

## António Ferreira da Silva and the Teaching of Chemistry at the Academia Politécnica do Porto (1877–1910)

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### Resumo

*No final do século XIX, a química ganhou notoriedade como uma das principais “ciências ao serviço” da nação. O surgimento de novos tópicos, métodos e práticas úteis contribuíram para a valorização da química e para a definição de medidas governamentais em temas como saúde pública, educação e proteção ambiental. Lente na Academia Politécnica do Porto entre 1877 e 1910, António Ferreira da Silva (1853–1923) desempenhou um papel central na modernização do ensino e da investigação em química em Portugal. Ferreira da Silva foi responsável pela introdução de cursos suplementares de química, pela reformulação do ensino prático, e pela elaboração de novos procedimentos e regulamentos de ensino “que em muito engrandeceram a educação científica” em Portugal. Enquanto lente da Academia Politécnica do Porto, Ferreira da Silva privilegiou ainda a articulação entre o Laboratório da Academia e as indústrias nacionais, contribuindo, em larga medida, para emergência da Química Analítica como uma nova disciplina.*

**Palavras-chave:** António Ferreira da Silva; Academia Politécnica do Porto; Química Analítica.

### Abstract

*By the turn of the nineteenth century, chemistry had become a “science at the service” of the nation. The emergence of useful topics, methods, and practices contributed to the valorization of chemistry and to the definition of new governmental directives on issues such as public health, education and environment. Lecturer at the Academia Politécnica do Porto between 1877 and 1911, António Ferreira da Silva (1853–1923) played a crucial role in the modernization of the teaching and practice of chemistry in Portugal. Ferreira da Silva created new supplementary chemistry courses, reformed the practical teaching of chemistry, and drafted new proceedings and syllabi “that glorified scientific education” in Portugal. As lecturer of the Academia Politécnica do Porto, he made important steps in the establishment of collaborations between the Academia’s Laboratory and national industries, which largely contributed to the emergence of Analytical Chemistry as an autonomous discipline.*

**Keywords:** António Ferreira da Silva; Academia Politécnica do Porto; Analytical Chemistry.

### THE ACADEMIA POLITÉCNICA DO PORTO

On May 26, 1834 Queen Maria II (1819–1853, r.1826–1828; 1834–1853) reclaimed the Portuguese throne. Between 1834 and 1836, the quick succession of governments made it extremely difficult to solve the most pressing issues that had been brought by the independence of Brazil in 1822, the Liberal Wars (1828–1834), and the expulsion of male religious orders in 1834. Whereas the independence of Brazil and the Liberal Wars had caused serious difficulties to the crown’s finances, the expulsion of the religious orders—which at that time were responsible for the primary education of thousands of students throughout the

country—were an educational catastrophe.<sup>1</sup> After two years of political turmoil, Manuel da Silva Passos (1805–1862), who served as Minister of the Kingdom between September 10, 1836 and June 1, 1837, undertook a series of initiatives that aimed to effectively reform key structural areas, as economy and education. To solve the financial problems, the liberal government turned to the northern regions of Portugal, specifically in the Porto and Douro area. The decrease of income from the trade routes with Brazil had brought an end to many important companies in the region. Inspired by industrial revolution, the liberal government sought to capitalize the “rich and numerous” population of the city of Porto and its “extensive commercial know-how.”<sup>2</sup> A plan was then put in motion to create a new and vibrant city, a “city of engineers.”<sup>3</sup>

Besides the University of Coimbra, there existed two other higher technical schools in the country: the “Academia Real de Marinha e Comércio do Porto” (Royal Academy of Navy and Commerce of Porto) and the “Academia Real da Marinha de Lisboa” (Royal Academy of Navy of Lisbon). These institutions were under the direct administration of the Ministry of Kingdom and the Ministry of War, respectively. Both were aimed at training and instructing aspiring men to become military officers. In 1836, Minister of the Kingdom Passos Manuel and José de Alexandre Campos e Almeida (1794–1850), vice-rector of the University of Coimbra, undertook a series of initiatives to reform secondary and university education.<sup>4</sup> The social and economic changes in the major cities of Portugal influenced the reshaping of the forthcoming academies. With the exception of medicine, which was regularly taught in Coimbra, Porto, and Lisboa during the nineteenth-century, each city offered unique courses for the formation of lawyers, officers, and engineers. Established in Lisbon in 1290 as the country’s first “studium generalium”, and effectively moved to Coimbra in 1537, the University of Coimbra housed schools of Law, Philosophy, Theology and Medicine, and was responsible for the education of “organic intellectuals” and “future law-makers”. Under the direction of the Ministry of War, the city of Lisbon witnessed the creation of military and technical schools responsible for the education of officers and engineers. Finally, the city of Porto harbored schools of engineering, commerce, and industry and trained future “industrialists, traders, farmers”. As Luís Reis Torgal put it, Porto had become “the city of engineers.”<sup>5</sup> This was the spirit that transpired in the Academia’s syllabi: each subject was designed to give the aspiring engineers the basic scientific

