

# The influence of the *École des ponts et chaussées* of Paris on the Lisbon Polytechnic School (1836–1860)

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## Abstract

Unveiled here is the extent that the Parisian *École des ponts et chaussées* (EPC) was a reference for the organization of the Lisbon Polytechnic School (LPS, *Escola Politécnica de Lisboa*) and the role played by the engineers trained in the French school in the organization and teaching methods at the LPS. The LPS, founded in 1837, was influenced in its functioning by various foreign schools, more specifically the EPC. These influences were felt at the level of teaching methods, textbooks and other publications, as well as through the men who circulated between the two schools and acted as vehicles of transmission of knowledge and methods.

**Keywords:** Lisbon Polytechnic School, *École des ponts et chaussées*, engineering training, technical knowledge transfer, expert mobility.

## Introduction

During the first two decades of the nineteenth century, Portugal lived a period of political and military instability,<sup>1</sup> which undermined the growth of technical education, in particular engineering education that remained restricted to the training of military engineers<sup>2</sup>. Thus, these

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<sup>1</sup> Political instability was caused initially by the French invasions that forced the royal family to move to Brazil (1808) and after by the civil war between absolutists and liberals.

<sup>2</sup> On the subject see, among others, Diogo, Maria Paula and Matos, Ana Cardoso de (2006), “Aprender a ser ingeniero. La enseñanza de la ingeniería en el Portugal de los siglos XVIII y XIX” in António Lafuente, Ana Cardoso de Matos and Tiago Saraiva (ed.) *Maquinismo Ibérico – Tecnología y cultura en la península ibérica, siglos XVIII-XX* (Aranjuez: Doce Calles, 2006), p. 143-166; Matos, Ana Cardoso de, Santos, Maria Luísa e Diogo, Maria Paula, “Obra, Engenho e Arte nas raízes da engenharia em Portugal,” in Manuel Heitor, J. M Brandão de Brito and Maria Fernanda Rollo, *Momentos de Inovação e Engenharia em Portugal no século XX* (Lisboa: D. Quixote, 2004), vol. 2, p. 10-44.

were the engineers to whom the government resorted whenever it was necessary to adapt buildings to manufacturing facilities<sup>3</sup>, to build roads, or to carry out any other public works.

The reality of a civil war in the country and the implementation of the absolutist regime between 1828 and 1834 forced several liberals into exile in countries such as France or England. While living abroad, many Portuguese liberals visited some of the most important technical schools, the main industrial establishments or major public works that were being carried out. These visits allowed them to realize that the existing engineering education in Portugal was insufficient to provide engineers with the necessary skills to contribute both to the modernization of regional infrastructures, which required large engineering projects, and to the economic progress of the country, which presupposed a deeper knowledge of sciences such as chemistry or physics and their possible applications in industry.

In the 1820s, the government sought to compensate the shortcomings of technical education in Portugal by sending students to complete their training abroad, a practice dating back to earlier times. This practice would be kept up in the following decades<sup>4</sup>.

At the Parliamentary session on 21 February 1828, the MP Araújo e Castro (1771–1849) submitted a draft proposing that the government should give permission “to send to foreign countries, wherever suitable, men capable of making useful observations of economic and administrative nature, and young scholars to improve themselves in the sciences, and in arts”, and he further added: <sup>5</sup>

One cannot ignore that it is useful to learn from foreigners what is worth imitating; studying their institutions, and their practical methods; ascertain the causes of their prosperity or decline; and make a judicious and prudent application of whatever is useful. This has always been the tactics of great legislators.

As a result of their exile, some liberal engineers felt obliged to continue their studies abroad, particularly in the engineering schools of Paris, where they were able to become acquainted with new teaching methods and the results of practical applications of scientific and technical knowledge.

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<sup>3</sup> We refer, for instance, to the adaptation of the Convent of São Sebastião in Portalegre to install the Royal Wool Factory. Ana M. Cardoso de Matos, *Ciência, tecnologia e Desenvolvimento Industrial no Portugal Oitocentista* (Lisboa: Estampa, 1998), p. 353-356.

<sup>4</sup> It was the case of the law of 3<sup>rd</sup> July 1839 that provided for sending students to France, as pensioners of the State, in order to study sciences applied to industry (especially chemistry and physics), civil engineering, agriculture and surgical operations. We do not know all of the students who were sent to France, but between 1831 and 1851, seven Portuguese attended the EPC in Paris. Anousheh Karvar, *La formation des élites scientifiques et techniques étrangères à l'École polytechnique aux 19<sup>e</sup> et 20<sup>e</sup> siècles*, Thèse en histoire (Paris: Université de Paris 7, 1997), p.14.

<sup>5</sup> “Sessão de 21 de Fevereiro de 1828”, *Diário da Câmara dos Senhores Deputados* (Lisboa: Imprensa Nacional, 1828), p. 578.

Therefore it was no coincidence that the establishment of the Army School, in 1836, and the creation of the Lisbon Polytechnic School (LPS, *Escola Politécnica de Lisboa*) and the Polytechnic Academy of Porto (*Academia Politécnica do Porto*), in 1837, had as one of their main promoters the engineer Bernardo de Sá Nogueira de Figueiredo (1795–1876), Viscount of Sá da Bandeira. He had studied at the Academy of Artillery, Fortification and Design (1815–1817), in the University of Coimbra, where he graduated in Mathematics and Philosophy (1819–1820), and in Paris and London (1821–1825)<sup>6</sup>. Possibly during his stay in Paris, Sá da Bandeira had contact with the various engineering schools and even attended the *École des ponts et chaussées* (EPC).<sup>7</sup> Similarly, some of the engineers who played an important role in the early years of the LPS had completed their training at the EPC in Paris, although as *auditeurs* (literally listeners).<sup>8</sup> It would thus appear that the creation and organization of the LPS was influenced by foreign schools, especially French. It is often argued that the EPC had a major influence on the organization of the Lisbon Polytechnic.<sup>9</sup>

In this paper I have sought to address the following questions: the profile of the engineers graduating from the Polytechnic School who, in first half of the nineteenth century, completed their training at the EPC of Paris; to which extent this school was a reference in the organization of the LPS; and the influence that the Portuguese engineers who graduated from that school had in the Lisbon Polytechnic.

## 1 – The Portuguese engineers who attended the EPC prior to the creation of the LPS

In the first half of the nineteenth century the EPC<sup>10</sup> still had as its primary mission the training of engineers who were to join the French *Corps des ponts et chaussées*.<sup>11</sup> Due to the characteristics of

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<sup>6</sup> André Meyreles de Tavora do Canto e Castro, *O Marquez de Sá da Bandeira. Biographia fiel e Minuciosa do Illustre Finaso redigida sobre Documentos Officiais e Parlamentares com o auxilio de valiosos apontamentos prestados por elle mesmo em 1873 e de outras informações fidedignas* (Lisboa: Empreza Editora Carvalho C<sup>o</sup>, 1876), p. 4-7.

<sup>7</sup> Even though the years that are usually indicated for his stay in this city (1825-1826) do not correspond to the date we have, it is possible that the date indicated in the archives of the EPC is not correct, or that during his tour of several countries undertaken between 1828 and 1829, Bernardo de Sá Nogueira de Figueiredo had visited Paris and completed the training he had previously started at that school.

<sup>8</sup> Initially foreign students were only given the status of “auditeurs,” which simply allowed them to attend oral classes.

<sup>9</sup> It has been mentioned several times that the LPC was organized according to the model of the EPC, but until now the influence of the latter was not mentioned by Portuguese historiography.

<sup>10</sup> This school was established in 1747. About the EPC see Antoine Picon, *L'invention de l'ingénieur moderne L'Ecole des Ponts et Chaussées 1747-1851* (Paris : Presses de l'Ecole Nationale des Ponts et Chaussées, 1992).

<sup>11</sup> This was a corps of state engineers that worked in public works. See Antoine Picon, *Le Corps des Ponts et chaussées de la conquête de l'espace national à l'aménagement du territoire* [URL : <http://www.gsd.harvard.edu/images/content/5/3/537902/fac-pub-picon-corpsdespontsetchausseese.pdf>] accessed 19/11/2013].

its teaching, this school was a reference for European or non-European engineers wishing to play an active role in public works designed to modernize their respective countries.<sup>12</sup> However, until 1851 most foreign engineers who attended this school had only the status of *auditeurs*, i.e., they were just allowed to attend lectures and only gradually came to be accepted as regular students.<sup>13</sup> From the 1830s, a significant number of *auditeurs* was also given access to participate in the “annual work campaigns” together with the regular students.

