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In: Martina Bečvářová (author); Christa Binder (author): Mathematics in the Austrian-Hungarian Empire. Proceedings of a Symposium held in Budapest on August 1, 2009 during the XXIII ICHST. (English). Praha: Matfyzpress, 2010. pp. 93–102.

Persistent URL: http://dml.cz/dmlcz/400822

THE MATHEMATICS AND ITS PROFESSORS AT THE MINING AND FORESTRY ACADEMY IN SCHEMNITZ (BANSKÁ ŠTIAVNICA)

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Abstract: The Mining Academy in Schemnitz (Selmecbánya – today Banská Štiavnica, Slovakia) established in 1762 was one of the first technical university in the world. The mathematics played an important role in its studying programs already from the beginning. Lectures were mostly focused on those areas of the mathematics that could be essentially applied in the field of mining measuring, mining gadgets constructing, etc. There were several very interesting attempts of implementing some lectures concerning infinitesimal calculus, descriptive geometry, etc. The study is focused on analysis of the mathematical tuition at the Academy and on the contribution of most significant professors in this field (e.g. N. Poda, J. Möhling, J. Schitko, K. Jenny, S. Farbaky, O. Schwartz, K. Walek – mathematics; J. Hönig, E. Pöschl, L. Fodor – descriptive geometry).

1 Bergschola of Samuel Mikoviny – predecessor of Schemnitz Academy

The Schemnitz vicinity (Selmecbánya – today Banská Štiavnica, Slovakia) and several other regions of today's Central Slovakia were developing from the middle Ages as significant centres of mining and metallurgy. The tradition of specialized training of mining professionals in Schemnitz can be supported by different documents from the beginning of 17th century, whereas since 1735 we can even discuss about systematically organized school type education. Under the leadership of the excellent math-cartographer, Samuel Mikoviny the mining school was founded in these conditions and later become the world's famous mining academy in Schemnitz.[1] Mikoviny's role at this academy was not only practical training in the field of mining-metrics, construction and other departments but also conducting mathematics tutorials, especially geometry and trigonometry that are related to arithmetics and algebra. In addition while lecturing he used the handbook *Vermehrte Geometria subterranea oder Markscheide-Kunst* ... by Nicolaus Voigtel published in Leipzig-Oerfurth in 1714. Considering the knowledge of Mikoviny's unique cartographical, mining-metrical and water-constructional work we can assume that his lectures had excellent professional level and met the high academic criteria. Since 1748 Mikoviny was delegated with more and more demanding geodesic

[1] More about the history of the first mining schol in Schemnitz: Mihalovits J.: *Az első bányatisztképző iskola alapítása Magyarországon.* Sopron, 1938. [Bányászati, kohászati és erdészeti felsőoktatásunk története 1735–1935, 1. füzet], p. 5–24; Vlachovič J.: *Dejiny banského školstva na Slovensku v 18. storočí.* In: Z dejín vied a techniky na Slovensku, 3. Vydavateľstvo Slovenskej akadémie vied, Bratislava, 1964, p. 33–96; Zsámboki L. (ed.): *Selmectől Miskolcig 1735–1985*. Nehézipari Műszaki Egyetem, Miskolc, 1985, p. 13–50; Kamenický M.: *Banícke školstvo na Slovensku do založenia Baníckej akadémie v Banskej Štiavnici.* SAP – Slovak Academic Press, Bratislava, 2006, p. 33–70.

and constructing tasks therefore he could not fully perform his teacher's duties and his former assistants accepted his position at the academy.[2]

