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1. Development of science and education in the railway industry of Ukraine in the late nineteenth century - in the early twentieth century

Abstract

According to scientific and archival sources, statistical data, the study analyzes the formation of scientific thought in the railway industry of Ukraine in the second half of the nineteenth century – in the early twentieth century.

This study examines the process of development of scientific views and education on the Ukrainian railways in the late nineteenth century at a time when European countries have formed their own railway network. It is noted that the first to build railways was England, which in the late eighteenth century – in the early nineteenth century began to lay iron rails and build the first locomotives.

It is proved that in the middle of the XIX century railways in Europe are becoming the main mode of transport. Becoming a general condition of the production process in the capitalist economy, the railways began to play an independent role as a powerful factor that stimulated the rapid growth of major branches of heavy industry. The unsatisfactory state of roads in the Russian Empire, in particular in Ukraine, hampered economic development in many sectors of the economy. The role of engineers O. Borodin, L. Leva, A. Raevsky, Y. Lomonosov, G. Dubelir in the formation of technical support of Ukrainian railways is analyzed.

An important role in the formation of the railway network and the development of scientific thought in technical support belongs to S.Yu. Witte, who after graduating from the institute began working on the railway, and as director of the Department of Railways and Minister of Railways, focused on improving the operation of railway transport, the rational use of the railway network.

The study notes that the development and expansion of the railway network is impossible without technical, scientific and staffing.

The importance of the study lies in the application of a systematic approach to studying the history of the formation of qualified personnel for the Ukrainian railways

of the second half of the nineteenth century. through the establishment of professional railway schools in Ukraine, the opening of mechanical and engineering and construction departments at the Kiev Polytechnic Institute.

Although at the beginning of the construction of railways came landless peasants to earn money to pay taxes to landlords. Later, the railway profession became a family one. The creation of a network of special technical educational institutions has become a necessity to improve their skills.

Nevertheless, the problem of technical, scientific and personnel support of the railway network in the second half of the XIX century. and today remains in need of further study.

Introduction

Characterizing the state of scientific development of the problem, we note that the topic of technical and personnel support of Ukrainian railways is considered by scientists in the late nineteenth century.

On the basis of scientific research, analysis of archival sources, statistical data of the research the analysis of formation of world and domestic technical thought, creation of conditions for formation of qualified personnel for railways is carried out.

The source base of the problem is given first of all by an array of works of pre-revolutionary history of Ukraine, in particular by collections of statistical data.

A fundamental study of the historical and economic nature was carried out by Andreev P., dedicating it to the 25th anniversary of the South-Western Railway (1909) [1].

A special role in covering the issues of technical support of the railway network was played by journalistic materials of the late XIX - early XX centuries. (magazines «Engineer», «Railway», «Bulletin of South-Western Railways»).

An important role in the scientific achievements of scientific and technical topics is the study of outstanding engineers of his time O. Borodin, Y. Lomonosov [2,3]. An important fact for the study of this problem is contained in the memoirs of

contemporaries, namely S. Witte, who as director of the Department of Railways and Minister of Railways, paid attention to improving rail transport, rational use of the railway network [4].

Characterizing the state of scientific development of the issue of formation of qualified personnel of railwaymen, it should be noted that in historiography it is covered unevenly. The first researchers of Ukrainian history of the second half of the XIX century, who covered the socio-economic development of the Ukrainian lands after the abolition of serfdom, were Yu. Lavrov [5], O. Lugova [6], F. Los [7], E. Belinsky [8], as well as studied the development of railway construction and the need to improve training for this industry.

V. Shatayev's dissertation research presents an analysis of scientific, engineering, organizational, educational and public activities of the famous domestic railway engineer, railway scientist, specialist in railway engineering O. Borodin [9].

Historiographical review of the problem indicates the need for further uniform coverage of railway construction and its technical support.

In the 80-90's of the twentieth century interest in the history of training qualified specialists for the railway industry of Ukraine in the second half of the XIX century is restored. Development of education in Ukraine in the second half of the XIX century scientific works by E. Lutsenko, E. Stepanovych, M. Puzanova, G. Tereshchenko, V. Kizchenko are devoted to the issues of training qualified railway personnel [10, 11, 12, 13].

Peculiarities of training qualified personnel in technical railway schools, through the prism of railway development on Ukrainian lands, were considered in a number of scientific works by S. Bogatchuk [14, 15, 16].

M. Honchar's dissertation research considers the historical way of building the system of training skilled workers, in particular, the development of lower vocational education in the south of Ukraine in the second half of the XIX century - in the early twentieth century [17].

Setting objectives researchers' attention to the issues of railway construction in Ukraine in the second half of the XIX century, its active spread after the agrarian

reform of 1861, the formation of its scientific and technical point of view, personnel policy remains relevant.

The purpose of the research is an attempt to evenly cover the issues of railway construction, the formation of scientific and technical thought, the problems of training qualified personnel for the railways of Ukraine in the second half of the nineteenth century.

Thanks to the informational and analytical-synthetic methods of research on this topic, the development of scientific and technical views in connection with the development and expansion of the railway network is considered.

1.1 World experience in the formation of railway networks

The railways did not appear immediately. Their appearance was preceded by a long period of time, during which people's minds formed railway thinking. From time immemorial, people have been looking for the most efficient methods of moving and transporting goods.

In the fifteenth century in the mining of the Czech Republic, Saxony and some other countries, the wooden trunk was widely used. For a long time, coal was transported in sacks, baskets tied to the backs of horses [18, p. 46]. At the same time, cheap women's and children's labor was used in the mines.

The need for rapid movement of coal fuel from mines to manufactories led to the emergence in the second half of the eighteenth century iron track between coal mines and plants in Wales.

The first cast iron rails were laid in 1767 by Richard Reynolds, one of the owners of the Colebrook Metallurgical Plants. He replaced the wooden beds with cast-iron corner rails attached to wooden beams.

In 1789, engineer W. Jessop developed high mushroom-shaped rails. The use of angular, flat and other rails allowed the use of trucks with ordinary wheels. But under the weight of loaded carts, cast iron rails often collapsed. Due to this, the carts were replaced by trains of three or four cars with a capacity of 1-2 tons.

The English engineer Thomas Severi was the first to implement the idea of a steam engine by I. Newton [19, p. 11]. He used a steam engine to pump water out of the mines. Gradually, this idea was further developed, and in 1769 the French engineer Jean Cuño built the first steam locomotive that moved by steam. It was a wooden tricycle powered by a small steam engine. The present invention testified to progress in the development of engineering thought. However, the engine had a significant drawback – the cylinders passed a large amount of steam, which did not allow to actively implement it [20, p. 22].

But technical and engineering thought did not stop there.

One of the successors of the theoretical and practical search for the design of the steam engine was the Englishman D. Watt. In 1774 he built a steam engine at one of the factories, which he soon patented as an advanced double steam action steam engine [21, p. 88-103].

In parallel and independently of European inventors, the American engineer O. Evans in 1784 proposed the production of high-pressure steam engines (3.5 atm.). This gives rise to the development of the steam locomotive.

The first locomotive of truly practical importance was designed by the eminent engineer and inventor R. Trevithick of Cornwall.

In 1804, one of the world's first locomotives, the English mechanic Richard Trevithick, was tested and launched a series of experimental English locomotives. Thanks to the use of the flywheel, the locomotive rolled easily on smooth rails. However, during the tests, the locomotive began to break the cast iron rails because it was too heavy. [19, p. 842].

In 1814, D. Stephenson (1781-1848) built the steamer «Blucher», a year later – another. In parallel, he drew attention to the need to replace the rails. In order for the surface of the rails to be smooth and the rails themselves to lie in a horizontal plane, he established an embankment and excavations, with the help of which the horizontal level of the rail track was achieved [22, p. 118].

However, in the first two decades of the nineteenth century few were interested in Stephenson's innovations.

In 1823, D. Stephenson founded the world's first locomotive plant in Newcastle, England, which later became a large transport engineering company, exporting locomotives to almost all countries.

In 1825 he built the locomotive «Locomotive», which moved at a speed of 24 km per hour. The most famous of the locomotive models was the Rocket - a locomotive that won the «Rhinehill Test» between locomotives of different developers. His technical work met the requirements of: 1 / the use of smooth rails with such masonry wheels; 2 / exit of the spent steam in a flue; 3 / use of a tubular boiler [19, p. 843]. The car was able to reach a speed of 20 km per hour and weighed only 4.5 tons.

The opening of the Manchester-Liverpool Railway in England in 1830 gave rise to the widespread use of the steam-powered railway network and the establishment of railway enterprises. The increase in railway construction in this country soon became speculative. Private companies built their own without any agreement with the government, forcing fierce competition. Further development of the railway business significantly affected all sectors of the economy, especially metallurgy and engineering [15, p. 24].

In 1831 D. Stephenson proposed his new type of locomotive «Planet», which with a load of 76 tons gained 20 km per hour [20, p. 42].

Further development of locomotive building in the country took place by improving certain parts and types of locomotives.

Following England, other European countries became interested in building railways.

In 1834, the Belgian parliament approved a project for a single railway network. From 1835, the Brussels-Mechelen railway started operating. In the same year, the first Belgian locomotive plant began in Serena, whose products became very popular in Europe.

