

Organic Chemistry in Portugal from 1900 to 1970: A Contribution to the History of Science

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Article history: Received: 07 October 2017; revised: 12 November 2017; accepted: 14 November 2017. Available online: 26 December 2017. DOI: <http://dx.doi.org/10.17807/orbital.v9i5.1086>

Abstract: The main purpose of this article is to describe the contributions made by various professors in Portuguese institutions, (located at Lisbon, Coimbra and Oporto), for the development of organic chemistry, between 1900 and 1970, so that we can get a better idea of the Portuguese work done in this area (i.e., teaching, pedagogical, etc.). For this purpose, we will take particular attention to technical books used in class (lecture and laboratory). Another point of this article is to refer the organic chemistry laboratories, existent in various Portuguese universities, in order to understand the importance of practice for the complete university student training.

Keywords: organic chemistry laboratories; Portuguese institutions; professors of organic chemistry; technical books

1. INTRODUCTION

In Portugal there are some studies about organic chemistry. However, these studies are particularly related with the technical aspects of organic chemistry and not with its history. There are some exceptions, such as those made by the group Working Party (WP), Science and Technology in the European Periphery (STEP), History of Chemistry of the European Association for Chemical and Molecular Sciences (EuCheMS).

And so, this article aims to make a contribution to the history of chemistry through the study of several scholars who taught organic chemistry in Portuguese institutions, between 1900 and 1970. The word «institution» [1] comes from the Latin meaning «creation, foundation», which means that the main role of an institution is to introduce innovation in the teaching of knowledge, so that scientific research might progress in the right way. In Portugal, the main scientific institutions are located in Lisbon, Coimbra and Oporto.

In Portugal, the development of organic chemistry was due, particularly, to the effort of the Professor Andrade Gouveia (1905-2002), who after

receiving his PhD from Liverpool, he brought major innovations to Portuguese Institutions, particularly in the promotion of links between universities and industry. In fact, after Professor Andrade Gouveia received his PhD, many more connections were forged between universities and industry in Portugal, such as, Cires ((resins industry, CUF ((fertilizer industry), Petrogal (oil industry), Borealis (plastics industry), and so on.

Moreover, at the first conference in Portugal about «The History and the Development of the Science in Portugal», Professor Andrade Gouveia enjoyed the collaboration of A. G. Debus (University of Chicago) and W. R. Shea (McGill University), which contributed to the internationalization of the history of chemistry in Portugal. Later, there were two more conferences called «IUHPS» (International Union of History and Philosophy of Science), and «ICSU» (International Council of Scientific Unions) about the scientific revolutions in the chemistry field, particularly in the area of the history of science.

2. MATERIAL AND METHODS

In this work, we did a deep bibliographical

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research about -scholars and institutions in Portugal which have contributed to the development of organic chemistry, between 1900 and 1970. In addition to the Portuguese National Library, we consulted the main historical archives and libraries of the various centres of higher education in Portugal, located at Lisbon, Coimbra and Oporto, where there is the teaching and research in organic chemistry. In Portugal, the main archives and libraries are the archive of Torre do Tombo, archive and library of Technical Higher Institute, archive and library of the Faculty of Sciences of the University of Lisbon, archive and library of the Faculty of Pharmacy of the University of Lisbon, library of the Portuguese Chemical Society, library of the Academy of Sciences, archive and library of the Faculty of Sciences and Technology of the University of Coimbra, archive and library of the Faculty of Pharmacy of the University of Coimbra, archive and library of the Faculty of Engineering of the University of Oporto, archive and library of the Faculty of Sciences of the University of Oporto, archive and library of the Faculty of Pharmacy of the University of Oporto.

We did also some personal contacts with scholars who taught organic chemistry in Portuguese institutions (all of them disciples of others deceased scholars) who have given us some personal information on how the classes in organic chemistry occurred (lecture and laboratory) in the first half of the 20th century. The name of them are: Professor Bernardo Herold of Technical Higher Institute, Professor Amélia Pilar of Faculty of Sciences of the University of Lisbon, Professor José Pedro Sousa Dias of Faculty of Pharmacy of the University of Lisbon, Professor Artur Silva of Portuguese Chemical Society, Professor José Simões Redinha of Academy of Sciences of Lisbon, Professor António Amorim Costa of Faculty of Sciences and Technology of the University of Coimbra, Professor João Rui Pita of Faculty of Pharmacy of the University of Coimbra, Professor Rodrigo Guedes de Carvalho of Faculty of Engineering of the University of Oporto, Professor Carlos Corrêa of Faculty of Sciences of the University of Oporto, Professor Madalena Maria Pinto of Faculty of Pharmacy of the University of Oporto.

