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## Features of Training Professional Personnel for the Mining Industry in Russia in the first half of the 19th century

I.V. Voloshinova <sup>a, \*</sup>, V.G. Afanas'ev <sup>a</sup>, A.B. Tesla <sup>a</sup>

<sup>a</sup>National Mineral Resources University (Mining University), Saint-Petersburg, Russian Federation

<sup>b</sup>Peter the Great Saint Petersburg Polytechnic University, Saint-Petersburg, Russian Federation

### Abstract

In this article, the features of training personnel for the mining industry in Russia in the first half of the 19th century are discussed. The ambiguous policy of the government in the development and improvement of mining education was closely related to the situation in the mining industry, in particular with the crisis in ferrous metallurgy in the first two decades of the 19th century, due to a sharp reduction in metal imports, taxes and wars. Feudal Russia lagged behind European countries, where a large machine industry drove the rapid development of metallurgy. The situation was also reflected in the "Mining regulations" introduced in 1806, which became the main regulatory document for the country's mining industry. The special section on education, which required mining chiefs to establish mining schools at factories, changed over the course of three years and schools were abolished. The subsequent increase in metal production, higher prices for products, and the government's patronizing policy led to a shortage of mining personnel. The urgent need for miners required the government to expand opportunities for entering the profession of mining engineers. Not only the Saint Petersburg Mining Institute and corresponding schools and colleges, but also educational institutions that had suitable existing laboratory facilities were involved in the process of training professional mining engineers. These other institutions were the Institute of Technology, the School of Land Surveyors and the Mint of St. Petersburg. Economic and political changes in the country caused the development of mining education to continue for several decades.

**Keywords:** professional personnel, mining industry, Mint, School of Land Surveyors, Resource Estimation School.

### 1. Introduction

Despite various crises, throughout the 19th century Russia continued to actively develop its mining industry. It was essential to organize a training system for mining and expand it significantly to facilitate the productive use of the fossil resources of the regions. Studying the processes governing the organization and functioning of mining technical educational institutions in Russia in the 19th century seems to be an urgent issue, since decisions about the training of professional personnel for the mining industry involved not only the establishment of mining schools, but also the repurposing of existing technical educational institutions that had the necessary laboratory facilities. When designing the educational process, the example of Western European mining schools was taken into account and creatively applied.

### 2. Materials and methods

This article is based on a comprehensive analysis of archival sources containing information on various aspects of the history of the formation of the Russian mining industry in the first half of the 19th century. Archival

\* Corresponding author

E-mail addresses: [Voloshinova\\_IV@pers.spmi.ru](mailto:Voloshinova_IV@pers.spmi.ru) (I.V. Voloshinova),

[Afanashev\\_V.G.@pers.spmi.ru](mailto:Afanashev_V.G.@pers.spmi.ru) (V.G. Afanas'ev), [antes@list.ru](mailto:antes@list.ru) (A.B. Tesla)

documents of the Russian state historical archive in Saint Petersburg (RGIA) Foundation No. 37 "Mining Department" and 44 Fund "Headquarters of the corps of mining engineers" are used as sources. The headquarters established in 1834 on the basis of the Regulations on Corps of Mining Engineers, was, in addition to the management of mining, coinage and salt production, in charge of training and parts of the Mining Department: namely, the Mining Institute, which was organized on the model of private military schools; the Mining Technical School at the St. Petersburg Practical Technological Institute; and the Medal Department at the Mint and Assay School. Data from the aforementioned documents indicate the size and social composition of the student body and provide rich detail on the resolutions published in the Complete Collection of Laws of the Russian Empire that cover issues relating to the training of personnel for the mining industry.

The paper also uses historical and comparative methods to study the process at work in the development of the system for training mining specialists. The dynamics of this process are considered both in direct connection with the historical context in which it took place, and in its qualitative change at various stages of its development. One of the main methodological principles of the study, namely the principle of historicism, necessitated the study of the problems of mining establishments, taking into account the specific historical conditions of that time. In this study, a chronological approach, determined by the multi-aspect nature of the topic, is used.

