DOI: 10.61782/fa.2023.0184

forum acusticum 2023

OVERVIEW OF HISTORICAL DEVELOPMENT OF ACOUSTICS IN PORTUGAL

P. Martins[1*] **J. Patricio**[2]
[1] Portuguese Acoustical Society, Portugal
[2] National Laboratory for Civil Engineering, Lisbon, Portugal

ABSTRACT

There is an apparent interest in identifying the genesis and the different historical moments in which knowledge is based. The result of complex processes that involve consent, conflicts, different types of mediation between various subjects and institutions, aims to understand its dynamics, continuities and discontinuities in the established evolutionary processes. The existence or development of prejudices, which can be considered to have been paradigmatic in relation to the development of a practice of Acoustics in Portugal, has initially created some constraints and difficulties, reflected for example in construction costs.

At former times, a sequence of stages occurred. They were felt as moments of marginality, with an inferior status, which were pointing out to a progressive acceptance, as the demands of comfort and environmental protection were gaining generalized recognition. Simultaneously, with accentuated technical and scientific evolution, stages of acceptance similar to those that generally occurred in more developed countries have emerged.

This paper focuses on the development and evolution of Acoustics in Portugal, mainly in its more relevant branches for the whole Society, presenting its first stages, its spread in research institutions and academia, and its importance for the whole community, as well as the links that have been established at international level.

Keywords: *Acoustics, Associations, Country, History.*

[*] ***Corresponding author***: *pms1940@gmail.com.*

1. INTRODUCTION

Acoustics is one of the most important disciplines we have nowadays to deal with the comfort and well-being of individuals and societies. It a matter of concern for public authorities, for universities, for private sector, for developers and for the community as a whole. Its spread and inclusion in the curricula of academia had its beginning in the last century, becoming the matter more acute and relevant in the last half of the 20th century.

In Portugal, due to the awareness of population requiring better living and working conditions, the jump of its inclusion in the let's say more common world, (not just that confined to research or academia) was done in the last quarter of 20th century. Nowadays, the subsequent sustainable concept is a common matter in all branches of society.

2. PRESENTATION

Science can be seen as an attempt to communicate with nature, to establish a dialogue where questions and answers stand out. This description must be, obviously, completed in such way the man of science can be distinguished from the magician or the sorcerer and, at the furthest point, from the bacteria, which also interrogates the world around and tries to decipher the chemical and physical signals according to which they orient their actions.

Technology can also be described through the dialogue it creates and allows with nature, in which, however, the human intervention component is privileged, being dominated by efficiency and productivity criteria, from which, logically, similarities and differences with respect to fundamental science derive.

Sound emerges as an almost inevitable by-product of all activity. Nothing relevant happens without noise, and silence can thus be interpreted as a paradox. Sound is, in fact, an absent presence or a present absence, with possible associations with desires and terrors, hearing and representing a connection with something beyond the world of forms. Hearing is, according to the bibliographical references available, the first sense to awaken in the fetus, dominating amniotic life as a perception of a world in which it will live, with no possibility to "escape": it is possible to close your eyes, but you cannot "close your ears" …

Man is characterized as a species by his ability to think, that is, to process acquired knowledge and elaborate reasoning, thus creating a novel knowledge, surpassing infinitely oneself, an inner reflection at the level of the most advanced structures. Because it is difficult to understand whether, a thought does not have the support a language, and since verbal language is clearly privileged for man, it can be said, by the way of a synthetic definition of the species: Man speaks.

Acoustics emerges then as the branch of knowledge that deals directly with the preferential vehicle of communication of human thought, very close, therefore, to the essence of this thought. Touching on Aesthetics and the Arts through Music and Audio-visual Techniques, on the Human Sciences, on Biology, on Chemistry, on Physics, it reveals, a diagonal character, a special ability to unveil correlations between different areas of knowledge.

In Portugal, the development of knowledge in the scope of Acoustics, began essentially in the sense of applications, we would say, with a technological character that, without a healthy scientific base, very often led to failures, which evolved positively as a scientific base was established, currently considered perfectly through the undoubted consideration of Acoustics as a scientific discipline, along with its full consideration in the field of applications, therefore of technology.

