



THE PHONLAB PROJECT: COIMBRA PHONETICS LABORATORY – HERITAGE PRESERVATION AND DEVELOPMENT

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Abstract: PHONLAB is an R&D project on the history of experimental phonetics, funded by the Portuguese body, the Fundação para a Ciência e a Tecnologia – Foundation for Science and Technology. It brings together researchers from the Universities of Évora (Portugal), Coimbra (Portugal) and Stockholm (Sweden), and aims to recover for historiography and the collective memory the importance of the Experimental Phonetics Laboratory of the University of Coimbra (1936-1979) and its founder and director, Armando de Lacerda (1902-1984). In the funding year, 2022, the International Phonetic Association and the International Speech Communication Association Special Interest Group on “The History of Speech Communication Sciences” provided support for the holding of the 5th International Workshop on the History of Speech Communication Research, entitled ‘Lacerda 120’ in Portugal – the first of these scientific workshops to be dedicated to the memory of an individual phonetician. In addition, in 2023, the Royal Swedish Academy of Sciences dedicated a one-day symposium to Armando de Lacerda. PHONLAB focuses mainly on the material culture of objects from the past and has enabled the instruments of the Phonetics Laboratory, library resources and archives to be discovered as part of the heritage of the University of Coimbra Faculty of Arts and Science Museum by members of the project team and to be identified, preserved and assigned new value. The ultimate objective of this initiative, described in the paper, is to create a permanent exhibition at the University of Coimbra dedicated to Armando de Lacerda and the Coimbra Phonetics Laboratory.

1 Introduction

The aim of this paper is to present some findings of the PHONLAB project (2022.06811.PTDC) "Phonetics Laboratory: Coimbra – Harvard. Rethinking 20th-century scientific centers and peripheries" [1]. We begin by describing the project, presenting the reasons that support a strong case for project funding, its objectives, the bodies taking part and how the team is made up. We then highlight the outputs already achieved since the launch of the project, especially findings associated with the material culture of objects: the curation of historical instruments in the field of experimental phonetics identified by the project team, the process of digitising audio recordings and the curation of the library and experimental phonetics archive held at the University of

Coimbra Faculty of Arts (FLUC) and the University of Coimbra Science Museum. The project focuses on the history of the Coimbra Phonetics Laboratory (1936-1979) and the aim of this paper is to highlight some of its achievements, which led to its heritage value being recognised in 2023 by the Royal Swedish Academy of Sciences and thus recovered as an important element in the fields of historiography and phonetics, having previously been confined to oblivion [2].

2 PHONLAB: an R&D project focusing on the history of experimental phonetics

The PHONLAB project contributes to the history of experimental phonetics viewed from what might perhaps be regarded as the unusual perspective of the emergence, development, and impact of the experimental phonetics laboratory operating at the University of Coimbra in Portugal from 1936 to 1979, and regarded by many experts in mid-20th century as the most advanced experimental phonetics laboratory in Europe [3]. After the closure of the Coimbra laboratory in 1979, its memory and that of its founder and head, Armando de Lacerda (1902-1984), was consigned to oblivion, and the aim of this project is to revive it.

Our aim is to construct a biography of the laboratory by identifying and documenting the instruments and techniques used there and providing recognition for the actors who either worked at the laboratory or who were associated with it and the scientific networks they used. The importance of PHONLAB also lies in the fact that numerous historical sources that have not been studied and that deal with the work of the laboratory, potentially throwing light on the development of the field of experimental phonetics throughout the 20th century are now rapidly degrading and may soon disappear due to irretrievable damage.

Funded by a Portuguese body, the Foundation for Science and Technology, this 250K-euro research project began in March 2023 and has a life of 36 months. The project team comprises 12 members: historians of science, phoneticians, linguists, librarians, archivists, audiovisual technicians, disseminators of science, and curators, attached to the universities of Évora, Coimbra and Stockholm. There are also three consultants involved in the project: Michael Ashby (UCL), in the field of experimental phonetics; Ana Simões (University of Lisbon), in the field of history of science; and Marta Lourenço (MUHNAC, University of Lisbon), a specialist in the material culture of objects. In order to carry out project tasks, a PhD researcher in the field of history of science was contracted for a period of three years and a scholarship holder (a PhD student of information science) was contracted for a period of one and a half years. Also taking part in the project were two “research initiation” scholarship holders, whose scholarships were associated with the “Summer with Science” programme, funded by the Foundation for Science and Technology.

