



Research article

Mining Museum as a space of science and education in Mining University

Daniil Yu. DOROFEEV¹✉, Natalya V. BOROVKOVA¹, Marina A. VASILEVA²¹Empress Catherine II Saint Petersburg Mining University, Saint Petersburg, Russia²Peter the Great Saint Petersburg Polytechnic University, Saint Petersburg, Russia

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Abstract. An interdisciplinary investigation is presented focusing on the study of the Mining Museum collections in relation to research, educational and social practices. Natural science and artistic exhibits are considered. The authors made an attempt to determine the significance of the mineralogical collection based on the criteria proposed by I.V.Pekov. For the first time, general statistics on the new minerals in the mineralogical museums of the USSR was collected in 1988; in subsequent years, such information was not published. Collection of the Mining Museum comprises mineral species received after 1988 and having the status of holotypes, neotypes, and cotypes. In anticipation of the 250th anniversary of Saint Petersburg Mining University its special contribution to the progress of science was noted; the merits of scientists were immortalized in the names of minerals stored in the Mining Museum collection. An important role of the Museum in recording and representation of achievements of the Mining University is shown. The authors present the Mining Museum as a special educational space where an objective image of the world is created shaped by the scientific and humanitarian environment. The Museum is regarded as a space for forming the professional identity, important for the successful work of future University graduates. The interior of the Mining Museum designed and created in the 1st half of the XIX century taking into account the ideas about the succession of scientists from different epochs, respect for scientific traditions of antiquity and achievements in the field of studying the world plays a significant role in this process. Images of thinkers of the antiquity in the interiors of the educational and public spaces of the XIX century made it possible to emphasize the importance of cultural correlation with ideas of the Enlightenment. Specific examples from the collection show how the Mining Museum was implementing the scientific and educational goals of the Mining University throughout its history.

Keywords: Mining Museum; Mining University; history of science; holotype; neotype; cotype; Russian scientists of the Enlightenment

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Introduction. The Age of Enlightenment is the most important stage in development of European science. The advances of natural science are especially worth noting; it used the basic principles of classical mechanics by I.Newton. H.Huygens, J.Buffon, P.Laplace, L.Euler, A.Volta, C.Linnaeus – these names point to the level that the science reached in the XVIII century. By this time, modern system of institutionalization of science had been completed, which is a necessary condition for its development and efficiency.

Development of the natural science disciplines associated with a focus on applied research presupposed an emergence and active development of not only educational institutions with a broad profile, but also more specialized institutions, in particular, mining. In 1747, the Mining School was founded in Paris, and in 1765 – the Freiburg Mining Academy (back in 1739 in Freiburg, M.V.Lomonosov studied mineralogy and metallurgy in the chemical laboratory of J.F.Henkel). In this process, Russia was in close interaction with the Western European educational experience and was even ahead of the Western countries in a number of points [1].



In a certain sense, institutionalization of natural science, technical and engineering education had a certain priority over general humanities. Thus, modernization of metallurgy and metallurgical industry by Peter I was largely caused by the need to wage the Northern War. Renovation and modernization of industrial facilities made it possible to gain victory and create a strong army and state [2]. It is not surprising that by personal decree of Peter the Great, as far back as 1719, the Berg College was founded which was responsible for organizing mining industry in Russia. After the foundation of the Academy of Sciences and St. Petersburg State University (1724), Moscow State University (1755), and the Academy of Arts (1757), specialized natural science and engineering educational institutions appeared in Russia. Considering a special need to extract and process mineral resources on the scale of the state, the decision of Catherine the Great to set up the Mining School in 1773, the first higher Russian state technical educational institution, seemed quite logical and far-sighted. Its first Director was the President of the Berg College M.F. Soimonov [3].

The Mining School was a natural creation of the Age of Enlightenment, the time when the value of specialized scientific knowledge was combined in the educational process with a broad general cultural outlook. The Mining Museum was important both for specialized professional and for general cultural education. Its unique natural science collection formed almost from the time the Mining School was founded in 1773. The Mineral Cabinet, the beginning of the modern museum, was approved by the Charter of the Mining School dated June 28, 1774 [4]. However, systematization and further scientific formation of the Museum collections began a little later, when an outstanding Russian mineralogist Professor D.I. Sokolov developed a project for reorganization of a single “museum” of the Mining Cadet Corps according to the latest principles of science of that period. The results of the most important scientific research were transferred to the museum for storage – geological collections of the Imperial Mineralogical Society acquired during the research for compilation of the first geological map of the Russian Empire under the leadership of Academician N.I. Koksharov. As far back as the beginning of the XX century this collection was one of the largest in the world [5]. Over the years, the mineralogical collection only grew (largely thanks to active geological expeditions in Soviet times). Now, this is one of the oldest mineralogical museum collections [6]. Items and collections of not only leading professors at the Mining University (N.I. Koksharov, E.S. Fedorov, I.A. Time, P.V. Eremeev, M.P. Rusakov, S.S. Smirnov, etc.) and of prominent world-famous scholars (D.I. Mendeleev) are kept here, but also of famous statesmen (Minister of the Russian Empire L.A. Perovsky, President of the Imperial Mineralogical Society N.M. Leuchtenbergsky). The richest diverse collection formed over 250 years is important for training skilled professionals in mining, geology and engineering in Russia. Of great interest are the front halls of the Museum, where the architectural and decorative space is naturally associated with a very interesting collection of portrait sculptures of the thinkers of antiquity and the Russian thinkers and scientists and the collections of minerals, rocks, and mechanical articles. Thus, a visual and artistic synthesis of science and art is created, which actively participates in the educational process thanks to an aesthetic image that visualizes an outstanding progress in the history of science. During its existence, the Mining Museum turned into a treasury where the unique scientific heritage of Russia is stored.

