

SPECTROSCOPIC PORTRAITURE: A CASE STUDY IN THE EARLY YEARS OF THE UNIVERSITY OF LISBON



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Lisbon, 18-20th April 2011

*SCIENTIFIC PHOTOGRAPHY:
STUDY OF INSTRUMENTATION AND CHEMICAL-PHYSICAL
PROCESSES DURING THE PERIOD 19TH-EARLY 20TH
CENTURIES*

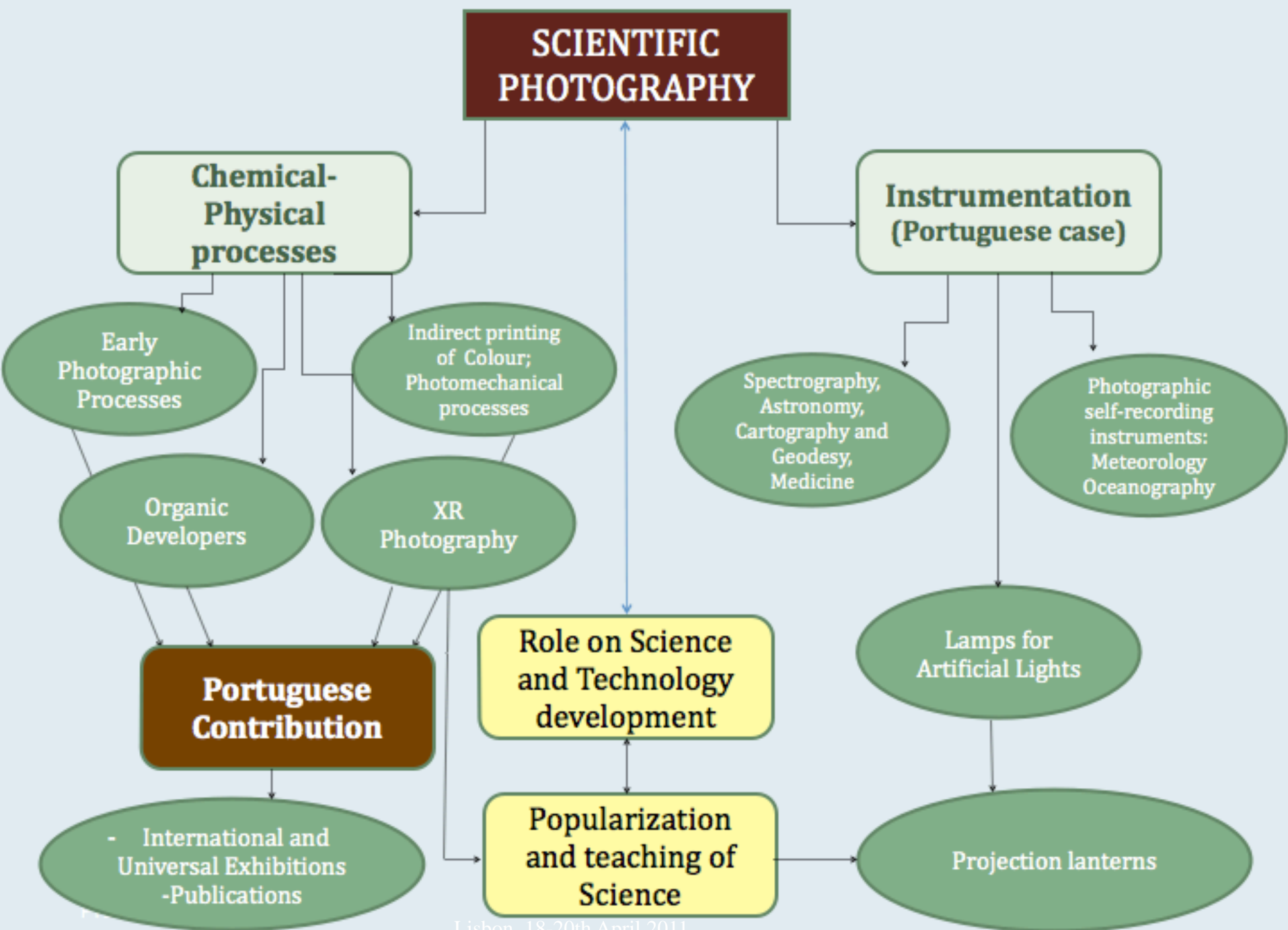
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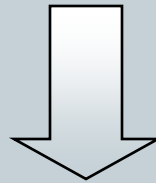
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Introduction