3 Cleaning and inventorying of instruments used at the Coimbra Phonetics Laboratory

Before the project was launched, several research papers had already been produced and published on the work of the Coimbra Phonetics Laboratory, while others had been published on its founder and head, Armando de Lacerda. Recognition of Lacerda's importance in the field of experimental phonetics came on the 120th anniversary of his birth with the holding of “Lacerda 120” – the 5th International Workshop on the History of Speech Communication Research in Porto in 2022) [4]. It was the first such workshop

to be dedicated to the memory of an individual scholar, the papers presented at the meeting having been published in the collection entitled “Studentexte zur Sprachkommunikation” [5].

Lacerda’s pioneering work associated with his successful integration of the use of empirical methodologies in the field of experimental phonetics has also been recognised by the Royal Swedish Academy of Sciences as an exemplary reminder of the power and importance of grounded multidisciplinary approaches to the study of complex Humanistic issues. This led to the academy holding a one-day symposium dedicated to Armando de Lacerda in May 2023, funded by Kungl Vitterhetsakademien and Sven och Dagmar Saléns Stiftelse (Sweden), the Instituto Camões (Portugal), and the Portuguese Embassy in Stockholm.

This preliminary research was essential for enabling the identification of the instruments used in the past at the Coimbra Phonetics Laboratory, which were located in the repository of the University of Coimbra Science Museum on the first floor of the Colégio de Jesus building at the beginning of the project. After being duly identified, the instruments were cleaned and inventoried. The process involved carrying out a number of operations following standard practice in the field of the conservation and restoration of museum objects, such as cleaning, measurement, photographic recording and description.



Figure 1. Cleaning the device for holding Lacerda polychromograph paper. Gilberto Pereira, conservator of instruments at University of Coimbra Science Museum (May 2022). Credit: Quintino Lopes.

A total of 12 instruments were inventoried, two of which comprised four items, thus giving a total of 18 items. Of note is Armando de Lacerda's polychromograph, presented by the inventor at the 1st International Congress of Phonetic Sciences in Amsterdam in 1932, whose use presented several advantages in comparison with the kymograph. Also noteworthy is Lacerda's chromograph or pitch-measuring apparatus, produced in Hamburg by technician Constanz Schneider, whom Lacerda met during his sojourn at the Hamburg Phonetics Laboratory in 1930-1931. In addition, there is a set of objects and parts belonging to the instruments of the Coimbra Phonetics Laboratory, which were cleaned and inventoried.

Following the cleaning and inventorying of all the instruments identified as belonging to the Coimbra Phonetics Laboratory, the respective inventory files produced are held by the University of Coimbra Science Museum. They are also available online on the project website, enabling researchers all over the world to access the information published and providing them with the opportunity to contribute towards its development.