Methods. Study of the role of the Mining Museum in the history of science can be accomplished along several methodological trends. Let discuss those of them that currently seem most important.

The first trend is to disclose the definition of relevance and scientific value of the mineralogical collection of the Mining Museum for modern scientists as well as to assess the contribution to the progress of science by the scientists of the Mining University whose names are forever immortalized in the names of minerals. This is a direct indication of the importance of the Museum for the development, institutionalization, popularization, historical and cultural, and social legitimization of science and scientific knowledge. The history of collection of each scientific museum reflects the



progress of knowledge in a certain area, but in case of the Mining Museum, this is especially evident, since it concerns closer, and, therefore, faster interaction and transfer of scientific achievements from the laboratory workbenches to the museum showcases.

The second research trend is to consider the museum space as a means of presenting the scientific achievements of scientists. The Museum is not just rooms with stands and cabinets with exhibits, it is a space organized and decorated in accordance with a certain logic and order, the purpose of which is to represent the significance and value of the collection as fully and expressively as possible.

The third trend considers the University and the Museum as special cultural spaces that give insight into the world and science, knowledge and law, value and beauty. Striving for the maximum scientificity and objectivity, the Museum and the University are an integral part of a certain cultural, social and political situation, which always needs to be known and taken into account. After all, mineral resources in the XXI century are no longer so much the natural as the geopolitical, social, and economic potential, the efficient management of which is the most important state task [7]. It is important to consider the Mining Museum as a single space in which the collection and the interiors, the logic of the exhibition and the work of the curators create a representation of the current picture of not only specific scientific ideas, but also views on science in general, its place in the society and culture as well as its aesthetic visualization. Special attention is paid to the Museum interiors, the symbolic significance of its decorations, in particular, sculptural images of thinkers of antiquity.

Modern scientific methodology (analytical, comparative, historical scientific, textual, hermeneutical) is used to study these prospects which allows revealing the unique value of the Mining University in the history of the Russian and European science and culture in general through reference to the collections of the Mining Museum.

Discussion of results. Importance of the Mining University for the national science is illustrated by exhibits of the Mining Museum. Its collections are diverse and comprise fauna, models and prototypes of mining equipment of the XVIII-XX centuries, items of decorative and applied art. But we will focus on the mineralogical collection. Back in the first half of the XIX century the names of lecturers and graduates of the Mining Institute were assigned to the newly discovered minerals (hesite, 1830; chevkinite, 1839; samarskite, 1847). The names of 57 employees of the University and the Museum immortalized in the names of mineral species are a fact of recognition of their merits in the progress of science. In accordance with classification of the International Mineralogical Association (IMA), 62 mineral species have been registered to date (including karpinskite – debatable, varieties of mineral species and pseudomorphosis – mushketovite) named in honour of the experts, graduates and lecturers at the Saint Petersburg Mining University. Eleven of them are permanently displayed in the main thematic exhibition of the Mining Museum (Table 1).

Table 1

**Minerals named after graduates, personnel and experts
of Empress Catherine II Saint Petersburg Mining University***

Name	Brief characteristic	Exploration maturity
Betekhtinite A.G.Betekhtin – Professor, mineralogist	Complex sulphide of copper, lead and iron – a mineral of rhombic crystal system. Forms thin needles and granular aggregates. Colour black, brownish-black, metallic lustre, hardness 3-3.5. Opaque. Medium cleavage. Occurs in association with bornite, chalcocite, chalcopyrite, galena, native silver, celestite, anhydrite, and calcite.	First discovered in 1955 in veinlets cutting copper slates of Mansfeld (Germany). Described in 1955 by Arno Schüller, Erika Wohlmann, the second discovery of betekhtinite – at the Dzhezkazgan deposit (Kazakhstan).

* When compiling Table 1, materials collected by G.N.Bogdanova, E.S.Svirina, N.N.Devnina and N.V.Borovkova during preparation of the exhibition at the Mining Museum were used.



