he stayed in the homestead «*Tūtes*» in *Zvārde* Parish. Before he started his family in 1950, his living conditions could be considered quite comfortable, but then the place became very cramped. Five people lived in a small two-room apartment with furnace heating, given that one of the rooms was walk-through. In the autumn of 1967, *V. Dāle's* family received the right to live in a new comfortable three-room apartment in Riga, at 145/1 *Gorky* (*K. Valdemāra*) Street.

V. Dāle was one of the 25 graduates of Riga State Technical School of 1942. He graduated from the Department of Electrical Engineering obtaining the qualification of a technician electrician. He was one of the most notable graduates of the technical school. A special chapter on his further achievements was included in the edition dedicated to the 100th anniversary of Riga State Technical School [3]. During World War II, he was not drafted into the German Army due to health issues, but most students of the technical school were forced to go off at the front. Three of them fell and 11 continued their lives in exile after the war. Many of them achieved significant success working in power engineering companies or used to be responsible for power engineering issues while working in various jobs [4].

V. Dāle gained his first practical work experience while renovating «*Latvenergo*» companies and working at «*VEF*» Factory. From 1942 to 1944, he worked at «*Siemens-Schuckertwerke*» Company, where he headed the engineering design group of the Company's Riga Branch. It is stated in his personnel record file that he also worked as a draftsman in the company. *V. Dāle* also worked at the Institute of Power and Mechanical Engineering and the Latvian Power System. From 1944, he worked as a technician at the company «*Latpromenergomontaž*» of the Ministry of Power Stations of the Union of Soviet Socialist Republics (USSR), in Riga.

In 1946, the Institute of Physical Energetics of the Academy of Sciences (AS) of the LSSR was founded (currently, the State Agency «Institute of Physical Energetics»). According to its statutes, one of the functions of the institute was to conduct fundamental and applied research in order to acquire new knowledge in power engineering and related natural sciences and engineering industries and to ensure the sustainable development and advancement of these industries [5]. *V. Dāle* wanted to join the family of young scientists of this institute. In his application, he mentioned that while working in the energy

distribution meter repair workshop and laboratory of the company «*Latvenergo*», he realized that he wanted to improve his qualifications. He also expressed his certainty that he would be able to achieve this goals conducting his scientific work. In 1949, *V. Dāle* graduated as an extern from the 8th Riga City Workers' Youth *Rainis* Secondary School. At that time, he already was a student of the Faculty of Mechanics of the State University of Latvian (SUL). An application dated 2 November 1944 has been preserved. He started his studies in December of the same year. There was a total of 18 students, three of them from Riga State Technical School (RSTS; *V. Dāle*, *Kārlis Tomariņš* (1923–2016), later a lecturer at Riga Polytechnic Institute (RPI), from 1990 – Riga Technical University (RTU), and *Helmuts Fridrihsons* (1924–1972)) and three other colleagues from «*Siemens-Schuckertwerke*». Several teachers who taught *V. Dāle* at RSTS at that time worked at SUL; thus, they continued to teach him and his groupmates at the university – *Kārlis Dommers* (1899–1983; at RSTS, he was also his form teacher, RPI lecturer (1958–1962)), and *Alfrēds Auziņš* (1879–?). He had to work in the daytime and study in the evenings.

In 1950, *V. Dāle* graduated from the Faculty of Mechanics of SUL, obtaining the qualification of an electrician of electrical networks, stations, and systems. The title of the new engineer's diploma paper was «*Asinhronmotors Latvijas PSR lauksaimniecībai*» (Asynchronous Motor for the Agriculture Sector of the Latvian SSR). His scientific supervisor *Jānis Demants* (1905–1981; RPI lecturer (1958–1975)) wrote in his review, «The diploma paper developed by *Dāle* has demonstrated that he is able to use all available literature, make independent conclusions, apply his methods in the calculations and that he is generally able to conduct scientific research» (20 July 1951). The diploma paper comprising 206 pages was written by hand, it consisted of nine chapters and 30 subsections, the bibliography comprised 28 bibliographic entries. In the course of the development of the diploma paper, *V. Dāle* designed 13 kW asynchronous motor for driving threshing machines, which was more economical as compared to the ones used at the time. The invention was very important for agriculture [6].