<sup>1</sup> Rui Ramos, “A revolução liberal (1834–1851),” in Rui Ramos, Bernardo Vasconcelos e Sousa, Nuno Gonçalo Monteiro, *História de Portugal*, 8ª edição (Lisboa: Esfera dos Livros, 2009), pp. 491–519; Francisco Malta Romeiras and Henrique Leitão. “The Role of Science in the History of Portuguese Anti-Jesuitism,” *Journal of Jesuit Studies* 2 (2015): 77–99.

<sup>2</sup> Rafael Ávila Azevedo, “O Porto na época moderna: da Academia Real da Marinha e Comércio do Porto à Academia Politécnica do Porto,” *Revista de história* 4 (1981): 133–150, here 146–148.

<sup>3</sup> Luís Reis Torgal, “A instrução pública,” in *História de Portugal. Volume 5: O Liberalismo (1807–1890)*, ed. José Mattoso (Lisbon: Círculo de Leitores, 1993), pp. 646–647.

<sup>4</sup> See especially: Rómulo de Carvalho, *História do ensino em Portugal: Desde a fundação da nacionalidade até ao fim do regime de Salazar-Caetano* (Lisbon: Fundação Calouste Gulbenkian, 1986) and Jorge Ramos do Ó, *Ensino liceal (1836–1975)* (Lisbon: Ministério da Educação, 2009).

<sup>5</sup> Torgal, “A instrução pública,” 646–647.

knowledge to pursue and independent and prosperous commercial activity. And chemistry was no exception.

The 1836 reform set the juridical foundations of the Academia Politécnica.<sup>6</sup> Unlike the Academia Real de Marinha e Comércio, the new Academia Politécnica was mostly concerned with the education of engineers, merchants, farmers, factory managers, and craftsmen. Between 1837 and 1843, the Academia Politécnica continued to offer courses on naval studies to future navy officers and pilots. From 1844 onward, however, the ties between the Academia Politécnica and its predecessor were effectively put to an end, when the course on naval studies was abandoned.<sup>7</sup> As a “school of engineers,” the Academia was dedicated to the teaching of mathematical subjects and “practical matters” that the students would require in their professional lives. Chemistry, however, had still a path to cross. At first, the teaching of chemistry emulated the syllabi and methods employed at the University of Coimbra since the Pombaline reform of 1772. With the nation’s best equipped chemistry laboratory, the teaching of chemistry at the University was conceived to support the medical and pharmaceutical courses. Therefore, the University of Coimbra was seldom the stage for a hands-on experimental teaching of chemistry.<sup>8</sup>

Since 1837, the Academia Politécnica offered a course on “Chemistry, chemical arts and mine founding.” The program was not particularly extensive and allowed for a certain degree of freedom. Nonetheless, it established important boundaries, as the clear separation between theory (“Chemistry”) and practice (“Chemical arts”) testify to. Following what had been a fairly common tradition, the teaching of “Chemistry” focused on the origin of substances, whereas the teaching of “Chemical Arts” was dedicated to its applications. The teaching of “Chemistry” was subdivided into mineral, vegetal and animal chemistry, and there was a common emphasis on classification and analysis. Curiously, the teaching of nomenclature was only part of mineral chemistry.<sup>9</sup> Despite the considerable efforts put by English and German chemists to harmonize nomenclature in organic and inorganic chemistry, the Academia chose to adopt French nomenclature during its entire existence (1837–1910).<sup>10</sup>

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<sup>6</sup> *Diário de Governo* (November 19, 1836). On the history of the Academia Politécnica see especially: Artur Magalhães Basto, *Memória histórica da Academia Politécnica do Porto*, 2 ed. (Porto: Universidade do Porto, 1987).