3. RESULTS AND DISCUSSION

In this section, we will present the results of our investigation about the historical contributions made by several scholars in Portuguese institutions, from 1900 to 1970, to the development of organic chemistry,

describing and discussing the most relevant facts of our research.

In Lisbon, the course of chemical engineering (whose roots are in the industrial course of commerce of Lisbon) was one of the 5 courses of engineering created in the Technical Higher Institute, in 1911. The course of chemical engineering of this institution has a discipline called «organic chemistry» which was taught, from 1911 to 1970, by the Professor Charles Lepierre (1867-1945) (who taught from 1911 to 1922), Professor Arnaldo Peres de Carvalho (1904-1989) (who taught from 1935 to 1947), Professor Pierre Laurent (1909-?) (who taught from 1952 to 1961) and Professor Bernardo Herold (1933-alive) (who taught from 1962 to 1970). In this discipline, particular attention has been given to the study of “hydrocarbons”, through the use of several technical books, such as, «General Chemistry, Inorganic and Organic and Analysis of Elements» [2] (written by Charles Lepierre), «Méthodes et Réactions de l'Analyse Organique» [3] (translated into Portuguese by Pierre Laurent) and «Organic Chemistry» [4] (translated into Portuguese by Bernardo Herold). All these scholars were austere man, who -have written important papers in organic chemistry area, as well as, possessing a dynamic energy which contributed to the improvement of the prestige of this institution. In the fifties, the organic chemistry laboratory of Technical Higher Institute (Figure 1) [5] was renovated by Professor Pierre Laurent. Until now, the laboratory was a small space where Pierre Laurent showed only a few practical experiments, in which students did not participate. However, in the second half of the 20th century, in addition to lecture, the course of chemical engineering required laboratory in order to prepare the future engineers in a more complete way. To do so, Professor Pierre Laurent asked for the collaboration of several international institutions, such as, the Liège University (particularly, through the knowledge of Pierre Tarte on macrocyclic acetates) and the Calouste Gulbenkian Foundation's financial support (which contributed to the renovation of the “new” organic chemistry laboratory). This laboratory was equipped with the support of some Portuguese institutions, such as Dyrup, Ciba, the Portuguese Society of Liquid Air, among others. In 1953, this laboratory could hold up to 48 students and so, it allowed not only the discovery of new vocations in the field of organic chemistry but also consolidate the knowledge of future chemical engineers. However, both Professor Arnaldo Peres de Carvalho and Pierre Laurent were removed from this institution for political reasons. In fact, their political

ideology opposed that of the Portuguese Government, which meant that they had no time to “make their own school” (with their own pupils) in this institution.