Classificação: Fonética			
Materiais		Dimensões (cm)	Localização
x	Meta	x	Madeira X: 51 / 55 / 51 / 51
x	Vidro		Cerâmica Y: 52 / 36 / 52 / 52
x	Plástico		Outro Z: 131 / 133 / 131 / 135
			Deslocações:
Fotografias:			
Fabricante/Autor: Armando de Lacerda			Data: 1940/50?
Importador:			Data:
<p>Descrição:</p> <p>O cromógrafo é constituído por quatro elementos estruturalmente homólogos; ambos têm um formato retangular e são compostos por metal - pintado de preto. Simultaneamente, todos possuem entradas nas suas laterais que permitem a conexão dos quatro aparelhos através de tubos de borracha - como ainda se preservam e outros meios. Por outro lado, cada elemento conservava a sua função específica, como indicam os diferentes materiais presentes na parte frontal dos mesmos. Os componentes técnicos não são facilmente identificados e intitulados, ainda assim, estão presentes cabos de metal e borracha, visores para leituras, uma peça que se assemelha com um candeeiro e um conjunto de estruturas de metal e madeira. Por último, identificam-se diversos objetos nos espaços para anulação existentes em cada aparelho. Numa visão frontal, contabilizamos a partir da esquerda o aparelho (nº1) até ao (nº4). No primeiro estava uma caixa de metal com fitas - (10/16/16) -, quatro instrumentos para gravação de som (bocais) - 4 x (7/14/10) - e sete outros materiais ligados com a ciência, entre eles um tubo de borracha com cerca de 1,90 m. No segundo estava um recipiente de plástico manchado de azul, provavelmente por substâncias químicas usadas nos registos - (27/10/10) -, e um aglomerado de objetos - entre eles tubos de borracha e fitas - divididos por gaveta, porque diferentemente dos restantes três módulos, o nº2 tem gavetas na parte traseira. No terceiro estava uma tábua de madeira com um orifício no centro - (1/44/12), um recipiente de plástico transparente com uma tampa verde - (27/10/10) -, dois cilindros de metal com saídas para tubos de plástico - (17/17/13) - e uma caixa de metal com diversos objetos - (9/42/13). Ao contrário dos restantes, no quarto não havia outras peças soltas. As fotografias anexadas seguem a lógica apresentada. Na primeira linha encontram-se os materiais do primeiro aparelho, na segunda linha os materiais do segundo aparelho, e na terceira e quarta fila os materiais do terceiro aparelho.</p>			

Figure 2. Partial view of the inventory file for Lacerda's chromograph. The file was produced by Diogo Silva (September 2022), research initiation fellow (Verão com Ciência, FCT). Credit: University of Coimbra Science Museum.

4 Digitisation of the Armando de Lacerda tapes

20 reels of magnetic tape from the Coimbra Phonetics Laboratory are also held at the University of Coimbra Science Museum. In November 2020, a protocol was signed by the University of Coimbra Science Museum and the Institute of Contemporary History at the University of Évora, for collaboration with a view to developing the Coimbra Phonetics Laboratory collection and studying the work of the laboratory. With the same objectives, in October 2019 a Memorandum of Understanding was signed by the University of Évora and Ferraz de Lacerda, Lda., a private company whose CEO is engineer Paulo de Lacerda, grandson of Armando de Lacerda. Funding provided by the company as part of the aforementioned Memorandum of Understanding enabled these reels of recordings made at the phonetics laboratory to be digitised at Stockholm University.

4.1 Preparatory digitisation operations

An initial batch of three magnetic tapes, presumed to contain recordings from the early days of the Coimbra Phonetics Laboratory was sent to the Phonetics Laboratory at Stockholm University in order to be digitised. However, it soon became evident that the reels could not be played on the tape recorders kept in storage at the Stockholm laboratory. The Coimbra laboratory reels' single mounting point for playing on a tape-recorder was not compatible with the three mounting points of the more modern ReVox B77 tape-recorders at Stockholm University and therefore recordings could not be played back on these machines. Fortunately, the problem was soon solved by modifying the mounting-piece of one of the tape-recorders at the Swedish laboratory workshop enabling

Armando de Lacerda's tapes to be played on one of the Swedish lab's ReVox B77 machines.



Figure 3. One of the early tapes from the Coimbra Phonetics Laboratory (November 2020). Credit: Francisco de Lacerda.



Figure 4. Adapting the ReVox B77 tape recorder to play Armando de Lacerda's oldest tapes (November 2020). Credit: Francisco de Lacerda.