### 3. Discussion

Domestic historiography of the history of educational institutions that trained professional personnel for the mining industry began several decades after they came into existence (Herman, 1810; Loransky, 1873). The accumulation of data about these institutions proceeded through the publication of a number of important documents in works on mining and industry, often covering the activities of V.N. Tatishchev (Popov, 1861; Lebedev, 1875; Chupin, 1887 and etc.).

Among the publications of Soviet researchers on the history of primary and secondary education in the Russian Empire, the work of N.V. Nechaev (Nechaev, 1956) in which mining schools are named the first vocational educational institutions is the most significant for our topic. A number of studies on the role of V.N. Tatishchev in the organization of mining schools reflect the government's industrial policy on the regulation of business activities (Budrin, 1948; Pavlenko, 1951; Safronova, 1975; Yukht, 1976). Various aspects of the educational activities of mining schools and specialized schools are reflected in a number of major works (Kozlov, 1955; Penzin, 1983, etc.).

In the 1990s, topics covered in research on the history of education were expanding, with researchers showing particular interest in regional educational institutions (Chernoukhov, 2001; Kallistratova, 1997; Shkerin, 1996, etc.).

Contemporary Russian historiography is also widely represented by works specializing in the history of pedagogy and its problems; specialized education; and the creation of schools, vocational schools and universities. A number of studies are devoted to the role of V.N. Tatishchev and other mining engineers who left an important mark in the history of the country (Safronova, 2004). In the historiography of education, new topics of interest have appeared: for example, the various approaches to the training of engineers; the psychological and legal features of obtaining a profession (Egorova, 2009; Grigoriev, 2011; Vakhnin, 2019; Rudenko, 2019; Sharok, 2018; Pakholkova, 2020); the educational system viewed as a service sector (Vakhnin et al., 2020; Elmurzaev et al., 2020); and various other approaches. All this emphasizes the relevance of studying this topic.

### 4. Results

Throughout the 18th century, a system of new educational institutions of all levels, focused on the needs of the mining industry, was being formed. The first mining schools were opened in the 1720s in Kungur, Uktus and Yekaterinburg. In 1763, 308 people studied in Yekaterinburg mining school (Pyatnitsky 1948: 26). In Ural and Siberian state-owned factories, a system was created defining four types of school: primary, arithmetic, German and Latin (in Yekaterinburg). For the arithmetic school, V.N. Tatishchev developed the first program in the history of Russia in which professional education was added to general education at school: practical training began, the inclinations and physical capabilities of children were taken into account when choosing crafts, the students were paid for their work and the best students were assigned to vacancies. This practice continued for a short time, until, at the beginning of the 1740s, the transfer of state-owned factories to private hands began. The new owners were not obliged to maintain the schools and their number began to decline. According to Safronova's data, by the mid-1740s only twelve schools remained in the Urals, and by 1750 their number had decreased to seven (Afanasyev, 2012: 52).

The metallurgical industry of the Urals experienced a rapid rise in the second half of the 18th century: up to 80 factories appeared there in 1750–770, and the improvement in quality, primarily of metal, depended on the availability of trained workers (Yurkovsky, 1972: 15). The number of graduates was clearly not enough. However, the officials of the Berg-Collegium preferred to rely not on the training of workers in specialist schools, but rather on-the-job training of younger workers to gain the experience and skills needed to become senior foremen. This situation affected all regions. The educational institutions of the mining industry did not have a uniform training program or a clear system for training specialists – a situation

which was also observed in other countries, for example, in Germany (Mokeyev, 2012). When a specialist mining school was opened in Barnaul in 1779, the number of subjects studied there was greater than in Yekaterinburg. This was due to the fact that the school had to accept, first of all, the children of noblemen and mining officers, who had a more thorough training compared to the bulk of the inhabitants. Initially, 20 people were admitted to the school, but by 1791 the number of students had grown to 90, since it was allowed to admit the most talented students of mining schools (Afanasyev, 2012: 53).