After graduating from the SUL, *V. Dāle* was assigned to *Ķegums* Power Plant, but he asked to revoke this assignment due to family circumstances. In the summer of 1950, *V. Dāle* started his family getting married to *Aina Eglīte* (1925–2006), who also graduated from the SUL that year and whose working life was also dedicated to the planning and development of the electrification of Latvia, specifically during her work at the Council of Ministers of the LSSR as a senior reporter. Their first child, *Edgars Dāle*, was born soon afterward, and six years later, their

daughter *Austra Dāle* was born. *V. Dāle* and *Aina Dāle's* marriage lasted for 56 years.

In April 1950, *V. Dāle* started working in the meter repair and testing laboratory of «*Energosbit*» division of «*Latvenergo*». On 15 December, he applied for the position of a junior research associate at the Institute of Power and Mechanical Engineering of the AS of the LSSR. At the end of his life, he admitted in an interview that «working there has become a part of my life and an addiction – 42 years!» [7].

Years as a Junior Research Associate

Figure 1. *Voldemārs Dāle* (1957).

In 1951, *V. Dāle* enrolled in a full-time postgraduate program in general power engineering at the Institute of Power and Electrical Engineering of the AS of the LSSR (Decree No. 35/195 of the AS of the LSSR of 4 October 1951). The period of post-graduate studies finished in 1954, but the thesis had not yet been completed. A diary of post-graduate studies that *V. Dāle* started on 19 June 1951 is still available. In the diary, he quite frankly expressed his thoughts about his ideas, attempts to realize them, and tasks. There are clear, critical descriptions of the external reasons why it was not possible to fulfil them within the expected deadlines. On 3 March 1953, *V. Dāle* wrote to *Kārlis Plaude* (1897–1975), the President of the AS of the LSSR, that his «situation was very serious». Classes in philosophy were planned for spring or late summer, but they were not organized and ended only

in November. The program in power engineering was not transferred from the capital of the Soviet Union, Moscow, and *V. Dāle* could not find a supervisor for his thesis of the candidate of technical sciences. *V. Dāle* tried to work on various topics, but he was not optimistic about a positive result [8].

In 1954, *V. Dāle* started working in the General Power Engineering Sector of the Institute of Physical Energetics (IPE) as a junior research associate, where he was engaged in determining the optimal parameters of electrical networks in rural areas and developing dynamic design methods. A record of the 5 May seminar of the sector has preserved. It was mentioned that *V. Dāle* agreed to work as an associate and reported on the program for further work: «*Методика учета сельскохозайственных электрических нагрузок при выборе параметров местных электрических сетей и станций*» (*Lauksaimniecības elektrisko slodžu uzskaites metodes, izvēloties vietējo elektrisko tīklu un staciju parametrus*; Methods for metering the agricultural electrical loads, choosing the parameters of local electrical networks and stations). The main task of this work was to demonstrate the shortcomings and inconsistency of the current approach and to develop the methodology for a new approach. During this difficult period, peculiar life habits of a hermit researcher were formed. A purposeful and serious sense of responsibility for one's tasks, understanding that in order to achieve something, that is, to invent, create, and prove, it is necessary to work persistently – all these feelings created the previously mentioned sense of work addiction. In order to be able to work productively, *V. Dāle* learned shorthand on his own using a textbook «*Stenogrāfija*» (Stenography), which was published by the Stenography Commission of the AS of the LSSR [9]). Many of his undeciphered summaries have been preserved in the shorthand record. The work of the researcher and inventor became his life. In the 1950s, he worked a six-day workweek at the Institute, spent evenings at the desk, and lived in silence at home. Excellent knowledge of the German language, the ability to use both Russian and English professionally, excellent logic, and a Christian philosophy-based view of life – all these factors can be considered important in the creation of his personality – the personality who does not cooperate with local authorities to the degree possible, does not aspire to high positions, and does not accept offers to take lucrative positions, because only members of the Communist Party can take them. It should be noted that *V. Dāle* never became a member of the Party.