4.2 Addressing the issue of possible signal degradation

Print-through was a major concern since the tapes may well have been stored for nearly 80 years, leading to a high risk of magnetic smearing across wound tapes packed closely together. This is a common issue with the retrieval of stored cassette-tape or tape recordings, leading to an echo effect when recordings are played back. The typical remedy for minimising print-through effects is to rewind the tapes on reels with different cores, so that with each rewinding through-magnetisation is dissipated across a range of locations throughout the magnetic tape and does not interfere audibly with comprehension when tapes are played back. This method consists essentially in smearing low-intensity echoes so that they form diffuse background noise which is weak and distinguishable from the original recorded sound. In the case of the Armando de Lacerda's

tapes, it was essential to preserve as much of the original sound as possible and so a strategy was employed whereby the tapes were digitised the first time they were played back so that a mathematical deconvolution technique could be used in order to remove echo effects from the digitised signal. By doing this, the complex phenomenon of multiple echoes produced by repeated playbacks could hopefully be avoided.

The tapes were digitised by playing back the two sides of the recording simultaneously, i.e. reading the full recording on both sides of the tape, one side containing a “forward recording” and the other side containing a “reverse recording”. Surprisingly, no audible print-through effects were detected on the digitised recordings. The recording level was very good, with a signal-to-noise-ratio of 40 to 45 dB while print-through seemed not to have occurred, which may be due to the thickness of these early magnetic tapes being similar to that of modern standard tapes.

4.3 Calibrating recording speed

Unfortunately, the digitised tapes lacked calibration tones, which meant there were no clear benchmarks for determining precise recording levels or tape speed. To address this issue, background noise analysis was used to estimate the tapes’ actual recording speed. An arbitrary 1.780-s “silent segment” was selected from the first recording, across the range from 1:06.842 to 1:08.622, and amplified by 40 dB. At this level of amplification, low-frequency periodicity was determined, which was assumed to have been produced by the 50-Hz electromagnetic background noise of the power grid. Fifty consecutive peak-to-peak periods of the background noise signal were selected. Segment duration was 813 ms, giving an average duration of 16.26 ms across the segment. Assuming that background noise was due to a 50-Hz electromagnetic disturbance originating in the power grid, a 0.813 correction factor for tape speed was calculated. When this was applied to digitised recordings, Lacerda’s voice was readily recognised by his grandson. This was in contrast with his initial reaction to uncorrected digitised recordings: he had some difficulty in recognising Lacerda’s voice, and this suggests the correction factor was reliable.

The tapes contained recordings of the first three lessons of Armando de Lacerda’s Elementary Course in Portuguese Phonetics for Foreigners (Curso Elementar de Fonética Portuguesa para Estrangeiros). The lessons were recorded by Lacerda himself, one lesson per tape, consisting of two parts recorded on each side of the tape (part one on the “forward recording” and part two on the “reverse recording”).

4.4 Digitisation of remaining tapes

Upon the successful digitisation of the first batch of three tapes, 17 more tapes from the Coimbra Phonetics Laboratory were digitised in Stockholm. Because they were more modern in design, the issues associated with the initial three tapes did not arise. The digitisation process went smoothly. Of the batch of tapes described above, two were found to contain Lessons Four and Five, the next stage of the Course in Phonetics, while most of the remaining tapes were found to be blank. Some tapes contained test recordings (with someone counting for establishment of recording level) and recordings of what appears to be radio theatre, as well as choral and orchestral music, and short demonstrations and conversations on how different settings would affect the quality of recordings.