By the 19th century, Russia had mining schools of the lowest order, secondary technical educational institutions and higher education institutions: the first technical university was established in St. Petersburg in 1773. The formation of a system of specialized mining education in the country took decades.

In the 19th century, mining was a key area in the country's economy, and its development was supported by local and central authorities. The pace of its development was driven by the intensification of mining production and the improvement of the use of labor resources (Egorova, 2009: 4).

The reforms introduced by Alexander I in the field of education also affected the training of mining professional personnel: instead of small and main schools, factory schools, mining and district schools were established. A few years later, on July 13, 1806, Alexander I approved the draft of the Mining Regulations, which defined the relationship between the provincial administrations and the mining sector. The rights and obligations of managers of state and private mining plants were established (PSZ-I. Vol. 29. No 22208). Although the draft of the Mining Regulations was supposed to be extended as an experiment to the Ural Mining Plants for a period of only five years, it remained in effect until 1861. Changes and additions were made to it and some articles ceased to be effective, but on the whole it remained much the same and determined state policy with regard to the mining industry. Over time, the impact of the articles of the draft of the Mining Regulations spread to all factories in the mining sector, although the introduction of a unified mining legislation lasted for a rather long period.

The section of the draft of the Mining Regulations "On Mining Schools" provided for the creation of a system of mining education on the basis of continuity: primary schools were to be established at all mining plants. The best graduates were sent to the main mining schools in the factories of the mining district. The worthiest students were then given the opportunity to study at the Mining Cadet Corps in St. Petersburg. At the same time, it was noted that "the mining school in Yekaterinburg is insufficient not only for all factories in the Ural ridge, but for factories that depend on the Yekaterinburg administration alone; moreover, it does not include those subjects that need to be taught" (PSZ-I. Vol. 29. No 22208).

In the main schools, the children of the officials of the mining department were obliged to study in order to have sufficient training to enter the Mining Cadet Corps. Upon completion of their studies, graduates had to stay in St. Petersburg for a year and become acquainted with the work of the Mint, the Foundry Yard (Liteiny Dvor), Sestroretsk Armory and other enterprises of the capital, as well as to learn the techniques of stone processing and the use of mining tools. After that, they were sent for two years to mines and mining factories and as trainees, where they had to "go through the entire service order, starting from the lowest degrees, in order to actually and by their own experience acquire a clear and perfect knowledge of the responsibilities for their future subordinates and the ability to accurately instruct them and correct them" (PSZ-I. Vol. 28. No 21133).

Factory schools were opened in the factories and mines of the Urals. The Vyysk School, founded in 1806 for the children of factory employees, became widely known. The school was known by various names; Chernoukhov lists the following names that appear in sources and literature: "Vyysk Factory School, Nizhny Tagil Factory School, Vyysk School, etc." (Chernoukhov 1998: 338). In addition to general education, the school's curriculum included accounting, metallurgy, mechanics, mining and forestry. Special subjects were taught by the leading specialists of the plant, who were often educated abroad. In the case of the school in Vyysk, Kallistratova notes that it was formed under the charter of 1828 and consisted of three classes. The training lasted six years. The school had three officials and teachers and five supernumerary employees. A preparatory class was established at the school with one teacher. One document described by Kallistratova notes that in the coming year (1840) at the factory school there were 66 students, with an additional 23 in the preparatory class. Of these, three were children of the clergy, one the child of a merchant, and 85 were children of serfs. Kallistratova points out that the "formulary lists of employees at the Nizhniy Tagil factories for 1847" include not only information about the positions held by servants of all ranks and assessments of their abilities, diligence and behavior, but also a column entitled "Where I studied". Particularly common is the entry: "Vyysk School", often supplemented by the label "Abroad", "in Sweden" or "in England" (Kallistratova, 1997: 16).