In France, Austria, Prussia and other Western European countries, railway construction is not as widespread as in England. The first French railway was opened to traffic in 1837, while the first 23 km long equestrian rail line (Saint-Andresier) was built in 1823 and used to transport coal [18, p. 107].

The first rail horse line in the United States was built in 1827. In the 1829s and 1830s, American engineers Miller, Cooper, and others tested their first steam locomotives, and their inventions were not used in the country in the first half of the 19th century.

It should be noted that almost all countries of the capitalist world until the mid-nineteenth century were covered with rail tracks, and from so on in domestic traffic begins to dominate rail transport.

Thus, the construction of the railway network is gradually unfolding in many countries around the world, namely: Great Britain – 1825; USA – 1830; France – 1832; Germany – 1835; Belgium – 1835; Canada, 1836; Russia – 1837; Austro – Hungarian Empire – 1838; Italy – 1839; The Netherlands – 1839; Switzerland – 1844; Denmark – 1847; Spain – 1848; Sweden – 1851; Norway, Portugal – 1854; Bulgaria, Turkey – 1860; Romania – 1870; Serbia – 1884; Greece – 1889 [23, p.145].

Widespread deployment of railway construction in the 40s of the XIX century in Western Europe contributed to the formation of railways as the main mode of transport.

During the industrial revolution in Western Europe, rail transport became one of the most important factors in the sudden and strong expansion of the world market and the formation of capitalism in the dominant world economic system. As a result, a new international division of labor was created, which turned one part of the globe mainly into a branch of agricultural production and the other into a branch of industrial production. Therefore, the backward countries were faced with the question: either to rebuild their outdated economy by accelerating the industrial revolution and the developed capitalist mode of production, or to perish as an independent state. In this situation, the priority was to create a railway network to connect the separate and unrelated branches of the economy.

Rail transport soon became all-encompassing, providing all the major economic connections of the various European countries. And the economic effect of the introduction of railways was primarily due to the acceleration of transportation, which

created a powerful impetus to further concentration of production and ensure the growth of productivity of social labor and the development of productive forces.

1.2 Scientific and technical support of the Ukrainian railway network

At the end of the XIX century Ukrainian territory was already one of the economically developed regions of the Russian Empire with a strong railway network, which needed to improve its technical support.

The Russian Empire, later than other countries, embarked on the path of capitalist development. The growth of industrial and agricultural production and export of bread after the reform of 1861 caused a sharp increase in traffic, for which there was a need for further development of the railway industry.

Prior to the reform, the main modes of transportation were postal, trade (milky ways) [24, p. 54].

Postal roads are not suitable for transporting goods in winter, especially in the southern regions, where snow does not always linger long. It is difficult to move on such roads [25, p. 81-82].

The need to build railways in Ukraine arose long ago. The geographical location of the region its natural resources were a prerequisite. Ukraine needed railways to export products, mainly from the fertile south-western region and industrial products from the Donbass and Kryvyi Rih regions. After the defeat in the Crimean War, the tsarist government realized the need to connect the center of the country with ports on the Black and Azov Seas, as well as the western borders, for strategic reasons. Accordingly, in Ukraine there were three main centers of railway construction: South-Western region, in the area of which gradually emerged a network of south-western railways; the industrial district of Donbass and Kryvyi Rih, in the area of which the Donetsk and Kateryna railways arose; and a network of Southern Railways was built to connect with the sea and the industrial regions of Ukraine. After the construction of the Kursk - Kharkiv - Azov line, they began to build railways specifically for the export of coal from Donbass.

The first such railway was the Konstantinovka-Yelenivka highway, which was put into operation in 1872. It was the beginning of the development of the network of future Donetsk railways. In 1884, the Catherine Railway was built, built for the export of industrial products of Kryvyi Rih. The first was the line Nizhnedneprovsk - Dolynska. In 1904-1906 the so-called Second Catherine Railway was built, which merged with the First in the direction of Dolgintsevo - Volnovakha. Since the railways of Ukraine were built in large industrial cities and agricultural areas, they became the largest in length and scope of work among the railways of the Russian Empire [26, p. 55].

Railway construction in the Russian Empire began to take shape in the mid-nineteenth century. Improving railway technology is one of its main tasks.

In 1837, for the first time in the Russian Empire, a railway was built between St. Petersburg and Tsarskoe Selo, which revealed the need for active use of domestic railway equipment [15, p. 32].

At the beginning of the development of railway transport, the locomotive fleet of railways consisted mostly of locomotives manufactured abroad, or in Russia, but on foreign projects. A characteristic feature of the locomotive fleet of Ukrainian railways was its multi-series nature. This was due to the fact that railway companies systematically bought locomotives from almost all European manufacturers.

In 1846, the Alexander Plant began producing the first Russian cars for the St. Petersburg-Moscow railway. Since 1851, cars were manufactured by the St. Petersburg plant, which ceased its activities during the Crimean War. The war revealed the need for accelerated expansion of the railway network and high quality equipment.

In 1882, a compound machine was first installed on one of the locomotives in the Kyiv workshops of the South-Western Railways. Studies have shown that this machine saves up to 20%. The study of its effectiveness continued until 1885 on the initiative and under the guidance of the founding engineer of the Russian school of railway traction O.P. Borodin on a passenger locomotive type 2-2-0 tandem compound system, the results of which were positive. Private railways became interested and began to order such machines [27, p. 12].

Railway workshops played an important role in improving technical support.

The beginning of car building in Ukraine was laid by the workshops of the South-Western Railways. Carriage construction was developed in the workshops of other railways, such as Kharkiv-Mykolayiv, but later it stopped completely. The first industrial enterprise in Ukraine to organize car-building was the Kyiv South-Russian Machine-Building Plant. Besides, car-building was organized at the Nikolaev plant, at the enterprises in the city of Gorlovka and in some others.

In 1884, at the 7th Congress of Engineers of the Traction and Rolling Stock Service of the Russian Railways, engineers of the South-Western Railways and the Kovrov Railway Workshops presented drawings and technical conditions for freight cars. The best project of covered wagons and platforms, presented by the South-Western Railways, was chosen, which was taken as a basis and began to be widely implemented in production.

In 1886, the workers of the Kyiv workshops of the South-Western Railways made the first eight-wheeled Pulmon cars of the II class. In parallel, they made eight-wheeled cars of II and III class. By 1903, the workshops produced only 65 such cars [15, p. 33].

Since 1891 began to use the first four-cylinder high-speed locomotive of the tandem-compound system, built according to the project of the technical department of the traction service of the South-Western Railways under the leadership of O.P. Borodin and the head of the technical department L.M. Lions called "№101" [28, p. 28].

In 1895, several more such locomotives were built: «№102», «№103», «№104», «№105», the first three were later named: «O.P. Borodin», «S.F. Stempikovsky», «L.M. Levi»[15, p. 34].

In 1896, this project was used by workers of the Odessa railway workshops in the construction of the locomotive «№107», which at the All-Russian Exhibition in Nizhny Novgorod attracted the attention of many engineers. At the same time, research was conducted on the operation of components and units of machines. Thus, in 1896 experiments were conducted on the device Ecohomie-Steah-Bok, which was used for

washing locomotives with Lefeld pumps, used steam heating from the locomotives themselves [29, p. 15-16].

Since the 1890s, locomotives have been built at two specialized locomotive plants in Ukraine: Kharkiv and Luhansk. Later, steam locomotives were built at the Nikolaev Shipbuilding and Kramatorsk Machine-Building Plants.

Engineers worked on scientific developments in this field. Thus, in 1906, according to the project of engineer A. Raevsky, Kharkiv Locomotive Plant began construction of a more powerful locomotive type 1-4-0 series Shch [15, p. 33].

Since 1913, all Russian railways have been using a freight locomotive with five paired axles of the 0-5-0 series E of even greater power, developed and built by workers of the Luhansk Locomotive Plant and the Vladikavkaz Railway.

At the same time, the ideas of O. Borodin and L. Leva on dynamometric tests of locomotives while moving were realized. In other countries there was no such well-established system of research [30, p. 103].

In 1913, the technician of the railway-driver depot station. Bobrynska South-Western Railway B.L. Karvatsky proposed the idea of redesigning the triple valve and crane driver of the Westinghouse system, which would make the braking system less exhausting. Unfortunately, this idea did not receive support [31, p. 209].

Engineers of the Kharkiv Locomotive Plant A. Raevsky, A. Lipko-Parafievsky, B. Korchevsky worked on the creation of a special internal combustion engine for operation on railways. In 1910 they developed a locomotive project. The first step in obtaining energy for motion was the invention of the internal combustion engine with diverging pistons and cylinders. The engine transferred its work to two jack shafts connected by a drawbar system with movable axes. The movement from the place and charging of the cylinder of the main engine was driven from the compressor by means of the additional engine [32, p. 132].

Engineer Yu. Lomonosov played an important role in the formation of the scientific school in the railway industry. After graduating from the St. Petersburg Institute of Railways in 1898, he was sent to the Kharkiv Locomotive Plant, where he worked for a short time, later leaving the job of his own volition.

On April 3, 1899, Yu. Lomonosov was confirmed as a full-time engineer of the 9th grade and assistant chief of the main depot of the traction service of the Kharkiv-Mykolayiv Railway. For some time he worked at the Warsaw Polytechnic Institute. In 1901, Yu. Lomonosov was offered to work at the Kyiv Polytechnic Institute as a full-time lecturer and acting extraordinary professor at the Department of Civil Engineering [33, p. 17-19].