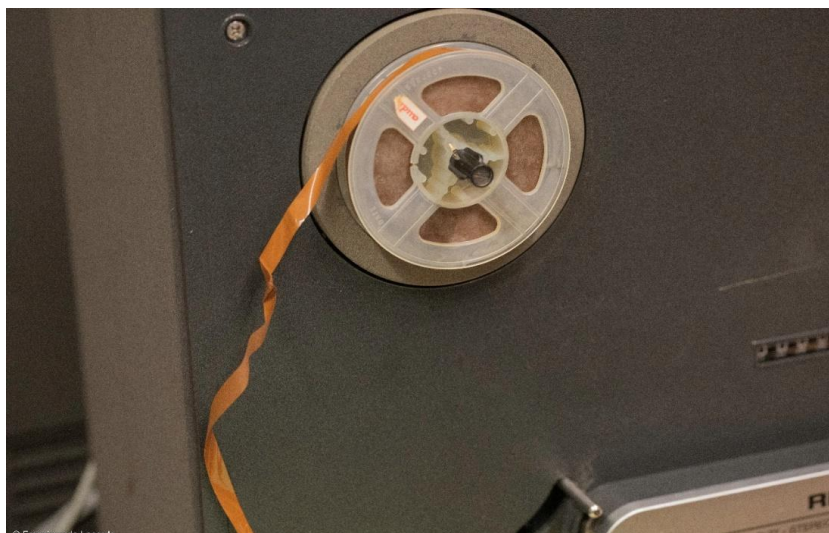


Figure 5. Preparing to play one of Armando de Lacerda's most recently produced tapes (December 2020). Credit: Francisco de Lacerda.

5 The Coimbra Experimental Phonetics Laboratory Library

In 1951, the Coimbra Phonetics Laboratory moved to the new University of Coimbra Faculty of Arts building, where it was housed in 10 rooms located on the second floor. One of these was the laboratory Library and Reading Room [6].

When the PHONLAB project began, much of the bibliographical collection of the Phonetics Laboratory Library was located in the repository of the FLUC Central Library. This collection had not yet been catalogued; however, there was a register of monographs in a separate record book, with records from August 1979, the year the laboratory closed. This book contains handwritten information enabling the identification of items: book order number (also known as registration number), author, title, place of publication, publisher's name, publication date, volume, entry date (or registration date), cost, shelf location (call number), and observations.

Following the interest that some senior staff and technical staff at the FLUC Central Library showed in the story of Armando de Lacerda and the Phonetics Laboratory, especially Carla Ferreira, Helena Quaresma and Maria da Luz Jorge, more laboratory bibliographical collections were found in May 2019 in a number of crates in the store rooms of the FLUC Central Library and subsequently in former laboratory rooms. In addition to bibliographical items, the crates also contained documentary collections from the Coimbra Phonetics Laboratory, including items such as photographs, correspondence, manuscripts and press clippings.

Regarding the bibliographical collection of the Phonetics Laboratory Library, this comprises mainly monographs along with journals with a range of titles. Bibliographical curation has begun and to date 1,923 titles of monographs have been registered and are kept in a store room at the Central Library on the first floor of the FLUC.

The bibliographical curation of these items was carried out in several stages. All the works in question bear the stamp of the owners, the library. Using the Millennium (Innovative Interfaces) system digital platform, the documents were catalogued based on standard procedures for cataloguing Monographs in accordance with the International Standard Bibliographic Description (ISBD), established by the International Federation of Library Associations and Institutions (IFLA). Finally, in order to create a common research language by subject, classification was carried out based on the Universal

Decimal Classification (CDU) Authority Table, which provides for the standardisation of document classification criteria. Once bibliographical curation operations were completed, the works were made searchable in the Public Open Access Catalogue (WebOpac) of University of Coimbra Libraries [7].



Figure 6. Partial view of the bibliographical collection of the Phonetics Laboratory Library, curated as part of the PHONLAB project (photograph taken in February 2024). Monographs predominantly deal with topics in the field of phonetics and linguistics, while there are also some in the fields of physics, engineering, mathematics, medicine, philosophy, psychology, music and sociology, among others. Credit: Helena Quaresma.

The Millennium System was used for journals and cataloguing was carried out in accordance with the standards specified for this type of publication set out in the ISBD standard. Journal titles and the respective issue numbers were made searchable on WebOpac. Journals are from a range of different countries, such as Portugal, Italy, the Netherlands, Germany, Brazil and the USA.

As regards periodical publications, of note is a complete collection of *Revista do Laboratório de Fonética Experimental da Faculdade de Letras da Universidade de Coimbra*, published in eight volumes from 1952 to 1975. One of PHONLAB's outputs was the digitisation enabling OCR of this collection. The aim is to make it available online on Impactvm, a web platform for academic journals based at the University of Coimbra whose aim is to promote scientific knowledge produced in Portuguese-speaking countries.