Later, the section of the regulations "About mining schools" was changed. On October 6, 1809, a decree "On the abolition of the main mining schools belonging to the factories of the Ural ridge" was issued (PSZ-II. Vol. 30. No. 23894), which specified that the students of these schools should instead be trained at the Mining Cadet Corps in St. Petersburg, adding to the previous number of pupils appointed by the staff with another 50 people from the children of officials serving at the plants of the Ural ridge, trained in small schools belonging to those factories. Thus, the children of non-officials could not receive mining education, and this development in the mining education system lasted for many years. In the main schools there was not a single graduation, while at many factories, schools did not even open (Shkerin, 1996: 56-62).

By the early 1820s, it was clear that the mining industry was in a state of crisis, and further steps were taken to create a more effective system of education for mining specialists. In 1825, the Director of the Department of Mining and Salt Affairs, E.V. Karneev, submitted a proposal to transform the system for training mining specialists to the Minister of Finance E.F. Kankrin. The project envisaged the creation of schools with a three-year term of study at all state-owned factories and some salt boards. Students from the nearest private factories could be admitted to these schools for free, but the owner of the factory must undertake to provide them with food, clothing and housing (RGIA. F. 37. Op. 2. D. 24 L. 1-6).

In the first and second grades, these schools would teach reading and writing, arithmetic, etc., and in the third year, Latin was introduced to support admission to higher educational institutions. Priests of parish churches and mining officers serving at the plant were involved in teaching. The schools were intended not only for the children of artisans and factory workers, but also for officials, with the difference that the children of artisans and factory workers could only study the two primary grades, while the children of officials, after completing the full course, were obliged to enter schools of a higher level (RGIA. F. 37. Op. 2. D. 24. L. 11-13).

Such schools, along with mining sixth-form colleges, were to be established in some mining districts. The latter, with a four-year course of study, would be similar to provincial sixth-form colleges, but teaching disciplines relevant to mining. In mining sixth-form colleges, both mining officers and people who did not work in the mining sector, but who had higher education, could teach. It was assumed that only children who successfully passed the exam in factory schools could be admitted to these educational institutions. As for the contingent of students, any children of officials or people of a free state "who showed excellent success in factory schools and [gave] undoubted hope for their further ability to study" could become students at the discretion of the local authorities (RGIA. F. 37. Op. 2. D. 24. ll. 5-15v.). The factory schools were controlled by the directors of the mining sixth-form colleges, and their funding came from the mining directors. The staff of factory schools, mining sixth-form colleges and the Mining Cadet Corps was determined by a special committee. The proposal also included prospective training courses and programs.

This project received the support of the Minister of Finance, and was transferred for implementation to the Committee under the leadership of the man who proposed it: Director of the Department of Mining and Salt Affairs, E.V. Karneev. The organizers decided to start with appointing staff and drawing up curricula for the Mining Cadet Corps, in order to further coordinate its activities with the courses offered in the mining sixth-form colleges and ensure continuity of education. For a number of reasons, the draft of the charter of the Corps was not submitted to the Minister of Finance for consideration until May 1829.

By that time, the new charter governing educational institutions was already in force, and a special mining department was opened at the Technological Institute in St. Petersburg. In the early 1830s, the mining department was reorganized on a new basis and the need for further work from the Committee disappeared. At this point, all of its office work was transferred to the archive.

The practice of training directly in production was preserved. So, according to the regulation of the Committee of Ministers of January 23, 1826, under the Moscow Mining Board, five students of assaying could be retained from among those dismissed from the merchant, bourgeois and other societies. They were each to be provided with an apartment and firewood on the premises of the Mining Board, and assigned an annual salary of 100 rubles until graduation, at which point they could apply for vacancies as assay specialists in the city (PSZ-II. Vol. 1. No. 82). This stipulation tackled the fact that assay tents established in cities for testing and branding gold and silver items often became inactive in the event of death or removal from office of assayers, due to a lack of qualified personnel to replace them.