Foreign students were usually admitted on the basis of the recommendation of the ambassador of their country of origin, or of another person who would belong to the elite or hold a prominent political position. Only from 1851 were foreigners allowed enrolment in the EPC under the same conditions as the French. It was incumbent upon the school board to select and accept those considered most likely “to follow regular schooling.”<sup>14</sup> Despite various constraints, since the late eighteenth century until 1879 the majority were foreign students<sup>15</sup>.

Between 1825 and 1851, 18 Portuguese engineers completed their studies at the EPC as *auditeurs*<sup>16</sup> (Table 1), and until the education reform in Portugal that established the Army School (1836), the Polytechnic School of Lisbon and the Polytechnic Academy of Porto (1837), eight engineers attended the Parisian school.

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<sup>12</sup> Therefore, between the late eighteenth century and early twentieth century engineers from various countries graduated from the EPC. On the subject see Matos, Ana Cardoso de (2009), “Asserting the Portuguese Civil Engineering Identity: the Role Played by the *École des ponts et chaussées*,” in Ana Cardoso de Matos, Maria Paula Diogo, Irina Gouzevitch, André Grelon (ed.), *Les enjeux identitaires des ingénieurs : entre la formation et l’action/The Quest for a Professional Identity: Engineers between Training and Action* (Lisboa :Colibri/CIDEHUS/CIUHCT, 2009), p. 177-209; Assimacopoulou, Foteini, Mavrogonatou, Georgia and Chatzis, Konstantinos (2009) “Implanter les “Ponts et Chaussées” européens en Grèce : le rôle des ingénieurs du corps du Génie, 1830-1880,” *Quaderns d’Història de l’Enginyeria*, 2009, p. 331-350; Kostov, Alexandre (2009), “Les Ponts et Chaussées français et les pays balkaniques pendant la seconde moitié du XIXe et au début du XXe siècle: les cas de la Roumanie, de la Serbie et de la Bulgarie,” *Quaderns d’història de l’enginyeria*, 2009, vol. X, p. 367-388; Irina Gouzevitch, André Grelon, Anousheh Karvar, *La formation des ingénieurs en perspective: modèles de référence et réseaux de médiation : XVIIIe-XXe siècles* (Rennes : Presses universitaires de Rennes, 2004); Gouzevitch, Irina et Gouzevitch, Dimitri (2003) « Se former et s’informer: Un regard sur l’émigration scolaire est-européenne dans les établissements français d’enseignement technique entre 1800 et 1940 » in H. Rudiger Peter et N. Tikhonov (eds), *Les universités : des ponts à travers l’Europe* (Frankfurt am Main; Berlin; Bern: Peter Lang, 2003), p.247-278; Gouzevitch, Irina, “La science sans frontières: élèves et stagiaires de l’Empire russe dans l’enseignement scientifique supérieur français XIX<sup>e</sup>-XX<sup>e</sup> siècles,” *Cahiers d’histoire du CNAM*, 1996, 5, p.63-92.

<sup>13</sup> Picon, *L’invention de l’ingénieur moderne*.

<sup>14</sup> The fact of mentioning the person who had proposed them in the processing of the students, implies that this data was also taken into account.

<sup>15</sup> During this period the Portuguese represented the third largest group of students (*auditeurs*). The admission of these students was made with the permission of the Director-general of the School. From 1832, these students were given the status of “free students”. Picon, *L’invention de l’ingénieur moderne*, p. 405-406.

<sup>16</sup> On this subject see Matos, Ana Cardoso de (forthcoming), “A intervenção dos engenheiros portugueses formados na *École des Ponts et Chaussées* de Paris no território, na política e no ensino técnico de Portugal na primeira metade do século XIX” in Heloisa Meireles Gesteira, Luis Miguel Carolino e Pedro Marinho (org), *Formas e Representações do Império*, (in press)

Name	Training/posts/functions in Portugal prior to attending the EPC	Year of attendance at the EPC
Caetano José Vaz Parreiras (1797–1848)	Lieutenant	1825
Gregório António Pereira de Sousa (17??–18??)	Captain	1825
José Feliciano da Silva Costa (1798–1866)	Captain	1825
Januário Pedro Celestino (Soares) (1??–??)	Royal Navy Officer	1826
Sá (1??–??)	Staff Officer	1829
José de Meneses Pitta e Castro (1804–1884)	Officer	1830
Count of Calhariz (son of Marquis of Palmela) (1812–1832?)		1830
Joseph de Braamcamp (1??–??)		1831

Table 1 - Portuguese engineers who attended the *École des Ponts et Chaussées* in Paris, prior to the creation of the Polytechnic School of Lisbon.<sup>17</sup> Source: “Auditeurs libres et visiteurs à l’*Ecole des ponts et chaussées* de 1747 à 1851.” EPC Archives and individual files, Paris; Historical Archives of the Ministry of Public Works, Transport and Communications, Lisbon.

Following the government’s decision to select three engineers to complete their training at the EPC, the first group left for Paris in 1825, comprising José Feliciano da Silva Costa, Caetano José Vaz Parreiras, and Gregório António Pereira de Sousa (Table 1). Despite the status of *auditeur*, attendance at the EPC, required the completion of preparatory engineering studies, a precondition fulfilled by the Portuguese engineers prior to their departure.

José Feliciano da Silva Costa had been trained as a military engineer, most probably in one of the engineering schools existing in Brazil,<sup>18</sup> and reached, in 1821, the rank of Captain in the Constitutional Legion, in Bahia. In 1823, he came to Lisbon, possibly with the aim of heading to Paris to complete his training at the EPC.<sup>19</sup>

Caetano José Vaz Parreira, in turn, was born in Elvas,<sup>20</sup> southern Portugal; he attended the Royal Academy of Artillery, Fortification and Design. Having completed his education in 1816, he became Second Lieutenant and, on 19 November 1820, First Lieutenant in the Royal

<sup>17</sup> Information on some of these engineers differs from that indicated in Macedo, Marta Coelho de, *Projectar e construir a Nação – engenheiros e território em Portugal (1837-1893)*, Ph.D. dissertation, (Coimbra: Universidade de Coimbra, 2009), p.62, note 196.

<sup>18</sup> It is possible that he went to Brazil with his parents in 1808, when the Portuguese royal family moved to Brazil, and that he did his training at the Royal Academy of Artillery, Fortification and Design, in Rio de Janeiro, founded in 1792 by Queen D. Maria I. This school was founded according to a similar school created two years before in Lisbon.

<sup>19</sup> When he returned from Paris, he became involved in the civil strifes alongside the liberals. In 1833, he was in charge of the direction of the lines of the fortifications of Lisbon, and in the following year the fortification of Leiria. At the end of the civil war he had reached the rank of colonel and was appointed chief of the 2nd Directorate of the Ministry of War and then inspector general of military barracks and works. The first of these appointments began in 1835. Pereira, Zília (2004), “Costa, José Feliciano da Silva e (1797-1866)”, M. F. Mónica, *Dicionário Biográfico Parlamentar 1834-1910* (Lisboa: Imprensa Ciências Sociais/Assembleia da República, 2004), p. 881-882.

<sup>20</sup> He was the son of Brigadier José Caetano Vaz Parreiras, who in the Peninsular War fought alongside Soult (who?).

Corps of Engineers (*Real Corpo de Engenheiros*).<sup>21</sup> He was then in charge “of various commissions both military and scientific, among which various constructions and road improvements in the province of Alentejo, southern Portugal, which he satisfactorily accomplished until November 1824”<sup>22</sup> notably, the “Survey of the Royal road from Montemor-o-Novo to Badajoz.”<sup>23</sup> That same year, he was chosen to attend the EPC. The competence shown in performing his duties at the Corps of Engineers must have been decisive for his inclusion among the selected engineers. As he stayed in Paris until 1833, the period Queen Maria II<sup>24</sup> spent in France to complete her education, Vaz Parreira was appointed her mathematics teacher, a position he held until he returned to Portugal in 1836.<sup>25</sup>

Little is known about the initial education of Gregório António Pereira de Sousa, but in 1821 he was First Lieutenant of the Royal Corps of Engineers and that same year he was commissioned to undertake an inspection of the “Fisheries, Forts and Batteries of the Kingdom of the Algarve.” In 1824, he was one of the three engineers selected to study at the EPC.

