

REGULATIONS OF THE MINERAL CHEMISTRY LABORATORY OF THE POLYTECHNIC SCHOOL OF LISBON IN 1889

Maria Luisa Cordeiro Rolo LABORINHO DOS SANTOS ALVES

Universidade de Lisboa, PORTUGAL

luisa.laborinho@gmail.com

Abstract

Built “with the thought of filling the lack, in Lisbon, of (...) an establishment where at least the rudiments of natural sciences could be taught”, the Polytechnic School of Lisbon appears as a space where science teaching reveals specific characteristics, and laboratory practice, in spite of several difficulties, is progressively introduced as an important factor in the teaching and learning process.

The works carried out in the laboratory of 6th course –General Chemistry and Notions of its main Applications to Arts– that transformed the old laboratory in the magnificent Mineral Chemistry Laboratory, constituted a landmark in the evolution of the experimental teaching in our country.

The Director of the Laboratory, Professor José Júlio Bettencout Rodrigues wrote very detailed regulations for the work in this laboratory that we will analyze in this communication. In his “Projecto sumário de Regulamento dos Trabalhos e Serviços do Laboratório de Química Mineral da Escola Polytechnica de Lisboa” in 1889/1890 he specifies the rules related to the management of the laboratory, like the opening hours timetable in different days of the year, as well as some elementary safety rules. He also details the process of assessment of students. These regulations for the practical work in the laboratory are very complete, as compared to those of other laboratories at that time. They reflect not only concerns for the good management of the laboratory, but also pedagogical concerns related to the teaching and learning of good practice of the students, and are an important conquest in science education in Portugal. The laboratorial practice is gradually an important agent in the process of teaching learning that deserves to be remembered.

Built “with the thought of filling the lack, in Lisbon, of (...) an establishment where at least the rudiments of natural sciences could be taught”¹, the Polytechnic School of Lisbon appears as a space where science teaching reveals specific

¹ FACULDADE DE CIÊNCIAS DE LISBOA (1937). *Escola Politécnica de Lisboa. Primeiro Centenário da Escola Politécnica (1837-1937)*. Lisboa. 14 vols, 2, vol.1, pp. 5-6.

characteristics, and laboratory practice, in spite of several difficulties, is progressively introduced as an important factor in the teaching and learning process.

Founded in 1837, the pathway from its beginnings until the publication of the Regulations² in 1889, when the practical work in the 6th Chair (Chemistry) was implemented in a systematic, although not compulsory way, was not straightforward. That is, during about half a century, there was a large gap between the will for the implementation of practical work and its effective concretization.

Portugal, like other European countries, recognized the potential of chemical knowledge for the development of the country, and strove for the implementation of a quality teaching of this discipline. Vincent and Stengers refer a “global process of professionalization of sciences that occurred during the first half of the 19th century, affecting all fields of knowledge” and “where chemistry is frequently in the frontline” because “this process is due to an *effective* and not only formal transformation of the chemical practices”³. They also refer that “In the formation of chemical, experimental work is recognized as a necessity. It is no longer making some spectacular demonstrations before an audience of curious, but to train students in laboratory work”.

In this context of *effective* transformation, the implementation of chemistry practical work in the laboratory of the 6th Chair – “the most expensive chemistry discipline and the one with most students”⁴– is significant and deserves to be pointed out, referring the professor who undertook this transformation, José Júlio Bettencourt Rodrigues. In 1885, after several unfruitful attempts to establish practical classes, he wrote a striking document addressed to the Polytechnic School Council, where he brings to light the “critical state of chemistry teaching”⁵. Finally he succeeded in changing the situation, making clear the need for major works that were, by then, carried out in the laboratory of 6th course – *General Chemistry and Notions of its main Applications to Arts* – transforming the old laboratory in the magnificent *Mineral Chemistry Laboratory*, which constituted a landmark in the evolution of experimental teaching in our country.