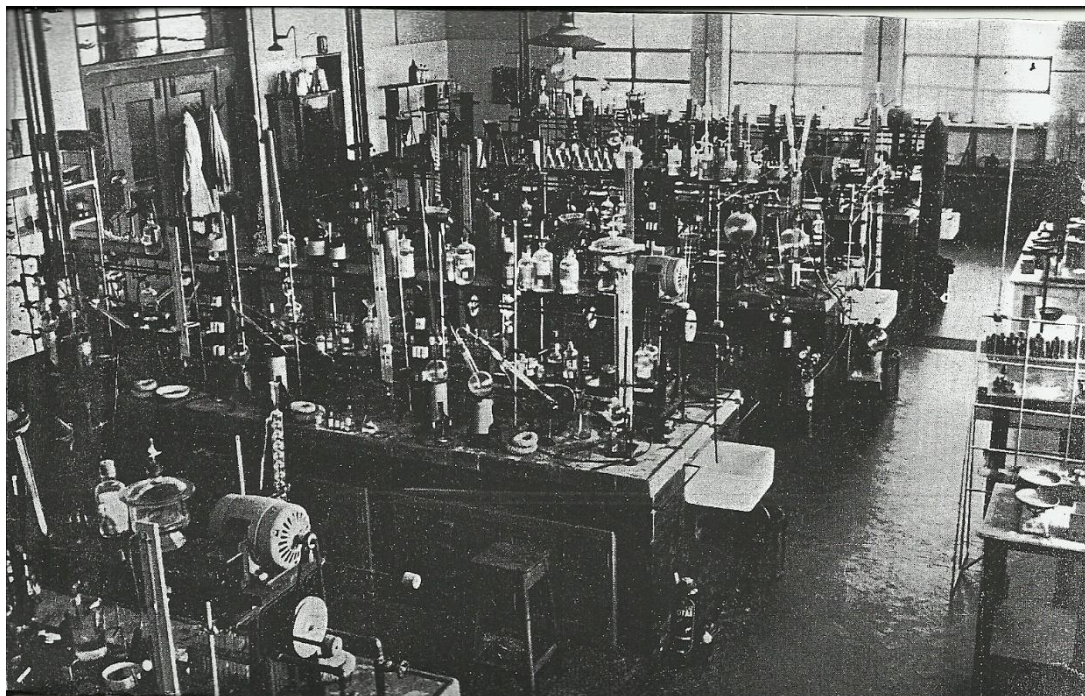


Figure 1. The organic chemistry laboratory of Technical Higher Institute, in the fifties.

The Faculty of Sciences of the University of Lisbon was created in 1911, with a strong vocation for research and teaching in the field of «chemistry» which was performed by Professor Aquiles Machado (1862-1942) (who taught from 1900 to 1921), Professor António Pereira Forjaz (1893-1972) (who taught from 1922 to 1941) and Professor Paul Jacobsohn (1904-1991) (who taught from 1942 to 1970). In this institution, particular attention –has been given to the study of “stereochemistry” which is reflected by the use of certain technical books, such as, compêndio’s «Elements of Mineral Chemistry and Organic Chemistry» [6] (written by Aquiles Machado), «Introduction to Organic Chemistry» [7] (written by António Forjaz) and «Summary of Organic Chemistry lessons» [8] (written by Paul Jacobsohn). Professor António Pereira Forjaz became Director of the Faculty of Sciences of Lisbon, and during his tenure, and with the support of a group of remarkable lecturers (such as, Professor Antenor Borges de Almeida), this institution enjoyed a dynamic period. In addition to lecture, Professor António Pereira Forjaz was continually involved in organic chemistry research and produced high-quality papers that saw international recognition. Lectures are complemented by laboratory which were also an important part of the “Preparatórios” (Preparatory studies) for the Medicine, Engineering

and Pharmaceutical courses, in the first half of the 20th century. However, during the first half of the 20th century, the laboratory experiences (Figure 2) [9] were mainly descriptive in which students were only spectators of the teacher’s experiments and where knowledge was transmitted in a non-organized way. Most positively, the work done by the Professor Aquiles Machado, which was continued by Professor António Pereira Forjaz, led to the construction of an organic chemistry laboratory which was, in the middle of 20th century, a benchmark in the experimental study of chemistry.

In fact, in the second half of the 20th century, the chemical laboratory of this institution was one of the biggest laboratories in Europe, with an area of 860 m², including an “Anfiteatro de Chimica” (Amphitheatre of chemistry) which could hold up to 200 students. This organic chemistry laboratory was constituted by an “office”, with two large rooms equipped with instruments and devices belonging to the various chemical subjects. These two rooms allowed the students of the course of physical-chemistry to do practical work in organic chemistry. One of these rooms was for risk-free practical work, while the other was for more dangerous experiments. The work done by professor Paul Jacobsohn in the field of biochemistry was continued by Professor Amélia Pilar

Rauter (1950-alive). She is the founder and coordinator of the Portuguese Carbohydrate Chemistry Group (CCG) of the Portuguese Society of Chemistry. She wrote the book «Carbohydrate Chemistry – Chemical and Biological Approaches» [10] which is a “benchmark” in the field of Portuguese biochemistry.



Figure 2. The organic chemistry laboratory of Faculty of Sciences of Lisbon, in the fifties.

Since 1921, the Pharmaceutical School of Lisbon has a discipline called «organic pharmaceutical chemistry» which was taught, from 1911 to 1970, by Professor Raul Lupi Nogueira (1874-1945) (who

taught from 1900 to 1913), Professor Alberto Ralha (1921-2010) (who taught from 1944 to 1957) and Professor Lício Godinho (1935-alive) (who taught from 1958 to 1970). In fact, on this course of pharmacy, particular attention has been given to the study of “organic compounds with a therapeutic action” which are reflected by the use of several technical books, such as, «The insulin under the chemical-pharmaceutical point of view» [11] (written by Raul Nogueira), «Lessons for the discipline of organic pharmaceutical chemistry» [12] (written by Lício Godinho) and «The basic principles of organic chemistry» [13] (translated into Portuguese by Alberto Ralha). Lectures are complemented by laboratory experiences. In the first half of the 20th century, the course of pharmacy was taught at Medical School of Lisbon, and so the pharmaceutical teaching went into decline (especially laboratory experience) because the pharmaceutical students need a different preparation from that of physicists. In 1950’s, this situation, changed through the work of Professor Alberto Ralha who contributed to the construction of a “new” Faculty of Pharmacy of Lisbon (Figure 3)[14] located on “Quinta da Torrinha”, with two laboratories of organic pharmaceutical chemistry. Professor Alberto Ralha was trained in some European laboratories, such as Zurich and Basel, which gave him new skills for the construction of a proper laboratory in organic pharmaceutical chemistry in this institution.