In 1826, another Portuguese engineer also left for this school. Known as Januário Pedro Celestino, he is actually likely to have been Januário Pedro Celestino Soares, a naval officer and the youngest son of Brigadier Pedro Celestino Soares (1751–1836), who was professor of design at the Academy of Artillery, Fortification and Design.<sup>26</sup> He had five brothers who followed a military career,<sup>27</sup> among them Francisco Pedro Celestino Soares (c.1790–18??), who was appointed, in 1826, substitute lecturer to the Academy of Fortification, Artillery and Design, his

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<sup>21</sup> Together with José Feliciano da Silva Costa in *Diário do Governo* (Lisboa: Imprensa Nacional, 12, 1821), p. s/n. The Royal Corps of Engineers, created in 1793, was a specialized body of military engineering, belonging to the Portuguese Army, which resulted from the transformation of the Corps of Sapper Workers (*Corpo de Obreiros Sapadores*), created in 1647 by King João IV, in the context of the War of the Restoration of Independence of the country (*Guerra da Restauração 1640-1668*).

<sup>22</sup> *Diário do Governo* (Lisboa: Imprensa Nacional, 1848), 148: p. 803.

<sup>23</sup> Arquivo Histórico Militar, PT/AHM/DIV/3/01/06/01.

<sup>24</sup> Daughter of the King D. Pedro IV of Portugal, who was Emperor of Brazil as D. Peter I, and the Archduchess D. Leopoldina of Austria.

<sup>25</sup> Later he was appointed *aid-de-camp* to King D. Fernando. In 1841, as reported by Maria Helena Dias, he was part of a commission composed of Pedro Folque, José Carlos de Figueiredo, Marino Miguel Franzini and José Feliciano Silva Costa, to assess the topographic surveys that had been carried out by José Maria das Neves Costa (1771-1841). Maria Helena Dias (2005), *Brigadeiro José Maria das Neves Costa, 1771-1841. Biografia sucinta e aspectos relevantes da sua actividade no campo da Cartografia militar portuguesa* (Lisboa: IGE, Novembro 2005), p. 16.

<sup>26</sup> Pedro Celestino Soares was also a corresponding member of the Royal Academy of Sciences. Villa-Boas, Custódio Gomes de (1793), *Ephemerides nauticas ou Diario astronomico para o anno de 1792 calculado para o meridiano de Lisboa e publicado por ordem da Academia Real das Sciencias por...*, (Lisboa : Academia Real, 1793), p. 149.

<sup>27</sup> Januário was the only one going to the EPC. Although we do not know the date of his birth, it must have occurred between the late eighteenth and early nineteenth century, for his third brother was born in 1793 and before Januário there was still another son.

position becoming permanent in 1835.<sup>28</sup> Januário probably went to Paris influenced by both his father and brother Francisco.

An engineer only referred to as Sá who appears as a member of the General Staff was possibly, as mentioned before, the Viscount of Sá da Bandeira known to have studied in Paris, despite the fact that the years usually indicated for his stay in the French capital (1825–1826) do not coincide with the dates specified in the documents of the EPC.<sup>29</sup>

As regards the engineer referred to as Pitta e Castro, who attended the French school in 1830, the question as to whether or not he is José de Menezes Pitta e Castro, who became the 1<sup>st</sup> Baron of Proença-a-Velha, on 1 July 1863, must be raised.<sup>30</sup> Pitta e Castro was an army officer who was exiled in Paris, and consequently it is plausible to assume that he attended the EPC.

That same year, another Portuguese engineer, referred to as the Count of Calhariz, son of the Marquis of Palmela, Don Pedro de Sousa Holstein (1781–1850), also attended the French school. Calhariz was possibly Don Alexandre de Sousa e Holstein (1812–1832), the eldest son of the Marquis of Palmela and 1<sup>st</sup> Count of Calhariz, who had been born in Cadiz, Spain, and died in the Azores. As he died about two years following his return from Paris, he did not have the time nor the opportunity to put into practice his French training.

Joseph Braamcamp, an émigré between 1823 and 1835, whose presence in Paris is referenced in 1831, was probably the son of Anselmo José Braamcamp de Almeida Castelo Branco (1792–1841).<sup>31</sup> However, it is impossible to say for sure whether or not he was Geraldo José Braamcamp de Almeida Castelo Branco, who became later Councillor and Governor of the City of Lisbon, or José Augusto Braamcamp de Almeida Castelo Branco, honorary State counsellor, Peer of the Realm, Governor and Mayor of Lisbon.

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<sup>28</sup> With the closure of this Academy and the creation of the School of the Army, he became a teacher in this school. In 1856 he assumed the direction of the Military College and later of the School of the Army. Francisco Pedro Celestino Soares was also a deputy and held other political offices. Marques, M. A. (2006), “Soares, Francisco Pedro Celestino (1791-1873)”, M. F. Mónica (coord.), *Dicionário Biográfico Parlamentar 1834-1910* (Lisboa: Imprensa Nacional/Assembleia da República, 2006), Vol. III (N-Z), pp. 767-769. Two of his other brothers, José Pedro Celestino Soares and Joaquim Pedro Celestino Soares were also deputies. José Pedro Celestino Soares was also the 1st Viscount of Leceia.

<sup>29</sup> I was not able, for now, to confirm this hypothesis; however, in the list of *Auditeurs libres et visiteurs à l'École des ponts et chaussées de 1747 à 1851* published by the archives of the EPC the name Sá appears referring to an “officier d'Etat, major,” indicating the year of 1829 for his admission to this school.

<sup>30</sup> His son João Filipe de Menezes Pitta e Castro, born in 1861, was a deputy in 1892.

<sup>31</sup> He was the grandson of the minister of Prussia in Portugal at the time of Marquis of Pombal and became Honorary Minister of State, extraordinary colonel of militia and deputy. Sardica, J.M. (2006), “Castelo Branco, Anselmo José Braamcamp de Almeida (1792-1841)”, Mónica, M. F., *Dicionário Biográfico Parlamentar 1834-1910*, vol 1, p. 685-686.

## 2 – The objective of creating the LPS

On 10 September 1836, Passos Manuel (1801–1862) was appointed Minister of the Kingdom and, despite his short mandate,<sup>32</sup> he played a crucial role in the reform of the Portuguese teaching system. The various measures he took were undoubtedly influenced by the years he had spent abroad. In 1828, when the absolutist regime was established in the country, his involvement in the civil wars alongside the liberals, had forced him into exile. After passing through Spain, England and Belgium, he finally settled in the outskirts of Paris.<sup>33</sup> During the time he spent abroad he realized, on the one hand, the importance of technical training in the economic development of any country and, on the other, the delay Portugal had in terms of technical teaching. Consequently when he took office, he initiated a reform that encompassed all levels of education. In order to establish in Portugal a system of military education similar to that adopted in the countries he visited, in 1836, he replaced the Royal Academy of Artillery, Fortification and Design for the Army School (*Real Academia de Artilharia, Fortificação e Desenho pela Escola do Exército*). This school included a course on military engineering and another one of civil engineering.<sup>34</sup> On 15 December of that same year, he determined that the training provided by the Faculty of Mathematics of the University of Coimbra was a sufficient qualification for any position or office that required a degree in Civil or Military Engineering.<sup>35</sup> Education in this faculty covered key areas of engineering such Arithmetic, Geometry, Trigonometry, Physics, Mineralogy, Metallurgy, Hydraulics and Civil, Military and Underground Architecture.

The following year the Polytechnic School of Lisbon and the Polytechnic Academy of Porto were created, under the tutelage of the Ministry of War. This initiative had the influence of Sá da Bandeira, who was then heading the government. The LPS was intended to “provide students with the necessary skills to pursue different courses in the application schools of the Army and Navy, while providing the means to disseminate a higher general education and subsidiary instruction to other scientific professions.”<sup>36</sup> Having in mind this objective, five preparatory courses were established: a four-year general course, covering Mathematics,

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<sup>32</sup> He left the Ministry on 1<sup>st</sup> June 1837.

<sup>33</sup> He left Portugal in May 1826 and only returned in 1832 to integrate the liberal troops who fought against absolutism.

<sup>34</sup> The civil engineering course, which lasted two years, was organized from a set of disciplines taught to military engineering. About the School of the Army, see Marta Macedo, *Projectar e construir a Nação. Engenheiros, ciência e território em Portugal no séc. XIX* (Lisboa: ICS, 2012).

<sup>35</sup> Maria Helena Lisboa, *Os engenheiros em Lisboa: Urbanismo e Arquitectura, 1850-1930* (Lisboa: Livros Horizonte, 2002), p. 61.

<sup>36</sup> Preamble of the Decree of 11<sup>th</sup> January 1837.