In the late 1950s and 1960s, the field of power engineering, especially electrical power engineering, was developing rapidly. This was the time when continuous electrification was planned and partially

implemented, and unified electric power systems were created. As early as 1956, a publication on the issues of agricultural electrification was drafted [10], and an article on the five-year electrification plan of the *Daugava* basin was published in the journal «*Zvaigzne*» [11]. The scientific associate of the Institute of Physical Energetics of the AS of the LSSR *V. Dāle* published an informative article in the journal «*Zinātne un Tehnika*» on the planned electrification plan of the *Daugava* cascade and its great significance. The author mentioned various limitations and disadvantages at the same time offering possible solutions. The article outlined the importance of securing the fish roads, possibilities of ensuring migration of sea fish, and other significant factors of the construction of the Riga-Kherson waterway (including ship locks). The article demonstrated that the proposed plan was the result of many years of work when the information on the 1020 km long *Daugava* River bed, catchment basin, rainfall, geological composition of the soil at different stages, the importance of basin of Lake *Lubāns,* natural waterfall indicators (221 m), the structure of the banks, and the influence of weather conditions on the sector of electric power engineering was gathered and summarized. The scheme of the *Daugava* River cascade was added, starting from the Vitebsk Dam to the *Dole* Island. It was concluded that, for example, while constructing the *Pļaviņas* HPP, «it is possible to obtain unusually favourable economic indicators for the hydroelectric power plants of the European part of the USSR, which can be explained mainly by favourable topographical conditions – without significant flooding, a power station with 40 m pressure can be built here» [12]. The construction of the *Pļaviņas* HPP had already started in the previous decade. The project caused wide discussions and public protests, since it implied the flooding of the *Staburags* Waterfall. Despite the protests, the first symbolic cubic meter of concrete was poured in October 1961, and everything was put into full operation in July 1968 [13]. This article was also important because it was a good illustration of the challenge a new associate had to face, when he had been assigned the task of revealing the great economic importance of this project in the most logical, professional, and emotionless way. Therefore, it was not possible for the researcher to take the opposite side. Further activity of *V. Dāle* was always aimed at proving the far-reaching influence of logical connections and the role of pursuing priorities. Independent energy supply is the precondition of independence of every country. The conviction that Latvia needs and is able to have an independent, cheap, self-sufficient production and supply system of energy resources was one of the main missions of *V. Dāle*.

The 1960s were the time when a new branch of science – cybernetics – was also recognized and mastered. Computing

technology was developing rapidly, almost from scratch. Taking modern mathematical methods and computing techniques as the basis, research in general power engineering could develop to a qualitatively new level. In mid-1960s, IPE bought a small electronic computing machine «*НАИРИ*» and established a computing laboratory. In 1969, the electronic computing machine «*M-220 A*» was installed in the Dispatcher's Office of the North-western United Power System of the USSR located in Riga, and this marked the beginning of the widespread use of electronic computing machines (ECM) in the Latvian power engineering practice. The Laboratory of Complex Power Engineering Problems (Head *J. Mazurs*) was established at the IPE. In 1969, following the initiative of the President of the Presidium of the AS of the LSSR, Academician *K. Plaude*, who was also the Director of the IPE, the Laboratory of Mathematical Modelling of Power Systems (LMMPS) separated from the Laboratory of Complex Power Engineering Problems as an independent unit. *Zigurds Krišāns* (1930–2016), *Omārs Paegle* (1929–1988 (1987?)), and *V. Dāle* became the key researchers of the new laboratory. A close creative cooperation was established between the two laboratories, and it was maintained for the entire period of scientific activity of the researchers. The group was jokingly called *коефициент полезного действия* (*КПД*) – the coefficient of efficiency. The abbreviation used to denote this coefficient in Russian looks as though it was composed of the initial letters of the surnames of the key researchers of the laboratory – *К.* (K – for *Krišāns*) *П.* (P – for *Paegle*) and *Д.* (D – for *Dāle*). Their cooperation started already in the 1950s and they regularly published joint publications since 1955. Until 1971, they developed a total of 53 % joint publications including manuscripts with an approximate volume of 214 author sheets (bibliography compiled by *V. Dāle*). In the period from 1956 to 1996, 43 entries appear in the general catalogue of NLL and the world's largest library catalogue Worldcat.org* [14–16].