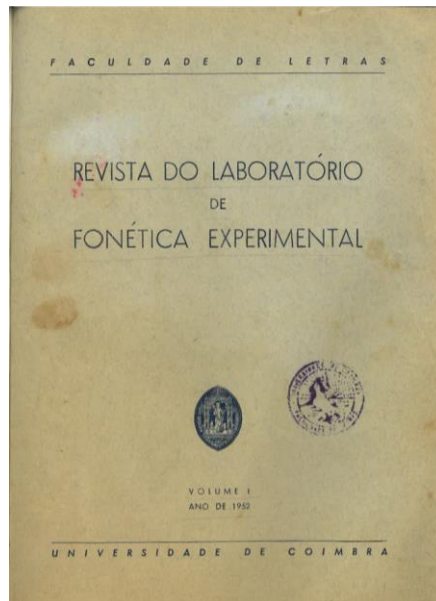


Figure 7. Cover of the first volume of the Revista do Laboratório de Fonética Experimental. The complete collection of this journal was digitised as part of the PHONLAB project and will soon be made available online. Credit: Faculdade de Letras da Universidade de Coimbra.

6 The Coimbra Experimental Phonetics Laboratory archives

As mentioned in Section 5, the collection of documents of the Coimbra Phonetics Laboratory was found in May 2019 in several crates in the store rooms of the FLUC Central Library and identified, while additional documents were found more recently in former laboratory rooms. To enable curation operations to be carried out, a scholarship holder with a further education qualification in archival studies was contracted for project work for a period of 18 months. This collection of documents complements the Paulo de Lacerda Family Archive (Porto), which contains Armando de Lacerda's personal documents. The personal archive was enriched by the donation of items by António Almeida and Marika Hammarström, mediated by consultant Quintino Lopes, sourced from the funds of documents of António Almeida and Göran Hammarström, two of Armando de Lacerda's disciples.

With regard to the categories and types of documentation found at the Faculty of Arts of Coimbra in the Coimbra Phonetics Laboratory archives, there are: Edison's phonograph wax cylinders, chromograms, maps, correspondence, postcards, pamphlets, manuscripts, photographs, zinc engravings, newspaper clippings, and reports dating from the period from 1936 to 1979, when the laboratory was operational.

The first stage in the process of the organisation and curation of the archive was the removal of documentation from the crates in which it was found, mixed with Phonetics Laboratory Library books. After the documentation had been separated, it was sorted by category and type of document. The original form of organisation was preserved in accordance with the way the library was managed. This principle of archive management is essential for preserving the context and authenticity of documents, thereby enabling the best possible understanding of their content and history, in accordance with standard NP4041:

“A basic principle provides that the organisation of documents sourced from a given archive must remain the same as that established by the producing body so that the

relationship between them, and, consequently, their authenticity, integrity and probative value is preserved.” [8:16].

Regarding conservation, most of the documents were found to be in good condition, although some were dirty, perforated or showed signs of oxidation to staples and clips, most of which were rusty. The documents are currently being cleaned, and materials such as staples and clips which cause damage removed. The archival curation of correspondence sent and received is now underway, proceeding in the order items are dated, while each item of correspondence is protected using a covering made of acid-free paper in order to ensure its long-term preservation. An initial analysis carried out enabled correspondence in languages such as Portuguese, German, English, French, Italian and Spanish to be identified, providing an indication of the laboratory's involvement in international networks.

When all stages of suitable curation operations of all document types have been carried out, an inventory of the collection as a whole will be produced. This is an essential instrument for the management of archives as it consists of a detailed and systematic description of all documentary material contained in the collection, thereby facilitating access to and consultation of documents. Furthermore, an inventory allows for the suitable management and preservation of the collection by providing information about the location, content and conservation status of each item.



Figure 8. Archival curation of the collection of documents of the Coimbra Phonetics Laboratory by project scholarship-holder Dayane Farias. Work began on 1st April 2024 at the Central Library of the University of Coimbra Faculty of Arts and documents will eventually be made available to researchers around the world. Photograph taken in April 2024. Credit: Quintino Lopes.

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