2 Mathematics as "primary importance science" at the Mining Academy in Schemnitz

In 1762 the Empress Maria Theresia established a new mining school in Schemnitz that clearly embodied university attributes and included it among the pioneering institutions of technical university education in the world. This school gained the status of the Mining Academy with a three-year cycle of teaching in 1770, while the type of education was highly progressive in various ways.[3] Antoine François Fourcroy upon submitting a proposal for the establishment of the École Polytechnique in Paris also referred to the example of North Hungary, in particular to a unique form of laboratory teaching of chemistry.[4] Mathematics played a significant role in the educational system at the Academy and was indicated in documents as "primary importance science" necessary for mining and metallurgical sciences. What is more some mathematical knowledge was required for the admission to the Academy, in the early years it had to be demonstrated to Abbe Marcy, Vienna Royal mathematician, and subsequently acting at the local university.[5]

The Department of Mathematical Sciences (including applied mining-mensuration, construction machinery, engineering, etc.) was founded in 1765 under the leadership of the Jesuit Nicolaus Poda, a then prefect of the university observatory and science museum in Graz.[6] He continued with similar activities at his new establishment especially compiling mechanical and machinery collections, whereas the descriptions of these unique mining machineries used in North Hungarian Mines were published as a book. It appears that the Jesuits, who had relations to universities, had experience in mathematical teaching and are credited for building a tradition of this department in Schemnitz. Poda teached in Schemnitz till 1771 when his successor Karl Thierenberger, also a Jesuit, replaced him. In the early years both Thierenberger and Poda were able to use mathematical guide from Edler Franz von Gerliczi – probably lecture notes *Sammlung der ersten Lehrsätzen und Aufgaben der Rechenkunst, der Geometrie und Trigonometrie* ... (Wien, 1768). According to the inventory in 1770 several well known mathematical works were found in the library, for example, Christian Wolff's and

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[2] Author's study on the topic of mathematical teaching at the Mining Academy in Schemnitz: Morovics M. T.: *Vyučovanie matematických predmetov na Baníckej akadémii v Banskej Štiavnici.* In: 230 rokov Baníckej akadémie v Banskej Štiavnici. Zborník prednášok 7. sekcie, Historický ústav SAV, Bratislava, 1992, p. 182–206.

[3] About the history of Mining academy in Schemnitz in genaral: Faller G.: *Gedenkbuch zur hundertjährigen Gründung der königlichen ungarischen Berg- und Forstakademie in Schemnitz 1770–1870.* Schemnitz, 1872; Pauer J.: *A selmeczbányai magyar királyi bányászati és erdészeti akadémia története.* Selmecbánya, 1896; Vlachovič J.: *Dejiny*...; Vlachovič J.: *Banská akadémia v Banskej Štiavnici v 19. storočí.* In: Z dejín vied a techniky na Slovensku, 4. Vydavateľstvo Slovenskej akadémie vied, Bratislava, 1966, p. 7–46; Zsámboki L.: *Selmectől* ...; Herčko I.: *Stručné dejiny Baníckej a lesníckej akadémie v Banskej Štiavnici.* Ústav vedy a výskumu UMB, Banská Bystrica, 2009; Biographical lexicon of professors: Zsámboki L.: *A selmeci bányászati és erdészeti akadémia oktatóinak rövid életrajza és szakirodalmi munkássága 1735–1918.* Miskolc, 1983.

[4] Zsámboki L.: *Selmectől* ..., p. 105–112.

[5] *Hofkammers Sitzungsprotokoll – Wien, 22. Oktober 1762.* Hofkammerarchiv Wien, Münz- und Bergwesen, I. Abt. Fasc. Rote Nr. 225. Hungarian translation of document: Zsámboki L.: *Selmectől* ..., p. 53–59.

[6] K. K. Hofkammer-Decret, Wien 13. August 1765. Published in Faller G.: *Gedenkbuch* ..., p. 6–9.