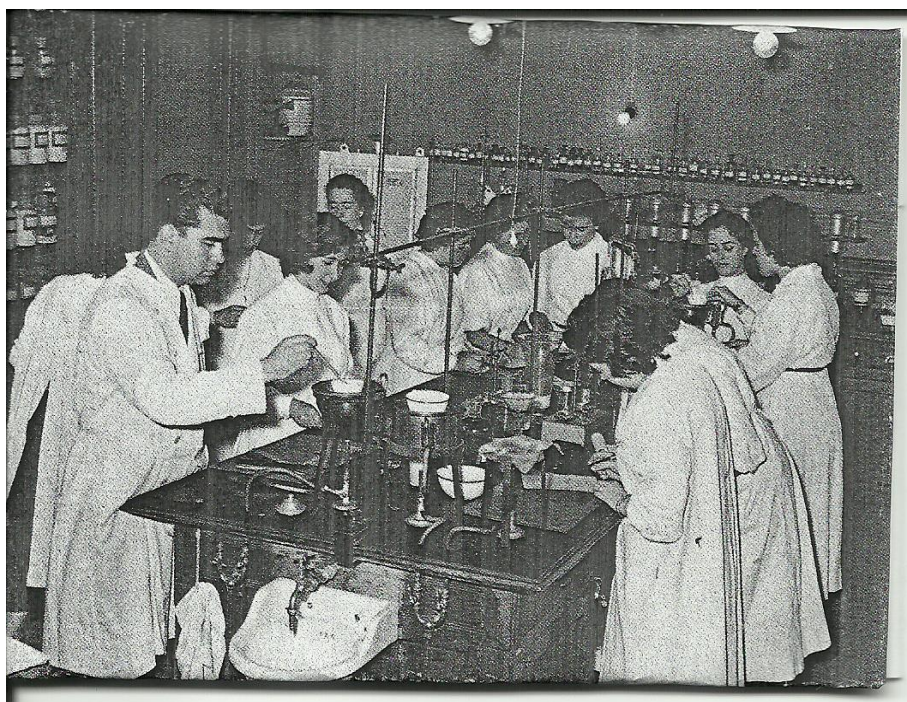


Figure 3. The organic chemistry laboratory of Faculty of Pharmacy of Lisbon, in the fifties.

Portuguese Chemical Society is a scientific society which is -responsible for the publication of the magazine intituled «Magazine of Pure and Applied Chemistry» [15]. The first director of this magazine was the renowned Professor António Ferreira da Silva. The constant improvement of pedagogical conditions, together with proper communication with students and university staff, have made this magazine a “benchmark” for all Portuguese chemistry. The goals have been always the same: high quality papers that combine simple and technical language, which have allowed both students and scholars to enjoy themselves in the “world of chemistry”.

The Academy of Sciences of Lisbon is a Portuguese Institution whose main goal is to support the development of research in Portugal, both in humanities and sciences. In relation to sciences, this institution has a section called “chemistry” that is led by the best teachers, in Portugal, in this field of knowledge. One example is Professor Rómulo de Carvalho for his major contribution (scientific and pedagogic) to the history of science, namely his work called «The relationship between Portugal and Russia in the 18th century» [16]. In addition to having taught in physics and chemistry [17], Professor Rómulo de Carvalho also wrote poetry [18] and produced superb poems, such as, «Philosophical Stone» which relates chemistry and philosophy (called “alchemy”).

On the other hand, since the reform of Portuguese higher education, in 1911, «chemistry» has been one of the main disciplines taught in the course of physical-chemistry at the Faculty of Sciences of the University of Coimbra. This course has a discipline called «organic chemistry», which was taught from 1911 to 1970 by Professor Álvaro José da Silva Basto (1873-1924) (who taught from 1900 to 1924), Professor António Jorge Andrade Gouveia (who taught from 1934 to 1964) and Professor Albuquerque Rocha_Gonçalves (1939-alive) (who taught from 1964 to 1970). In this discipline, particular attention has been given to the «mechanisms of organic compounds», which are reflected by the use of several technical books, such as «Introduction to the study of Organic Chemistry» [19] (written by Álvaro Basto), «Organic Chemistry» [20] (written by Andrade Gouveia) and «Contribution to the synthesis of chiral allenic esters» [21] (written by Albuquerque Gonçalves). Professor António Andrade Gouveia endeavoured to make the University of Coimbra one of the best European schools, in terms of chemical research, with adequate and fully equipped laboratories. Organic chemistry