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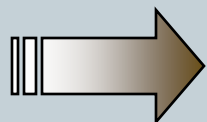
The evolution of spectroscopy methods in Chemistry



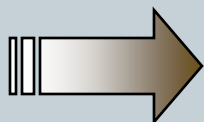
Spectral Analysis:
Teaching and Research in the Faculty of
Science, University of Lisbon

Sources

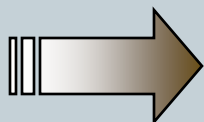
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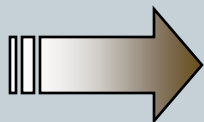
Scientific Instruments



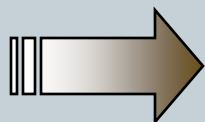
Curricula of the first Chemistry's courses of the Faculty of Sciences, University of Lisbon



Historical archive of the Museum of Science, University of Lisbon



Catalogs of Scientific Instrument Makers



Manuals and chemistry treatises

The Polytechnic School of Lisbon *Faculty of Science - University of Lisbon*

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Spectral Analysis

The Polytechnic School: 1837 - 1911

Faculty of Science: 1911 - ...



Street-front on later nineteenth century in Museu da Ciência da Universidade de Lisboa (1999). *Laboratório Chimico da Escola Polytechnica*, p. 5.

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A large, vintage surveying instrument, likely a theodolite or transit, is displayed on a wooden table. The instrument has a brass body with a large black circular scale and a black tripod stand. A small white tag is attached to the instrument. In the background, there are some books and a wooden cabinet. A small white tag with the text "PT" is visible in the bottom right corner.

Historical Archive MCUL,
PT-MCUL-EPC-SEC-01-02499-00012-C0018

Achilles Machado: the teaching of spectral analysis

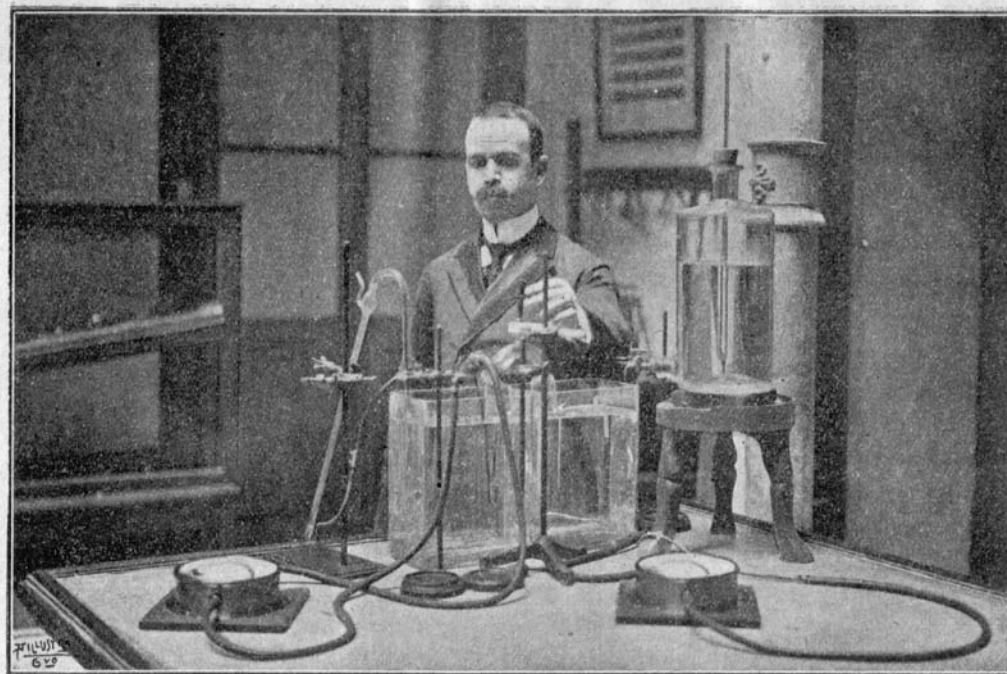
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Achilles Machado (1862 – 1942), Chemistry professor at the Polytechnic School and Faculty of Science.