During this period, *Z. Krišāns*, *O. Paegle* and *V. Dāle* made a significant contribution to promoting the inclusion of 20 kV voltage in the USSR State Standard and the development of a 20 kV network in Latvia. In the mid-1960s, they developed the principles of dynamic design, which helped solve the issues of Latvian power system network development in the period from 1970 to 1975. In 1967, a team of scientists developed the mathematical model ORS-5 (*ESM – БЕСМ3М*), for the first time adopting dynamic programming to optimize network development. In the first 15 years since the establishment of the laboratory, computing technology and programming languages changed completely, and cooperation in the field of practical use of developed models expanded rapidly. Many original modelling and optimization methods were created, studied, and tested.

Figure 2. From left: *Zigurds Krišāns*, *Voldemārs Dāle*, *Omārs Paegle* (1966).

In 1964, a monograph «*Оптимизация электрических сетей при росте нагрузок*» (Optimization of Electrical Networks along with Increasing Loads) on the research results in the optimization of the development of electrical networks was published [17]. The decision of the Academy of Sciences on the publication was made already on 13 September 1963. It demonstrated that contextually innovations were in line with the latest trends in Europe. The book contained six chapters, the first of which was written by *V. Dāle*, the others were a collective work. The bibliography contained 110 sources in Russian, English, German, and French, predominantly references to the latest research, which were made in the decade up to 1962. The book contained bibliographic references to such periodicals as «Zeitschrift für Elektrizitätswirtschaft», «Elektrizitätswirtschaft», «Deutsche Elektrotechnik», «Electrical Review», «Electrical World», etc. In 1965, *V. Dāle*, together with his colleagues *Z. Krišāns* and *O. Paegle*, received the LSSR State Prize in Science for this monograph. Considering the scientific novelty of this method, which was developed with the reference to Richard Ernest Bellman's (1920–1984) research on dynamic programming first published in 1957, it may be concluded that research in Latvia was conducted in direct response to the latest discoveries (R. E. Bellman's book was translated into Russian and published in 1960). Newspaper «*Cīņa*» also wrote about this award, commenting that the candidate of technical sciences *O. Paegle*, group leader, senior engineer *V. Dāle* and candidate of technical sciences *Z. Krišāns* had

developed a mathematical model for optimizing energy distribution systems [18].

V. Dāle defended his dissertation of the candidate of technical sciences – «Specifics of the Selection of Electrical Network Parameters Considering the Dynamics of Electrical Loads» (Supreme Attestation Committee of the USSR, 28 March 1966, Minutes No. 5) only in 1966, at Kyiv Polytechnic Institute, Ukraine, The manuscript of the work was dated 1964 (the abstract was dated 1965). It was written in typescript in Russian, its volume amounted to 269 pages, it contained three chapters. The last page listed seven publications written on this theme during the writing of the dissertation. The first article was published in 1956, the other six publications were written from 1963 together with *O. Paegle* and *Z. Krišāns*, including the already mentioned monograph of 1964. The dissertation presented an example of a dynamic design program for digital computing machines in complex cases of electrical load balancing, considering the economic and technical indicators of the network [19].

Years as a Senior Research Associate

On 14 December 1972 (decision of the AS of the LSSR Presidium, Minutes No. 30/879), *V. Dāle* was appointed as a senior research associate at LAS IPE in the field of electrical systems and their management (certificate approved in Moscow on 17 April 1973). In his report on scientific and organizational research work from 1969 to 1974, *V. Dāle* noted that the work to be carried out was planned for three problems of pan-Soviet Union significance: 1) development of the scientific basis and optimization theory to reach the balance between fuel consumption and power supply; 2) development of the principles of system design and inter-system links for the unified power system of the USSR; 3) development of forecasting methods and theory of the perspective structure of the fuel and power economy and optimization of management of large energy systems. During the reporting period, *V. Dāle* worked on solving the optimization problems of the development of various power engineering facilities, mainly electrical networks. The fundamental findings made and justified in his earlier works were fully employed and advanced to a new level, allowing to conclude that it was mandatory to solve development tasks in compliance with dynamics, and that development processes, not states, should have been optimized. If earlier *V. Dāle* conducted research and implemented its results in practice considering mainly electrical networks of agricultural districts, in this period, he expanded the scope of his work to address development of the principles of system design and inter-system links for the unified