<sup>7</sup> *Collecção de leis e outros documentos oficiais publicados no 1.º semestre de 1837 (Sétima série, 1.ª parte)* (Lisboa: Imprensa Nacional, 1837), pp. 96–97.

<sup>8</sup> On the history of the University of Coimbra and the Pombaline reform see especially: *História da Universidade em Portugal*, 3 vols. (Coimbra: Universidade de Coimbra, 1997) and Ana Cristina Araújo, ed., *O marquês de Pombal e a Universidade* (Coimbra: Universidade de Coimbra, 2000). For the teaching of science at the University of Coimbra see: Carlos Fiolhais, Carlota Simões, Décio Martins, eds., *História da ciência na Universidade de Coimbra: 1772–1933* (Coimbra: Imprensa da Universidade de Coimbra, 2013) and Rómulo de Carvalho, “As ciências exactas no tempo de Pombal,” in *Como interpretar Pombal? No bicentenário da sua morte*, ed. Manuel Antunes (Lisbon: Brotéria, 1982), pp. 215–32.

<sup>9</sup> *Anuário da Academia Politécnica do Porto 1883–1884* (Porto: Typographia Central, 1884), pp. 259–61.

<sup>10</sup> For a global history of chemistry, see: Bernadette Bensaude-Vincent, Bernadette and Isabelle Stengers, *A History of Chemistry* (Cambridge, MA: Harvard University Press, 1996).

Because the Academia was, most of all, a school of engineering, the teaching of chemistry highlighted its practical uses. The teaching of “Chemical arts” was specifically meant to give a solid training on the main applications of chemistry to future engineers. The topics were rather diverse and ranged from writing chemical formulas to experimental demonstrations. This allowed the students to get acquainted with the multiple applications of chemistry and ensured that they learned “how the devices work.”<sup>11</sup> Moreover, the syllabus emphasized that the future engineer should be able to use instruments and perform experiments to solve real problems with “chemical theories.”<sup>12</sup> At the Academia, chemistry was, therefore, meant to become more than just a handmaiden discipline for the arts. It was meant to be a discipline for the common good, a science at the service of the nation.

In 1860, almost thirty years after the foundation of the Academia, several faculty members manifested their concern with the teaching of chemistry.<sup>13</sup> According to the Academia’s Academic Council, the teaching of chemistry was in need of a serious reform. Due to space constraints and lack of consistent funding, the hands-on experimental teaching of chemistry had only begun in 1844. But, the most pressing issue was the syllabus itself. According with what had become the common practice in European colleges and universities, the teaching of chemistry should reflect the separation between pure and applied chemistry, rather than focus on chemistry, chemical arts, and mine founding. Having the European framework in mind, the Academic Council thus proposed the creation of two new courses: inorganic and organic chemistry. This reform was very much welcomed, deeming it especially helpful for the “students’ scientific education.”<sup>14</sup> The Academia started to offer courses on inorganic and organic chemistry in 1861. However, the lack of an appropriate endowment to improve the laboratory seriously limited its possibilities.<sup>15</sup>

### ANTÓNIO FERREIRA DA SILVA AND THE TEACHING OF CHEMISTRY

The turning point for the teaching of chemistry came with the arrival of a new professor, António Joaquim Ferreira da Silva (1853–1923). Son to António Ferreira da Silva (1806–1869) and Margarida Emília Ferreira (1827–1914), António was born in Oliveira de Azeméis, in the outskirts of Aveiro, on January 6, 1853. He studied natural philosophy at the University of Coimbra between 1872 and 1876 and moved to Porto the following year to take a temporary position as lecturer at the Academia Politécnica. In 1880 he became a

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<sup>11</sup> *Collecção de leis e outros documentos oficiais publicados no 1.º semestre de 1837 (Sétima série, 1.ª parte)* (Lisboa: Imprensa Nacional, 1837), pp. 96–97.

<sup>12</sup> *Collecção de leis e outros documentos oficiais publicados no 1.º semestre de 1837 (Sétima série, 1.ª parte)* (Lisboa: Imprensa Nacional, 1837), pp. 96–97.

<sup>13</sup> Arquivo do Fundo Antigo da Faculdade de Ciências da Universidade do Porto, *Livro de correspondência expedida: Laboratório da Academia Polytechnica (1885–1898)*, pp. 60–65.

<sup>14</sup> *Anuário da Academia Politécnica do Porto 1881–1882* (Porto: Typographia Central, 1882), pp. 43–45.