Bernard Forest Belidor's textbooks, table of logarithms of trigonometric functions by Adrian Vlacq or mathematics lexica by Alexandre Saverien.[7]

The first detailed curriculum was maintained in the royal chamber's decree on 14th of April 1770. The arithmetic section briefly started with repeating basic arithmetic operations (that was required for admission), followed by proportios, sequences, decimal fractions, logarithmic calculus, roots, various practical computational procedures (quality of ores, the ratio of the components of alloys, the conversion of cash currencies, ...) and so on. The curriculum prescribed also the elementary basics of algebra and the solution of simple equations. The geometrical section consisted the plane and solid geometry, trigonometry, basic geodesy. On the one hand the plan emphasized the importance of mathematics while on the other hand pointed out that everything should be accepted without long theoretical evidence, only with the intention that listeners should gain mathematical skills to be able to work out the technical tasks. The mathematics tutorials were followed by lectures of various physical and technical disciplines (mechanics, engineering, basics of optics and hydromechanics). Technical drawing was part of the first year's study and according to the curriculum from 1770 the mathematical disciplines were lectured four times two hours per week.[8]

The Curriculum was based on the requirements for the mining-metallurgic praxis and it was reflected in the teaching of mathematical disciplines. Overall we can state that the curriculum in 1770 as a whole represented the Mining Academy in Schemnitz as a modern technical university, which vocational studies requisited a demanding mathematics and natural science training course.

3 Progressive initiatives of professors in the field of analysis and descriptive geometry

The implementation of the progressive curriculum was faced with several constraints. Foremost it was the massive work load of math professors, who were conducting also other lectures simultaneously and sometimes performed practical tasks as well. However the conservative attitudes of the Royal Chamber (the superior authority) in some cases also became obstacles to some innovations by the professors. For instance the effort of Johann Möhling to introduce "higher mathematics" lectures was strongly rejected due to the claim that the teaching of mathematical subjects should be limited only to the immediate needs of the mining metrics and the theory of mine works.[9] We can speculate that the subject of these lectures might have been the infinitesimal calculus.

The first curriculum of the Academy in 1770 was significantly changed as late as in 1809, when a so called philosophical course was introduced as a form of preparatory studies. Its establishment was forced particularly by the lack of preparedness of many candidates in the field of mathematics. According to the new outlines the content of arithmetic and algebra has remained at about the same level, however some fundamental theorems on conic sections, namely the analytical geometry, enriched the content of the

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[7] Pauer J:. *A selmeczbányai ...*, p. 193.
[8] *Systema Accademiae Montanisticae per Sac. Caes. Resolutionem confirmatur 3tia Aprilis anno 1770.* Hungarian translation of document in Zsámboki L.: *Selmectől ...*, p. 69–85. For more information about mathematics, geometry and technical drawing see p. 72–76.
[9] Mihalovits J.: *A selmeci bányászati akadémia alapítása és fejlődése 1846-ig.* Sopron, 1938, p. 22.

geometry. What is remarkable on the philosophical course outline is that the non-compulsory lectures enabled the teaching of infinitesimal number and so called "higher geometry" that in this case probably meant the analytical geometry of space. The recommended textbook was the German edition of *Anleitung zur Mathematik* by George Ignaz Metzburg, Professor of the University of Vienna.[10] As it is known, in the 1808 the Forestry Institute was founded at the Mining Academy in Schemnitz. The students of forestry attended the philosophical course together with the students of mining and metallurgy.

The first implementer of this curriculum was Professor Joseph Schitko who worked at the Academy almost a quarter of a century and became well known mainly as a constructor of water pillar machines. Schitko's extraordinary construction success was based on his mathematical knowledge and proficiency. His lectures on differential and integral calculus[11] were in the second decade of 19th century according to the nature of school – with the exception of the Ecole Polytechnique in Paris – pioneering in the international field as well. For instance at the Prague's Polytechnic the infinitesimal number lectures were introduced only in the mid 19th century. In comparison at the German Technical School, the mathematical analysis was lectured on a larger scale and compulsory, from 1825 when these schools were created, the first Polytechnics in Karlsruhe.[12] It is notable that over time the attitude of the Royal Chamber to these lectures was mitigating and in the 1821 Professor Schitko obtained written permission to examine "high analysis", including the issuing of certificates.[13]