1917 – Achilles Machado published a textbook on chemical analysis with a chapter on spectral analysis



*“Análise Química Qualitativa
Lições do Professor Achilles
Machado”*



O professor *Achilles Machado*, procedendo a estudos de electro-química

Achilles Machado: the teaching of spectral analysis

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In his book, Achilles Machado referred classic experiences of spectroscopy, with special emphasis on the sodium line D experience

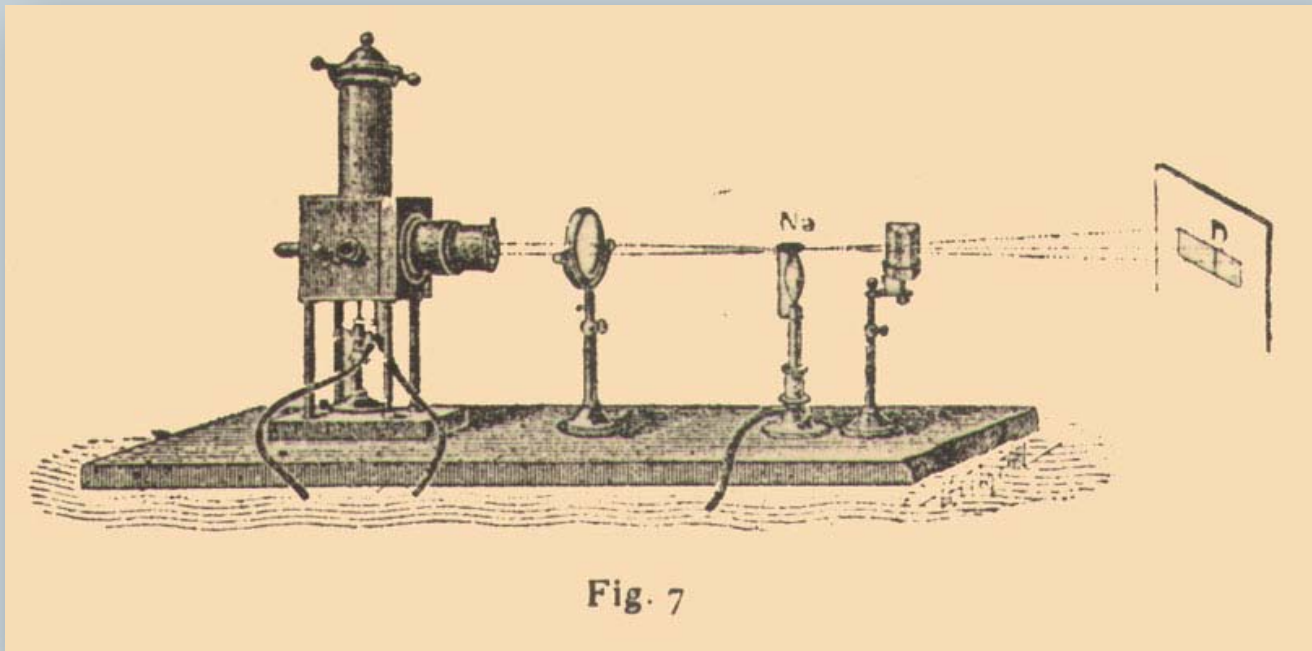


Fig. 7

(Machado; 1917)

Achilles Machado: the teaching of spectral analysis

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In the Museum of Science (MCUL) collection:



Duboscq' Projection
Lantern with accessories
(MCUL2004)