Astronomy, Geodesy, Physics, Chemistry, Mechanics, Mineralogy, Geology, Economics, Zoology and Botany; a four-year preparatory course for officers of the General Staff, Military Engineering and Civil Engineering; finally, three preparatory courses lasting three years intended to train artillery officers, naval officers and naval engineers.

These courses should be completed with attendance of the Army School or of other specialised professional schools, as stated, in 1859, by Júlio Máximo de Oliveira Pimentel (1809–1884): “The Polytechnic School was established to offer scientific education to those intended to serve the State in technical professions (...). It is an instruction directed entirely towards useful applications and free from any merely speculative tendency.”<sup>37</sup>

### 3 – The establishment of the LPS and the need to adapt its building

Feliciano da Silva Costa<sup>38</sup> was appointed as director of the LPS in 1837. He was assisted in logistic matters by José Cordeiro Feio (1787–1884), Dean of the Naval Academy; General Fortunato José Barreiros (1797–1885), lecturer of the old Academy of Artillery, Fortification and Design; Guilherme José António Dias Pegado (1803–1885), lecturer of the Royal Military College, and António Cabral de Sá Nogueira (1799–1879)<sup>39</sup>, provider of the Mint House. All were prestigious men and played a key role in adapting and introducing teaching methods followed in foreign technical and engineering schools.

The Lisbon Polytechnic was set up in the buildings of the former College of Nobles, which also housed the Army School. As the space available to these institutions was scarce, the Board of the LPS reacted negatively when São Mamede parish asked to be granted ownership of the church of the College of Nobles. By fearing a further reduction of its space the Board protested: <sup>40</sup> “everything that means limiting its space presents the greatest inconvenience in as much as the Army School currently occupies the best part of the building.”

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<sup>37</sup> Pimentel, Júlio Máximo de Oliveira, Discurso pronunciado na sessão solene de distribuição dos prémios aos alunos (Lisboa, 1859).

<sup>38</sup> Among the reasons that led to the appointment of Feliciano da Silva Costa are not only “the knowledge he had acquired in studies done in some of the best known and accredited scientific institutions of Europe, but also the fact that he had been chairman of the commission responsible for proposing the plans for the organization of higher education (indispensable basis of the courses of various application schools) and for the schools of the army”, Pedro José da Cunha, *A Escola Politécnica de Lisboa. Breve Notícia Histórica* (Lisboa: Faculdade de Ciências de Lisboa, 1937), p.6.

<sup>39</sup> António Cabral de Sá Nogueira was Bernardo de Sá Nogueira de Figueiredo, Viscount of Sá da Bandeira’s brother.

<sup>40</sup> It was considered that the claim should be denied “saying that the effects necessary to granting the claim will be entirely contrary to the alleged” and “harmful to the school.” “13th session April 6, 1837”, Book of Proceedings No. 1, fol. 23, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

The building had to undergo adaptations to its new function, which were deemed indispensable:<sup>41</sup>

At least an amphitheatre should be made available for lectures on Physics and Chemistry, and the arrangements of the respective laboratory, as well as establishing lectures on mathematics as to contain the students and offer the comfort needed to fulfil legal requirements.

As there were no architectural plans of the building, the works to be carried out were much delayed. The school decided that it should not “undertake any work without a well-matched plan”, whose coordination was entrusted to Filipe Folque (1800–1874)<sup>42</sup> upon the Director’s request.<sup>43</sup> On 13 January 1838, Oliveira Pimentel<sup>44</sup>, professor of chemistry, presented a plan of the works to be carried out, notably in the chemistry amphitheatre, which needed to be equipped with benches and a sort of shelf so students could write.<sup>45</sup>

In April 1843, a violent fire destroyed part of the building of the school, creating greater logistic difficulties and jeopardizing the efforts made to adapt the building to the teaching of the various lecture courses.<sup>46</sup>

Reconstruction works dragged on for quite some time, forcing students to attend lectures in neighbouring buildings outside the school. Chemistry and physics were taught at the Mint, a situation that was far from satisfactory. In February 1848, Guilherme Pegado, professor of Physics, suggested the use of an old house located nearby, which belonged to the school, “as the works of reconstruction are progressing slowly, and given that the chemistry and physics lecture-rooms at the Mint are somewhat tight.”<sup>47</sup> This proposal was not accepted by the School Board on the grounds that it would increase expenditure, which could further delay the reconstruction of the School.

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<sup>41</sup> “Sessão 11 de Março de 1837,” Book of Proceedings No. 1, fol. 16, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

<sup>42</sup> Filipe Folque (1800–1874) was Professor of Astronomy between 1837 and 1856. On Filipe Folque and its teaching in the Polytechnic School see Carolino, Luís Miguel (2012), “Measuring the Heavens to Rule the Territory: Filipe Folque and the Teaching of Astronomy at the Lisbon Polytechnic School and the Modernization of the State Apparatus in Nineteenth Century Portugal”, *Science & Education* (2012) 21, p.109–133 [DOI 10.1007/s11191-010-9320-5].

<sup>43</sup> “Sessão 21 de Março de 1837”, Book of Proceedings No. 1, fol. 19v, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

<sup>44</sup> About Júlio Máximo de Oliveira Pimentel see Matos, Ana Cardoso de (2013) “Matemático por formação, químico por paixão: Júlio Máximo de Oliveira Pimentel, um “politécnico” no Portugal Oitocentista”, Ana Maria Pina, Carlos Maurício, Maria João Vaz (org.), *Metamorfozes da Cultura, estudos em homenagem a Maria Carlos Radich* (Lisboa: CEHC-IUL, 2013), p.165-189.

<sup>45</sup> “Sessão de 13 de Janeiro de 1838,” Book of Proceedings No. 1, fol. 76, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

<sup>46</sup> The fire “which almost completely destroyed the building of the College of Nobles, the architectural structure of the Laboratory, Gallery and Amphitheatre, as well as the annexed rooms.” *Química*, 102, Julho-Setembro, 2006, p. 46.

<sup>47</sup> “Session 18 mars, 1848”, Book of Proceedings No. 4, fol. 13, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

Convinced that it would be necessary to lithograph a series of documents, including texts for students and exams, as early as 1837, Filipe Folque<sup>48</sup> volunteered to “deal with the arrangements to set up a lithographic machine.”<sup>49</sup> A few days later, he reported to the Board “the inquiries he had made on the best way to establish lithography in the School”<sup>50</sup> and was authorized to make the necessary acquisitions.

In this lithography not only exams and other current documents but also texts written by the professors to support their lectures were printed. Such was the case of *Sketch on General Physics and its Main Applications (Esboço de physica geral e suas principaes applicações)* by Guilherme J. A. D. Pegado, which was printed in 1849.<sup>51</sup> In order to publicize the works being lithographed in the School, in 1839 the School Board established that a copy of all publications should be sent to the Public Library and to the Academy of Sciences.

The lithography also enabled them to print other kinds of publications like the *Polytechnic School Yearbook (Anuário da Escola Politécnica)*. As early as 1837, the Government determined that the Board of the LPS should “proceed with the composition of the school yearbook, similarly to the Yearbook of the *Bureau des Longitudes de Paris*,”<sup>52</sup> but with changes the Board would deem useful.<sup>53</sup> The Lisbon *Polytechnic School Yearbook*, however, only began to be published in the first decade of the twentieth century.<sup>54</sup>

#### 4 – Equipping the school to train good engineers

While the School Board attempted to adapt the building, it sought to obtain the necessary tools for teaching the various disciplines, thus resorting in the collaboration of other institutions. On 11 March 1837, the Director reported that he had received a letter from the Ministry of War

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<sup>48</sup> Filipe Folque graduated from the University of Coimbra in Mathematics, in 1826. In 1836 he was appointed professor of the Marine Academy, where he created the course of surveyor engineer.

<sup>49</sup> “Session 18 Mars, 1848”, Book of Proceedings No. 4, fol. 30, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

<sup>50</sup> “Session 27 May”, Book of Proceedings No. 4, fol. 31, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

<sup>51</sup> Guilherme J. A. D. Pegado, *Esboço de physica geral e suas principaes applicações* (Lisboa: Lythographia da Escola Polytechnica, 1849).

<sup>52</sup> The *Bureau des Longitudes* is a French scientific institution, founded by the decree of 25<sup>th</sup> June 1795, which in the nineteenth century was responsible for the global synchronization of clocks.