laboratories of the Faculty of Sciences of Coimbra] were the only ones that existed in Portugal, before 1911. In the first half of the 20th century, this laboratory had an area of 12,400 m², with three large rooms for experiments. One of these three rooms was for organic chemical experiments (with very simple and basic laboratory devices), while the other two were for chemical analysis. In the second half of the 20th century, there was a renovation of laboratorial materials, as a response to the new challenges of this time. Indeed, Portuguese organic chemistry has made great strides, where the University of Coimbra has played a pioneering role in the organic chemistry field, particularly due the efforts and dedication of Professor Andrade Gouveia.

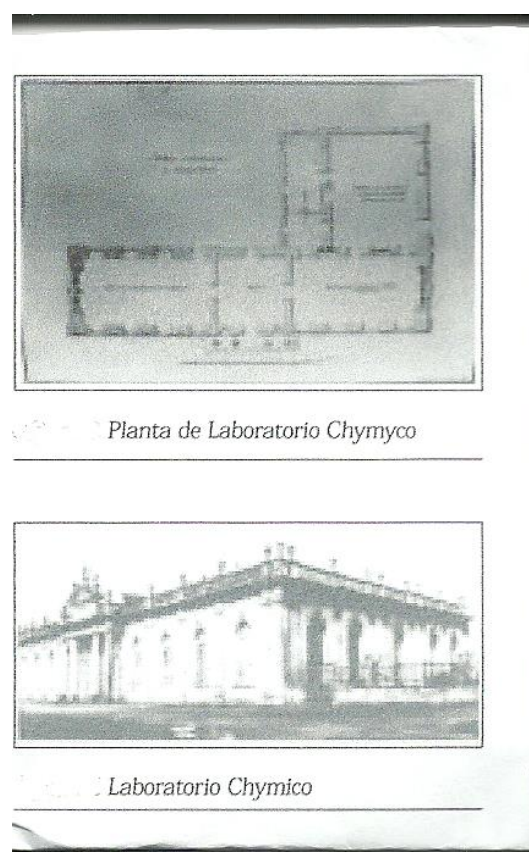


Figure 4. The organic chemistry laboratory of Faculty of Coimbra, in the first half of the 20th century.

Still in Coimbra, the Pharmaceutical School of Coimbra has conferred first degrees and PhDs in pharmacy, even before the 20th century. It is worth to mention that the University of Coimbra was the “cradle” of the pharmaceutical teaching in Portugal. This course of pharmacy has a discipline called «organic pharmaceutical chemistry», which was taught from 1911 to 1970 by the Professor Álvaro José da

Silva Basto (who taught from 1900 to 1924), Professor Guilherme de Barros e Cunha (1898-1984) (who taught from 1932 to 1947), Professor André Campos Neves (1926-alive) (who taught from 1959 to 1970). In this course of pharmacy, particular attention has been given to the study of “steroids”, which are organic compounds used for therapeutic purposes. They are reflected by the use of certain technical books, such as, «The pharmaceutical education at the University of Coimbra» [22], (written by Guilherme Cunha), «Organic Chemistry» [23] (translated into Portuguese by André Neves) which describe the pharmaceutical application of several organic substances. In this institution, the lectures are also complemented by laboratory experience taught in the laboratory of the Pharmaceutical School of Coimbra (Figure 4) [24]. This laboratory was built in the building S. Boaventura due the personal contacts made by Professor Álvaro José da Silva Basto with Town Hall of Coimbra. In fact, this laboratory was pioneer in laboratory experience, in Portugal. In the first half of the 20th century, this laboratory could hold up to 30 students and had one large room equipped with instruments belonging to the various subjects of practical chemistry. For example, one of the chemical examination was related with the determination of fusion point and the preparation of some organic pharmaceutical compounds. In the first half of the 20th century, organic chemistry laboratory of the Pharmaceutical School was shared with the laboratory of Faculty of Sciences, both in Coimbra. In the second half of the 20th century, Professor André Campos Neves improved the laboratory experience of this course through the writing of some technical manuals on pharmacy which contributed to a better preparation of pharmaceutical students in this institution.

Finally, in 1911, the University of Oporto was created in Portugal. This University contains the Faculty of Sciences, the Faculty of Engineering and the Faculty of Pharmacy.