Duboscq' Lens
(MCUL2003)



Duboscq' Prism
(MCUL310)

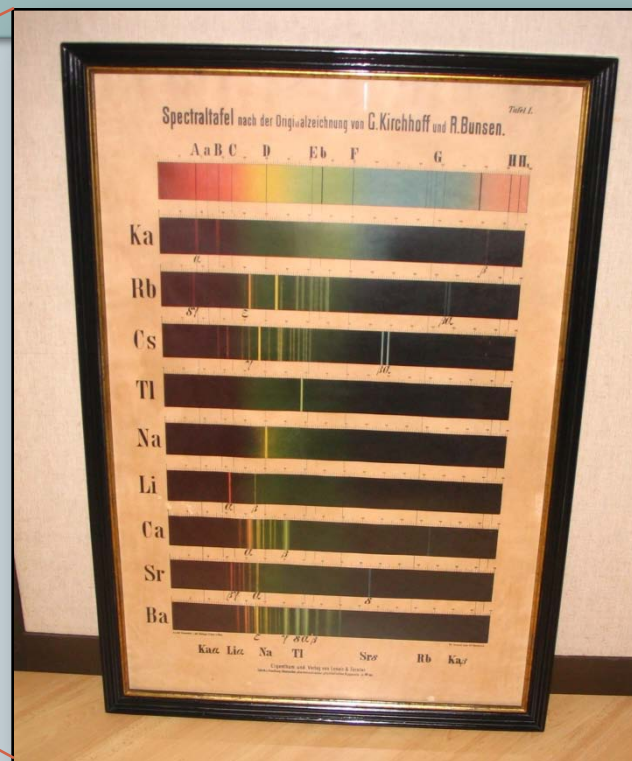
Achilles Machado: the teaching of spectral analysis

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- After 1870, the maker Duboscq offered for sale, spectra tables to Physics cabinets as well as to Chemistry laboratories.
- Students visualized the spectra obtained by projection and they compared them with the spectral table.



Laboratorio Chimico, s.d.
(MCUL Historical Archives, U.L.).



Spectral table , MCUL2017
(Photo: M.C. Elvas, courtesy of Museum of Science, UL)

Achilles Machado: the teaching of spectral analysis

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A constant deviation spectrometer was purchased by the Faculty of Science to the maker Adam Hilger in 1912.

In his book, Machado explained the method to work with the ***constant deviation spectrometer***, which presented the graduated drum with an helicoidal groove

This apparatus can be adapted to function as a spectrograph



(MCUL897)

António Pereira Forjaz: research on spectral analysis

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António Pereira Forjaz (1893 – 1972)

He was appointed as Chemistry Professor of the Faculty of Science on December 1918



Pereira Forjaz
(Enc. Luso Bras.)

➡ 1915 - Forjaz had published a study with spectral analysis: *“Sky Petrography – Spectrograph Contribution to Portuguese Meteorites Study”*. Forjaz decided in this study to apply the Gramont’s method to a meteoric iron fragment existent at the Faculty of Science, having determined its qualitative composition.

➡ 1916 - Forjaz obtained his PhD degree, with a thesis entitled *“Spectral Analysis Study of Uranium and Zirconium Portuguese Minerals”*.

First Ph. D. Thesis of the University of Lisbon

António Pereira Forjaz: research on spectral analysis

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In order to study Portuguese mineral of uranium and zirconium, Forjaz used a Pulfrich and Löwe spectrograph, from the maker Zeiss. With this equipment he could do the direct observation of spectra and photograph them.



Zeiss's spectrograph, MCUL4446

(Photo: M. Peres; courtesy of Museum of Science, U.L.)

This equipment was imported in 1909 by the firm J. Ribeiro of Lisbon, and after that sold to the Polytechnic School.