3. SOME RELEVANT STEPS IN THE DEVELOPMENT OF ACOUSTIC APPLICATIONS IN PORTUGAL

In Portugal, in addition to some "early" examples – see, as a reference, in Fig.1 (acoustic study of Teatro of S. Miguel (in Azores, carried out using a model from the field of optics, in 1947 - the study of Acoustics only began to take place at a higher level, and with a technological polarization, that is, interventions made essentially on the environmental arenat, in particular the built environment, around the beginning of the last quarter of the last century

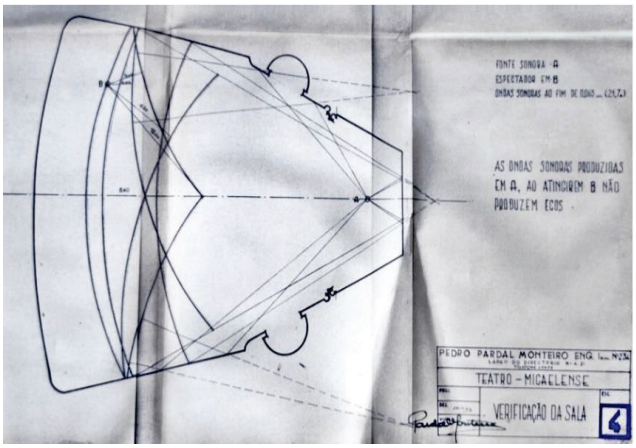

Figure 1. Aspect of the model of Azores Theatre

It should be pointed out that the first doctoral dissertation in the scope of Acoustics (by the main author of this work) took place, in Portugal, in 1975, having as theme the acoustic component of the environment. About ten years later, under the supervision of the author of this work, the teaching of Acoustics at a higher level began, as part of the degree in Technological Physics at the Faculty of Sciences in Lisbon, a graduation that covered the gap between Theoretical Physics, which is concerned with the analysis of models and development of methodologies for the study of physical phenomena, and Engineering, which applies to the establishment of appropriate solutions to technical problems.

The achievement of what we can refer to as a full "citizenship right" for Acoustics, was carried out through a strategy considering the three ways pointed out below.

- Structured grouping of technicians, from different backgrounds, who carried out, in a broad sense, activities in the field of Acoustics, strengthening awareness of this fact and thus creating a basis for group intervention in the country and possible connections abroad.
- Publication of national regulationthat established criteria for the technical-scientific discipline of action, as well as the legal obligation to integrate the Acoustics

area in projects related to the various domains where this need arose.

- Legal establishment of the necessary and sufficient conditions for the exercise of the profession of designer in Acoustics, definitively ruling out those professionals, that although unprepared, tried to intervene.

Below, in summary of the ways in which these actions took place.

I. Creation, at the end of the 1970s, of the Portuguese Acoustical Society (Sociedade Portuguesa de Acústica – SPA), in which the Professor Andrés Lara-Saenz, president of the Spanish Acoustical Society, played at the time an active role, after having been contacted in Madrid during the 9th International Congress on Acoustics (July 4-9, 1977), which he chaired. The importance of the creation of the Portuguese Acoustical Society is fundamental because it meant the awareness of professionals in the area and, consequently, the need/possibility of consolidating it in terms of social intervention. The first author of this paper was the President of its board, whom has been followed by Professor Bento Coelho and, later, by Professor Jorge Patrício, who currently holds the presidency of the Society and who gave it the international representation that it enjoys and which is focuses on forward.

II. Development and legal publication of the" General Regulation on Noise", the first Portuguese legal text specific to the area of applied acoustics, for whose development there were direct interventions by the President of the National Commission for the Environment, Engineer Correia da Cunha and the Secretary of State for Environment, Engineer Carlos Pimenta. This Regulation was approved by Decree-Law nº 251/87, published on the 24th of June, precisely the day on which the 5th Congress of the Federation of European Societies of Acoustics ended in Lisbon (22nd to 24th of June 1987), the first international meeting in the field of Acoustics held in Portugal. This regulation provided a technical-scientific basis for carrying out studies and from here the development of Acoustic Engineering began with an effective support. In 1989, this legal text was subjected to a small change being revoked in the year 2000, with a validity, therefore, of 13 years, from which the Noise Pollution Act was published,. The legal frame was completed in 2002 with the publication of Building Acoustic code which has become an integral part of the construction licensing process of housing buildings, and on applications in which the acoustic component of the environment has relevancy.