The course of chemistry of the Faculty of Sciences of the University of Oporto has a great prestige due, in particular, to the work done by the Professor António Ferreira da Silva (1853-1923) (who taught in this institution from 1900 to 1923), whose papers are a “benchmark” for chemistry, in national and international level. The name of other teachers who have taught «chemistry» in this institution were Professor José Pereira Salgado (1867-1946) (who taught from 1919 to 1943) and Professor Alberto Carlos Brito (1902-?) (who taught from 1948 to 1970). In this institution particular attention has been given to

the study of “classic groups” of organic chemistry, such as, hydrocarbons, alcohols, aldehydes, and so on, which are reflected in the use of certain technical books, such as «Elements of analytical and organic chemistry» [25] (written by António Silva), «Chemistry at the Academy Polytechnic of Oporto» [26] (written by José Salgado), and «Lessons in Organic Chemistry» [27] (written by Alberto Brito). The chemistry of the Academy Polytechnic of Oporto, which existed until 1911, was the forerunner of the current course of chemistry of the Faculty of Sciences of Oporto. In the beginning of the 20th century, the course of chemistry of this institution had a poor laboratory (Figure 5) [28] with little equipment and small rooms. Most positively, some renovations were performed by Professor António Ferreira da Silva who made it better equipped and more spacious, allowing seating for 50 students.

For this reason, the laboratory received his name. After the death of Professor António Ferreira da Silva, Professor José Salgado carried on his efforts, which led to an improvement of organic chemistry laboratories. For example, some furniture and laboratory equipment were offered by Calouste Gulbenkian Foundation. In 1964, with the separation of the courses of physics and chemistry, a larger library containing more technical books of organic chemistry and a more spacious amphitheatre which could hold up to 50 students, was made.

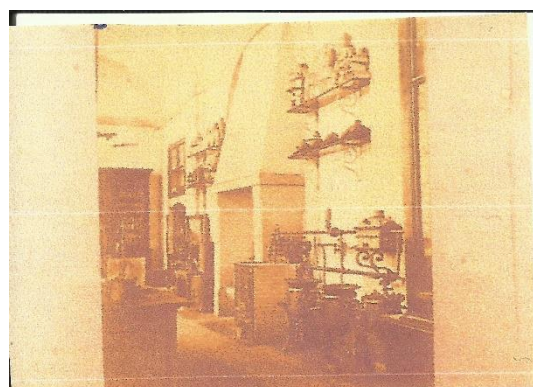


Figure 5. The organic chemistry laboratory of Faculty of Sciences of Oporto, in the first half of the 20th century.

In the beginning of the 20th century, the course of chemical engineering of the University of Oporto was taught both in Faculty of Sciences (the first 3 years) and in Faculty of Engineering (the last 3 years) of the University of Oporto. From 1926 onwards, the Faculty of Engineering of the University of Oporto has

begun to teach the full 6 years of the course of chemical engineering. This course has a discipline called «organic chemistry», which was taught from 1911 to 1970 by Professor António Ferreira da Silva, Professor José Pereira Salgado, and Professor Henrique Serrano (1897-1967) (who taught from 1948 to 1968). In this course particular attention has been given to the study of organic compounds with an industrial purpose (such as, milk, wine, oils, fuel and others organic products), which are reflected by the technical books used in the classes, namely, «Unit Processes in Organic Synthesis» [29] (translated into Portuguese by Henrique Serrano). Lectures are also complemented by laboratory (Figure 6) [30] of this institution located on “Rua do Braga”. - Professor José Pereira Salgado

published numerous papers not only related with his area of expertise (chemistry) but also associated to pedagogy and education. For this reason, the laboratory received his name.

Moreover, scholars of the course of chemical engineering of this institution have promoted the link between the University and some chemical industries and so, in 1958, a Center for organic chemistry research was created in this institution which has attracted several researchers (portugueses and foreigners) experts in the study of the chemical processes of ágar-ágar extraction and phenolic compounds.