Since 1905, after defending his dissertation, Yu.V. Lomonosov begins to study the problems of passenger traffic on the railways in terms of the locomotive service, emphasizing the need to increase the speed of locomotives.

In his monographs Traction Calculations and Scientific Fundamentals of Railway Operation (1912), Yu.

At the same time, the scientist is working on creating a new type of locomotive – an oil locomotive, which would work on the principle of internal combustion engines. In 1913, this project was approved by the Ministry of Railways.

A huge role in the development of the science of electric traction belonged to scientists A. Wolf, G. Graftio and G. Dubeliru [34, p. 49].

From 1905 to 1916 G. Dubelir worked at the Kiev Polytechnic Institute. In his article "Basic principles of designing the profile of railways with electric traction" (1904) from a scientific point of view notes the superiority of electric railways over steam. His work was highly appreciated by Yu. Lomonosov.

It is necessary to note the significant contribution of G. Dubelir in the creation of the first Kiev tram (the first in Russia). In 1910 he developed projects to rebuild the power grid of the Kiev tram [35, p. 129].

An outstanding scientist, G. Dubelir, has repeatedly delivered speeches during the Electrotechnical Congresses. His report "The current state of the issue of the use of electric traction on railways" at the II Electrotechnical Congress (December 1901-January 1902) aroused great interest among those present. He stressed the need to use electric traction on railways, its impact on increasing train speeds.

S. Witte played an important role in the formation of the railway network and the development of scientific thought in the technical support of railways. 44].

After graduating from Odessa University in 1870, S. Witte decided to work on the railways. In a short time, he acquired practical knowledge in the railway business, studying the responsibilities of assistant and chief of the station, controller, traffic auditor, acquainted with freight and passenger traffic, and more. In the management of the Odessa railway he acted as the chief of the movement [4, p.87]. One of his proposals was a recommendation to strengthen the role of the state in regulating private transportation and restricting free competition.

Emperor Alexander II thanked him for the excellent performance of transportation of troops and military cargo during the Russo-Turkish war of 1877-1878 by Odessa Railway [36, p. 297].

In 1878 S.Yu. Witte takes part in the formation of the Society of South-Western Railways (included Odesa, Kiev-Brest and Brest-Grayev) and is a member of the tariff commission [2, p. 126].

Since 1879, S.Yu. Witte is the head of the operational department on the board of the Society of South-Western Railways in St. Petersburg.

At the same time, he participates in the work of the commission on the study of railway affairs in Russia. On behalf of Count Baranov S. Witte wrote an essay "History and activities of the congresses of representatives of the Russian railways", which was part of the work of this commission [37, p. 579].

In 1880 S.Yu. Witte was appointed chief of operations, and in 1886 - manager of the South-Western Railways. He held this position until 1889. During the period of his leadership, the railways were brought to a high level, their shares increased significantly, the demand for them increased [3, p. 142].

In his book "Principles of railway tariffs for freight" (1883) S.Yu. Witte raises the issue of railway financing and government policy in the field of tariffs, draws attention to the participation of the treasury in private railway construction. Through his actions, he pushed the government to take practical action, to eliminate the deficit and increase the profitability of the railways. And on March 9, 1889, S.Yu. Witte was appointed Director of the Railway Department of the Ministry of Finance and Chairman of the Tariff Committee (15, p. 34).

From 1892 to 1903 S.Yu. Witte served as finance minister. He supports Emperor Alexander III in privatizing the state's private railways, which were bought back during his time at the Ministry of Railways.

He considered erroneous views on the predominance of strategic and political views over financial and economic in the organization of work, and stressed that the lack of necessary savings in the operation of railways and negative attitude to railway tariffs creates chaos in improving railways in Russia [38, p. 514-521]. Back in the 80's of the XIX century. Witte asserted that in the construction of railways, first of all, it is necessary to take into account its economic importance, not military [39, p. 1-4].

A prominent place in the development of the theory and practice of domestic steam locomotive belongs to the scientist – engineer Alexander Parfenovich Borodin.

After graduating from the Institute of Railway Engineers in 1872, O. Borodin began working on the construction of the Riga-Vyazemskaya Railway, after the commissioning of which he was appointed manager.

At the beginning of 1877, O.P. Borodin was offered to head the Kyiv-Brest railway. In 1878, with the formation of the South-Western Railways, O.P. Borodin was appointed chairman of the central board [40, p. 12].

O.P. Borodin was interested in all the affairs of the railway, worked from 7 am to 1 am [41, p. 1-6]. In his article "The purpose of railway workshops and the artificial revival of the railway industry" (1882), he noted the unsatisfactory condition of railway workshops, which must be provided for all for the repair of rolling stock, to be independent of private plants.

In 1879, O. Borodin first organized a mechanical and chemical laboratory on the South-Western Railways. A mechanical laboratory was opened at the Kyiv Railway Workshops, which conducted the necessary tests of the quality of metals and bandages. The chemical laboratory with the participation of Borodin was founded to analyze the quality of water, fuel, coal, was equipped with all necessary equipment [42, p. 77-78].

O. Borodin initiated the main works on the repair of rolling stock in two workshops - Kyiv and Odessa, which were equipped with the necessary mechanisms. This allowed to build not only cars but also steam locomotives in railway workshops.

During the management of the South-Western Railways O.P. Borodin raised workshops and laboratories to a high level among all Russian railways [43, p. 343].

The main idea was to build new rolling stock. In 1880 - 1882 he worked on the implementation of the idea of building a new freight car and platform.

In the 80's of the XIX century. a large number of locomotive series were used on the Russian railways. For example, on the South-Western Railways, their number reached 45, which created difficulties during their repair. That is why O. Borodin insisted on the need to build locomotives on the same projects for all [44, p. 81].

From 1881 on the South-Western Railways at the initiative of Borodin on all locomotives were installed automatic brakes Westinghaus [2, p. 56].

Thanks to O. Borodin in 1882 the world's first locomotive laboratory was opened in Kyiv [45, p. 171], whose workers created the first dynamometer car. Such a laboratory was established by Professor Goss at Pardew University in the United States only in 1891 [46, p. 110].

In 1881, O. Borodin conducted a detailed study of the application of the «Compound» system. The results showed that the use of the machine system «Compound» gives significant fuel savings [47, p. 154]. In 1885, a four-cylinder tandem-compound locomotive of the 2-2-OP type was built on the South-Western Railways under the leadership of Borodin. In America, such locomotives appeared only in 1889. Already in the 90s, a locomotive of this type was distributed on other railways in Russia.

O. Borodin took part in the congresses of engineers of Russian railway rolling stock. Almost all the conventions were chaired by him. He was highly respected for his objectivity, decency, high organization during the meetings themselves, for developing the most important issues. This gave an opportunity to unite people, to help understand the most important issues of railway organization, their material support [48, p. 303, 377].

In 1889, in connection with the transfer of S. Witte to the Ministry of Finance, O. Borodin was appointed manager of the South-Western Railways [49, p. 17-19]. Working in this position, O. Borodin dealt not only with organizational and technical

issues. On his initiative, libraries, schools, and canteens for workers were established on the South-Western Railways. All the time Alexander Parfenovich took care of their financial situation.

He was one of the initiators of the founding of the technical magazine «Engineer», published in Kiev by the Society of Engineers. In 1885, O. Borodin became the editor-in-chief of this magazine in connection with the departure of N. Demchynsky from Kyiv. Most of his articles were published in «Engineer», which was the only independent Russian technical journal.

O. Borodin's theoretical and practical activity was highly appreciated by progressive scientists. In 1902, a locomotive laboratory was established in St. Petersburg on the example of the South-Western Railway Laboratory, named after O. Borodin. In 1907, a gold medal in his name was approved for the most talented railway engineers.

O. Borodin, S. Witte, Y. Lomonosov, G. Dubelir and others, as qualified engineers, played an important role in the formation of railway transport in Ukraine. All of them made a lot of efforts to improve the work of railway transport and laid the foundations of the technical and economic potential that belongs to the Ukrainian state today. Their organizational talent, scientific and technical knowledge and dedication are a model for all subsequent generations of railroad workers and statesmen.

1.3 Training for Ukrainian railways

History of the development of railway transport in Ukraine in the late nineteenth - early twentieth century indicates the need for qualified training of its staff, which should become a national task.

The development of industrial education in Russia in the late XIX - early XX century was caused, on the one hand, by the rapid growth of industrial production, which required specially trained personnel, on the other – increasing interest in vocational education of the general population and awareness of government educational level. Therefore, the creation of industrial education in Russia in the late

XIX - early XX century, despite a number of shortcomings, was the result of a set of scientifically sound, organizationally sound measures by state and public organizations and using private initiative on the ground.

It was during this period, under the influence of the "industrial revolution" that was gaining momentum in Europe, modernization of production, numerous reforms proclaimed by the tsarist government of the Russian Empire, and social challenges. It is important for today to study the regional features of the development of vocational education, the conditions in which the training of skilled workers in the second half of the nineteenth - early twentieth century [17, p. 243].

The reform of 1861 and the rapid development of capitalist relations in industry and agriculture contributed to the emergence of a large number of free labor in Ukraine. It consisted of the poorest part of the peasantry, who were forced to hire day laborers for the landlords or, in search of work, to leave the countryside, as can be seen from Table 1.