The Mining Academy in Schemnitz had taken a pioneering position in the introduction of descriptive geometry teaching as well. Lectures in this area were implemented at the Academy by Professor Johann Hönig in 1839 again among the first schools of the Habsburg's monarchy. In comparison, the Prague Polytechnic started similar lectures in the beginning of 40s in the 19th century, thus practically at the same time, however the first such trials in Prague (Karl Wiesenfeld) dates back to the year 1829.[14] Professor J. Hönig worked at the Mining Academy during the years 1839–1844 at a newly established Department of Technical Drawing. Immediately after the designation he started lecturing descriptive geometry and he did not need the decree of the Royal Chamber, which allowed those lectures to be only optional. He urged for his students not only to attend lectures, but also take the test. In addition to his efforts, perhaps due to the high demand, he did not meet with too much understanding from the audience and that created conflicts, dealt with the Royal Chamber as well.[15] Later J. Hönig left the Academy and became a professor at the University of Technology in Vienna, where he

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[10] *Hofkammerdekret, Wien, 13. Sept. 1809.* Hungarian translation in Zsámboki L.: *Selmectől ...* . p. 115–118.

[11] Vlachovič J.: *Banská akadémia ...*, . p. 13.

[12] Nový L. et al.: *Dějiny exaktních věd v českých zemích do konce 19. století.* Praha, 1961, p. 137–138; Stäckel P.: *Die mathematische Ausbildung ... an den deutschen Technischen Hochschulen.* Leipzig – Berlin, 1915, p. 25.

[13] Vlachovič J.: *Banská akadémia ...* . p. 13.

[14] Drábek K.:*125 let katedry matematiky a deskriptivní geometrie stavební fakulty ČVUT.* Dějiny věd a techniky 12(1979), p. 34–35; Nový L. et al.: *Dějiny ...*, p. 137–139.

[15] Vlachovič J.: *Banská akadémia ...*, p. 22-24; Čižmár J.: *K dejinám vyučovania deskriptívnej geometrie na vysokých školách na Slovensku.* In: Zborník vedeckých prác k 60. výročiu Stavebnej fakulty STU v Bratislave, STU, Bratislava 1998, p. 77–80; Čižmár J.: *On the history of the instruction of descriptive geometry at educational institutions of university type in Slovakia.*
Available: <http://math.unipa.it/~grim/quad15_cisnar_05.pdf>

issued his main work *Anleitung zum Studium der Darstellenden Geometrie* two years later. It was the first textbook of this subject published in the Habsburg's Empire, which was used not only in Vienna but also at the Prague Technical College, and later probably in Schemnitz as well.[16]

Among the most significant professors we can mention also Christian Doppler, who worked at the Academy for only a short period (from December 1847 to January 1849), moreover in the age disturbed by revolution.[17]

The introduction of lectures on differential and integral calculus as well as on descriptive geometry belonged to the most progressive moments in the development of the Academy in the first half of the 19th century. During the period of industrial revolution both of the disciplines became an essential part and prerequisite for creative engineering praxis that started the path of development from empiricism to scientism. The mining academies in the Monarchy and in Germany were passing some crisis in their development during the first half of the 19th century. These institutions, which a few decades ago, still represented a progressive type of technical colleges, had lost their pioneering position. More future forwarded in this area became the modern universities of polytechnic-type model arising under the Paris Ecole Polytechnique in historical symbiosis with the development and dissemination of the industrial revolution. The reform efforts of the Academy's professors, among them mathematicians, to move towards modernization lasted for a long time.