The letter that A. W. Von Hoffmann wrote to José Júlio Rodrigues⁶, which is transcribed below (with our underlining), in its original language, reveals the importance of the laboratory:

« Lisbonne, août 17, 1890
 Monsieur et très cher collègue.
 Je ne puis pas quitter Lisbonne sans vous témoigner ma reconnaissance pour l'accueil aimable que je dois à vous et à M. Lourenço.
 Il m'est à la fois un plaisir et un devoir de vous dire l'impression qui a produit sur moi la visite à l'École Polytechnique de Portugal. J'ai été étonné de trouver un établissement de premier ordre, dont tout pays aurait droit d'être fier.
 J'admire surtout les laboratoires et l'amphithéâtre de chimie. Ayant construit les laboratoires des universités de Bohn et de Berlin, je crois posséder quelques connaissances des institutions chimiques, et je n'hésite pas d'affirmer que je ne connais pas un laboratoire mieux installé pour l'enseignement et pour la recherche.
 Les salles de travail et l'auditoire commandant une profusion d'espace, d'air et de lumière que je n'ai pas rencontré souvent ailleurs. Permettez en outre d'ajouter que je ne me rappelle pas un laboratoire où on a réussi à combiner d'une manière semblable l'élégance et l'utilité.
 Adieu, mon très cher collègue
 Monsieur le Professeur José Júlio Rodrigues
 Votre dévoué
 A. W. Von Hoffmann »

The first practical course was opened in the academic 1889-1890 and it was a remarkable achievement with an epistemological, didactical and pedagogical range. This step in chemistry teaching required new regulations for the laboratory practice.

² RODRIGUES, José Júlio (1889). *Projecto summario de regulamento dos trabalhos e serviços do Laboratório de Chimica Mineral da Escola Polytechnica de Lisboa posto em execução como experiência e sob a responsabilidade do respectivo Director no anno lectivo de 1889 e 1890*. Lisboa, Imprensa nacional.

³ BENSUAUDE VINCENT, Bernadette et al. (1996). *História da química*. Instituto Piaget, pp140.

⁴ RODRIGUES, José Júlio (1885). *Exposição ao Conselho da Escola Polytechnica sobre o ensino e mais serviços da 6ª cadeira, acompanhada de várias propostas tendentes a melhorarem e reformarem o ensino da Chimica Mineral*. Lisboa, Typographia Universal, pp 5.

⁵ RODRIGUES, José Júlio (1885). *op. cit.*, pp. 4-8.

⁶ HOFMANN, A. W. von (1891). “Carta a José Júlio Bettencourt Rodrigues” in *Estabelecimentos Científicos em Portugal*. O Occidente, Lisboa, vol.14 (434), 11 de Janeiro, pp 13-14.

The Director of the Laboratory, Professor José Júlio Bettencout Rodrigues wrote very detailed regulations for work in this laboratory. In his "*Projecto sumário de Regulamento dos Trabalhos e Serviços do Laboratório de Química Mineral da Escola Polytechnica de Lisboa*" in 1889-1890 he specifies the rules related to the management of the laboratory, like the opening hours in different days of the year, the timetable for students and workers, as well as some elementary safety rules. He also details the process of assessment of students.

These regulations for the practical work in the laboratory are very complete compared to those of other Portuguese laboratories at that time. They reflect not only concerns for the good management of the facility, but also pedagogical concerns related to the teaching and learning of good chemistry practice of students, being a landmark in science education in Portugal.

Comparing the *Regulamento* with the two previous Portuguese laboratory regulations before 1889, namely:

1. *Regulations of the Chemistry Laboratory of the Commercial and Industrial Institute of Lisbon*, written by professor António Augusto de Aguiar, dating from 1872, with 20 articles (it includes organization, laboratory work, the kind of teaching applied, the way it was performed, and to whom it was directed. It doesn't refer to security rules. It doesn't offer general information about the laboratory work. It mentions who subsidizes the laboratory and the necessary funding);
2. *Regulations of the Practical Chemistry Course of the Coimbra University*, written by Professor Corrêa Barata, dating from 1879, with 12 articles (it includes laboratory work, functions of the auxiliary personnel who work in the laboratory, and also conditions for admission to the course. It refers five safety rules: the student is required to remain in the designated place for the implementation of his practical work, having no access to any other lab space without permission. The student should show, in his practice, order and cleanliness. The use of small quantities of chemicals and "fume cupboards" is recommended. The poor performance or the breach of the rules is punishable by expulsion of the course).

Indeed, the *Regulations of the Mineral Chemistry Laboratory of the Polytechnic School of Lisbon* in 1889, reflect a change from a "teaching that previously was nothing but mere individual attempts, without a pedagogic range", into a "regular course with a special application, independent teaching, budget, reliable personnel and adequate material"⁷. This document, besides presenting a significant difference, the details of the articles submitted, informs a lot about the practical chemistry at the time.

It has 66 articles, divided into three parts:

- The *first part* consists of 19 articles specifying the general instructions for the functioning of the laboratory of the 6th course (chemistry mineral).
- The *second part*, details the "demonstration work at the 6th course and scientific investigations that could be performed in the laboratory". It consists of two sections:
 - First section - Experiments of the "general course", with 1 article;
 - Second section – Scientific work not related to the regular course, with 3 articles.
- The *third part* contains instructions for the students' laboratory work in the 6th course, with a total of 43 articles in one section.