Excess of free hands in the Ukrainian provinces

Table 1

№ п/а	**Provinces**	**Surplus labor after the reform of 1861**
1	Volyn	111.312
2	Kyiv	281.065
3	Podilska	258.082
4	Kharkiv	122.715
5	Chernihiv	172.379
6	Ekaterinoslavskaya	167.695
7	Tavrian	268.445
8	Kherson	514.843

Sources: Yavorsky M. Ukraine in the era of capitalism [Electronic copy]. Vyp. 2. On the path of capitalist accumulation / M. Yavorsky. Poltava: State Publishing House of Ukraine, 1925. P. 48-49.

As we can see from the table, in fact in each province there is a large number of "free" workers. Although, according to scientists, the population of the Black Sea provinces found it easier to find work due to the small population of the region.

Only a part of the landless peasantry was able to find a job on the spot: go to hire a landlord or fellow villager, stay with local, non-agricultural, handicrafts, because they were common.

According to estimates by Lavrov Yu. in the 80's of the XIX century from Voronezh, Kursk, Orel, Kyiv, Volyn, Podolsk, Kharkiv and Chernihiv provinces 1423854 people went to work every year [5, p. 44]. In 1889, 34,380 people from the Kyiv province alone went to work, 17,730 of them (51.6%) were employed in field work, and 16,750 (48.4%) - in industry, railways and other industries [6, p. 25].

In 1891 alone, 191.5 thousand people came from the village to earn money: 191.5 thousand from the Kyiv province, 173 thousand from the Poltava province, 164.2 thousand from the Kharkiv province, and – 134.2 thousand from the Chernihiv province. , Podolsk – 108 thousand people. , and only – 771.2 thousand people. [7, p. 65]. A large mass of peasants who did not receive land began to work in factories, sugar industry, coal and metallurgical industries of Donbass.

Also, it should be noted that in the study period the number of plants and factories is growing, while concentrating a large number of workers. Thus, we can analyze the example of the Podolsk province in table 2. [51, p. 29].

Factories and plants of Podolsk province (1862-1886)

Table 2

Years	Number of factories and plants	Number of workers	The cost of annual products
1862	657	6.469	4.147.553
1863	576	7.002	3.338.662
1864	620	7.453	3.400.697
1865	1.297	12.818	3.777.970
1866	776	14.437	5.334.400
1882	2.279	2.3069	26.923.378
1883	3.437	25.274	31.513.172
1884	3.670	26.374	26.739.489
1885	3.604	26.333	27.003.260
1886	3.907	25.321	27.630.170

Sources: Guldman V. Report of the Podolsk Provincial Statistical Committee for 1886 / Compiled by V.K. Guldman. Kamenets-Podolsk, 1888. p. 29.

We can analyze that the growth of the factory industry was sharp in the late 1870s after the Russo-Turkish War.

Construction of the Ukrainian railways began after the 1861 reform to transport grain and coal to other regions and abroad to help landowners.

About 600 thousand workers who previously worked in agriculture, absorbed the construction of railways [8, p. 44]. They worked on the construction of the Kyiv-Baltic, Lozovo-Sevastopol railways and others, were hired individually, in groups, whole villages. On the Lozovo-Sevastopol railway, contractors hired up to 5,000 workers from the peasants under contracts for a period of one year, taking into account the seasonality of agricultural work [52, p. 416].

Railway construction in the Russian Empire required a large amount of labor, because most of its construction processes were performed manually. Railway transport with its deep division of labor, relatively high technical level gave rise to a significant professional separation of railway workers and the emergence of such specialties, which were on the border between workers and employees.

In the late XIX - early XX centuries to a large extent, the replenishment of railway workers was at the expense of their families. Also, the inhabitants of the surrounding villages were hired as switchmen, repairmen, coal miners, conductors, they were less demanding in terms of working conditions and their payment [53, p. 653].

Former servicemen were also employed on the railways. In 1890, 4.4 thousand people (out of a total of 15.6 thousand) worked on the South-Western, Kateryna, Kursk-Kharkiv-Mykolaiv, and Fastiv railways [54, p. 17].

More than a third of all railway staff were skilled workers in railway workshops and depots.

Intensive railway construction required skilled labor, which forced the government to pay attention to the training of specialists in this field. That is why there is a need for educational institutions that would train highly qualified railway personnel.

Until the 70's of the XIX century. the country did not have technical schools that would specifically train workers for the railways. In 1869, under the leadership of the Chief Inspector of Railways Delvig, a commission was set up to consider raising the technical and professional level of railway workers. She has developed a number of proposals, including the recruitment and training of qualified technicians and machinists from among experienced factory workers familiar with the technology.

To provide higher technical education on July 28, 1864, the Institute of Railway Engineers was founded in St. Petersburg, which trained engineers specializing in railway transport, which received mostly children of nobles. A large constellation of scientists-engineers who raised the railway business in Ukraine, such as Yu. Lomonosov, G. Dubelir, O. Borodin and others, emerged from the walls of this institute [35, p. 153-164].

At the same time, the question arises regarding the establishment and financing of technical railway schools. In 1870, the Ministry of Railways together with the Ministry of Finance adopted an agreement to deduct from the gross profit of railways 15 rubles from a mile of operated roads for the development of technical schools [55, p. 17-18].

Despite some financial difficulties, in the 70's of the XIX century in Russia technical railway schools begin to open. They only partially met the needs of the railways for skilled workers, initially preferring to train locomotive drivers, their assistants and track foremen.

In 1869, the training of lower technical personnel for the maintenance and construction of railways began with lower technical railway schools.

In 1870, the Kharkiv Technical School was the first in Ukraine to operate, admitting people aged 13 to 19. In addition to general education, mandatory technical disciplines were taught: locomotive construction and maintenance; general information on the construction of railways and telegraph services. The school trained specialists for traction and road repair services 100 students studied in it [16, p. 43].

In 1870, the Ministry of Railways decided to annually deduct from the profits of the railways for 15 rubles from each mile for the arrangement and maintenance of

railway schools. This decision had a positive effect on the development of schools throughout the country and at the beginning of 1917 there were 47 lower technical iron schools in the empire (nine of them in Ukraine), which trained drivers, conductors, rolling stock and track repairmen, and other support staff. [23, p. 146].

The creation of the first railway schools was an exceptional initiative of the railway owners. Until 1886, these institutions were maintained. Schools had a primitive appearance and were mostly based at depots or railway workshops. All schools differed from each other in terms of curricula and facilities. In addition, most of them did not look like technical schools.

In 1879, the Ministry of Railways approved a program of teaching in railway schools. It provided for a six-year training course. One year was devoted to the preparatory class, three years – training in technical classes, two years – acquaintance with the service on the railway or in workshops [56, p. 146].

Despite the stable development of the network of railway schools, the regulations governing the rules of their formation and operation were approved only in 1886. In the same year, most railway schools were subordinated to the Ministry of Railways [55, p. 37-38]. The following year, uniform curricula were approved for them. In 1894, the Ministry of Railways approved a new curriculum that divided railway schools into general and construction.

The 1886 regulations provided for a five-year training course. For three years, students studied in classrooms, and the next two – in railway workshops. However, not all graduates went to work in the specialty. Thus, of the 7,747 graduates of 1898, only 60.3% expressed a desire to work on the railroad. Most of the graduates held the positions of steam locomotive drivers, assistant drivers and road foremen [55, p. 52].

The activities of secondary railway schools of that time can be analyzed on the example of Catherine's Railway. The first schools on the road appeared in 1889–1890 at Katerynoslav and Hryshyno stations, initiated by employees themselves who were willing to voluntarily deduct part of their earnings from school maintenance (for example, an employee who received 20 rubles a month donated 10 kopecks).

Such a low fee was set to make schooling available to employees of all categories. These reimbursements accounted for half of the cost of maintaining the schools, the other half was allocated annually by the treasury in the form of financial aid, premises for schools with heating and lighting. Employees' cash benefits were a significant addition to the Treasury's cash aid, which enabled the Road Administration to: a) increase the number of schools on the lines each year; b) better pay for teaching work, respectively invite more qualified and experienced teachers; c) to introduce into the course of study such practical classes as needlework and cooking for girls and carpentry and metalwork for boys [23, p. 144].

At the same time, the development of railway networks required an increasing number of skilled railway builders and support staff. To solve this problem, the Ministry of Railways initiated the creation of two railway schools in the south of Ukraine with intensive teaching of construction – Mykolaiv and Sevastopol. It should be noted that at the end of the XIX century in the Russian Empire only these two schools trained railway builders.

Mykolayiv Technical Railway School began its work in 1894. One group (up to 30 students) was admitted to the school every year. It was quite popular among the population, as evidenced by the fact that in the 1899-1900 academic year, 82 applications were submitted for 36 places. The tuition fee was symbolic – 10 rubles. per year [17, p. 30].

The average age of students was 16-18 years. In the first year of the school, only 3 of 29 students were children of railway workers, others – from the families of the clergy, farmers, artisans, merchants, etc. [57, p. 10].

The reason for this disparity was the poverty of railway workers, who did not have the financial means to send their children to school. To support low-income students, in 1897 a guardianship was opened at the school, which the following year opened a dormitory, where 40 students lived in the 1899-1900 school year. The monthly fee for living in a dormitory was 11-12 rubles. [17, p. 30].