4 The Academy in the era of industrial revolution

The Mining Academy in Schemnitz entered the 19th century with the curriculum approved in 1846 that was a result of the previous reform efforts. This curriculum was useful mainly because the voluntary courses of infinitesimal calculus were integrated to the compulsory courses and with the attempt of J. Hönig proper teaching of descriptive geometry was introduced. However the technical development set new requirements for a new curriculum that culminated in lengthy discussions and frequent adjustments of the curriculum mostly during the 50s and 60s of the 19th century.[18]

After the revolution 1848/49 Karl Jenny, a former assistant at the Vienna Polytechnic became the first professor of the Department of Mathematical Sciences at the Academy.[19] His entity personated the truly representative of the emerging industrial revolution, whereas his primary credit was to extent and improve the engineering education as well as increase the quality of mathematical education and to be a organic link between these disciplines. Since 1852 he was teaching special lectures on applications of differential and integral calculus in geometry and mechanics that documented his progressive approach.

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[16] Sklenáriková Z.: *Z dejín deskriptívnej geometrie v Rakúsko-Uhorsku.* p. 6, 9–10.
Available: <http://www.sccg.sk/~kg/sklenarikova/Dokumenty/d_honig.pdf>

[17] Hansmann L.: *Johann Christian Doppler v Banskej Štiavnici.* In: Zprávy Československé společnosti pro dějiny věd a techniky 1(1965), p. 61–65.

[18] Faller G.: *Gedenkbuch ...*, p. 46, 56-57; Zsámboki L.: *Selmectől ...*, p. 134–135. Sklenáriková Z.: *Z dejín deskriptívnej geometrie v Rakúsko-Uhorsku.* p. 6, 9–10.

[19] Zsámboki L.: *A selmeci ...*, p. 206.

K. Jenny's efforts as well as others' efforts to change the overall concept of teaching in the 50s and 60s of the 19th century assumed a close functional link between engineering subjects and descriptive geometry that provided very effective tools to solve several construction tasks. Eduard Pöschl, who worked at the department between 1850 and 1887 and was a long-time professor of this subject, was also fully aware of this fact.[20]

K. Jenny and E. Pöschl belonged to a group of professors whose progressive tutorial activity prepared the ground for further radical reform of the Academy, which took place in 1872 mostly thanks to István Farbaky. He said in an extensive memorandum about the reform: *Mathematics and chemistry, experimental physics and descriptive geometry together with geometric and hand drawing composes inseparable part – we can say a basic element of any branch of technical education. What is more, mathematics as embodied logics apart from its immediate benefits has a significant advantage that develops intelligence and craft of young people and creates customs of accurate, efficient and consistent mind thoughts.*[21] It is obvious that I. Farbaky attributed mathematics a broader function that would require a narrower, pure pragmatic orientation.

The reform that took place at the Academy in 1872 can be called an industrial revolution reform. Along with the introduction of separate studying fields several other modern technological disciplines and coherent theories were implemented, for instance technical mechanics, theory of elasticity and breaking strength or the mechanical theory of heat. All in all this naturally increased the demands on the mathematical preparation for the students.[22] Otto Schwartz was the professor of mathematics in this period (until 1909). He was an eminent teacher, whose lectures are preserved in lithographic scripts but however from the scientific point of view he did not belong to the significant figures.[23]

In 1887 E. Pöschl was replaced by László Fodor (previous surname Mayerhoffer) at the Department of Descriptive Geometry. His persona is often referred to the biggest expansion of descriptive geometry's teaching at the Academy and to basics of lecturing of grafostatics as a separate subject as well. His lectures were published in a two volume textbook *Az ábrázoló geometria elemei* [The basics of descriptive geometry – Selmecbánya 1892, 1896]. Apart from this textbook he published a series of high school and university textbooks of descriptive geometry, which remained in many editions for three-quarters of the century the main tool of teaching of this subject in the Hungarian Empire, later Hungary.[24]

5 Academy on the path towards modern technical university

The last third of the 19th century was a period in the history of the Hungarian Empire marked with the extremely high acceleration of economic, technological and cultural development, which was connected to the political changes after the Austrian-Hungarian