The government realized there was a need to expand the network of specialist educational institutions, so in 1828 the St. Petersburg Technological Institute was opened, and on March 23, 1832, the rules for admitting boarders and half-boarders were approved (PSZ-II. Vol. 7. No. 5245). These rules allowed the government offices in charge of manufacturing and factories to send their people to the institute as boarders. The institute was allowed to accept up to 16 students from state-owned mining plants, selected from among the most educated children of unter-shichtmasters. Applicants had to be at least 13 years old and were trained at the factory's expense. From each cohort, four students were selected and sent, after graduation, to continue their studies at the School of Navigation in order to acquire skills in steamship control. Graduates of the institute were obliged to serve at state-owned mining plants or on steamers for 12 years, receiving a salary of at least 600 rubles a year. After the expiration of this period of service, and if their record was unblemished, they could be awarded a rank equal to that of non-commissioned officer, and their compulsory service would be extended for another six years. After completing this second term, they could leave the service or remain in the mining department "by voluntary agreement." Those who did not receive a rank after 12 years could leave the service at that point, and both they and their children would receive the rights granted to state students of this educational institution. In this case, if they graduated from an educational institution "with perfect success, with good behavior" and with the rank of "learned masters", they were exempted from recruitment and corporal punishment, unless specified in a court sentence, and did not have to pay poll tax. They were allowed to work without registration in a shop, and were not obliged to enroll in the "trade categories, if they themselves did not start a bargain or factory." Those students who had demonstrated good behavior but were not successfully enough at their studies returned to the communities

from which they came with the rank of master. Children of the foreign Zlatoust gunsmiths could also be enrolled among the institute's boarders. Those who studied at the expense of factories were obliged to spend 12 years working in the mining sector, while the rest enjoyed the rights of state students.

In 1832, the Director of the schools of Perm province, V.I. Antropov, proposed creating an additional mining course at the district school in Yekaterinburg. He presented the Minister of Public Education with a draft of a two-year course which included the study of commercial sciences, accounting, mineralogy and geognosy. In the autumn of 1835, classes began for this additional course (Korotkov, 1913: 70-71).

In July 1832, the School of Land Surveyors was opened within the Forestry Institute. This school also accepted the children of non-shichtmasters of state mining plants, and graduates were obliged to serve under the Ministry of Finance for 12 years, receiving a salary of 300 to 600 rubles per year as well as additional government maintenance (PSZ-II. Vol. 7. No 5486).

On February 7, 1833, the Committee of Ministers issued its highest approval to provisions "On the establishment of a school at the St. Petersburg Mint for preparing children of lower ranks for the technical aspects of this art" (PSZ-II. Vol. 8. No. 5961). The school was opened "only for experience" and for the first time up to 30 children of the lower ranks of the Mint were to be admitted to it. The St. Petersburg Mint was run by mining engineers who held the position of Mintzmeister: one who controls the minting of coins. The Minzmeister was personally responsible for the quality of coins, their weight, and the conformity of the precious metals used (Bazhin et al., 2018: 132).

On January 1, 1834, Emperor Nicholas I approved the "Regulations on the Corps of Mining Engineers", which was established "to manage the administrative and artificial aspects of mining, coinage and salt production" (PSZ-II. Vol. 9. No. 6685). Under the "Regulations on CME", a Mining Technical School was created at the Practical Technological Institute in St. Petersburg. The purpose of this school was to train mechanics "to build all kinds of mining machines." Its students received the same theoretical teaching as the Institute's other students, but with emphasis on the study of mechanics. Practical classes were provided only for those subjects that related to hydraulic devices, metal and wooden machinery. Senior students were taught courses in mining sciences, mining machinery, water devices, mining buildings, smelting and underground industries, as well as short courses in architecture and foreign languages.

Children of non-commissioned staff and foremen of mining plants, as well as children of mining officers who served exclusively in the mining department but were not born into the nobility, were assigned to the Mining Technical School. Students of the Institute who had already studied there at their factory's expense were, from 1832, transferred to the number of the first students. The school would fill further over the next several years.

Although the school was a structural part of the Institute of Technology, it was run under the close supervision of its commanding staff, headed by the captain of mining engineers. The school consisted of four sergeant-majors, or overseers, selected from among retired guards non-commissioned officers, and 60 students, who were divided into 6 departments of 9 people each. Students were maintained on the same grounds as the graduates of the Technological Institute; upon graduation, they could enjoy all the rights of the graduates of the institute, without losing those that they had from birth.