The educational process in technical railway schools lasted 5 years and was divided into two stages: the first stage – training at the school, the second stage – two

years of internship. During the course, students studied general, special disciplines and mastered crafts.

The school was in full state support. For example, in the 1897-1898 academic year, 1,489 rubles were spent on his needs. 93 kopecks, most of which are for the payment of full-time employees (11,109 rubles 65 kopecks). Own income was meager, and mainly consisted of tuition fees (675 rubles.) [17, p. 31].

Another way of training workers for the needs of the railway was apprenticeships in railway workshops and depots, where young people acquired practical skills in rolling stock maintenance and mastered the locksmith, carpenter, turner or painter.

For example, boys aged 15-17 (mostly from railway families) were admitted to the workshops of the Kursk-Kharkiv-Sevastopol Railway for a five-year term. To enter, they provided a certificate of completion of primary school or passed the appropriate exam. Illiterate children were not accepted. At the initial stage, the training was carried out by students practicing practical exercises under the supervision of a master mentor, and therefore they had to work daily at the level of workers (10 hours or more). Lack of theoretical training made such training ineffective [17, p. 32].

The unsatisfactory financial situation of the vast majority of railway workers made it impossible for them to try to provide their children with a decent secondary education so that they could continue their education at the Technical Railway School. Therefore, only 28% of all children of railway employees studied in the relevant schools. To solve this problem, the Ministry of Railways has introduced preparatory classes and student dormitories at schools [55, p. 44, 48, 50].

In 1909, new curricula were adopted, which provided for the creation of three departments in schools: mechanical, electrical and construction. The mechanical department trained machinists, masters of locomotive repair, the electrical department – alarm technicians, telegraphs, electrical machines, lighting [58, p. 112].

In 1912, the Regulations on Railway Schools of the Traffic Service were approved, which were to train secondary agents for the traffic service: commercial clerks, weightlifters, cashiers, telegraphists, technical traffic clerks, station chiefs and their assistants, taxi drivers, and transmission agents.

In order to increase the education of employees of railway depots and workshops, directly next to them, the owners established free courses, where workers could gain working skills without leaving work.

Railway schools can also be attributed to lower technical schools, as these institutions have similar curricula, terms of study and qualification levels of graduates [17, p. 85]. Among other lower vocational schools, railway schools have made significant progress in organizing educational work and the quality of student learning. In addition, they were very popular among young people. However, they also had shortcomings, in particular the low level of general education of students.

With the construction of the Kiev-Odessa railway (1870-1871) similar technical schools were opened in Kiev, Odessa. The training program provided for the training of skilled workers of various specialties to service the railway [10, p. 12].

In 1871 a railway school was opened in Odessa for the training of machinists, road builders, car inspectors, telegraphists and draftsmen.

When entering the school, preference was given to the children of railway workers who graduated from the city school. Both residents of Odessa and people from line stations were received. A dormitory for 70 people was provided for non-locals. The school had two groups of students – mechanical and telegraphic, each of which had 30 people. The training lasted for three years, and after graduation about 25 specialists graduated. The curriculum was expanded.

Students were provided with basic knowledge about the construction of the railway, the organization of train traffic, commercial activities, as well as taught special subjects. For mechanics – algebra, geometry, drawings, basics of mechanics and heat engineering, water supply equipment, steam locomotive and car. Telegraphists studied the basics of electrical engineering, office work, information transmission equipment, mechanics, station equipment. All three years the obligatory subjects were the Law of God, Russian literature. A well-equipped locksmith's workshop and foundry were set up to acquire skills at the school. In the last year of study, a six-month internship on the railway or in workshops was envisaged. There was no summer vacation. Discipline among students was maintained. For example, for a misdemeanor a student could get

a ruler on his hands or was forced to kneel in a corner with textbooks in his outstretched hands. The graduates of the school first became locksmiths in the depot, and later could apply for the positions of drivers, depot duty officers, car masters and senior car inspectors.

At the same time, railway companies were looking for simpler and cheaper ways to provide themselves with skilled workers. For example, in the early 70s of the XIX century at the workshop of the Odessa Railway organized training of young people in metalwork, copper, blacksmithing, foundry, turning, carpentry, wallpaper, painting and the ability to service boilers.

Boys aged 14-18 were recruited, mostly from the children of workshop and railway workers. The term of study was 4 years. The seriousness of the process of selecting future students can be evidenced by two points: 1) a list of documents that had to be submitted to the administration, a certificate of completion (if any); 2) the entrant had to study all four years. In case of early termination of education, his parents had to reimburse the workshop for 25 rubles. for each year of study, about which they wrote a receipt [17, p.17].

In 1873 at Art Olviopil Kherson province opened a railway school for the training of railway masters [59, p. 13]. In 1874, a technical railway school began to operate on its basis, the graduates of which after a three-year theoretical course had to work on the railway for two years and only then received a certificate of education [60, p. 213].

Children from different social strata and groups studied in schools. Thus, in 1877 in Kharkiv, Odessa and Olviopil technical railway schools 238 students were divided by social status: 103 – from the nobility, clergy and merchants, from the burghers – 97 students, from the peasants – 14, from former soldiers – 8. Other 16 students – children of foreigners [61, p. 108].

In 1878, the Ministry of Railways convened a congress of representatives of railway companies and teachers, which considered the most important issues and problems of educational institutions and approved standards for the number of teaching

hours, the distribution of subjects. In August 1879, these programs were approved by the Minister and introduced in all railway schools in Russia [62, p. 9].

New railway schools continued to open in Ukraine, as the demand for skilled workers was not met by existing facilities. Thus, in 1878 such a school began to operate in Kremenchug, Poltava province [63, pp.12-16]. In 1881 began training and retraining of technical staff for railways Donetsk Technical Railway School in Lugansk, Ekaterinoslav province [64, p. 130].

The Ministry of Railways continued to work on further improving technical education. From 1881 to 1886, the Ministry considered the draft "Regulations on Technical Railway Schools", which was later approved by the State Council. In 1887, all Russian schools began to operate in accordance with the new regulations, which allocated 13,200 rubles annually for the maintenance of each technical institution in Ukraine. According to this provision, only citizens of the Russian Empire aged 14 to 17 were admitted to technical railway schools.

The obligatory condition for enrollment in an educational institution was graduation from a city school or gymnasium. Entrants took exams in mathematics and Russian. The term of study in such schools lasted five years. After completing a three-year course, students of the Technical Railway School received certificates and went on a two-year internship, during which they acquired the appropriate specialization. Yes, in 1901. out of 179 trainees of railway schools on four railways of Ukraine (South-West, Kursk-Kharkiv-Sevastopol, Kateryna and Kharkiv-Mykolaiv) 124 people specialized in traction service (70%), 23 (12%) in track and construction repair service and 32 people (18%) - on other railway services [13, p. 52].

In 1890, a technical school was opened in Konotop, Kursk-Kyiv Railway, where the level of teaching was quite high. Only specialists with higher technical education had the right to teach special technical subjects. This is evidenced by the success rate of up to 95%, in contrast to other schools, where it remained at 30-50% [65, p. 355].

In 1896, at the request of the board of the Lozovo-Sevastopol Railway Company, a railway school was opened in Sevastopol to improve the skills of personnel. Its graduates received the specialty of railway construction technicians [55, p. 19].

Thus, for the period from 1870 to 1896 in Ukraine were opened 9 technical railway schools, while in Russia there were 33 [10, p. 15]. The number of students was constantly increasing. If in 1888 1443 students studied in all schools of Ukraine, then in 1898 - 2825 students [66, p. 35].

To increase the number of students in the late 90's of the XIX century dormitories were opened in technical schools, as most parents could not keep their children in private apartments due to financial difficulties. In this case, the railway companies went to meet those wishing to learn.

Nevertheless, the opening of technical railway schools did not make it possible to provide the railways with highly qualified personnel.

Higher engineering education, as already mentioned, was provided by the St. Petersburg Institute of Railway Engineers. One of its graduates O.E. Betulinsky worked in the management of the Kyiv district of railways. Since 1877, initially holding the position of chief engineer and deputy manager of the Kyiv-Kharkiv-Azov Railway, he has improved the condition of railway lines and reduced operating costs. A graduate of the Kursk-Kharkiv-Azov (1866-1870) and Lozovo-Sevastopol (1872-1874) railways worked on the construction of this university. Stempinsky, making every effort to improve the situation on this railway network [13, p. 108].

High rates of industrial development in southern Russia in the second half of the XIX century and the spread of railway construction revealed the need to establish higher technical educational institutions in Ukraine. On March 14, 1897, the tsar issued an order to open a polytechnic institute in Kyiv. Those who had a certificate of completion of gymnasiums and other secondary schools were admitted to the entrance exams.

From the first years of its existence, the engineering and construction and mechanical departments of the institute were staffed by a prominent specialist in the field of locomotive engineering, Professor Yu. Lomonosov and G. Dubelir – a prominent specialist in the field of road construction and electric transport theory.

The term of study at the Kyiv Polytechnic Institute was 4 years. The work of scientific and technical circles and a large library on the construction and operation of

railway networks played an important role in the training of highly qualified engineers, where students expanded their knowledge and got acquainted with the achievements in industry at that time. The first to form an engineering circle (January 1902), in which professors G.D. Dubelir, E.O. Paton and others. Under the guidance of Professor O.O. Radziga started a mechanical circle.