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[20] Csáky K.: *Híres selmecbányai tanárok.* Lilium Aurum, Dunajská Streda, 2003, p. 139.
[21] Farbaky I.: *A selmeczi m.k. bányászakadémia szervezési javaslata.* Bányászati és Kohászati Lapok 4(1871), p. 13.
[22] Item, p. 67 etc. (serie of articles)
[23] Zsámboki L.: *A selmeci* ..., p. 308–309; Pöss O.: *Otto Schwartz.* In: Tibenský. et. al.: Priekopníci vedy a techniky na Slovensku, 2. Obzor, Bratislava, 1988, p. 442–445.
[24] Mihalovits J.: *Dr Fodor László emlékezete.* A M. K. Bányamérnöki és Erdőmérnöki Főiskola Évkönyve 1924/25, Sopron, 1925, p. 39–45.

settlements but also with the duration of delayed, but still intensive industrial revolution. The Mining and Forestry Academy in Schemnitz had to respond to the new emerging requirements of the whole industry and got involved in a competition for residence of the other technical university in the Hungarian Empire apart from that in Budapest. The need for continuous upgrading of the teaching process was highlighted by the forces alongside academic experts and by the production sphere. László Tetmayer, former graduate of the Academy and now a director of metal works in Ózd was an active promoter of this modernization. He wanted to reorganise the Academy into a technical university with 4-years study period. Attainment of the standards of technical universities in the teaching of preparatory disciplines, including mathematics was one of the preconditions for the implementation of this plan.[25]

The preparation of the reform took several years and the preparation committee under the leadership of Professor Jenő Sobó submitted a proposal at the end of May 1900, that – after approval – became a crucial document of the last major reorganization of the Academy in 1904, under which the Academy was renamed to University.[26] The creators of the proposal were influenced by the analysis of the curriculum of the several technical universities and mining academies, for instance in Budapest, Austria, Germany, Bohemia and Switzerland, in order to achieve the standards of these institutions.

After the reorganisation in the year 1904, the Mining and Forestry University in Schemnitz according to hour load of mathematical subjects achieved the average standard of the mentioned European technical universities and outrun almost all of the mining academies. More precisely the University was at the same level as the Technical Universities in Karlsruhe and Zurich, was behind only to Prague and Munich, and on the other side overtook the Polytechnics in Vienna, Berlin, Dresden, Aachen and Brno. Hourly grants of descriptive geometry were similar but can not be considered as a single and most objective criterion for comparison. The content comparison has shown that the German Universities were better at parts dedicated to differential equations especially since the Schemnitz curriculum did not content important issues such as variation calculus, calculus of probabilities or the method of least squares at all. On the other hand the content comparison might be in certain way inadequate, because there were tendencies at these universities at the end of the 19th century to instate the leading theoreticians and mathematicians to the heads of the Departments of Mathematics that resulted in setting disproportionately high criteria for a given type of school.[27]

The last professor of mathematics in Schemnitz was Károly Walek, who implemented the intentions of the last reform and joined the Department of Mathematics as an assistant in 1902. He was a former graduate of the Academy but later he obtained special math education and doctorate at the University of München. What is more Walek was very editorial active in the field of application of mathematics, especially after moving the

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[25] *Jelentés a kongresszusi ünnepségekről ...* . Az Országos Magyar Bányászati és Kohászati Egyesület Közlései (Bányászati és Kohászati Lapok melléklapja) 1(1897), p. 97–102.

[26] Project of reform: *Előterjesztése a selmeczbányai ... akadémia tanári karának az akadémia reorganizációja tárgyában.* Štátny ústredný banský archív Banská Štiavnica, fond Banská a lesnícka akadémia 1770–1918, II. spisový materiál, kart. 13, I. č. 165/1900.