Graduates of the Mining Technical School were graded first or second class. The former could, after serving the legally required number of years of service, rise to the rank of officer and be promoted to the officer class rank, and if they successfully passed a mining sciences exam, they could attain the title of mining engineer. For those graduating with a second-class grade, this path was longer. If their training had been at the expense of a factory or mine, graduates were obliged to return to the organization that funded them, but they were to be used "only in the mining part itself." Before being assigned government posts, they were provided, in addition to an apartment and wood for heating, with a salary: first class graduates received 600 rubles, and those who graduated second class received 400 rubles per year. 38,000 rubles were allocated for the maintenance of the School, which came out of the total budget allocated for the maintenance of all factories. Under the additional statutes approved on March 19, 1837, the number of students was increased by 30 (RGIA. F. 44. Op. 2. D. 1455. L. 3).

In 1839, a medal department was attached to the School. It was transferred from the St. Petersburg Mint, where, in turn, a special status preparatory school was organized which, by 1841, had 40 students (RGIA. F. 44. Op. 2. D. 1189. L. 6). The statutes of the Mining Technical School, approved on April 14, 1842, again increased the number of students in the school, to meet the needs of the St. Petersburg–Moscow railway; another 30 funded places to study mechanics were added by Imperial order (RGIA. F. 44. Op. 2. D. 1451. L. 3).

With the publication of new statutes on the Ural Mining Plants in 1847, the number of mining roles generally decreased, and the output of the school turned out to be greater than the actual need of mines. Therefore, according to the report of the Minister of Finance on July 4, 1847, in 1837 the number of staff at the school was changed and the number of students was reduced to 60 (RGIA. F. 44. Op. 2. D. 1455. L. 3-4).

According to a brief review of the actions of the headquarters from 1834 to 1841, presented by the Chief of Staff of the Mining Engineers Corps, K.V. Chevkin, to the Chief Commander of the Corps, Duke Maximilian of Leuchtenberg and Minister of Finance E.F. Kankrin, 11 mining conductors or mechanics who graduated from

the school after completing a six-year training course in 1841 went to serve at state-owned mining factories, while 78 students remained in the educational institution (RGIA. F. 44. Op. 2. D. 1189. L. 6).

In St. Petersburg, in April 1842, an assay school was opened (PSZ-II. Vol. 17. No. 15519). The school was run by the headquarters of the MEC. The educational institution admitted 15 children of mining officials, factory people and people "from all free states" who were at least 15 years old. In addition to the regular number of funded students, admission by self-funding applicants was also allowed for a tuition fee of 30 rubles per year. Young people who knew Russian, grammar and arithmetic were allowed to study. The full course of study lasted three years and covered the following subjects: the law of God (i.e. religion); practical exercises in office work; and short courses in physics and mineralogy, chemistry and assaying. Mining engineers could also become instructors at the school, receiving an additional salary.

At the end of the training, an exam was held, according to the results of which the full-time pupils were released as first-class or second-class assayers. All state students, upon graduation, were provided with uniforms and were obliged to serve for ten years in the mining sector. Assayers had to serve exclusively in the laboratory or assay department of factories or in assay tents. They enjoyed the same rights as mining foremen and were paid a salary of not less than 130 rubles per year for first-class assayers, and 100 rubles per year for second-class ones. In addition, if the assayer was trusted to attain a regular government position, even before receiving the officer's rank, then he received the salary of that position and enjoyed the advantages of the 14<sup>th</sup> class (the highest of the 14 government ranks).