<sup>53</sup> “Session 27 May, 1837,” Book of Proceedings N<sup>o</sup>1, fol. 31, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

<sup>54</sup> Annuals were published for the academic years 1908–1909, 1909–1910, 1910–1911 e 1911–1912. Historical Archives of the Polytechnic School (PT/MCUL/EPL/EPL/RO/04).

“informing that an order had been given to the Arsenal of the Army to provide some items for the workshop attached to the Physics Cabinet.”<sup>55</sup> In late March 1837, having learnt that an army officer was going on a Government commission to England and France, the Board of the School considered that “it would be appropriate to take this opportunity to obtain information, and order items needed in the School.”<sup>56</sup>

In January 1838, Oliveira Pimentel was authorized to spend two hundred thousand reis (then the Portuguese currency) on items needed in the Chemistry cabinet and laboratory, and a sum amounting to 120,000 reis was allocated to the laboratory of zoology.<sup>57</sup> Meanwhile, Guilherme Pegado requested permission to purchase apparatuses to be used in “experiments on electricity.”<sup>58</sup>

In the following years the acquisition of items and apparatuses to be used in the teaching of the various courses continued, by resorting to donations from other institutions. For example, on 23<sup>rd</sup> March 1839, Folque suggested a letter to the Ministry of War asking for four mathematics kits and a theodolite from the Arsenal for the use of students at the LPS.<sup>59</sup>

At the same time, the School was trying to provide its library with books that were deemed essential. In 1838, again Folque<sup>60</sup> suggested the purchase of the following items: *Great Catalogue of Stars* by Giuseppe Piazzi,<sup>61</sup> *Calculation of the effect of machines* by Coriolis<sup>62</sup>, *Course on Industrial Mechanics* by Poncelet;<sup>63</sup> *Principles of Chemical Philosophy* by Dumas,<sup>64</sup> *Annaes de Fisica e Quimica (Annals of Physics and Chemistry)*, and *Annaes dos Conhecimentos Úteis (Annals of Useful*

<sup>55</sup> “Session of 15 Mars, 1837,” Book of Proceedings N<sup>o</sup>1, fol. 18v, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

<sup>56</sup> “Session 31 May de 1837,” Book of Proceedings N<sup>o</sup>1, fol. 21v, Historical Archives of the Polytechnic School, (PT/MCUL/EPL/CEP/01).

<sup>57</sup> “Session 13 January, 1838,” Book of Proceedings n<sup>o</sup>1, fol. 76.

<sup>58</sup> “Session 3 February, 1838,” Book of Proceedings n<sup>o</sup>1, fol.83v.

<sup>59</sup> “Session 23 Mars, 1839”, Book of Proceedings n<sup>o</sup>1, fol. 183v.

<sup>60</sup> As said before, Filipe Folque was Professor of Astronomy between 1837 and 1856.

<sup>61</sup> Giuseppe Piazzi (1746-1826) was an Italian mathematician and astronomer monk.

<sup>62</sup> This is the work *Du Calcul de l'Effet des Machines* published by the French Physicist Gustave Gaspard Coriolis (1792–1843) in 1827.

<sup>63</sup> This is probably the book by Jean-Victor Poncelet, *Introduction à La Mécanique Industrielle* (Paris: Gauthier-Villars, 1870). Jean-Victor Poncelet (1788–1867) was a known French mathematician and engineer who, in addition to this work, was the author of *Traité des propriétés projectives des figures*, 1822; *Cours de mécanique appliqué aux machines*, 1826; *Mémoire sur les roues hydrauliques à aubes courbes, mues par-dessous*, 1827; *Expériences hydrauliques sur les lois de l'écoulement de l'eau à travers les orifices rectangulaires verticaux à grandes dimensions*, 1832; *Traité de mécanique appliqué aux machines*, 1845 ; *Applications d'analyse et de géométrie: qui ont servi de principal fondement au Traité des propriétés projectives des figures*, 2 vols, 1862–1864.

<sup>64</sup> This is the book authored by Jean-Baptiste Dumas, *Leçons sur la Philosophie Chimique professées au Collège de France* (Paris : Bechet Jeune, 1837). Jean-Baptiste Dumas (1800 -1884) was a well-known French chemist, politician and academic, who taught at the Polytechnic School, at the Faculty of Medicine and at the Faculty of Sciences of Paris.

*Knowledge*).<sup>65</sup> In 1839, the School Board decided to entrust the Library officer with the selection of “books he deemed useful in order to purchase them for LPS Library,”<sup>66</sup> and required from him a monthly report on the progress of this task. In the following years, the purchase of books continued to be a main concern. In 1847, Fradesso da Silveira (1825–1875)<sup>67</sup> suggested the acquisition of the *Annales des ponts et chaussées*, which existed at the former Public Works Company,<sup>68</sup> or buying the volumes corresponding to 1834 and 1835.<sup>69</sup> The next year he suggested a subscription<sup>70</sup> to the *Revue de l’Instruction publique en France et dans les Pays étrangers*<sup>71</sup> and the purchase of *De l’Origine et les limitations de la correspondance entre l’Algèbre et la géométrie* authored by Cournot.<sup>72</sup> Other professors acted similarly; in 1848, Júlio Máximo Oliveira Pimentel proposed the acquisition of the *Traité des essais par la voie sèche* by Berthier<sup>73</sup> and the subscription of the journal *Technologiste*<sup>74</sup> until August 1847.

Considering that wall charts were most useful while lecturing on the various theories underlying the functioning of machines and apparatuses, especially when these were not available, Albino Francisco Figueiredo e Almeida (1803–1858) considered it useful to purchase a complete collection of wall charts *Recueil des Machines, instruments et appareils qui servent à l’économie rurale et industrielle. Deux parties = deux premières parties composées, chacune, de 12 livraisons = La troisième partie de deux livraisons*, and to draw large-scale drawings “to be used in the lectures”<sup>75</sup>

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<sup>65</sup> “Session of 23 Mars, 1839”, Book of Proceedings n°1, fol. 184. Considering that no more information is given, it was not possible to identify these two last books.

<sup>66</sup> *Ibidem*. The deposit of libraries was created following the nationalization of property of religious orders in 1834.

<sup>67</sup> On Fradesso da Silveira (1825–1875), in addition to being a professor at the LPS he was Director of the meteorological observatory of the same school. He was a corresponding member of the Royal Academy of Sciences of Lisbon and founder and president of the Association for the Promotion of Manufacturing Industry, honorary member of the Trade associations of Lisbon and Porto. He wrote several works about industry and undertook important administrative commissions and drafted several reports.

<sup>68</sup> The Portuguese Public Works Company was created in 1845 to undertake several works in Portugal, namely the construction of roads. On this subject see Maria Eugénia Mata, *A Companhia das Obras Públicas de Portugal* (Lisboa: Universidade Nova, Faculdade de Economia, 1992), working paper.

<sup>69</sup> “Sessão de 9 de Setembro de 1847”, Book of Proceedings n°4, fol 6.

<sup>70</sup> “Session of 18 de Março de 1848,” fol. 12.

<sup>71</sup> It must have been the journal *Revue de l’instruction publique* de la littérature, des beaux-arts et des sciences en France et dans les pays étrangers published by Hachette since 1840.

<sup>72</sup> This reference corresponds to the work of Antoine Augustin Cournot (1801–1877). Cournot was an important French mathematician and economist.

<sup>73</sup> This the treatise by Pierre Berthier, *Traité des essais par la voie sèche: ou, des propriétés, de la composition et de l’essai des substances métalliques et des combustibles. À l’usage des ingénieurs des mines, des exploitants et des directeurs d’usines*, Volume 1 (Paris, 1834). Pierre Berthier (1782–1861) was a French geologist and mineralogist, to whom we owe the discovery, in 1821, of bauxite, the ore resulting in aluminium. In 1827 he described another mineral now known as berthierite.

<sup>74</sup> This must be the journal *Le Technologiste ou archives des progrès de l’industrie française et étrangère. Arts métallurgiques, chimiques, divers et économiques*.

<sup>75</sup> “Session of 4 May de 1839”, fol. 2v. Book of Proceedings n°2, fol. 2v.