At the meetings of these groups listened to and discussed the reports of professors and students on the achievements of science and technology [10, p. 16-25]. During the year, excursions to the railway were organized for students. In 1902, under the leadership of Professor Yu.V. Lomonosov, organized an internship for students onthe East China Railway.

Students were heterogeneous in their social background. According to estimates Stepanovich EP most students were from the nobility, as in other higher educational institutions (in 1898 – 47.7% of the total number of students, in 1913 – 36.2%). In 1898, 34.6% of burghers studied, and in 1913 – 27.0%. The lowest number of students camefrom Cossack families – 1.2% and 2.8%, respectively [11, p. 59].

For the poorest students, whose living conditions were difficult (high tuition fees -100 rubles per year, exorbitant fees for apartments, meals), a member of the commission on higher technical institutions D.I. Mendeleev introduced a clause on the right of the institute's council to exempt from tuition fees about half of the students who needed it. This provision was used by the first rector of Kyiv Polytechnic Institute V.L. Kirpychev in 1903, who formed a society to help students at the institute. Teachers and professors helped low-income students with money every year. For example, in 1903 this assistance amounted to 5,112 rubles, in 1911 – already 6,245 rubles. [11, p. 62].

At the beginning of the XX century Kyiv Polytechnic Institute was the only higher education institution in Ukraine that trained specialists for roads. During the period from 1903 to 1912 the institute graduated 549 mechanical engineers [67, p. 13]. Despite the increase in the number of specialists trained by this institute, there was a shortage of them in transport, which had a negative impact on the activities and further development of this sector of the economy.

1.4 Schools for children of railway workers

With the development of the railway network, the number of employees and their families increased, and many social issues arose, one of which was the upbringing and education of children. Many children could not even get a secondary education due to the small number of schools in cities and towns, at railway stations. Only the children of senior employees who received higher salaries could hire a private tutor. Therefore, at many stations, employees and workers themselves tried to create small schools without sparing the last funds for their maintenance. Thus, in the early 70's of the XIX century at the Zdolbunove station of the Kyiv-Brest railway a private school for the education of children of lower employees was opened, in which not only children of this station studied [68, p. 2].

In 1875 it was decided to open such schools in Kiev, Kozyatyn, Zdolbuniv. The Rules for the Establishment of Such Schools stated that tuition should be free, with only 25 kopecks for library services per month. Accordingly, the curriculum in this school taught the Law of God, Russian language, arithmetic, Russian history, geography, art, drawings, spiritual and secular singing [68, p. 5].

According to the report on the educational activities of schools and colleges on the South-Western Railways at the end of 1907 their number was 30 (17 two-class 13 one-class), the total number of students was 5,125 people (3,395 boys and 1,730 girls) [68, p. 32].

Thus, in 1903, 78,590 rubles were allocated from the South-Western Railway for the maintenance of schools and dormitories, in 1904 – 81,050 rubles, in 1905 – 83,135 rubles. [69, p. 3].

As of January 1, 1909, there were 8,777 students in 35 schools of the South-Western Railways, which can be traced from Table 3 and table. 4.

Number of schools as of January 1, 1909

Table 3

№ n/a	Name schools	Discharge	Year of opening	Province
1	Kyiv	Two-class city	1876-1890-1899	Kyiv
2	Zdolbunivske	-//-	1877-1884-1905	Volyn
3	Kovel	-//-	1897-1904	-//-
4	Bender	Two-class rural	1899-1901	Bessarabian
5	Birzulske	-//-	1882-1883	Kherson
6	Bobrynske	-//-	1897-1899	Kyiv
7	Limestone	-//-	1897-1899	Podilska
8	Goltyanske	-//-	1893-1897	Kherson
9	Zhmerynske	-//-	1890	Podilska
10	Kazatinske	-//-	1878-1895	Kyiv
11	Korsunske	-//-	1899-1906	-//-
12	Kryzhopilske	-//-	1898	Podilska
13	Odessa	-//-	1893-1896	Kherson
14	Oknytske	-//-	1897	Bessarabian
15	Separate	-//-	1885-1901	Kherson
16	Rovno	-//-	1906-1908	Volyn
17	Sarpenske	-//-	1903-1907	-//-
18	Smilyanske	-//-	1907	Kyiv
19	Fastiv	-//-	1898-1900	-//-
20	Khrystynivske	-//-	1896-1905	-//-
21	Baltic	classmate	1898	Kherson
22	Biletske	-//-	1906	Bessarabian
23	Vinnytsia	-//-	1906	Podilska
24	Volochyske	-//-	1893	Volyn
25	Kiveretske	-//-	1899	-//-
26	Mogilev	-//-	1898	Podilska
27	Nemishayevske	-//-	1907	Kyiv
28	Novoselytske	-//-	1908	Bessarabian
29	Pechanivske	-//-	1907	Volyn
30	Radziwill	-//-	1906	-//-
31	Rybninske	-//-	1906	Podilska
32	Slobidske	-//-	1900	-//-
33	Troyanivske	-//-	1906	Bessarabian
34	Ungheni	-//-	1899	-//-
35	Florest	-//-	1898	-//-

Sources: Educational Institutions on the South-Western Railways [Electronic copy]: (1878–1903). Department 1. Kyiv: Ed. ed. "Herald of the South-West. railways "(Tour. T-va IN Kushnerev and Co.), 1904. p. 30-31; Report on the state of educational institutions for 1908 / South-Western Railways. Kyiv: Type. S.V. Kulzhenko, 1909. 134, p. 98-99.

As we see from table 3, schools are divided into categories:

a / two-class city: Kyiv, Zdolbuniv, Kovel

b/ second-class rural: Bender, Birzul, Bobryn, Vapnyar, Goltyan, Zhmeryn, Kazatin, Korsun, Kryzhopil, Odessa, Oknytsia, Rozdilne Rivne, Sarpen, Smilyan, Fastiv, Khrysty

c / single-class rural: Biletsk, Vinnytsia, Volochysk, Kiveretsk, Mohyliv, Nemishayev, Novoselytsia, Pechaniv, Radziwill, Rybn, Slobid, Troyaniv, Ungen, Florest.

What is the difference between a one-grade and a two-grade school? The difference is in the duration of training. In one-class schools - three years of study, all students are divided into 3 groups, and after graduation receive a privilege of the 3rd category for military service. In two-grade schools, students study for 5 years, all children are divided into 5 groups, and after graduation receive a 2nd category privilege for military service.

Almost all schools in the South-Western Railways belong to the type of mixed educational institutions, ie boys and girls study there at the same time, and there is a significant advantage in the number of boys on the side. In two-grade schools with a large number of students, girls are taught separately from boys, and in one-grade schools, they study together.

At the beginning of his activity, the girls studied at the Odessa school together with the boys, but six months later they were transferred to the premises of the parish school [70, p. 35].

Schools were divided according to educational districts and provinces, respectively:

1. In the Kyiv educational district – 23 schools (in the Kiev province – 8, Volyn – 8, Podolsk – 7).

2. In the Odessa educational district 12 schools (in the Bessarabian province –7, Kherson – 5). [70, p. 10].

The number of children enrolled in schools as of January 1, 1909

Table 4

№ п/а	Name schools	Number of students	Number of students per teacher	Number of groups in the school	How many students are engaged in the first shift
1	Zdolbunivske	1025	45	22	716
2	Kovel	835	42	19	532
3	Bender	441	37	11	441
4	Birzulske	443	40	10	276
5	Bobrynske	552	43	13	3987
6	Limestone	342	38	8	300
7	Goltyanske	231	46	6	231
8	Zhmerynske	259	37	7	162
9	Kazatinske	638	38	15	365
10	Korsunske	732	46	16	367
11	Kryzhopilske	214	31	7	139
12	Odessa	180	44	6	180
13	Oknytske	366	37	9	214
14	Separate	291	49	6	233
15	Rovno	222	37	6	181
16	Sarpenske	180	36	5	180
17	Smilyanske	249	41	6	141
18	Fastiv	280	35	7	280
19	Khrystynivske	272	45	6	272
20	Baltic	234	40	6	146
21	Biletske	46	46	3	46
22	Vinnytsia	38	38	3	38
23	Volochyske	84	42	4	83
24	Kiveretske	56	56	3	56
25	Mogilev	58	58	3	58
26	Nemishayevske	55	55	3	55
27	Novoselytske	35	35	3	35
28	Pechanivske	45	46	3	45
29	Radziwill	53	27	3	53
30	Rybninske	61	31	4	61
31	Slobidske	45	45	3	45
32	Troyanivske	71	35	4	71
33	Ungheni	35	35	3	35
34	Florest	70	35	4	70
35	Zdolbunivske	36	36	3	36
	Total	**8777**	**40** (In average)	**238**	**6546**

Sources: Educational Institutions on the South-Western Railways [Electronic copy]: (1878–1903). Department 1. Kyiv: Ed. ed. "Herald of the South-West. railways "(Tour. T-va IN Kushnerev and Co.), 1904. p. 30-31; Report on the state of educational institutions for 1908 / South-Western Railways. Kyiv: Type. S.V. Kulzhenko, 1909. 134, p. 100-103.p.