In 1865, due to the merger of the Laboratory of the Mining Department and the Assay Tent, the Assay School was abolished (PSZ-II. Vol. 40. No. 42236) and then reopened "on a new basis" (PSZ-II. Vol. 40. No. 42235). In essence, this "new basis" was expressed in the fact that the number of state scholarship holders decreased to 10 people. Individuals of all classes, aged at least 16 years old, could apply to enter the educational institution. The full course of study lasted three years and was divided into two classes. An exam was held every year and a half. It was impossible to remain on the same course for more than 18 months without a valid reason, and at the school in general for more than three years. Those who received at least four points in their final exams (which were of average difficulty); 4 points in each of assaying, chemistry, laboratory science and jurisprudence; and at least three points in other subjects, received the title of Assayer. Assayers went on to work at state institutions and were issued salaries and living expenses by the State Treasury. The school was run by the Mining Department and was closely managed by the manager of the Department's laboratory (PSZ-II. Vol. 40. No. 42236).

Also in the same period, new staff roles were created for state-owned mines. The first to be approved were new posts for the Olonets mines in November 24, 1839: one teacher with a salary of 228 rubles in silver and two assistants from the lower mining ranks with a salary of 84 rubles were designated for the Alexander Cannon Factory. At Konchezersk Factory, allowances were made for a priest who would also be a teacher, with a salary of 150 rubles (PSZ-II. Vol. 14. No. 12920). These new employees for the Olonets mines opened a school where up to 237 children could study (RGIA. F. 44. Op. 2. D. 1189. L. 6).

By the middle of the 19<sup>th</sup> century, increasing industrial development required the expansion of the network of mining education institutions. It was also necessary to introduce new academic disciplines focused on the needs of industry. The initiator of the reorganization of mining and metallurgical education in the 1840s and 50s was the Chief Executive of the Ural factories, V.A. Glinka. He presented a proposal to the headquarters of the Corps of Mining Engineers. This draft "Charter of educational institutions of the Ural mining plants" proposed the creation of a three-tier system: small mining schools, sixth-form colleges and district (main) mining schools. The Minister of Finance proposed creating a "practical" department for training lower ranks in the technical aspects of mining at the future Yekaterinburg District School (Shkerin, 1996: 184-194).

The State Council, established by Nicholas I on May 11, 1847, set out its vision of mining education. "For the dissemination of useful knowledge among factory workers, especially those related to mining, the following educational institutions are [to be] established: 1) initial factory schools in each factory village; 2) district schools in each factory district; and 3) the Ural Mining School in Yekaterinburg for all Ural Mining Plants" (Voloshinova, 2013: 46).

The new structure of educational institutions was recorded in the states of state-owned factories of the Urals in 1847: six district schools were added to 28 factory schools, in accordance with to the number of state-owned mining districts. (PSZ-II. Vol. 22. No. 21203). Local factory school education took two years. Training in the junior grade was conducted according to the Lancaster (peer-education) system. All teaching aids and textbooks were state-owned. In addition to provisions, pupils were given a salary (Korotkov, 1913: 81-82).

The best graduates went on to the district mining school, which had a four-year program. In addition to general education subjects, students studied drawing, mechanical drawing, geography and practical exercises in writing and bookkeeping. Chernoukhov provides the following enrollment data for district schools: "At the main plant of each of the six state districts, according to the statutes of 1847, a district school was created: three for 60 students (Yekaterinburg, Zlatoust, Goroblagodatskoe) and three for 50 students (Bogoslovskoe, Perm, Votkinsk). The best students were transferred to the Ural Mining School" (Chernoukhov, 1998: 16-17).

German was also taught in the district schools. In the work of a mining engineer, there were (and are) many terms from the German language (Sischuk, 2016: 504). In fact, in March 1816, after Poland joined the Russian Empire, the Mining School in the Polish city of Kielce was headed by Jan (John) Ullmann, a German by birth. In addition, Ullmann worked as an expert at the General Directorate of the Mining Industry in Kielce. The school's budget was rather small, amounting to PLN 28,000. The first professor of the mining school in Kielce was Joseph Tomaszewsky, who also took the position of Deputy Director of the school. It was Tomaszewsky who selected other teachers for the school. Almost all of them were graduates of the Freiberg Mining Academy. By the autumn of 1816, Marcel Krolkewitz and Jan (John) Graff had been given jobs at the new mining school. Friedrich Wilhelm Lempe joined them in 1817, as did Georg Bohumil Push in 1818. As a result, the mining school in Kielce managed to attract real professionals – talented teachers and scientists (Mokeyev, 2015: 984-985). Classes at the mining school were conducted in Polish and German. Moreover, initially all lectures and other events were held exclusively in German, with the exception of classes in mineralogy and geology, which were taught by Professor Joseph Tomaszewsky. Most of the teachers were Germans, and this determined the language used for teaching subjects.