## 5 - The first teachers at LPS: keeping up with the latest developments

When the LPS was created, the teachers of the 10 courses that made up the school curriculum had not yet been selected. At that time, only the following had been appointed: José Cordeiro Feio (1787–1884), professor of Elementary Algebra and Geometry; José de Freitas Teixeira Spínola Castelo Branco (1801–1---?), professor of Transcendental Algebra, Analytic Geometry and Differential Calculus; Albino Francisco de Figueiredo Almeida, professor of Mechanics and its Applications to Machines, in particular to steam engines; Filipe Folque, professor of Astronomy and Geodesy; Guilherme José António Dias Pegado (1803–1885), professor of Experimental Physics and Mathematics; João Ferreira Campos (1799–1869) substitute lecturer of mathematics ; João Gonçalo de Miranda Robalo Peleirão, lecturer of the navigation course associated with the Polytechnic School. The first four had been lecturers of the former Navy Academy. All were men renowned for their scientific capabilities and were members of the Board of the LPS, chaired by the Director, Feliciano da Silva Costa, who was the incumbent to ensure the scientific quality of teaching and developing all the necessary steps to complete the teaching staff.

In the following years, professors and lecturers for the other courses were selected and appointed. In 1837, Júlio Máximo de Oliveira Pimentel was appointed professor of the 6th course, General Chemistry and Notions of its Main Applications to the Arts. He was then a young graduate who had distinguished himself while attending the University of Coimbra. Shortly after, Francisco Xavier de Almeida and José Maria Grande (1799–1857) were also appointed and, in 1838, José Estevão Coelho de Magalhães (1809–1872), a renowned officer who held various political posts, notably in Parliament,<sup>76</sup> was appointed professor to the 10th course, Political Economy.<sup>77</sup>

Selecting teaching staff meeting all the requirements was not always simple. It was then legislated that the military lecturers of the Polytechnic School “must be given the same consideration as the lecturers of the Army School,”<sup>78</sup> and the School Board was authorized to suggest people from “among the individuals of the extinct Navy Academy and the College of

<sup>76</sup> About José Estevão Coelho de Magalhães see Arnaldo Cardoso Ressano Garcia, *Escola Politécnica de Lisboa. A 10ª Cadeira e dos seus professores (Economia Política, princípios de direito administrativo e comercial)* (Lisboa: Faculdade de Ciências de Lisboa, 1937), p. 5-16.

<sup>77</sup> At the time of the contest for this post, four candidates competed: Luciano Lopes Pereira, João Lineu Jordão, José Estevão Coelho de Magalhães and António de Oliveira Marreca. José Pedro da Cunha, *Nova Contribuição para a História da Escola Politécnica de Lisboa. Como em 1840 se completou o quadro dos seus lentes, o que permitiu entrar em pleno funcionamento* (Lisboa: Academia das Ciências, 1938), p. 7.

<sup>78</sup> Decree of 16th January 1837.

Nobles deemed competent to be part of the teaching staff of the Lisbon Polytechnic School.”<sup>79</sup> Also with this purpose, professors of the LPS were allowed to teach simultaneously in other schools. The accumulation of positions, however, had negative effects because teachers were often unable to meet the needs of the schools where they were teaching. For example, when in 1837 Guilherme Dias Pegado had to “employ all his time in the arrangements associated with the new course to be implemented in the Lisbon Polytechnic School,” he had to inform the Director of the Army School that for this reason he was unable to continue lecturing there.<sup>80</sup>

In early 1837, due to the difficulty in finding men with an academic profile suitable to fill the teaching vacancies at the LPS, the question of whether or not to resort to foreign teachers was raised. Albino de Figueiredo e Almeida considered that contracting foreign teachers should be a “last resort, after having by all means ascertained whether or not lecturers were available in the country, as well as the means to provide them with the practical experience they might lack.”<sup>81</sup> According to Figueiredo, only the courses on Chemistry and Metallurgy might require foreign teachers, because those on “the branches of natural history have no manipulation exercises, and the kind of practical knowledge needed can be attained everywhere and even without a teacher.”<sup>82</sup> He further argued that “there are few wise men everywhere; first or second class men decidedly do not come here, because they would have to sacrifice present and future scientific interests.” In addition, the salaries they would earn would be extremely costly to the Public Treasure, a situation that could be further worsened “for we do not have anyone outside of our party who could be a judge of the merit of these men; they can be charlatans rather than wise men.”<sup>83</sup>

Portuguese language was also a difficulty to be taken into account. This latter point was disputed by the Board secretary, Campos, who believed that because the Polytechnic School was located in a “capital like Lisbon where, if there is any principle of education, is the teaching of French to young people,” therefore students would have no difficulty in understanding teachers if these were French or spoke French. Even those who did not master the French language eventually had to learn it, for the students of the LPS had to “study in French textbooks.”<sup>84</sup> As some Board members favoured the admission of foreign teachers, they enquired of the

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<sup>79</sup> Information given by José Feliciano da Silva Costa to the other members of the Board, at the Board meeting of the Polytechnic School. “Session of 11 February, 1837”, Book of Proceedings n°1, fol. 4.

<sup>80</sup> “Session of 11 February, 1837”, Book of Proceedings n°1, fol. 3v.

<sup>81</sup> “Session of 18 de Fevereiro de 1837”, Book of Proceedings n°1, fol. 9v.

<sup>82</sup> “Session of 18 de Fevereiro de 1837”, Book of Proceedings n°1, fol 10.

<sup>83</sup> *Ibidem*.

<sup>84</sup> *Ibidem*, fols 11v-12.

Government if they could resort to this measure in order to fill in existing teaching vacancies. The Government responded positively, in particular for lecturing “the courses on the natural sciences and the sciences of observation, because there were no competent persons available in the country.”<sup>85</sup>

The lecturers of the LPS sought to keep up with the latest developments in their field of expertise, not only through the reading of international specialised literature, but also through travels or further education abroad. Prior to being appointed to the position of lecturer on chemistry at the LPS,<sup>86</sup> Júlio Máximo de Oliveira Pimentel put as a precondition for accepting, the promise of having permission to complete his training in chemistry in Paris. Only in 1844, however, when Fradesso da Silveira was appointed to the place of substitute lecturer, could Pimentel go abroad where “he received practical training; what he knows today on experimental chemistry, is due to the attendance of laboratories led by the most renowned present-day chemists.”<sup>87</sup> In effect, he studied in Paris with Eugène Péligot (1811–1890),<sup>88</sup> professor at the *Conservatoire des Arts et Métiers* and with his *préparateur*, the chemist Pierre-Antoine Favre (1813–1880),<sup>89</sup> later professor at the Faculty of Marseilles. Pimentel returned to Portugal in 1847, but his interest in visiting the main European laboratories and becoming acquainted with the latest developments of chemistry and its applications to agriculture and industry, led him to visit different European countries in subsequent years. These travels allowed him to make contact with important chemists, notably Justus von Liebig.<sup>90</sup>

Pimentel was soon recognized by his peers, and in 1860, *O Instituto*, a journal published in Coimbra, mentioned:<sup>91</sup>

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<sup>85</sup> “Session of 18 May, 1837, Book of Proceedings n°1, fol. 30.

<sup>86</sup> Probably influenced by Guilherme José António Dias Teixeira Pegado (1803-1---?), he was a professor at the University of Coimbra. Júlio Máximo de Oliveira Pimentel concluded in 1837 the course on Mathematics. During the years he was in Coimbra, he also attended the course of Natural Philosophy, but did not graduate in this area.

<sup>87</sup> The Instituto:jornal científico e litterario, Vol. 8, 1859/60, p. 43.

<sup>88</sup> Eugène-Melchior Péligot (1811–1890) was an important French chemist who was a professor at the Conservatory of Arts and Offices. Among the works we wrote he refer to *Traité élémentaire de manipulations chimiques* (1836), *Recherches sur l'analyse et la composition chimique de la betterave à sucre* (1839), *Le verre, son histoire, sa fabrication* (1879), *Traité de chimie analytique appliqué à l'agriculture* (1883).

<sup>89</sup> Pierre-Antoine Favre (1813–1880) conducted studies in the Faculty of Medicine, but in 1835 left this university to enter the private laboratory Eugène Melchior Péligot. At the time Péligot was appointed Professor of Chemistry of the *Conservatoire des Arts et Métiers*, Favre took over the position of preparer of the lessons of Peligot.

<sup>90</sup> Justus von Liebig (1803–1873), of German origin, was one of the most important chemists of his time.

<sup>91</sup> O Instituto:jornal científico e litterario, Vol. 8, 1859/60, p. 43.



the distinguished lecturer [Pimentel] of the Polytechnic School, trained in professional education by his frequent and laborious studies abroad, which were continued in his beautiful laboratory in Lisbon, is already known inside and outside the country, as one of the most renowned practitioners of the chemical sciences.

In 1845, Albino Figueiredo attended the EPC also with the aim of updating his knowledge, as will be analysed later on.