Table 1 continued

Name	Brief characteristic	Exploration maturity
Vysotskite N.K.Vysotsky – geologist	Palladium and nickel sulphide – a mineral of tetragonal crystal system. Commonly represented by tiny irregularly shaped secretions or isolated fine needle-shaped crystals. Silver colour, strong metallic lustre. Hardness 1.5. Opaque. Imperfect cleavage. Found in chalcopyrite-millerite ores of the Norilsk-I Cu-Ni deposit, in effusive andesitic diabases in association with Ni-pyrite, millerite, chalcopyrite, linneite.	The mineral was discovered at the Norilsk deposit in 1949. Described by A.D.Genkin and O.E.Zvyagintsev in 1962. The second mineral discovered using microprobe analysis.
Hessite G.I.Hess – Professor, chemist, the first one to study the mineral	Silver telluride – a mineral of monoclinic crystal system. Crystals of isometric habit, pseudocubic, rare and with a predominantly distorted habit, usually fine-grained dense aggregates. Colour lead-grey, steel-grey, metallic lustre, hardness 2-3. Opaque. Imperfect cleavage. Malleable, can be cut with a knife. Occurring in medium- and low-temperature hydrothermal deposits: in quartz Au-Ag veins, polymetallic and pyrite deposits with calaverite, sylvanite, altaite, petzite, empressite, ricardite, native gold, tellurium, pyrite, galena, chalcopyrite.	The mineral was first described in 1830 by G.Rose as “telluric silver” from the Zavodinskoye deposit of Rudny Altai. In 1829, Rose found two large pieces of silver ore in the Barnaul Museum; after returning to Berlin, he performed a complete chemical decomposition and discovered that it was a compound of silver and tellurium.
Jeremejevit P.V.Eremeev – mineralogist, crystallographer	Aluminum borate with additional fluorine anions. Mineral of hexagonal crystal system. Crystals columnar in habit, of prismatic habitus, with rounded, irregular or jagged terminal edges. Colour is not bright or saturated. Jeremejevit can be light blue, yellowish to pale yellow-brown, or light greenish, but is often almost colourless. Imperfect cleavage. Usually, transparent. Glassy lustre. Hardness 7.5. Forming in granite pegmatites. Associated with albite, garnets, topaz, tourmaline, apatite, zircon, fluorite, topaz, lepidolite, gambergite, beryl and other minerals.	The mineral was discovered by Yu.I.Eichwald on Mount Soktuy (Northern spur of the Adun-Chilon Ridge, Eastern Transbaikalia), initially mistakenly taken by P.V.Eremeev for beryl, but later sent for investigation to A.E. Artsruni and then studied by M.Webski and O.Damour. First mentioned in publication in 1868, composition published in 1883 by O.Damour, mineral was described in 1883 by M.Webski.
Kotulskite V.K.Kotulsky – Professor, geologist	Palladium telluro-bismuthide – a mineral of hexagonal crystal system. Recorded only in polished sections as impregnations in other minerals. Colour steel-grey, metallic lustre. Hardness 4-4.5. Found in Cu-Ni deposits in vein magnetite in close association with chalcopyrite, monchaite and michenerite.	The mineral was discovered in 1947 at the Monchegorsk deposit by A.D.Genkin. Described in 1963 by A.D.Genkin, N.N.Zhuravlev, E.M.Smironova.
Samarskite V.E.Samarsky-Bykhovets – Lieutenant General, mining engineer, Chief of Staff of the Corps of Mining Engineers	Mineral from the class of oxides, tantalum niobate of rare earth elements. Monoclinic crystal system, pseudorhombic mineral. Found in crystals of columnar, sometimes tabular habit; prismatic habitus. Crystals usually imperfect, edges matte, often rounded. Grains of irregular shape, sometimes solid masses, are recorded. Colour pitch-black, velvety black, sometimes with a brownish tint. Characterized by strong resin-like lustre, on a fresh fracture, lustre is to strong glassy. Almost opaque, translucent in thin chips. Hardness 5-6. Imperfect cleavage. Highly radioactive. Metamictic. Associated with pegmatites of granite type, where it occurs in association with monazite, zircon, biotite, uraninite, tantalite, magnetite, topaz, albite, beryl and garnet. Found in syenite-pegmatite veins in association with feldspars coloured reddish-brown next to it (result of exposure to radioactive decay products), with columbite, aeschenite, corundum, garnets and other minerals.	In 1839, was described as “uranotantalum” by the mineralogist and geologist G. Rose in the material received from the mining engineer and chemist P.I.Evreinov. Determined in a detailed chemical study conducted under the guidance of chemist G.Rose. In 1879, chemist Lecoq de Boisbordant discovered a new chemical element in samarskite and named it samarium after the mineral.