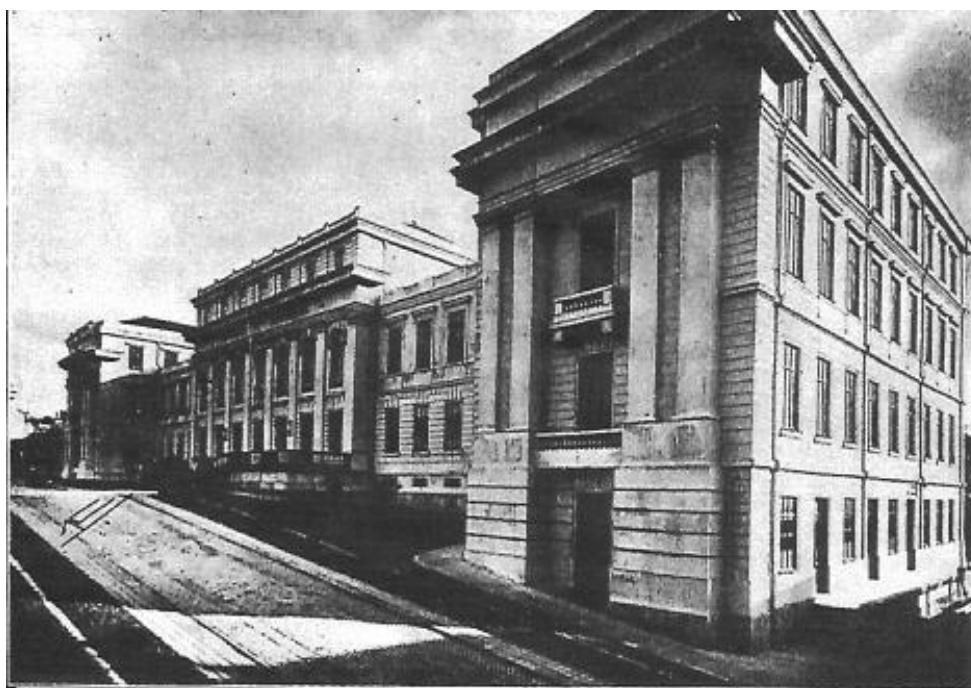


Figure 6. The Faculty of Engineering of Oporto, where are located the chemical laboratories, in the first half of the 20th century.

The course of the Faculty of Pharmacy of Oporto has a discipline called «organic pharmaceutical chemistry» which was taught from 1911 to 1970 by Professor Alberto Pereira Pinto de Aguiar (1868-1948) (who taught from 1900 to 1917), Professor Américo Pires de Lima (1886-1966) (who taught from 1922 to 1940), Professor Abel da Silva Pereira (1907-?) (who taught from 1940 to 1950) and Professor Joaquim António Polónia (1925-alive) (who taught from 1951 to 1970). This course has given particular attention to the study of organic compounds with a therapeutic purpose, which are reflected in the use of several technical books, such as «Reactions of the Tanret

reagent» [31] (written by Alberto Aguiar), «The role of vitamins in Vasco Gama's journey» [32] (written by Américo Lima), «Alkaloids» [33] (written by Abel Pereira), «Amidofebrin» [34] (written by Joaquim Polónia). Lectures are complemented by laboratory (Figure 7) [35] of this institution located on “Rua da Carvalhosa”. This laboratory boasted extensive laboratorial facilities, with a large library, which allowed laboratory experience for about 60 students. From 1940 to 1960, Professor Abel Silva Pereira was the responsible for the reorganizing and re-equipping of this laboratory with the financial contribution of Calouste Gulbenkian Foundation.