<sup>15</sup> Arquivo do Fundo Antigo da Faculdade de Ciências da Universidade do Porto, *Livro de correspondência expedida: Laboratório da Academia Polytechnica (1885–1898)*, pp. 61.

tenured professor of chemistry and married his second-cousin Idalina de Sousa Godinho (1864–1922). Idalina was daughter to the viscounts of São Tiago de Riba Ul, José Joaquim Godinho (1836–1885) and Alexandrina Rosa de Sousa (1838–1908). She and António were devout Catholic and fathered fourteen children.<sup>16</sup>

Besides being an active scholar, Ferreira da Silva embodied the motto “science at the service of the nation.” He was frequently asked to apply his skills as an analytical chemist in the resolution of economic and forensic quarrels. He became known for his participation as a witness and expert in the murder trial of Vicente Urbino de Freitas (1849–1913) in 1890, and for his decisive role in the controversies between the Brazilian and Portuguese governments over the adulteration of Port wine exported to Brazil in 1894 and again in 1900.<sup>17</sup> During the 1890s, he developed new methods and reagents for the identification of substances that rapidly became the standard procedure in chemistry textbooks, such as the Lafont-Ferreira da Silva reagent. Ferreira da Silva spent much of his career teaching chemistry at the Academia Politécnica do Porto (1877–1910), the Faculty of Sciences and the Faculty of Pharmacy of the University of Porto (1911–1923). He participated in a series of international conferences on nomenclature, sharing the stage with prominent chemist like Dmitri Mendeleev (1834–1907) and Marcellin Berthelot (1827–1907). Perhaps most importantly, he was the mentor and sole director of the Municipal Laboratory of Porto (1895) and the founder and President of the Portuguese Society of Chemistry (1911). He was also one of the founders and the first editor-in-chief of the earliest national journal exclusively dedicated to chemistry, the *Revista de Chimica Pura e Aplicada* (Journal of pure and applied chemistry, 1905).

Throughout his career Ferreira da Silva persistently kept record of all his activities as a professor, researcher, and editor. In 1885, he wrote a short report on the “teaching of chemistry at the Academia Polytechnical do Porto.”<sup>18</sup> This report includes statements from past and present professors as well as a personal assessment of the teaching of chemistry. After describing the early years of the Academia, Ferreira da Silva analyses the odd inclusion of “mine founding” in the syllabus of chemistry. For him, this decision had not been very well planned, as a decision of the academic council in 1838 then confirmed.<sup>19</sup> That year, the board decided to separate mine founding from chemistry and to create two new subjects, one dedicated to geology, minerology, agronomy, mine digging, and metallurgy, and other to animal, vegetal, and mineral chemistry. In an in-depth analysis of the 1838 programs, Ferreira da Silva enlists the

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<sup>16</sup> For a recent biography see: Jorge Alves and Rita Alves, *Nos Caminhos da Química, A. J. Ferreira da Silva* (Porto: Universidade do Porto Edições, 2013).

<sup>17</sup> António Ferreira da Silva, *A suposta salicilagem dos vinhos portugueses no Brasil (1900–1902): Memórias, notas e documentos* (Coimbra: Imprensa da Universidade, 1919); Antonio La-Grange, *Audiências de julgamento do Dr. Urbino de Freitas* (Porto: Typographia de Arthur José de Sousa e Irmão, 1893), pp. 203–31.

<sup>18</sup> Arquivo do Fundo Antigo da Faculdade de Ciências da Universidade do Porto (henceforth FAFC), *Livro de correspondência expedida: Laboratório da Academia Polytechnica (1885–1898)*, pp. 60–72.

<sup>19</sup> FAFC, *Livro de correspondência expedida*, pp. 60–61.

main topics covered in the new course of chemistry. For him, the professors of chemistry spent too much time teaching inorganic chemistry, especially nomenclature and chemical applications. Early on, his predecessors deemed the course too dense and proposed the creation of two complementary courses. With the pile of complaints increasing, the head of the Department of Philosophy decided favorably. Following the commonly accepted division between pure and applied chemistry, he thus proposed the creation of two courses: inorganic and organic chemistry.