António Pereira Forjaz: research on spectral analysis

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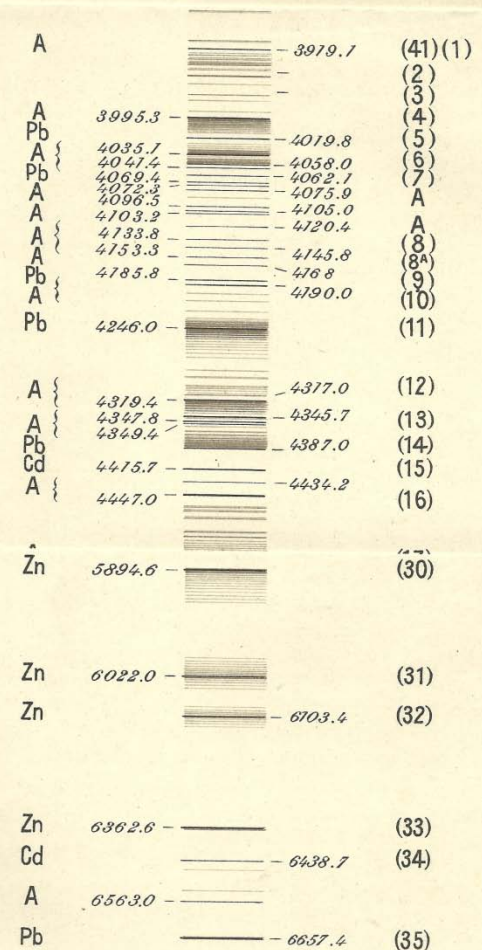
“Spectral Analysis Study of Uranium and Zirconium Portuguese Minerals”

Forjaz used:

- Panchromatic photographic plates, Wratten & Wainwright (Eastman Kodak)
- Crown and flint prisms for the visible spectrum
- Quartz prisms for the U.V.
- As a reference, the Eder and Valenta spectra.

(FORJAZ; 1916)

Espectro de faísca da liga Pb-Cd-Zn,
preconizada por EDER (1893)
(Esquema)



António Pereira Forjaz: research on spectral analysis

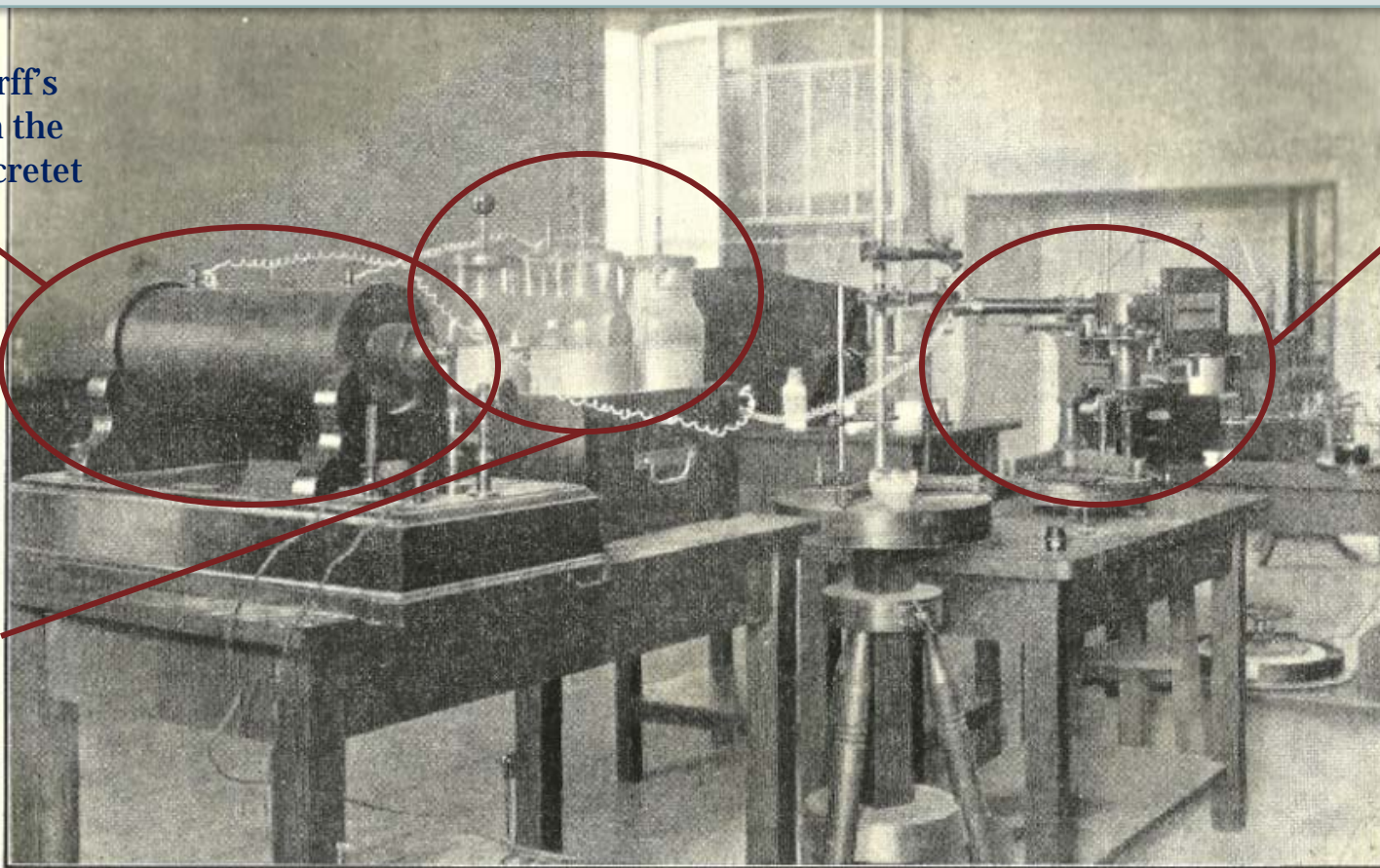
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Instrumentation assembly for the spectral quantitative analysis according the Gramont method.