## 6 – The failed attempt to transfer the teaching model of *École des ponts et chaussées* to Portugal

As mentioned earlier, the first director of the LPS was José Feliciano da Silva Costa. The choice of this engineer shows clearly the kind of teaching this school sought to implement by taking as its model the EPC of Paris. Silva Costa, who had completed his training in this Parisian school, had the opportunity to learn from prominent French engineers the best techniques and materials to be used in different public works. During the years he attended this school, he also realized the importance of practicing in the field. In his words, it was crucial to<sup>92</sup>

make students familiar with the practice of constructing any kind of building, an essential part of the education of any engineer, which can only be achieved by employing them in construction sites for a given period of time. Our Lisbon Arsenal, the Gunpowder Factory, the Mint and various other industrial sites available in the city can be used in providing students with the necessary practical skills about machines and foundries: furnaces, artillery equipment and gunpowder manufacturing.

In order to emphasize the importance of practical teaching,<sup>93</sup> he further argued:<sup>94</sup>

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<sup>92</sup> Livro 1950–Livro copiador de correspondência entrada 1837–1843, fol 130. Historical Archives of the Polytechnic School.

<sup>93</sup> The model of the EPC was followed in various other countries, creating a supra-national space of Bridges and Roads. On this subject see Gouzevitch, Irina, Gouzevitch, Dmitri and Chatzis, Konstantinos (2006), “*Betancourt et l’Europe des ingénieurs des “ponts et chaussées”: des histoires connectées*”, *Quaderns d’Història de l’Enginyeria*, 2009, vol. X, p. 3-18. On the influence of the model of the EPC in Spain see Martykánová, Darina (2009), “*Les fils du progrès et de la civilisation: les ingénieurs des travaux publics en Espagne aux XVIIIe et XIXe siècles*”, *Quaderns d’història de l’enginyeria*, 2009, vol. X, p. 251-270.

<sup>94</sup> Livro 1950–Livro copiador de correspondência entrada 1837–1843, fol 130. Historical Archives of the Polytechnic School.

This is exactly what is practiced in many schools, such as the *École des Ponts et Chaussées*, whose students receive theoretical instruction in the school based on the examination of models, visit industrial plants and spend part of the academic year as employees in works under the direction of engineers.

Despite the efforts of Silva e Costa, in the 1840s, the teaching practices at the LPS, in particular regarding public works, an area requiring the urgent training of engineers, were far from the model adopted in France. Between the late 1830s and the early 1840s, no significant public works were being undertaken in the country that could serve as a learning “yard” for both teachers and students. This is most probably the reason that prompted the LPS to send Albino Figueiredo to the EPC, who then from 1837 onwards had taught the course on Mechanics and its Main Applications to Machines back in Lisbon.

When Albino Figueiredo attended the EPC, teaching methods in this school had undergone changes since the 1820s. The reforms introduced in this school from 1830 to 1840 sought to include in the curriculum knowledge on new materials and production processes like those of the steel industry, as well as the development of new construction techniques. By then, Amédée Bommart (1807–1865), tried to reconcile the pragmatism that characterized the EPC with the requirement of conceptual rigour required by the “technologie de l’ingénieur.”<sup>95</sup> Despite the controversy over the areas of intervention and the skills of engineers and architects, architecture continued to be regarded as an indispensable element in the training of civil engineers. Léonce Reynaud (1803–1880),<sup>96</sup> architect and engineer, emphasised the utilitarian nature of architecture, which he associated with the “génie civil,”<sup>97</sup> his lectures focussing also on various building materials.<sup>98</sup>

When he returned to Portugal, Albino de Almeida sought to put into practice his experience abroad by volunteering to teach, without interfering with the course he already held, a “public and voluntary”<sup>99</sup> course on construction the syllabus of which was adopted by the Board

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<sup>95</sup> The kind of knowledge that enabled engineers to work in public works. Mathematics and mechanics had an important role in Bommart’s courses on bridges and roads. Picon (...), *L’invention de l’ingénieur moderne*, p. 512.

<sup>96</sup> Léonce Reynaud was the brother of Jean Reynaud, an engineer who had an important intervention in the city of Paris.

<sup>97</sup> Léonce Reynaud objected, in many of his views on architecture, to Viollet-le-Duc, the greatest French architecture theoretician from the second half of the nineteenth century.

<sup>98</sup> In particular new materials, as was the case of the Vicat cement.

<sup>99</sup> This course was open to all and as to the students, attendance of lectures was not mandatory.

of the LPS. Having learned the importance of drawing in the design and planning of various kinds of constructions, he argued that in order<sup>100</sup>

to facilitate the understanding of the topics lectured in this course (...) it is of the utmost convenience an auxiliary drawing course (...). The assistant-lecturer to the Professor of Drawing of this School, João Pedro Monteiro, willingly volunteered to deliver this course in addition to his duties in this school.

In lecturing this course, Almeida used what he had learnt in Paris, so “the fruit harvested there was not lost to his compatriots.” He taught on “topics on which he had become so proficient” and among his “audience were teachers like himself.”<sup>101</sup>

In the works he led throughout his life, Albino Figueiredo had the opportunity to put in practice and highlight aspects he had learnt at the EPC in Paris, including the graphic and technical description of the projects as well as budgeting.<sup>102</sup> As he claimed, in 1854:<sup>103</sup>

Both technical descriptions and graphic drawings are essential parts of any project, because not only do they complement each other, but they also largely justify each other. There is among us a decided tendency to suppress technical descriptions, but in order to give a measure of the serious consequences of this suppression, one should recall that in French engineering and in others as organized as this, the technical description is considered to be the crucial element of any project, and it characterizes the engineer who had authored it.

In 1859, Júlio Pimentel considered that, although the Polytechnic School should train State officials who would take care of jobs such as “the defence of the country, the construction of public buildings, roads, the elaboration of maps, the piping of rivers, the improvement of ports, the administration of mines, the direction of arsenals etc.,” the school’s main task was providing “these officials with a scientific education, and subsequently sending them to special schools

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<sup>100</sup> Arquivo Histórico da Escola Politécnica de Lisboa, livro 1951- Livro copiado de correspondência saída – 1846–1849, fol 84.

<sup>101</sup> “Processo Individual de Albino Francisco de Figueiredo Almeida. MOPTC- Historical Archive.

<sup>102</sup> On the subject see Matos, (2009) “Asserting the Portuguese Civil Engineering Identity”, p. 189.

<sup>103</sup> “Relatório acerca das obras da estrada de Aldeã-Gallega a Elvas, apresentado pelo Conselheiro Albino Francisco de Figueiredo, em virtude do disposto na Portaria do Ministério das Obras Publicas, Comercio e Industria, datada de 28 de Janeiro de 1854” in Boletim do MOPCI, nº 3, Março de 1854, pp. 234-235.

where they should complete their professional education.” According to Oliveira Pimentel, the problem was that “engineers of public works, mines and the Navy do not have adequate schools in Portugal to the complete their education of those professions.”<sup>104</sup>

By then, Pimentel considered that only the Portuguese students who had completed their studies in civil engineering abroad should be employed in these works. Like in other European countries, some Portuguese engineers sought to complete their training in countries where technical education in general, and in civil engineering in particular, was more developed, as in France.<sup>105</sup>

In 1860, José Rodrigues Coelho do Amaral (1808–1873) was entrusted the direction of the LPS. He had also attended the EPC and, between 1837 and 1851, had been a professor at the Army School, which had decided to send him to Paris for a training period. Whilst attending the EPC he was also asked to attend “the course on technology” at the *Conservatoire des arts et métiers* and to gather information about the *École de Metz*. He was also asked to purchase French technical and scientific textbooks and bring the *Cahiers de cours* of the EPC.<sup>106</sup> The inspiration drawn from the French schools led to a reorganization of the curricula at the LPS, which gave particular emphasis to the teaching courses associated with civil works.<sup>107</sup> On his return from Paris, Amaral began at the Army School teaching the course on Roads and Railways, created in 1849.

## 7 – The LPS engineers trained at the EPC: the attempt to implement the model and ensure expertise in public works

Through their teaching, the engineers who had attended the EPC transmitted to their students many of the principles and practices derived from their experience in France. They played also an important role in making their colleagues of the LPS, who had no foreign experience, aware of

<sup>104</sup> Júlio Máximo de Oliveira Pimentel, Discurso pronunciado na sessão solene de distribuição dos prémios aos alunos, Lisboa, 1859.