[27] Sobó J.: *Bányászati felső szakoktatásunk új szervezete.* Bányászati és Kohászati Lapok 37(1904), zv. 2, p. 663. Hensel S.: *Zur mathematischen Ausbildung der Ingenieure.* NTM Schriftenreihe für Geschichte der Naturwissenschaften, Technik und Medizin 26(1989), Heft 1, p. 44–45.

Schemnitz University to Hungary.[28] Implementer of the reforms in the field of descriptive geometry was the referred L. Fodor.

The Mining and Forestry University in Schemnitz was moved to Hungary in 1919 after negotiation with Czechoslovakia had failed. Later on, the University was divided into two specialized schools (Sopron, Miskolc), however this period is not in focus of this study. The progressive traditions of this institution are praised by several of nowadays technical universities in Slovakia and Hungary.[29]

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[2] Čižmár J.: *K dejinám vyučovania deskriptívnej geometrie na vysokých školách na Slovensku.* In: Zborník vedeckých prác k 60. výročiu Stavebnej fakulty STU v Bratislave. STU, Bratislava, 1998, p. 77–80.

[3] Čižmár J.: *On the history of the instruction of descriptive geometry at educational institutions of university type in Slovakia.*
Available: <http://math.unipa.it/~grim/quad15_cisnar_05.pdf>

[4] Drábek K.:*125 let katedry matematiky a deskriptivní geometrie stavební fakulty ČVUT.* Dějiny věd a techniky 12(1979), p. 33–45.

[5] *Előterjesztése a selmeczbányai ... akadémia tanári karának az akadémia reorganizációja tárgyában.* Štátny ústredný banský archív Banská Štiavnica, fond Banská a lesnícka akadémia 1770–1918, II. spisový materiál, kart. 13, I. č. 165/1900. [Project of reform.]

[6] Faller G.: *Gedenkbuch zur hundertjährigen Gründung der königlichen ungarischen Berg- und Forstakademie in Schemnitz 1770–1870.* Schemnitz, 1872.

[7] Faller J.: *Dr. Walek Károly ...*. Bányászati Lapok 7(1952), p. 617–618.

[8] Farbaky I.: *A selmeczi m. k. bányászakadémia szervezési javaslata.* Bányászati és Kohászati Lapok 4(1871), p. 67 etc.

[9] Hansmann L.: *Johann Christian Doppler v Banskej Štiavnici.* Zprávy Československé společnosti pro dějiny věd a techniky 1(1965), p. 61–65.

[10] Hensel S.: *Zur mathematischen Ausbildung der Ingenieure.* NTM Schriftenreihe für Geschichte der Naturwissenschaften, Technik und Medizin 26(1989), Heft 1, p. 44–45.

[11] Herčko I.: *Stručné dejiny Baníckej a lesníckej akadémie v Banskej Štiavnici.* Ústav vedy a výskumu UMB, Banská Bystrica, 2009.

[12] *Jelentés a kongresszusi ünnepségekről ...* Az Országos Magyar Bányászati és Kohászati Egyesület Közlései [Bányászati és Kohászati Lapok melléklapja] 1(1897), p. 97–102.

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[28] Faller J.: *Dr. Walek Károly ...* Bányászati Lapok 7(1952), p. 617–618.
[29] Translated by Martin Morovics.

[14] Mihalovits J.: *Dr Fodor László emlékezete.* A M. K. Bányamérnöki és Erdőmérnöki Főiskola Évkönyve 1924/25, Sopron, 1925, p. 39–45.

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[16] Mihalovits J.: *A selmeci bányászati akadémia alapítása és fejlődése 1846-ig.* Sopron, 1938.

[17] Morovics M. T.: *Vyučovanie matematických predmetov na Baníckej akadémii v Banskej Štiavnici.* In: 230 rokov Baníckej akadémie v Banskej Štiavnici. Zborník prednášok 7. sekcie, Historický ústav SAV, Bratislava, 1992, p. 182–206.

[18] Nový L. et al.: *Dějiny exaktních věd v českých zemích do konce 19. století.* Praha, 1961.

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