Rhumkorff's
coil, from the
maker Ducretet

Zeiss'
spectrograph

Leyden jars



António Pereira Forjaz: research on spectral analysis

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Forjaz used a Zeiss microscope comparator to measure the obtained spectra



Zeiss's microscope comparator, MCUL76
(Photo: M. Peres, courtesy of Museum of Science, U.L.)

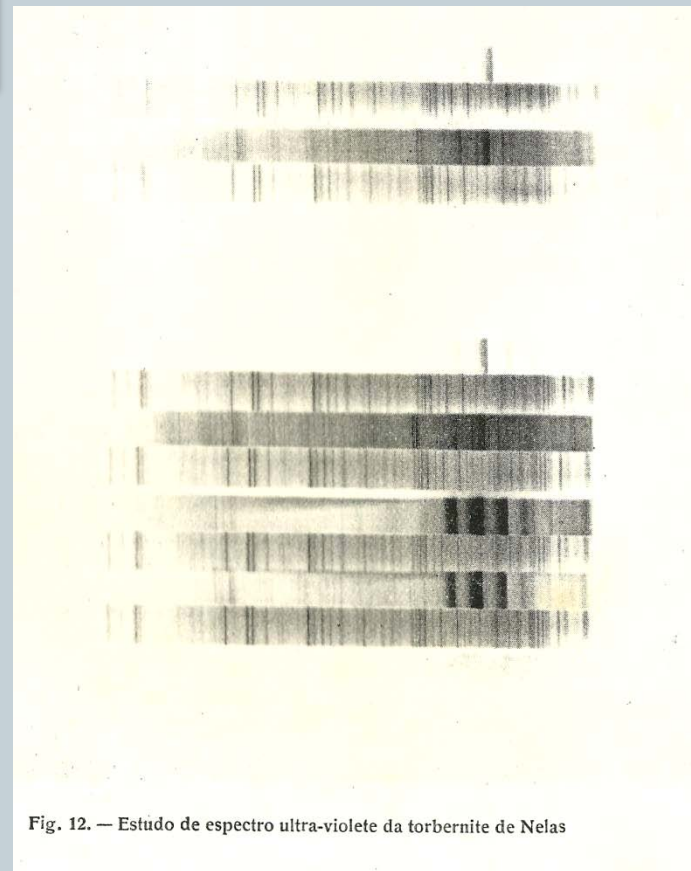


Fig. 12. — Estudo de espectro ultra-violete da torbernite de Nelas

UV spectra of Nelas's torbernite

FORJAZ, 1916

António Pereira Forjaz: research on spectral analysis

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Since 1928, Forjaz published several studies on the spectroscopic analysis of Portuguese waters:

- 1928: “Spectrochimies des eaux minérales portugaises; L’ eau du Gerez”, *Comptes Rendus de l’ Academie des Sciences de Paris*, T. 186, pp. 1366-1377
- 1928: “Espectroquímica das águas minerais portuguesas”, *Revista de Química*, n.º 2, pp. 79-84.
- 1929: “Spectrochimie des eaux minérales portugaises; L’ eau de Cambres”, *Comptes Rendus de l’ Academie des Sciences de Paris*, T. 189, pp. 703-704.
- 1931: “Étude Spectrochimique du sel portugais”, Conférence faite au Dixième Congrès de Chimie Industrielle (7-13 Sept 1930): extrait des *Comptes-Rendus*, Paris : Imp. de Vaugirard.
- 1933: «Recherches spectrographiques sur les eaux minérales portugaises: le germanium indicateur des eaux profondes», Communication présentée au Douzième Congrès de Chimie Industrielle (25 Sept-3 Octobre 1932): extrait des *Comptes-Rendus*, Paris : Imp. de Vaugirard.

António Pereira Forjaz: research on spectral analysis

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In order to do these water analysis Forjaz ordered to the maker Félix Pellin the construction of a Cornu spectrograph with his instructions and supervised by A. Gramont.



Pellin's spectrograph, MCUL3592
(photo: M. Peres; courtesy of Museum of Science, U.L.)



António Pereira Forjaz: research on spectral analysis

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The marine salt and waters were analysed with this spectrograph and:

- Panchromatic photographic plates anti-halo Lumière
- The Eder iron alloy as the reference spectrum



Spectrograph, MCUL3592, Chassis camera, MCUL170;
Spectrograms' box, MCUL3752
(photo: M. Peres; courtesy of Museum of Science, U.L.)

António Pereira Forjaz: research on spectral analysis

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The spectrograms analysis were done with a microscope comparator made by order to the Pellin instrument maker.



Pellin's microscope comparator MCUL3374
(photo: M. Peres; courtesy of Museum of Science, U.L.)

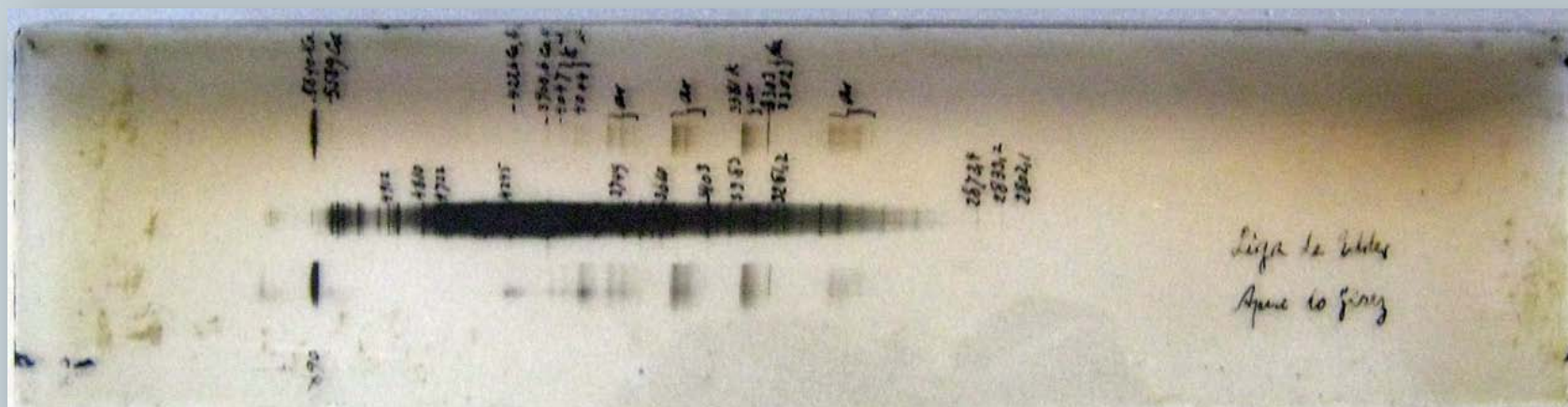
António Pereira Forjaz: research on spectral analysis