End of Table 1

Name	Brief characteristic	Exploration maturity
Fedorite E.S.Fedorov – Professor, crystallographer, mineralogist, petrographer	Calcium and sodium silicate. Triclinic crystal system. Forms pseudo-hexagonal pseudotabular crystals, mica-like plates. Mineral is colourless, silvery in larger grains of pale crimson-pink colour. Glassy lustre, hardness 5. Perfect cleavage along (001). Macroscopically, white and silvery fedorite is similar to muscovite. The mineral was found in joints among fenitized sandstones. Composes veinlets in fenitized sandstones or forms scattered impregnation. Associated with narsarsukite, quartz, apophyllite.	Found among fenitized sandstones of Cape Turij on Kola Peninsula, described in 1965 by A.A.Kukharenko, M.P.Orlova, A.G.Bulakh, E.I.Nefedov and others.
Chevkinite K.V.Chevkin – Major General Chief of Staff of the Corps of Mining Engineers	Rare earth island diorthosilicate. Mineral of monoclinic crystal system. Crystals of lamellar, tabular habit; crystals usually imperfect and small, but occasionally reach impressive sizes (the largest are up to 8-10 cm). Colour black, pitch black, velvety black, deep brown. Opaque or slightly translucent at edges. Hardness 5.5. Imperfect cleavage. Radioactive to varying degrees, often metamictic. Found in mafic granites, syenites, granite and syenite pegmatites in associations with ilmenite, titanite, zircon, gadolinite, orthite, apatite, quartz, less commonly in metamorphosed dolomites at contact with granites. A rare accessory mineral of granite pegmatites.	Studied and described in 1839-1840 by mineralogist G.Rose in material from the Ilmen Mountains. The sample was provided by mining engineer K.Lisenko.
Chernykhite V.V.Chernykh – mineralogist	Barium-vanadium mica. Mineral of monoclinic crystal system. Occurs as crystals of pseudo-hexagonal habit, confused scaly and star-shaped aggregates. Colour varies from olive green to dark green. Perfect cleavage. Lustre on cleavage planes pearly. Hardness from 2.5 to 3.5. Found in occurrence areas of vanadium-bearing coal shales; in quartz veinlets cutting interlayers of carbonate rocks, is corroded by calcite, barite and sulphides.	The mineral was discovered during the study of vanadium-bearing shales in southern Kazakhstan (Kara-Tau massif). Described in 1972 by S.G.Ankinovich, E.A.Ankinovich, I.V.Rozhdestvenskaya, V.A.Frank-Kamenetsky.
Shafranovskite I.I.Shafranovsky – Professor, crystallographer	Hydrosilicate of sodium, potassium, manganese and iron. Mineral of trigonal crystal system. Represented by dense aggregates of differently oriented isometric grains. When freshly chipped colour is olive-green, yellowish green. Strong glassy lustre. Slightly translucent in thin chips. In air, brightens, acquires a yellow colour and is covered with soda coating. Perfect cleavage along (0001). Hardness 2-3. Found in mafic pegmatite in association with villiomite, sodium phosphate, olympite, sidorenkite, phosinaite, and acicular aegirine.	Found by A.P.Khomyakov in 1978 in a pegmatite vein in deep zone of Mount Rasvumchorr (Khibiny, Kola Peninsula). Described by A.P.Khomyakov, Z.V.Vrublevskaya, B.B.Zvyagin, N.A.Matveeva, G.O.Piloyan in 1982.
Shcherbakovite D.I.Shcherbakov – Doctor of geological and mineralogical sciences, Academician of the Russian Academy of Sciences	Chain silicate. Mineral of rhombic crystal system. Occurs as long prismatic crystals, rarely intergrowth twins, aggregates in the form of fan-shaped intergrowths. Colour dark brown, reddish brown, light brown with a faint pinkish tint. Lustre glassy on edges, greasy in fracture. Opaque, semi-transparent in thin chips. Hardness 6.5. Perfect cleavage along (110), imperfect along (010) and (001). Associated with natrolite, pectolite, K-feldspars, astrophyllite, apatite, albite, galena, sphalerite, molybdenite, etc.	The mineral was discovered in a pectolite-atrolite vein in rischorrites at the mine of the Apatite Circus deposit on Mount Rasvumchorr of the Khibiny massif (Kola Peninsula). First described in 1954 by E.M.Eskova and M.E.Kazakova.



According to the IMA, the mineralogical collection of the Mining Museum is evaluated equally with the main repositories of the largest collections in Washington, Paris, and London. However, it is quite difficult to assess the true scientific value of the collection. Modern mineralogists have more than once tried to determine the criteria for classifying individual samples as “outstanding” or “unique” among fairly similar material of the same type. V.I. Stepanov identified three key features for this: aesthetics, rarity and exploration maturity or its prospects for the scientific study [8]. Professor I.V. Pekov proposed to combine such concepts as the quality of a mineralogical sample and the degree of its study into a single broad term “significance” of a mineralogical sample [9].

Of greatest value for the science are the samples from which the most important scientific discoveries were made, including the discovery and registration of new mineral species. At the end of the XIX – the first half of the XX centuries in scientific mineralogical community there was a strong opinion that most natural minerals were discovered long ago, and it is impossible to find the new ones. However, over the past fifty years their number more than doubled. The discoveries made during this period allowed the scientists to significantly change the ideas about the chemical and structural diversity of minerals. For most of modern high-quality mineralogical material, the most important criterion of significance and, therefore, value is the degree of study and reliability of the diagnostics performed.

Composition of mineral diversity is constantly changing due to discovery and recording of new mineral species. Currently, according to the IMA, 5,744 mineral names are known in the world [10], of which more than 2,240 are kept today in the systematic collection of the Mining Museum.