The subjects necessary for working in the mining industry were geology, geodesy, ore research and mine surveying. Graduates worked as draftsmen, caretakers, laboratory assistants and, sometimes, as masters and mine foremen (Kaimakova, 2012: 62).

The Goroblagodatsk district school was opened on May 1, 1848 at the Kushvinsky plant. In the first year, the children of government officers were accepted for training. Officials' children studied at their own expense. Two departments were created in this school. The first provided general preparatory education, but also taught drawing, acquainting students with the basics of drafting from cardboard models and originals. The second department added geometry, mechanical drawing, writing, drawing and Latin to the curriculum. The school year at district schools lasted almost 8 months, and the semesters ended with exams before the holidays. After graduating, former students were assigned to work in mining plants (Bakshaev, 2008: 139-147).

In 1851, at the suggestion of the Chief of Staff of the Corps of Mining Engineers, K.V. Chevkin, construction works on a building for the Ural Mining School commenced (Korotkov, 1913: 84). The manager of the school was a civilian official, M.S. Blinov, who wrote several scientific papers on the history of mining in Russia. The inspector of the school was a candidate of cameral sciences, N.K. Chupin, who stood out both for his knowledge of the natural sciences and his abilities in eight languages. In addition to being an inspector, he was instructed to teach geognosy and the art of mining. Metallurgy was taught by the mining engineer V.A. Grammatchikov, later Chief Head of the Ural factories. The training program included special disciplines such as mining and surveying, mineralogy, geognosy, mechanics and mechanical drawing, among others (Korotkov, 1913: 88-91). Descriptive geometry is the main discipline of engineering education. In the hierarchy of sciences, it is placed somewhere within or alongside the field of mathematics, but it also relates to architecture and mechanics, engineering and engineering graphics. This discipline is very important for future engineers, who need to develop skills in depicting the spatial arrangement geometric objects on the drawing plane (Voronina, Muratbakeev, 2017: 155).

Serious attention was also paid to disciplines such as Russian language and literature. Professor I.S. Rizhsky, who was a teacher at the Mining Cadet Corps of St Petersburg, published the textbook *Experience of Rhetoric* (1796). It considered issues of the normativity of the Russian literary language, logic and stylistics (Shchukina, 2017: 382).

Among mining schools of Russia, the Ural Mining School was distinguished by a high level of theoretical training. Practical training took place in the factories and mining plants, at the Mint and in chemical laboratories. The students were the children of low-income mining officials and artisans. All of them were state employees. Those who wanted to study in excess of the vacant places had to pay for their training. However, places reserved for the children of officials were often free, because such parents often wanted to send their children to study in St. Petersburg.

With the opening of the Ural Mining School, the system of mining and refinery education reached its logical conclusion. V.A. Glinka played a very important role in the formation of this system. As head of the Ural factories, he fought hard for his regional educational policy. To support his efforts, he had authority, perseverance, and the advantages of territorial remoteness from St. Petersburg and the trust of the Emperor (Shkerin, 1996: 56-62). In general, reforms in the field of education formed the basis for the appearance of relatively widely accessible professions that gave people the opportunity to climb the social ladder and obtain a new legal status (Bugueva, 2001).

## 5. Conclusion

By the middle of the 19th century, factory schools and district schools were established in every factory village and in all factory districts. Utilization of existing technical educational institutions that did not specialize in the mining sector but did have the necessary laboratory facilities helped solve the issue of training sufficient professional personnel for the mining industry. The government accelerated the process of training professionals for the mining industry in the first half of the 19th century and, in general, was able to resolve this issue successfully.

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