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Spectroscopic portraitures



(Eder alloy; MCUL3752)



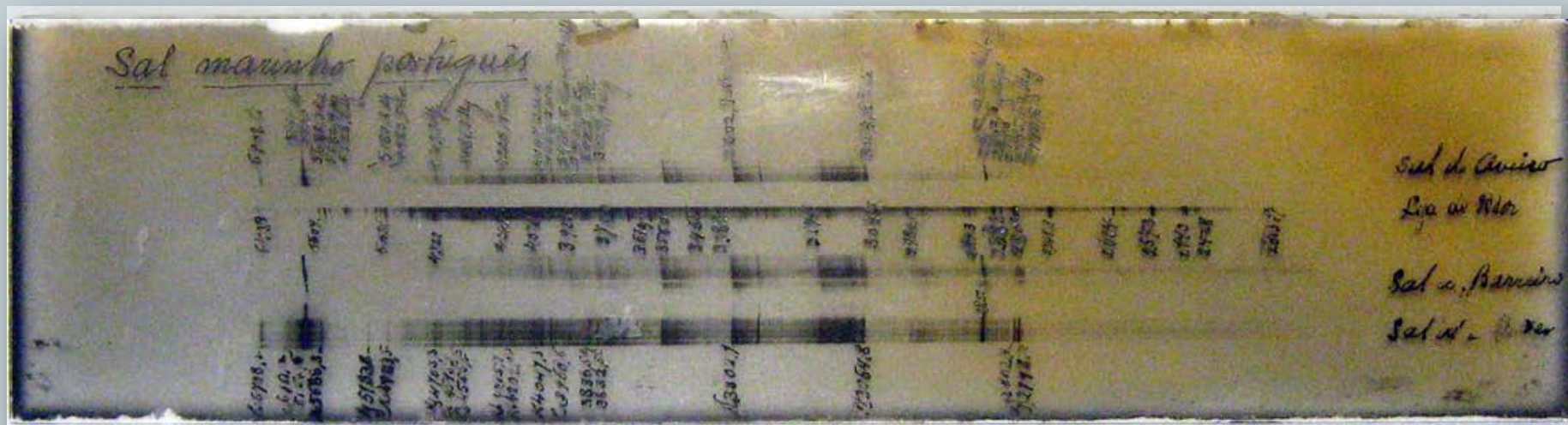
(photos: M. Peres; courtesy of Museum of Science, U.L.)

(Gerês's water, MCUL3752)

António Pereira Forjaz: research on spectral analysis

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Spectroscopic portraits



Setúbal's salt; MCUL3752

Aveiro and Barreiro's salts; MCUL3752

(photo: M. Peres; courtesy of Museum of Science, U.L.)

*"O mer, donne-moi un petit grain de ton sel et il me
livrera tes secrets."*

(Forjaz, 1931)

Conclusion

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We can conclude that:

- The Archives of the Museum of Science of Lisbon University show that during this period there was a significant investment in the acquisition of spectrosopes and spectrographs.
- From the very beginning of the Faculty of Science, spectroscopy was taught in the chemistry and physics syllabus at an analogous scientific level to other European University Schools.
- During this period a relevant number of quality research papers was published by Pereira Forjaz in the field of spectroscopy.

Acknowledgments

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- Eugénia Silva, Vitor Gens and Marta Lourenço (Museum of Science of University of Lisbon)
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- Wolfgang Wimmer (Carl Zeiss, AG)
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