Approval and introduction for scientific use of the new names of mineral species is effected by the Commission on New Minerals, Nomenclature and Classification of the IMA. In 2021, a monograph by Professor V.G. Krivovichev was published presenting the information on mineral species recognized by the IMA [11]. The process of recognizing the discovery of a new mineral can take many years before the Commission approves the new mineral species. The systematic collection of minerals at the Mining Museum clearly confirms this. The significance of the mineralogical collection consists in the value of individual samples, which, in the opinion of the leading experts, should be expressed in the degree and reliability of the study. Professor I.V. Pekov identified the most important category for determining the scientific value of the natural science museum objects (minerals) – “reliably diagnosed with a high probability” [9]. First of all, these are the original samples on which the first studies were conducted after discovery of a new mineral species, as well as those on which it was possible to redefine or significantly clarify the main characteristics of the mineral under study. These criteria include holotype, neotype, cotype, original, necrotype, or fragments of each of them.

Over 300 mineral species approved in the international classification over the past fifty years are stored in the Mining Museum. Most of them occur as single items and are of great scientific value. Generalized information on the occurrence of rare and new minerals in museum collections of the USSR was published by V.I. Stepanov in 1989 [12]. Data on the presence of new minerals of later acquisitions in the Mining Museum are published in the article for the first time.

Of greatest scientific value are the samples of mineral species classified as *holotype specimens* – the only original for which the first description of a mineral species was made, or the main one isolated from several originals investigated in the study. The collection of systematic mineralogy at the Mining Museum contains the original samples donated directly by members of scientific teams and classified as holotypes. In Table 2, the names of mineral species are shown in chronological order according to the date of their arrival at the Mining Museum. Most samples were submitted before the approval of the new mineral species by the IMA New Minerals Commission.

Another important group of mineral samples of high scientific value is the *neotype specimen*. This category traditionally includes the investigated original samples, which allowed rehabilitating the mineral as an independent species after it was discredited. This should also include the original



samples, the study of which made it possible to confirm the earlier known mineral as an independent mineral species. Collections of the Mining Museum contain neotypes donated directly by the teams of authors who recorded their discovery (Table 2).

Table 2

Mineral species					
Name	Number	First arrival to the Museum	From whom	First publication [11]	Reference number
Holotypes					
Velikite	1	1987	E.M.Spiridonov	1997	MFC 2097/1
Kochkarite	2	1988	E.M.Spiridonov	1989	MFC 2038/1
Krasnovite	1	1990	S.N.Britvin	1996	MFC 2044/1
Rimkorolgit	2	1990	S.N.Britvin	1995	MFC 2035/1
Miassite	1	1997	S.N.Britvin	2001	MFC 2159/1
Polkanovite	1	1997	S.N.Britvin	1998	MFC 2158/1
Bakhchisaraitsevite	1	1998	A.N.Bogdanova	2000	MFC 2160/1
Ferronordite (Ce)	1	1998	I.V.Pekov	1998	MFC 2110/1
Neotypes					
Isolueshite	1	1995	A team of authors	1997	MFC 2095/1
Chloromenite	1	1998	A team of authors	1999	MFC 2120/1
Cotypes					
Shkatulkalite	3	1991	Yu.P.Menshov, A.P.Khomyakov, I.V.Pekov	1996	MFC 2105/1,2,3
Fluorvesuvian	1	2002	S.N.Britvin	2003	MFC 2177/1

If the study is performed on several equivalent original samples and it is not possible to distinguish the only one from which the most important results were obtained that influenced the outcome of the study, all the samples are considered equally important. This type of the original is called a *co-type specimen*. There is no doubt that these samples were used in compiling the initial description of the mineral species. Two samples of the confirmed cotypes stored in the main collection of the Mining Museum are shown in Table 2.

The process of approval and recognition by the world community of the new mineral species often requires considerable time and a large experimental base. The Mining Museum contains samples of minerals, which appeared in the Museum collection long before the final recognition of the new mineral species. In 1989, D.I.Belakovsky and V.Yu.Karpenko handed over a sample of uvite, registered under No. MFC 2114/1 (currently the Mining Museum has three samples of this mineral). This is a mineral of tourmaline group; in 2010, the IMA approved its redefinition as part of revision of the nomenclature of the entire group, and in 2020 it was finally further studied and approved by the IMA Commission [13]. The main type deposit of uvite is the Facciatoia quarry, San Piero in Campo, Campo nell'Elba, province of Livorno, Tuscany, Italy. In collections of the Mining Museum, the first sample is from the Kuhi-Lal deposit, Tajikistan, the other two are from Bahia state, Brazil.

Actual investigation of mineral substance was and is carried out including the samples from the Mining Museum. In 2022, an additional study was performed using modern methods of optical electron spectroscopy and X-ray microanalysis of sulphide ores from the Norilsk ore field [14]. Updating of the information on the Museum collections is another sign of relevance and demand



among modern scientists. Providing the results of discoveries in the form of unique images of rare new minerals means recognition of significance of one of the oldest natural science collections in Russia, the Mining Museum.