The students, who until then only visualized experimentation during the theoretical course, started to perform laboratorial practice during the practical course. However, at the beginning, the practical course was not compulsory. The practical teaching, although having no obligatory character at first, was aimed at repeating "the experiments seen in the course"⁸, that are exposed in "special tables", similar to the experimental manuals used nowadays.

The first course started in the middle of November, 1889, and finished in May, 1890, "the students had to be present in at least 20 lessons of 2 hours each, with schedule to choose between 10 and 12 o'clock or between 10 and 14 o'clock"⁹.

⁷ JANEIRA, Ana Luísa (1987). *Sistemas Epistémicos e Ciências. Do Noviciado da Cotovia à Faculdade de Ciências de Lisboa*. Lisboa, Imprensa Nacional – Casa da Moeda.

⁸ OSÓRIO, Balthasar (1894). "José Júlio Bettencout Rodrigues – Licção de Abertura do curso de Química Mineral na Escola Polytechnica de Lisboa (1893-1894)". *Revista de Educação e Ensino*, Lisboa (9), pp.1-13.

⁹ RODRIGUES, José Júlio (1889). *Projecto summario de regulamento dos trabalhos e serviços do Laboratório de Química Mineral da Escola Polytechnica de Lisboa posto em execução como experiência e sob a responsabilidade do respectivo Director no anno lectivo de 1889 e 1890*. Lisboa, Imprensa nacional.

The maximum number of students in a class was 32 (24 in the gallery and 8 in the ground floor. The students usually stood up and worked “dressed with a special gown and bare-headed.”¹⁰

The rules stating the management of the laboratory includes the working days in the week and along the year, the opening hours in different days of the year; the access to the laboratory; personnel in charge and their duties; service areas of the laboratory; experiments of the general course. It also details the process of assessment of students, and the regulations also define the characteristics of the general course (registration, duration and functioning of the course, recommendations on the handling of chemicals and safety rules, equipment distributed to the students for their practical work, responsibility for the equipment, assessment and classification of the students).

Students assessment depended on their “tranquillity and moderation”, “cleanliness”, “accuracy and quickness”, “special attention” on their “way of taking notes” and how they “answered the questions made by the chief in charge or the assistant lecturer during the works and on their notebook”. *The notebook* should have the following characteristics: “in quarter” format, hardcover with at least 100 pages, firmly bound. The student’s name, registration number in the general course and in the laboratorial works should be on the cover, as well as his practical work schedule, and should stay in the laboratory. The quality notebooks and products obtained in these practical works were kept and archived as a merit evidence. The regulation is detailed in the rules that students must meet during the course of practical work.

The students were requested to extinguish any gas fire “no longer needed” and to spend only the water indispensable to their experimental work, only to use the strictly necessary quantities of the reagents for the experiments.

The student did not have access to the deposits of material, chemicals, or utensils they needed, without “written or verbal request”.

Some of the safety rules were related with the evaporation or manipulation of concentrated acids, corrosive or volatile liquids, chemicals with an unhealthy or unpleasant smell, namely sulphidric acid –outside the fume hoods, it was forbidden; spilling of water or chemicals on the tables or on the floor, throwing paper or other debris on the floor; pouring corrosive liquids in the bench sink; throwing thick liquids, debris, filters etc. In any other than the specific sink is forbidden; and on the tables there should be special containers for collecting residues.

The student had a list of the equipment and chemicals that he received and he had to account for at the end of each academic year. There was an audit of equipment and utensils. The first student in each group of students was the supervisor of equipment and utensils. He had the duty to inspect equipment and tools assigned to the group.

In 1901 the practical course became compulsory and its classification accounted for up to 6 points (in 20) of the final classification. The Mineral Chemistry Laboratory was restored, and opened its doors as a part of the Science Museum of the University of Lisbon in 2007.

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(It includes the Decree of 11 January 1837, creating the Polytechnic School of Lisboa, and may also contribute to the study of the legislative discourse of this period.)

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¹⁰ RODRIGUES, José Júlio (1889). *Projecto summario de regulamento dos trabalhos e serviços do Laboratório de Chimica Mineral da Escola Polytechnica de Lisboa posto em execução como experiência e sob a responsabilidade do respectivo Director no anno lectivo de 1889 e 1890*. Lisboa, Imprensa nacional, p.10.

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