In addition, it should be noted that out of 8,777 students - boys 5,701 (65%), girls - 3,076 (35%).

By classes of children are distributed:

a) in the first grade of two-grade schools and in single-grade schools 6,667 students, including boys - 4,126 people. (62%), girls - 2,541 people. (38%).

b) 2,110 students study in the second grade of two-grade schools, including 1,575 boys (75%) and 535 girls (25%).

According to religion, students are divided into:

a) Orthodox - 7,753 people. (5,049 hl .; 2,704 d.).

b) Catholics - 932 people. (585 hl .; 347 d.).

c) other religions - 92 people. (57 hl .; 25 d.).

The average cost of education in 1908 per student, respectively - 10 rubles. 66 kop. for six months. In two-grade schools, the lowest cost is 8 rubles. 95 k. (Sarni), the highest - 11 rubles. 68 k. (Golta); in classmates - 8 rubles. 92 k. (Vinnytsia) and 19 rubles. 83 k. (Balti) [69, p. 37].

The average cost of tuition in 1909 per student at the school - 21 rubles. 92 kop. [70, p. 11].

There were dormitories at 15 schools: Baltic, Bender, Birzul, Bobryn, Vapnyar, Goltyan, Zhmeryn, Zdolbuniv, Kozyatyn, Kovel, Korsun, Kryzhopil, Oknytsia, Troyaniv and Khrystyniv.

Dormitories were part of the railway schools because many employees did not have their own housing and were forced to live in small stations and races.

Kyiv Two-Class City School was opened the first of all schools on the South-Western Railways (1876), is one of the largest in number of students. In the first year, 60 children were admitted. In 1884, 108 people were already enrolled in the school. According to paragraph 4 of the Charter, schools began to accept girls. Training was free.

As of January 1, 1909, there were 1,025 students: 678 boys and 347 girls. Compared to the previous year, the number of students decreased significantly by 32. 153 children were admitted to the preparatory group.

Kyiv school was in great demand. Only children of railway workers were admitted. Children of other categories of the population are prohibited from entering the Kyiv School. In 1908 - 1909 Due to the lack of vacancies, 124 children who dreamed of joining the preparatory group were denied admission. Up to 60% of those wishing to study are denied admission to the school almost every year.

Classes at the school are held in two shifts due to the lack of free classes. Evening change is problematic. And the premises are not suitable for normal classes: low ceilings, poor lighting.

The maintenance of the school costs on January 1, 1909 in the amount of 23,256 rubles. per year. Expenditures per student per year reach an average of 22 rubles. 09 kop. [70, p. 25].

For the reporting year 1909, the school was divided into men's and women's, with preparatory classes and parallel departments. The school itself was located in 4 rooms, one of which can be called exemplary, the other had to meet sanitary standards.

Zdolbuniv City Two-Class School was opened on September 15, 1877 on the initiative of the Kyiv-Brest Railway Department in accordance with the program of single-class parish schools of the 4th category. In the first year, 60 children were enrolled: 42 boys and 18 girls. As of January 1, 1909, their number was 835 students (528 boys, 307 girls). In terms of the number of students, it ranked second among other similar educational institutions. Compared with 1908, the number of students increased by 60 people.

190 people were admitted to the preparatory group. The number of groups was increased to 19. The number of teachers was increased accordingly. One of the teachers received a salary from the local budget. The school was located in two rooms (8th and 5th grades), which were specially built. The total number of classes is 13, and groups of 19. Therefore, children study in two shifts: in the first - 13 groups (532 students), in the second (afternoon) - 6 groups (303 students) [68, p. 32].

The high demand for admission to this school is shown in Table 5.

Number of students of Zdolbuniv School (1878-1895)

Table 5

Year	Number of students	boys	girls
1878	71	53	18
1879	87	63	24
1880	95	66	29
1881	98	62	36
1882	100	66	34
1883	100	65	35
1885	150	101	49
1886	163	108	55
1887	184	117	67
1888	243	150	93
1889	272	170	102
1890	281	190	91
1892	263	187	76
1893	268	187	81
1894	267	181	86
1895	273	189	84

Sources: Educational Institutions on the South-Western Railways [Electronic copy]: (1878–1903). Department 1. Kyiv: Ed. ed. "Herald of the South-West. railways "(Tour. T-va IN Kushnerev and Co.), 1904. p. 10-13.

In 1884 there was a big event for the school – its transfer from one-class to two-class type. And as we see from the table of those wishing to enter this school is growing every year. Therefore, the question arose to increase the space for classrooms, which was done in 1886.

In 1895, a student orchestra was organized at the school, which enrolled everyone.

From 1897 to 1908, additional subjects were taught at the school: weaving skills, needlework, singing, gymnastics, and accounting.

In 1899, a dormitory was opened at the school, and premises were rented in a residential building owned by the South-Western Railways.

There are many Catholic students in the school (77 people). Therefore, the teaching of the Law of God was led by a priest. In 1908, additional subjects were taught needlework, singing, German, and hygiene.

Students whose parents live far from the station were provided with a dormitory, paid 550 rubles per year [70, p. 42].

Two-class city school at st. **Kovel** in two specially built stone buildings. The two-storey building, which consists of 10 rooms, houses a boys 'school, classes of the girls' school, two rooms for teachers and libraries. The preparatory class of the women's school was located in a one-story building. Classrooms are spacious and bright. Unfortunately, there was no assembly hall where children could spend their free time and hold literary evenings.

As of January 1, 1909, the school had 441 students (266 boys and 176 girls). In 1908, 27 people graduated from the school, 66 people were admitted to the preparatory group. 63 children were denied admission to the school [70, p. 28].

Kozyatyn two-class village school was opened in 1878, although it was planned to open in 1876. At first it was just a one-class parish school, located in one of the premises of the railway station. The building was two-story: on the first floor lived teachers, on the second - two classrooms, a library, a room for teachers. The first group accepted 63 students: 35 boys and 28 girls. In 1888, the number of those wishing to attend school increased to 93, although many had to be denied admission due to lack of space.

Only in 1898, when the school received an excellent room for study, although it was not enough to teach anyone. Therefore, classes were held in two shifts.

In 1902-1903, 313 boys and 225 girls studied at the school [68, p. 14-16].

Bender two-class village school. As of January 1, 1909, there were 443 students (322 boys and 121 girls). Compared with 1907, their number increased by 35 people.

Zhmerynka Two-Class Rural School Zhmerynka Station is located 3-4 miles from the villages of Velyka and Mala Zhmerynka. Such a school had to be opened for the children of the lower classes. The first private one-class school appeared in Zhmerynka in the early 1980s. It was maintained at the expense of tuition fees and a subsidy issued by the South-Western Railway Company in the amount of 600 rubles.

On August 30, 1890, the Society of South-Western Railways opened the Zhmerynka two-class school as a two-class rural school. A stone house with 3 classrooms, a teacher's room and two apartments was specially built for this purpose.

Unfortunately, there was no space for a library, and the rooms were not very comfortable to study.

If in the first year of opening the school received 162 students, in 1895 the number of students increased to 321, which led to the invitation of another teacher.

In 1898, craft carpentry and weaving classes were opened at the school, and a telegraph school was opened.

A wonderful orchestra was created in the school, the shareholders of the local railway shop donate 400-600 rubles a year, and 1,800 rubles were collected for musical instruments.

In addition, it should be noted that the school has a wonderful, beautiful library, equipped with textbooks. The poorest children receive free textbooks. In 1902-1903, 387 boys and 159 girls studied at the Zhmerynka School [68, p. 24].

Odessa two-class rural school. The school was opened on March 5, 1893 on the initiative of the former head of the school department of the South-Western Railways A. Krause. This school was located at the Odesa-Tovarnaya station, that is, in the area where only railway workers lived. At that time there were only two schools in Odessa itself, so it was difficult for railway children to enter and study there. In the first year, 2 groups of 98 students (83 boys and 15 girls) were opened.

In 1896 the number of students increased to 290, so we had to open a parallel department and hire another teacher. There were not enough classrooms, so the students had to study in the second shift, in the afternoon. Classes ended at 5 pm, it was difficult for both students and teachers.

Some students used the dormitory of the technical railway school, but there were not many of them (22 out of 290 students) [68, p. 24-25].

The Goltyansk two-class village school was opened in 1892 at private expense and withheld tuition fees. When the number of students increased to 25, the Road Administration decided to issue a subsidy of 450 rubles. per year.

In 1897 this school existed as a one-class school, but in 1898 it was reorganized into a two-class village school. For 1902-1903 n.r. 82 boys and 53 girls studied in it [70, p. 41-42].

Volochysk single-class folk school began operating in 1893. It was funded by tuition fees and voluntary donations from local officials. In 1902-1903, 16 boys and 19 girls studied there.

Khrystynivka One-Class Folk School was founded at Khrystynivka Station in 1896. The road board gave him a small classroom, and officials agreed to keep it at their own expense. In 1902-1903, 16 boys and 39 girls studied there [68, p. 27].

Bobryn two-class village school began to work and teach children as a primary school, which was funded by the board of Fastiv Railway. In 1897 it became known as the South-Western Railways. From the second half of 1899 this school was reorganized as a two-class village.

In 1902-1903, 168 boys and 97 girls studied there.

It should be noted that students who complete a full course of study are not always satisfied with the knowledge gained. Therefore, they enter technical railway schools or other educational institutions.