Educational significance of Antiquity in the Age of Enlightenment. The Mining Museum is unique not only due to its richest mineralogical collection. The researchers give different names to the impact of environment on people [15-17], but it is well known to everyone. When visitors come to the Museum, they perceive it as a whole: exhibits in showcases, interiors, decorative items, portrait sculptures and full figure sculptures. All this creates a specific environment – an atmosphere that emphasizes the scientific and cultural significance of the Museum and the uniqueness of its collection. In particular, ancient sculptures play a significant role in the interiors of the Mining Museum. For a modern person, their appearance there may not be entirely clear, so it should be explained based on the specific historical and cultural context of creation of the Mining Museum.

In the Age of Enlightenment, when the Mining University and the Mining Museum were founded, an appeal to Antiquity and humanities was an integral component of education including technical, engineering and mining education. In this respect, the education received at the Mining School (later the Mining Cadet Corps) complied with the high European standards. According to the Charter, there were 18 lecturers training not only in specialized and natural science disciplines, Russian, Latin and European (German and French) languages, but also general education subjects such as drawing, fencing, music, and dancing. It is worth noting the courses of logic and rhetoric taught by the famous Russian scientist and philosopher (author of the 1790 paper “Umoslovie or mental philosophy”), one of the founders of Kharkov University in 1804 and its first Rector I.S.Rizhsky [18]. All this points to a generally very high level of education at the Mining School (Cadet Corps) and in St. Petersburg in general in the XVIII – early XIX centuries. [19]. Naturally, the Antiquity held a very significant place in this educational process.

The fashion for the Antiquity and the works of antiquity (the so-called “antiques”) was largely caused by excavations in the mid-XVIII century in Pompeii and Herculaneum, which revealed the previously unknown masterpieces of plastic art to Europe. But even earlier, Peter the Great created the image of St. Petersburg in many respects precisely taking into account the ancient component of the city topography, in which Greek thinkers of antiquity were given a role, which is shown by the example of the Summer Garden [20]. The presence of ancient culture was also noticeable in educational institutions of St. Petersburg, for example, at St. Petersburg University and the Academy of Arts. Undoubtedly, formation of the antique context at Saint Petersburg Mining School (and, accordingly, the Mining Museum) was promoted by the building in neoclassical style specially constructed for it on the Neva embankment according to the design of A.I.Voronikhin in 1806-1811. Many contemporaries compared it to an ancient temple: the façade was decorated with a 12-column Doric portico and on both sides of the central staircase two symbolic sculptures made of Pudozh stone – “The Abduction of Proserpina by Pluto” and “Hercules Strangling Antaeus” (based on the sketches by the famous Russian sculptors V.I.Demut-Malinovsky and S.S.Pimenov), the frieze presents expressive bas-reliefs “Venus comes to Vulcan for the military armour of Mars” and “Apollo comes to Vulcan for the chariot made for him” (by stonemason S.Sukhanov based on the models of V.I.Demut-Malinovsky).

Science at the Mining School was closely associated with culture of antiquity. In the Age of Enlightenment, interest to such scientists of antiquity as Democritus, Theophrastus and Pliny the Elder, whom the Russian science of that time knew well, intensified. It is enough just to name the outstanding scientist of Russia, one of the founders of national mineralogy, chemistry and geology as full-value scientific disciplines – V.M.Severgin, who taught for many years at the Mining School (from 1791 to 1804) and trained a whole generation of Russian mineralogists, chemists and geologists. It was Severgin who was the first in Russia translator of the encyclopaedic work on nature by Pliny the Elder (24-79 AD) “Natural History”, more precisely, his last five books (33-37), most important for mineralogy and geology [21]. The value of this translation for the Russian natural science, especially for mineralogy and geology [22, 23], is difficult to overestimate, because thanks to it a



comprehensive dictionary of the Russian basic concepts for these sciences was compiled which allowed them to actively develop (after all, the availability of the developed terminology is one of conditions for the productive development of any science) [24-26].

It is natural to see sculptures and portrait sculptures of the thinkers of antiquity decorating the front halls of the Mining Museum. They symbolize the attention of the Mining University to world culture and to visualization and popularization of ancient and national science via great images in the history of science. The books of “Natural History” translated by Severgin discuss the visual and plastic works of ancient Greek and Roman art from the viewpoint of the material of their organic origin. The Mining Museum exhibits 20 portrait sculptures of the early XIX century representing famous scientists, thinkers, poets, mythological heroes of antiquity (Homer, Agamemnon, Socrates, Aristotle, Demosthenes, Pherecydes, Theophrastus, Apollodorus, Castor, etc.) as well as outstanding personalities of the XVIII-XIX centuries, whose images were created in the antique style (M.V.Lomonosov, F.Voltaire, V.S.Popov). Characteristically, many portrait sculptures of the thinkers of antiquity, for example Socrates, Aristotle, Theophrastus, etc., are displayed in the Mining Museum above the exhibition cabinets with minerals as if symbolizing the unity of ancient and modern science.