<sup>105</sup> On technical education in France see Charles R. Day, *Les Ecoles d'arts et métiers. L'enseignement technique en France, XIX<sup>e</sup>-XX<sup>e</sup> siècles* (Paris : Belin, 1991). On the training of engineers see, among others, Grelon, André (1996), “*La naissance de l'enseignement supérieur industriel en France*”, Quaderns d'història de l'enginyeria, vol. 1, 1996, p. 40-60; Chatzis, Konstantinos (2009), “*Les ingénieurs français au XIX<sup>e</sup> siècle (1789–1914) – Émergence et construction d'une spécificité nationale*”, Bulletin de la Sabix [En ligne], 44 | 2009, mis en ligne le 22 mai 2011, consulté le 23 juin 2011. URL: <http://sabix.revues.org/691>; Chatzis, Konstantinos (2010), “Theory and Practice in the Education of French Engineers from the middle of the 18th Century to the Present”, Archives Internationales d'Histoire des Sciences 60/1-164, 2010.

<sup>106</sup> As mentioned by Marta Macedo these “*cahiers des cours*” of the EPC will serve as study material and as source of inspiration for the lithographed manuals”. Macedo, Projectar e construir a nação, p. 61.

<sup>107</sup> *Idem*, p. 63-76.

the teaching methods and practices followed in that French school, as well as of the main technical publications. Joaquim Henrique Fradesso da Silveira (1825–1875), who had been educated at the LPS,<sup>108</sup> when he became substitute lecturer for Pimentel, suggested the acquisition of the *Annales des ponts et chaussées*.

Of the 35 Portuguese engineers who completed their training at the EPC until 1870, at least nine were initially trained or taught at the LPS, like Albino de Almeida.<sup>109</sup>

Before leaving to Paris, several of these engineers had a professional career in Portugal. For example, Valentim Evaristo do Rego (1822–1884), after completing his education at the LPS in 1845, was appointed to the Portuguese Public Works Company that same year and attended the course on Descriptive Geometry and Constructions with its applications, taught by the French engineer Athanase Du Pré (1808–1869), who had graduated from the Army School in 1853, where he had attended a course on military and civil engineering. Prior to attending the EPC, Rego held various positions: in 1852, he worked for the Central Peninsular Railway Company of Portugal, under the British engineer Thomas Rumball (1824–1902); he assisted Albino Almeida in the preliminary studies for the railway from Lisbon to Santarém; in 1855, Filipe Folque requested his services at the Commission for Topographic and Geodesic Works of the Kingdom; finally, in 1856, he worked with the Portuguese engineer Joaquim Nunes de Aguiar (1880–1915) on the committee for the railway linking Santarém to the Spanish border.<sup>110</sup>

Name & dates	Schools attended prior to teaching or attending the EPC	Years spent at the EPC
José Feliciano da Silva Costa (1798–1866)	1st Director of LPS	1825
José Rodrigues Coelho do Amaral (1808–1873)	Professor at Army School 2nd Director of LPS (1860)	1844–1847
Joaquim Tomás Lobo d'Ávila (1818– 1892)	LPS	1844 –1847
Albino Francisco de Figueiredo Almeida (1803-1858)	University of Coimbra 1823 Military school/ Professor at the LPS	1845–1847
Jaime Larcher (1826-1889)	LPS (1849–1850)	1851–1853
Valentim Evaristo do Rego (1825–1884)	LPS (1845) Lisbon Army School (1853)	1856–1859
Manuel Afonso Espergueira (1833–1917)	University of Coimbra LPS	1859–1862
Joaquim Pires de Sousa Gomes	University of Coimbra (1856) Military School (1860.) Professor at the LPS (1860)	1860–1863
Frederico Ressano Garcia (1847–1911)	LPS (1861–1865) Professor at the Lisbon Army School	1866–1869

Table 2 – Engineers who attended the EPC after completing their education at the LPS (1840–1870)

<sup>108</sup> Joaquim Henrique Fradesso da Silveira, (1825–1875), having been trained at the Army School, in 1839 entered the LPS where he graduated from the Navy course. During the years he was at the Polytechnic School he attended several other disciplines.

<sup>109</sup> On the subject see Matos (2009), “Asserting the Portuguese Civil Engineering Identity” and Matos (forthcoming), “A intervenção no território, na política e no ensino técnico dos engenheiros portugueses...”

<sup>110</sup> Processo Individual de Valentim Evaristo do Rego. MOPTC–Historical Archives.

Over the years during which they were at the EPC, Portuguese engineers contacted with the most important French engineers, and learnt how to outline and manage projects both through lectures and in the field. In this way they learnt the skills necessary to subsequently work in areas ranging from the construction of bridges to hydraulics and agriculture. Furthermore, the practical work they were assigned to while attending the EPC, not only completed their training, but also allowed them to have direct contact with public works.

When they returned to Portugal, some of these engineers engaged in teaching and pass on their knowledge to new generations of engineers. For example, Joaquim Tomás Lobo d'Ávila (1818–1892), following a period during which he worked in public works at the Ministry of the Kingdom Ministry, he was appointed professor of the course on railways at the Army School. According to the Report of the Secretary of War Affairs, dated 1851, this course was “designed to develop theories underlying public works, including roads and railways,” under the supervision of one of the most “distinguished” professors of the Army School, who “for some years, was in France, perfecting himself in this field.”<sup>111</sup> In 1855, Lobo d'Ávila stopped teaching and fully engaged in the construction of railways. On 29 November 1856, he was appointed government inspector of the Portuguese Eastern Railway.

## Conclusion

The creation and establishment of the LPS and the first years of its life show that this school, despite fundamental differences, took the EPC of Paris as a reference regarding teaching methods and the measures taken to improve its organization. In effect, the appointment of the engineer José Costa as its first director, with the task of organizing it, shows precisely the intent of taking this French school as a reference and an inspiration. Similarly, Albino Figueiredo, a renowned professor of the Lisbon Polytechnic, despite his teaching experience, felt the need to attend the EPC in order to update his knowledge in technical areas, which had seen the greatest development in recent years, notably the use of new materials and construction techniques.

The permanent influence of the EPC led some of the engineers teaching at the Lisbon Polytechnic to apply for scholarships with the purpose of advancing their education in that French school. The fact that various were selected in the annual competitions open by the Ministry of Public Works, Trade and Industry, shows the permanent concern in raising the

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<sup>111</sup> Relatório da Secretaria de Estado dos Negócios da Guerra de 7 de Janeiro de 1851, anexo ao Diário da Câmara dos Deputados, vol I, 1851.

standards of technical education provided by the LPS, despite the restrictions and lack of resources with which the school often struggled.

Following their return, the Portuguese engineers who graduated from the EPC, in particular those who had been initially trained at the LPS, were instrumental in building up road and railway networks. These were essential to the “conquest of the national territory,”<sup>112</sup> a fundamental prerequisite to the construction of the nineteenth-century liberal State, and the creation of a national market through a greater movement of people and goods between different regions.<sup>113</sup> The intervention of engineers in the Portuguese territory also contributed to the emergence of a technological landscape, where urban infrastructures and railways, with its bridges and viaducts, emerge as the most salient elements.<sup>114</sup>

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<sup>112</sup> The “conquête de l’espace national” is mentioned by Antoine Picon in “Le Corps des Ponts et Chaussées. De la Conquête de l’espace national à l’aménagement du territoire.”

<sup>113</sup> Although there is abundant literature on the construction of national States and markets, for the Portuguese case see David Justino, *A Formação do Espaço Económico Nacional. Portugal, 1810-1913*. 2 Vols. Lisboa, Vega, 1988.

<sup>114</sup> On this subject there is already a major international bibliography. On Portugal see the works of Tiago Saraiva, namely Tiago Saraiva, *Ciencia y Ciudad Madrid y Lisboa: 1851-1900*. Madrid: Ayuntamiento de Madrid, 2005; Marta Macedo, *Projectar e construir a Nação – engenheiros e território em Portugal (1837-1893)*, op. cit.; Matos, Ana Cardoso de, “Paisagem, Caminho-de-ferro e Património: espaços, estruturas, imagens e narrativas” in Isabel Lopes Cardoso (ed.) *Paisagem Património. Aproximações Pluridisciplinares*, Lisboa, Dafne Editora, 2013, pp.129-149; and the oral presentation by Ana Cardoso de Matos, “Engineers, landscapes and the railways heritage,” at the *Curso Património Científico, Técnico e Industrial*, conducted by the UNESCO Chair of Technology and Culture of UPC in collaboration with the Museum of Science and Technology of Catalonia with the support of Master Erasmus Mundus TPTI. Barcelona, 14 –21 September 2009 (forthcoming).