power system of the USSR as well. Mathematical models for optimizing the development of electrical power systems were developed based on the synthesis of dynamic programming methods and optimization of the system state, as well as functional equations and a system of constraints for the optimization of the development of the combined power systems taking into account the factors of the system's operating mode. As a result, a calculation methodology for optimizing the development of electrical networks of a complex electric power system was developed. A series of mathematical models with relevant program complexes for electronic computing machines was created on the basis of scientific-methodical works of *V. Dāle* [20].

In these circumstances, in 1969, the Presidium of the AS of the LSSR decided to establish a Laboratory of Mathematical Modelling of Power Systems at the Institute of Physical Energetics. In 1969, the scientific core of the new laboratory was formed by *V. Dāle*, *Z. Krišāns*, and *O. Paegle*. The perfectly coordinated joint work of these three scientists, to which *Dr. h. c. Dāle* contributed greatly, gave valuable scientific and practical results. In the early 1960s, they made a significant contribution to the creation of the 20 kV network in Latvia. In 1969, *V. Dāle* developed *ORS-12* (*ESM-M220*) computer program, with the help of which, the dynamics of the 330 kV network of any configuration was optimized for the first time. An original optimization (output states) method was developed for this model, it laid foundations for overcoming the problem of the number of states [21]. In 1969, the laboratory researchers already maintained good scientific connections with many research organizations.

The 1970s were the period of rapid development of this branch of science. The work of *V. Dāle*, the achievements of the LMMPS team and the contribution of each of its members were also valued at the national level. Researchers received several prizes. With the decision of the Presidium of the AS of LSSR dated 21 December 1973 No. 24/905, *V. Dāle* was awarded the second prize of the Presidium of the AS of LSSR for the work «*Matemātiskais modelis OM-2/1, kas paredzēts 110-35-20-10-6 kW sprieguma elektrisko tīklu attīstības variantu tehniski ekonomiskajai novērtēšanai*» (Mathematical model OM-2/1, intended for the technical and economic evaluation of the development options of 110-35-20-10-6 kW voltage electric networks). With the decision of the Presidium of the AS of LSSR dated 13 March 1975 No. 41, *V. Dāle* was awarded the second prize of the Presidium of the AS of LSSR for the work «*Elektroenerģētisko sistēmu galveno tīklu attīstības optimizācijai paredzētu matemātisko modeļu apakšsistēma*» (Subsystem of mathematical models intended for the optimization of the development of the main networks of electric power systems). With the decision of

the Presidium of the AS of LSSR dated 21 February 1980 No. 28, *V. Dāle* was awarded the first prize of the Presidium of the AS of the LSSR for the collective monograph «*Energosistēmu tīklu attīstības analīzes dinamiskās metodes*» (Dynamic Methods of Power System Network Development Analysis) [22].

Years as a *Ph.D*

The basic principles of dynamic design were already developed in the 1980s. However, during this period, electric power objects became much more complex, thus the development tasks also changed. Thus, *V. Dāle* was developing methods that could be used to solve these new tasks. Tasks of dynamic optimization were developed and formulated, criteria selection options, the structure of electric network preparation, and principles for optimal development of dynamic models were proposed. All theoretical conclusions were substantiated by both systemic and specific network modelling examples providing relevant evidence [23].

Figure 3. Staff of the Laboratory of Mathematical Modelling of Power Systems (c. 1989). In the first row from left: *Dagmāra Briede*, *Halina Abramova*, *Lidija Oļeiņikova*, *Ingūna Būmane*, *Svetlana Lunte*, *Ināra Greivule.* In the second row from left: *Tālivaldis Ķipurs*, *Voldemārs Dāle*, *Māra Ragovska*, *Zigurds Krišāns*, *Irēna Mistere*, *Omārs Paegle*, *Vairis Putniņš*. *Anna Kalpiņa* (b. *Onckule*), who worked in the laboratory since 1988, is not present.