The Hall of Columns displays sculptures of the great scientist and philosopher Aristotle and orator and political figure Demosthenes made by St. Petersburg craftsman A.A.Anisimov in 1820 based on a model from the cabinet of casts of the Imperial Academy of Arts. In the XVIII century the Russian lovers of ancient art often ordered wax or plaster copies of ancient Roman sculptures from European collections, after which the Russian craftsmen created marble replicas or cast them in bronze or copper for their customers and patrons. In Russia this was done in the second half of the XVIII century first of all, at the foundry workshop of the Imperial Academy of Arts (on the main façade of which there are sculptures of Hercules and Flora, and the dome is decorated with Minerva, the goddess of wisdom, surrounded by three artistic geniuses), the most famous producer of such copies was F.G.Gordeev, whose experience was, probably, borrowed and studied by A.A.Anisimov. The initiator of this spread of antiques in the Russian culture was the first President of the Academy of Arts, patron of M.V.Lomonosov and educator I.I.Shuvalov. It was due to his support that the Museum of the Academy of Arts, which has the most valuable collection of casts from ancient sculptures, was founded in 1758 [27].

It is obvious that all these images in the Mining Museum were not selected randomly and arbitrarily, but according to a certain plan. For example, Aristotle is the personification of the scientist-encyclopaedist; his student Theophrastus was the actual founder of mineralogy and botany (his books “On Stones” and “On Plants” are the only ones that have come down to us), Demosthenes was the most famous ancient Greek representative of rhetoric, a course on which he taught at the Mining School Rizhsky, Homer and Apollodorus were directly associated with ancient culture and education, Voltaire was a symbol of the Age of Enlightenment and the values of reason, etc. A detailed study of this part of the Mining Museum collection should be covered by special research, and there are still many discoveries to be made (for example, related to iconography of Aristotle’s sculpture).

These images played not only a decorative role creating the cultural and aesthetic atmosphere for the space of the Mining Museum and the University, but also an educational one. The Museum, both then and today, creates a particularly intense experience of the unique historical value of scientific and artistic object for all its visitors. Materiality of a mineralogical or sculptural specimen gives an almost somatic feeling of direct presence and contact with the history of science, art, and even country. The history of the Mining Museum, being an important page in the Russian culture and science, is inseparable from the history of Saint Petersburg and Russia.

Museum as a scientific and educational space. The Museum should record, preserve and study a certain historical and cultural content presented as an integral image. As for modelling as a scientific method, the model in its parameters should reflect the essential properties of a real object. What is meant when we talk about modelling the history of science, especially by means of a museum? This means that the Museum acts as a space for the formation of such a model. For example, if we are talking specifically about the mineral collection of the Mining Museum, we should consider the entire



complex process not only of scientific research of the mineral, but also of the recognition of this research by the scientific community. Or, for example, the appearance at the Mining Museum of a full figure and portrait sculpture of Aristotle and his student Theophrastus, the great ancient Greek encyclopaedists actively involved in the studies of nature in all its diversity (physics, mineralogy, botany, zoology, etc.), immediately forms its certain historical and cultural, historical and scientific, even aesthetic context of perception and interpretation of the Museum scientific collection. It becomes obvious that the addition of a new exhibit to the Mining Museum collection does not only reflect the scientific fact but is also an important stage in recognition of the value of this fact by the scientific and cultural community. The Museum staff do not act at their own will or preference when working with the collection; the mineral becomes or does not become an exhibit due to many causes and factors, but the very fact of inclusion in the collection plays a huge role, without it the recognition of the scientific discovery will be incomplete. The Museum invites visitors to get acquainted not only with mineral samples proper, but also with the scientific classification that was compiled by the scientists and is currently accepted.

An important feature of the Mining Museum is its constant involvement in the educational process, and the fact that it is virtually inside the educational space confirms this. Development of the modern museum proceeds as an “educational form of culture” [28], and current studies show the enormous importance of University museums for the progress in education, science and museum studies [29, 30]. Museums actively perform the educational function in culture and transmit certain views on science, history or art to a wide range of visitors. Museum space is a place of introduction to important social practices: through acquaintance with the picture of the world presented in the museum a person is drawn into a certain social group that shares these ideas, he is educated in the broadest sense – a qualitatively new image of a person forms through familiarization, both at the visual and information levels, with cultural, scientific, artistic heritage of our country and the world as a whole. The museum is seen today as a practice of commemoration, i.e., shared memory, the experience of forming, confirming and demonstrating collective identity [31, 32]. We do not necessarily mean the historical museums – in case of a University museum, the significance and awareness of this role of social construction is not less. We have already seen specific examples from the mineralogical collection or plastic images of thinkers which show how highly the contribution of an individual is valued in science [33]. Despite the fact that scientific research requires coordinated work of entire teams, there is always room in science for recognition of an individual contribution [34, 35]. Acquaintance with the history of discovery is an important aspect of familiarization with historical heritage of the Russian science and methods of social recognition of the personality of a scientist. In the Mining Museum, the students not only study minerals, but also learn what the success of a scientist who makes a discovery means and see how the discovery is recognized in the scientific world. Thus, they receive a model and a guideline for professional growth – this is formation of professional identity.