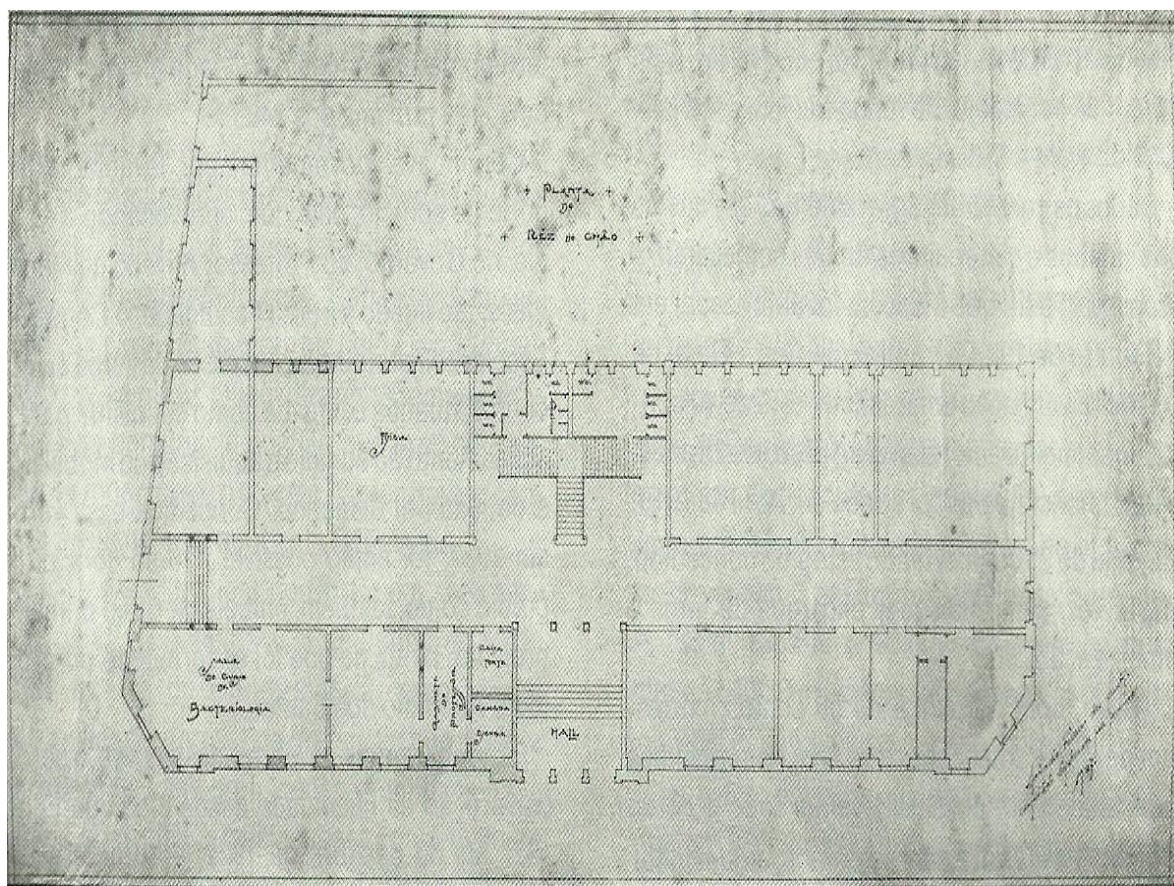


Figure 7. The plan of organic chemistry laboratory of Faculty of Pharmacy of Oporto, in the first half of the 20th century.

4. CONCLUSION

In the first half of the 20th century, it is true that the development of organic chemistry in Portugal lagged behind, in international terms. More positively, in the second half of the 20th century, the engineer Pinto Leite and the Portuguese Minister Veiga Simão have begun to change this situation. Through the financial support to various renowned Portuguese institutions, the development of organic chemistry was held successfully. These institutions are Technical Higher Institute, Faculty of Sciences of the University of Lisbon, Faculty of Pharmacy of the University of Lisbon, Portuguese Chemical Society, Academy of Sciences of Lisbon, Faculty of Sciences and Technology of the University of Coimbra, Faculty of Pharmacy of the University of Coimbra, Faculty of Engineering of the University of Oporto, Faculty of Sciences of the University of Oporto, Faculty of Pharmacy of the University of Oporto.

It was also very important the hugely work of many scholars in Portugal (called “main figures”) who through their hard effort and selfless dedication have

contributed to the increase prestige in teaching and investigation of Portuguese organic chemistry. These scholars were Professor Charles Lepierre, Professor Arnaldo Peres de Carvalho, Professor Pierre Laurent, Professor Bernardo Herold (who taught at Technical Higher Institute), Professor Achilles Machado, Professor António Pereira Forjaz (who was helped by Professor Antenor Borges de Almeida), Professor Kurt Paul Jacobsohn and Professor Amélia Rauter (who taught at the Faculty of Sciences of Lisbon), Professor Raul Nogueira Lupi, Professor Alberto Ralha, Professor Lício Godinho (who taught at the Faculty of Pharmacy of Lisbon), Professor Rómulo de Carvalho (who worked at the Academy of Sciences of Lisbon), Professor Álvaro José da Silva Basto, Professor António Andrade Gouveia, Professor Albuquerque Rocha Gonçalves (who taught at the Faculty of Sciences of Coimbra), Professor António Ferreira da Silva and Professor José Pereira Salgado (who taught both at the Faculty of Sciences of Oporto and the Faculty of Engineering of Porto), Professor Henrique José Serrano (who taught at the Faculty of Engineering of Porto), Professor Alberto Carlos Brito (who taught

at the Faculty of Sciences of Porto), Professor Alberto Pereira Pinto de Aguiar, Professor Américo Pires de Lima, Professor Abel da Silva Pereira, Professor Joaquim António Polónia (who taught at the Faculty of Pharmacy of Porto). In addition to their work as scholars, they also did excellent pedagogical work.

5. ACKNOWLEDGMENTS

Paulo Martins acknowledges both the suggestions of Professor António Manuel Nunes dos Santos and funding from the Foundation for Science and Technology (FCT), Portugal.

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