In the 1990s, a complete transition of computer technology from large third-generation computers to personal computers took place in Latvia. The use of computers in the economic activity was expanding, and the technical parameters of computers and their mathematical support were changing very quickly. In the second half of the 1990s, cooperation between «*Latvenergo»* and the power systems of Western countries was established. Funds for the restoration and modernization of Latvia's power system were founded, the weak points of which became apparently visible – the system consisted of low-voltage networks and medium- and high-voltage distribution networks in major cities. Therefore, the basic scientific research area of the laboratory in this period was the technological problems of the construction of the automated system for the optimization of the development of electrical networks. The aim of the research was to develop databases and interfaces for automated systems that would ensure a convenient interface between an engineer and a computer software system, solving both strategic and operational tasks. Low-voltage networks were the focus of the research, this issue had not been addressed by the laboratory before. Research was carried out in cooperation with RTU, the Royal Swedish Institute of Technology, the Latvian Power System, the Estonian Academy of Sciences, and the Lithuanian Academy of Sciences. Scientific cooperation and connections with research organizations, power systems, and design organizations in Western Europe were expanded and strengthened. The laboratory became an authority in research and practice.

In 1992, with the decision of the LAS IPE FEI Habilitation and Promotion Council of 14 July 1992, No. 2-92 *V. Dāle* obtained a degree in engineering (for the dissertation «*Elektrisko tīklu parametru izvēles īpatnības, ievērojot elektrisko slodžu dinamiku»* – «Specifics of the selection of electrical network parameters, considering the dynamics of electrical loads).

In 1994, *V. Dāle* was elected a professor (LAS IPE Science Council Decision No. 4 of 26 April1994) and, in recognition of his merits in science, he was awarded the title of an Honorary Doctor of Latvia's AS (*Dr. h. c.* – 15 March 1994) [24].

From 1995 to 1999, permanent cooperation with the Faculty of Power and Electrical Engineering of RTU was established. LMMPS developed the Master's study program «*Elektroenerģētisko uzņēmumu vadība*» (Management of Electric Power Companies) and a cycle of several courses. LMMPS also became part of RTU Institute of Electric Power Systems as one of the organizational units, it educated and trained Master's students to continue their field of work [25]. The year of 1999, when the staff of the laboratory included 29 employees,

was unexpectedly difficult. The theme of the planned research for the year was the scientific basis of dynamic analysis of power efficiency. The method of determining load schedules, the technology, and the method of low-voltage network energy loss calculations under conditions of information deficiency were being developed, and several program systems had been developed. However, all attempts to conclude contracts with «*Latvenergo*» management were unsuccessful. Despite the previous orders and the great interest shown by certain organizational units, LMMPS fell into debt. While distribution network companies needed LMMPS services to deploy loss calculations in low-voltage networks, the lab's operations were changing a lot, and it could implement only small direct contracts. In 1999, the first contract with the Network Service was also concluded, and the «*Zudumi'99*» program system was developed, which enabled mass calculations of low-voltage network energy losses [26].

Dr. h. c. V. Dāle retired from active scientific work in 1999 after 30 years of working at the laboratory. The core team of the laboratory at this time consisted of *Z. Krišāns*, *V. Dāle*, *A. Kalpiņa*, *I. Oļeiņikova*, *I. Greivule* (also retired in 1999), *V. Putniņš* (also retired in 1999), *I. Būmane*, *K. Krišāns* and *M. Ragovska*. The work started by *V. Dāle* has been continued by young, but already world-famous scientists who grew up and matured thanks to the scientific base created by the original scientific core of the laboratory – *V. Dāle*, *Z. Krišāns,* and *O. Paegle* [27, 28]. Dynamic programming methods for solving tasks of optimal network development are still relevant in the education process of young scientists. References to the solutions proposed by *V. Dāle* and his colleagues can also be found in textbooks on the optimization and planning of power supply systems. They are also relevant for 21st-century students [29, 30]. The mandatory reading list of the RTU study course «*Algoritmizācija un optimizācijas metodes industriālajā elektronikā*» (Algorithmization and Optimization Methods in Industrial Electronics) includes the book «*Elektrisko tīklu attīstības dinamiskā optimizācija*» (Dynamic Optimization of Electrical Network Development), which can be considered a targeted summary of all scientific activity, since it covers many principles and steps of formulating dynamic optimization tasks, starting from modelling to recommendations for the development of electrical network projects [23].