Conscious inclusion of oneself in the professional and scientific community is a long and complex process that is no less important for the success of a graduate than his professional training [36]. The Mining Museum plays a significant role in this process. Unlike the “visitor from the street,” the University students and graduates can consider the space of the Mining Museum theirs through belonging to the mining science and reflecting their own knowledge and ideas in the halls of the Museum. Modern science, including metallurgy and mineralogy, can also present itself in the virtual world [37], as can a modern natural science museum. However, it should be noted that the Mining Museum is also a home for humanitarians because it created a productive union of natural science and artistic and humanitarian knowledge. This is quite rare and, thus, all the more valuable. The feeling of professional unity does not appear by itself at lectures and practical classes, it grows out of social and cultural practices of professional interaction, the Museum is a space for their formation and representation. Of course, the Museum is a heterogeneous, complexly organized space with its own special order, in which certain relationships are clearly demonstrated: between objects in the scientific picture of the world, people in a professional group, history and culture, scientific



knowledge and education, science and art. Such unity forms by means of very specific methods of organizing the space.

The Museum guides the visitor, acquainting him with the collection in a certain order, focusing on the most important exhibits, creating the necessary impression of the entire process. Each of 20 halls of the Mining Museum has its own clear thematic layout. For example, the Malachite Hall starts with display of the systematic collection of minerals from simple to complex compositions (portrait sculptures of the scientists of antiquity are on cabinets with exhibits). According to the original plan in the 1820s. the decoration of the Hall and its exposition had to demonstrate the richness of subsoil of the Russian Empire. It is no coincidence that the compositional centre of the hall is a huge block of the Ural malachite weighing 1,504 kg donated by Empress Catherine II. It was moved from the Hall of Columns as a symbolic feature of the Ural Range with its riches. The walls were painted with a special mineral paint made from malachite. Such scientific, compositional and aesthetic design of the exhibition halls shows that the Museum developed together with the national mineralogical science. Interiors of the Museum main halls due to the displayed thinkers of antiquity fulfil an important educational mission.

Atmosphere of the presence of science is supplemented and expanded due to special museum mechanisms, such as identifying explanations of the exhibit, its visual and theoretical support, place in the exhibition, actualization of the value in the course of excursions, etc. The Museum is organized in a certain way in close integration with the educational process at the Mining University.

Conclusion. Impression of the importance of science, scientific knowledge and the exhibit, the time of direct acquaintance and contact with it is created thanks to the general atmosphere, the aura not of a single exhibit, but the Museum and University space as a whole organized in a certain way. The interiors of the Mining Museum were created purposefully, they reveal the aesthetics, logic and symbolism, which may not always be clear to a modern person, but upon careful study and perception, revealing the value, status and significance of educational spaces not only in the XVIII-XX centuries, but also in our days. Here, the past is inseparable from the present, directs us into the future, and the scientists of the past years and centuries set examples of the selfless service of science, which we can and, in a sense, should follow.

The Mining Museum is a unique scientific and educational space with centuries-long history. The authors demonstrate and explore its main functions: historical and cultural, scientific, educational, social. The tools (for example, selection and naming of exhibits, interior features, organization of museum space) that allow performing these functions are considered. Educational function of the Museum is realized through the collection and demonstration of the current scientific classification of exhibits – this is the most obvious level of Museum work. Visitors get acquainted with mineral samples and the scientific picture of the world that formed in modern science. The Mining Museum owes the uniqueness of its collection to its close proximity to world-class scientists of the Mining University. Scientific and socializing functions of the Museum are closely related to the educational function and consist in formation of notions about historical stages of the Russian science and the scientists most closely associated with these stages. While receiving education, the students are changing, their picture of the world is updated, and their professional identity forms. Potential of the Museum in this matter should not be underestimated: owing to the Museum space, the value of personal contribution of a scientist, the importance of the profession of a researcher in the life of the country and in the world culture are demonstrated. This is promoted not only by the collection containing many samples of “registered” minerals named after outstanding graduates and staff of the Mining University, but also by the Museum interiors. Appeal to ancient images in architecture of the XVIII century is caused by desire to demonstrate the cultural and scientific continuity of modern science with respect to the greatest progress and names of scientists of the past, primarily of the Antiquity. Sculptural images of thinkers, philosophers and scientists of antiquity are not only a decoration, but also aesthetically manifest the role of scientists and their contribution to the global process of cognition of the world. The space of the Mining Museum is made up of the collection and interiors, which together influence the visitors,



educating them through familiarization with the glorious pages of the history of science, showing the importance of the scientist's mission in the past and modern world and integrating their achievements into the national and world culture.

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Authors: Daniil Yu. Dorofeev, Doctor of Philosophy, Head of Department, Dorofeev_dy@pers.spmi.ru, <https://orcid.org/0000-0003-1583-4545> (Empress Catherine II Saint Petersburg Mining University, Saint Petersburg, Russia), Natalya V. Borovkova, Candidate of Art History, Senior Researcher, <https://orcid.org/0000-0001-7581-4138> (Empress Catherine II Saint Petersburg Mining University, Saint Petersburg, Russia), Marina A. Vasileva, Candidate of Philosophy, Associate Professor, <https://orcid.org/0000-0002-8874-4623> (Peter the Great Saint Petersburg Polytechnic University, Saint Petersburg, Russia).

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