This important reform, Ferreira da Silva argued did not remove all “the obstacles” to implement a modern teaching of chemistry.<sup>20</sup> As a series of reports by students and teachers alike testified to, the laboratory of chemistry was small and inadequate for teaching. Besides, the lack of an appropriate endowment prevented the execution of experiments. To circumvent this major constraint, professors need to “pay at their own expenses” the supplies and materials they needed to teach. Although these issues were frequently raised at the official meetings of the Academia, there was no silver lining to look for. In 1871, that is ten years later after the creation of the courses of inorganic and organic chemistry, there was an attempt to reform the statutes of the Academia. Regarding the teaching of chemistry, the new statutes proposed the reorganization of the courses and the creation of new subjects, such as analytical chemistry. However, the lower House of Parliament, the Câmara dos Deputados, did not endorse the reform.

After being appointed lecturer, Ferreira da Silva brought about a few significant changes in the teaching of chemistry. First, he extended both courses to two years. Moreover, he offered to teach organic and inorganic chemistry, without any financial compensation, because he wanted to ensure that all students were given the same lectures.<sup>21</sup> In 1885, that is when he wrote his report, the syllabi of organic and inorganic chemistry comprised general aspects and industrial applications. Besides, by this time, the course of organic chemistry already included a few lectures on analytical chemistry, as the 1871 reform had sought to implement.

Besides redefining the structure of the courses, the insertion of analytical chemistry as an independent subcategory, and the focus on industrial applications on both organic and inorganic chemistry were pivotal changes in the teaching of chemistry. Although the purpose of the Academia continued to be the education of future engineers and industrialists, the number of undergraduates from the pharmaceutical and medical schools were increasing rapidly. For Ferreira da Silva, this reform would greatly benefit the latter, as he was already witnessing in his lectures and practical lessons.<sup>22</sup>

Comparatively, the new programs were more detailed than the previous ones. The new syllabi were mainly focused on Portuguese industrial applications, with very few mentions to recent research in organic

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<sup>20</sup> FAFC, *Livro de correspondência expedida*, pp. 60–62.

<sup>21</sup> FAFC, *Livro de correspondência expedida*, pp. 61.

<sup>22</sup> FAFC, *Livro de correspondência expedida*, pp. 61–62.

synthesis. As Ferreira da Silva later recalled, it was extremely important for the prosperity of the country to promote the teaching of chemistry and, especially, its applications to Portuguese industries.<sup>23</sup> The syllabus of organic chemistry further promoted this link in the part dedicated to quality control and product analysis. Finally, the focus on forensic and toxicological chemistry sought to benefit future physicians and pharmacists. Besides from the numerous mentions of applied chemistry, the concept of pure chemistry was also updated. Again, these changes were made having in mind medical students. Among other things, the new programs made reference to Mendeleev's periodic table, and to new methods for the determination of chemical properties in complex compounds.<sup>24</sup> Finally, Ferreira da Silva also reformed the practical lessons at the laboratory. After the building of a new wing in 1868, he drafted a rulebook for the laboratory that gathered the first notions of laboratory safety. Furthermore, the 1885 reform also highlighted the importance of chemical analysis. Aside from the traditional experimentation and demonstrations, some attention was already given to the analysis of construction materials, fertilizers, and poisons.

Since its opening in 1837, the Academia Politécnica do Porto promoted the teaching of chemistry at a university level. During the nineteenth-century there were a few attempts to reform the Academia and the teaching of chemistry but these changes were only implemented in 1885, with Ferreira da Silva as its driving force. From that year onward, organic and inorganic chemistry replaced animal, vegetal, and mineral chemistry. For Ferreira da Silva, the teaching of chemistry needed to address certain issues of the society. From industrial applications, to public health and forensic chemistry, he pushed the role of the chemist and its laboratory to the "prosperity of the country."<sup>25</sup> After the republication revolution, in October 1910, the Academia became the cradle of a new Faculty of Sciences. However, the syllabi adopted in 1911 was an exact copy of the 1885 courses.

FIGURE 1

<sup>23</sup> António Ferreira da

<sup>24</sup> Isabel Malaquias, *Responses to the Pe* University Press, 201

<sup>25</sup> António Ferreira da



*cada 1 (1905): 1–3.*  
in Portugal,” in *Early*  
Pallo (Oxford: Oxford

*cada 1 (1905): 1–3.*

Academia Politécnica (currently the Reitoria da Universidade do Porto), 1890

FIGURE 2



António Joaquim Ferreira da Silva (picture from the Portuguese jornal *Charivari*, January 26<sup>th</sup>, 1889), 1889

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