Conclusion

The second half of the 20th century was the most productive period of Professor *V. Dāle's* activity. Starting from the late 1950s and 1960s, the power industry, especially electric power systems, and computer technology developed very rapidly, and a new branch of science – cybernetics – was established. Scientists, including *V. Dāle*, should have used modern mathematical methods and computing techniques in power engineering.

V. Dāle was not a member in any political parties or organizations, worked a lot, lived quite a reserved life, and served science. At the end of his life, *V. Dāle* admitted that «in the end, everything turned out quite well, I am a Latvian in Latvia, my life has been lived, but I can still experience something by observing, if not making an impact» [7]. In an interview in 2001, which was conducted by *V. Dāle's* granddaughter *Antra Ozola* (since 2022 – professor at the Faculty of Education, Psychology and Arts of the University of Latvia), when he asked about his character, he said, «A person gets into many situations in the course of his life, many things can get manifested in his personality and many things would never get manifested throughout his life. There are perhaps some values that you need to persistently hold to. It is good for a person to be independent, it is good for a person to be indifferent to other people's impressions. It is good if one can distinguish, if not distinguish good from evil, then at least useful from useless. .. I have always tried both consciously and unconsciously to be myself, to be what I was created to be. In my understanding, the main task is not so much to create my personality but rather to purify myself from the impact of those creators, to protect myself from them, and to try to be what I am, to try to understand it to some extent, and then to remain that way. .. Those who want to shape us attack us from all sides – using television, radio, newspapers, we find them at schools and churches, society, and among familiar people, etc. They all consider themselves creators, but you should try to get rid of them remaining as healthy as possible. .. You should try to live happily. You need to try to live decently. A righteous life is happiness, and a wrong life is unhappiness. .. Everyone has to decide for oneself, and every person deals with it in their own way» [31].

V. Dāle knew how to live his life so that not only his descendants could be proud of his achievements. The scientist was an erudite researcher with comprehensive and deep knowledge. He «knew how to get to the essence of the problem and to always find weak points of the proposed scientific hypotheses» [32].

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SOURCES OF ILLUSTRATIONS

Figure 1. A. Avotiņas personīgais arhīvs.

Figure 2. A. Avotiņas personīgais arhīvs.

Figure 3. A. Avotiņas personīgais arhīvs.

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Latvijas Zinātņu akadēmijas goda doktora Voldmemāra Dāles (1922–2008) zinātniskā darbība un ieguldījums enerģētikas attīstībā

Latvijas Zinātņu akadēmijas (LZA) Goda doktors (*Dr. h. c.*), ilggadējs Fizikālās enerģētikas institūta vadošais pētnieks profesors Voldemārs Dāle (1922–2008) visu darba mūžu veltījis zinātnei. Nozīmīgākā V. Dāles pētījumu joma bija matemātisko metožu un datortehnikas izmantošana elektroenerģētikas attīstības dinamiskā optimizācijā. Galvenie zinātniskā darba virzieni: energosistēmu attīstības plānošanas un prognozēšanas metodes; Latvijas un Baltijas energosistēmu attīstības problēmu izpēte; energosistēmu matemātiskās modelēšanas metodes, ievērojot apkārtējas vides faktorus. 1964. gadā iznāca monogrāfija par pētniecības rezultātiem elektrisko tīklu attīstības optimizācijā. Par šo darbu trīs zinātnieku grupai, tostarp V. Dālem, 1965. gadā piešķirta Latvijas Padomju Sociālistiskās Republikas (LPSR) Valsts prēmija.

Atslēgvārdi: Voldemārs Dāle, elektroenerģētika, energosistēmas, dinamiskā programmēšana, Fizikālās enerģētikas institūts.