According to statistics, the main contingent of students in schools are children and relatives of railway employees. Other children are admitted to schools only if there are vacancies with the permission of the railway chief.

Unfortunately, not all children of employees and workers have the opportunity to attend these schools due to overcrowding. As early as 1887, rules were adopted according to which the children of railway workers who were injured in the service were admitted to schools in the first place.

As we can see from the analysis of the activities of railway schools and colleges, the program of teaching basic subjects includes ancillary ones, such as: metalwork, carpentry, turning, knowledge of which will help graduates to enter the technical railway school. The boys of the senior groups with great pleasure are engaged in mastering various kinds of crafts. However, handicrafts are taught only in 7 schools: Kyiv, Birzul, Bobryn, Zhmeryn, Zdolbuniv, Starosel, Kryzhopil [68, p. 38].

Sewing, needlework, embroidery and knitting items have been specially introduced for girls in schools, which will be most useful for their future family life. Therefore, experienced seamstresses were specially invited to teach these subjects in

schools. Girls study with great pleasure. At the end of the school year, products made by their hands are sold. So, they already have their own earnings.

No less important in schools are the subjects related to aesthetic education: teaching music and singing, which students enjoy doing. Many schools have their own student orchestras: Kozyatyn, Zdolbuniv, Zhmeryn and others. In schools, children are engaged in choral singing, having great fun. Often student choirs perform in nearby churches on holidays and Sundays [68, p. 40].

All schools have libraries, which are replenished annually with new books that help to gain additional knowledge and broaden the horizons of students.

In 1906, the "Rules on Committees and Local Trustees for the Management of Educational Institutions on State Railways" were published, approved by the Minister of Railways on January 13, 1906 on the South-Western Railways. N. Anichkiv was appointed head of the school department [69, p. 1-2].

An important measure to support parents whose children study in secondary schools was the issuance of assistance to employees in the amount of 780 rubles. from the Committee [70, p. 6].

It should be noted that the following educational and charitable organizations operated on the South-Western Railways:

1. 35 schools and 15 dormitories at them

2. Dormitories at technical schools: Kyiv, Odessa, Bender

3. Boarding house for children of employees studying in secondary schools of Kyiv.

4. Orphanage for employees in Kyiv and preparatory school.

5. Organization of mutual assistance to needy children and relatives of employees on the South-Western Railways

6. Class of evening classes with workers at the Kyiv Railway School

7. Sunday readings in Kyiv, Odessa and other major stations

8. Evening special courses for employees of the Office

9. Technical library for employees of the Office

10. Joint library for employees of the Office

11. Libraries at large stations.

The above institutions acted independently [70, p. 9].

It is also necessary to note the difficulties faced by schools. Particularly unsatisfactory conditions in schools that are open at the following stations:

1. Kozyatin. The school is designed for 300 people and has 6 classrooms. During the reporting period, 732 people study there, so 2 additional private premises were rented, 6 groups were forced to practice in the afternoon.

2. Zhmerinka. The school has 9 classrooms for 400 people, 703 students, 6 groups are forced to study in the afternoon.

3. Korsun. The school has 3 classrooms. 4 groups are forced to practice in the summer rotunda, in the auditorium, on the stage [69, p. 22-23].

4. Be brave. The school is located in a private house (payment 1100 rubles), 7 study rooms, 302 students in the school. Although many want to enter this school, the management had to refuse due to lack of educational facilities.

5. Odessa. The school is located in the dormitory of the technical school, 5 classrooms should accommodate 9 groups, so 4 groups are engaged in the afternoon.

6. Golta. The school is located in the premises of the technical school, there are only 4 rooms, and groups - 6, that is, 2 groups are forced to study in the afternoon. It is necessary to build a new school building.

7. Khrystynivka. The house where the school is located is not suitable for children. It has 231 children, there are only 4 classrooms, so 2 are forced to study in the afternoon. Also, it is not possible to provide teachers with accommodation.

8. Separate. The school has only 4 classrooms, groups - 6, ie, 2 more, one group is engaged before lunch in the hallway, the second - in the afternoon.

Many students have a desire to continue their education after graduation, but due to lack of wealth do not have such an opportunity, among them many talented, intelligent children.

Simultaneously with technical schools and higher educational institutions, special schools were opened for the training of lower railway service personnel. On August 12, 1876, by order of the manager of the Kyiv-Baltic Railway, a decision was

made to open schools for the children of lower-ranking officials in Kyiv and Kozyatyn. Education in these schools was free, only for books students paid 25 kopecks. A two-class city school was opened in Kyiv. If in 1884 it had 108 students, then in 1902-1903. - 398 boys and girls who received special primary education. A school of the same type was opened in Zdolbuniv, where the number of children increased from 60 to 190 in 1877-1890 [71, p. 10].

In 1890 in Zhmerynka, and in 1898 in Fastiv the Society of South-Western Railways opened a two-class railway school. According to the program of these educational institutions, students studied the Law of God, mathematics, literature as in elementary school. Similar schools were opened at Art. Kivertsi (1899), at Art. Korsun (1898), at st. Limestone of the South-Western Railways. These schools were formed especially for the children of employees at the expense of the railway [72, p. 2-7].

By 1900, 31 schools had been opened on the South-Western Railways, where the children of employees were educated. Minors were taught the basics of literacy, arithmetic, and young people were prepared to work on rail transport. Similar schools were founded in Katerynoslav, Poltava, Kremenchug, Popasna and other cities [73, p. 10].

Until 1902, the South-Western Railways also practiced enrollment in evening courses without exams. For two years, students studied history, Russian literature, business, geography, accounting in the railway, railway law, mathematics, statistics, mechanics and other subjects, of which at the end of the exams [74, p. 14].

At the same time, drivers and their assistants were trained at railway workshops. To become a locomotive driver or his assistant, workers passed special exams. At the same time, technical libraries were established on the railways, which enabled workers to follow the new technical achievements in the railway business. The use of such a library for railway employees was free [75, p. 108].

Conclusions

Summing up, it should be noted that in the late nineteenth century – at the beginning of the XX century. A large number of educational institutions were formed, starting from the Kyiv Polytechnic Institute, technical railway schools and schools, as well as evening courses, training at railway workshops, classes in libraries, for training and retraining of the railway network in Ukraine.

We give a special role to scientists and railway workers. All of them made a lot of efforts to improve the work of railway transport and laid the foundations of the technical and economic potential that belongs to the Ukrainian state today. Their organizational talent, scientific and technical knowledge and dedication are a model for all subsequent generations of railroad workers and statesmen.

It should be noted that with the rapid development of industrial production in the second half of the nineteenth century the government was faced with the need to raise the educational level of the general population, its interest in receiving vocational education, specially trained personnel.

Therefore, the creation of a system of vocational education in the Russian Empire, in particular in Ukraine in the late XIX – early XX century, was the result of a set of scientifically sound, organizationally sound measures by state and public organizations and using private initiative on the ground railways in improving the professionalism of their staff).

Since the 70s of the XIX century began to open the first technical schools at the initiative of the Railway Board.

Simultaneously with technical schools and higher educational institutions (Kyiv Polytechnic Institute, which provided a large constellation of engineering professionals working on the railways), special schools were opened to train lower-level railway staff.

Analyzing the statistics, we conclude that many children could not even get a secondary education due to the small number of schools in cities and towns, at railway stations, and to hire a private teacher. Only senior employees, who received higher

salaries and hired teachers for their children, could afford it. Therefore, many stations tried to create small schools at the expense of employees and workers. In the early 70's of the XIX century. A private school for the education of children of lower-ranking officials was opened at the Zdolbunove station of the Kyiv-Brest Railway, where not only the children of this station studied.

In the mid-1970s, it was decided to open such schools in Kyiv, Kozyatyn, and Zhmerynka. The Rules for the Establishment of Such Schools stated that education should be free. Accordingly, the curriculum studied the Law of God, Russian language, arithmetic, Russian history, geography, art, singing, gymnastics.

Analyzing the curricula, we find that in addition to the main subjects in schools and colleges taught and auxiliary: for boys - locksmith, carpentry, turning, the knowledge of which contributed to further entry into the technical railway school; sewing, needlework, embroidery and knitting items have been introduced for girls, which may be most useful for their future family life.

Subjects related to aesthetic education play an important role in schools: music, singing.

It should be noted that the following educational and charitable organizations functioned on the South-Western Railways: 35 schools and 15 dormitories at them; boarding house for children of employees studying in secondary schools of Kyiv; orphanage for employees in Kyiv and preparatory school; organization of mutual assistance to needy children and relatives of employees on the South-Western Railways; class of evening classes with workers at the Kyiv Railway School; Sunday readings in

Kyiv, Odessa and other large stations; evening special courses for employees of the Office; technical library for employees of the Office; libraries at large stations.

All schools have libraries, which are replenished annually with new books that help to gain additional knowledge and broaden the horizons of students.

It should be noted that in all schools accepted only children of railwaymen. Up to 60% of those wishing to study were denied admission to the school almost every year.

It is also necessary to note unsatisfactory conditions in schools: the premises are not adapted for normal classes: low ceilings, poor lighting; classes were held in two shifts.

Dormitories were part of the railway schools because many employees did not have their own housing and were forced to live in small stations and races.

But in general it is necessary to note the high level of professionalism of staff on the Ukrainian railways.

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