III. Creation, on June 22nd, 2001, of the Specialization in Acoustic Engineering, with Engineer Francisco Sousa Soares being the Chairman of the Portuguese Order of Engineers (Ordem dos Engenheiros), who spared no effort to achieve this, because he had a clear notion of the need for this group – pointing out, of curiosity that, until then, those "who did" acoustic projects were from various origins. With the creation of the Specialization, whose first Coordinator was the author of this work, an area of Acoustic Engineering was established and a skill qualification mechanism was created to carry out studies in the area in question, the importance of which is evident.

In 2003, number 75 of the *Ordem dos Engenheiros* magazine was dedicated to Acoustics, realizing that at that time there were already twelve engineers specialized in Acoustics in Portugal. On March 19, 2004, organized by the Specialization, the First Journeys of Acoustic Engineering took place, being that a good indicator of its vitality.

In order to "penetrate", in operational terms, the opacity of the real, Man resorts to the construction of models that, not constituting homothetic descriptions of the real, are ideal structures, thus freed from that opacity, constructed taking descriptors polarized in the variables considered as necessary for the type of intervention in question; the possibility of using models of progressive complexity can be put in analogy with the use of fishing nets with meshes of progressively reduced dimensions, meaning a progressively increasing approach to the real. A reference, obviously very superficial, to the activity carried out in Portugal about models in the field of Acoustics is of interest since they are the necessary tools for carrying out projects.

The first models used were analogue that is representations at reduced scale of the real works in study, using sound fields created by air jets or noise from electrical discharges, explored in multiple frequencies of the real ones, by factors equal to those of the reduction of the dimensions of the structure built. For historical reasons, a big dimension model is presented to study the propagation of noise in the vicinity of Lisbon airport, in order to protect a neighboring traffic lane (Fig. 2), in which the sound source (noise of electric discharges) has integrated a mask that gave it directionality properties consistent with those of jet propulsion aircraft and where, to take into account the

effect, on sound propagation, of deflectors of the jet engines installed in the field, nozzles were used blowing air in the proper direction and sense.

Figure 2. Model to study the propagation of aircraft noise in the vicinity of Lisbon Airport

Reference is also made to another situation concerning a high-capacity auditorium which, by express will of the Promoter, it was also the subject of analogue modelling, with a 1/40 scale mode (see Fig. 3). As it involves testing at a high range of frequencies, it was necessary to test it with desiccated air (3% relative humidity) in order to avoid the occurrence of increased absorption due to phenomena of relaxation of oxygen molecules, so the tests were carried out in the laboratory of Grenoble of the Centre Scientifique et Technique du Bâtiment. The model was built in Portugal, as well as a glass reverberant box, to test the materials to be used in the model, to present, for the different frequencies, absorption characteristics like those that the materials to be used in the construction of the real one presented for frequencies 40 times lower. The testing at Grenoble has been carried out by a Portuguese team.

Figure 3. Model at scale 1/40 of the audience part of the auditorium

Nowadays, as the modern computers allow easily the calculations implicated in digital models, these are the commonly used by Portuguese acoustic technicians– see, as illustration, Fig. 4

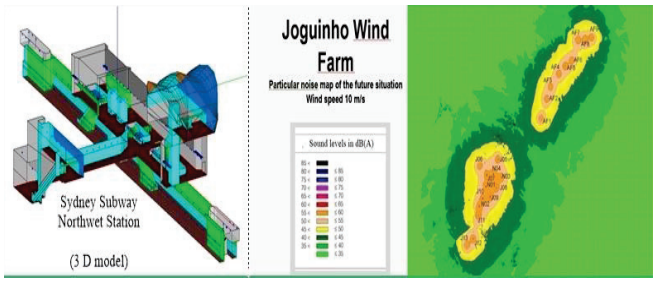

Figure 4. Model to study the propagation of aircraft noise in the vicinity of Lisbon Airport

4. PORTUGUESE ACOUSTICS IN THE WORLD

The Sociedade Portuguesa de Acústica (SPA) constitutes the uniting structure of Portuguese acousticians, in order to generate movements in the country, of technical-scientific training, and to facilitate the recognition, both in national territory and abroad, of the activity carried out by those that are dedicated to Acoustics in Portugal and also for those

who, despite not having this area as a fundamental subject of their activity, find in it aspects of interest and interrelationship with other subjects of knowledge that are important to deepen and develop.

SPA was created in the seventies of the last century. At the time, steps were taken to interest people linked to activities in the field of Acoustics and connections of an international nature were established Among these connections, as previously mentioned, the Spanish Society of Acoustics deserves particular relevance, which led to the establishment of a privileged link between the two Societies: Portuguese and Spanish, which came to materialize in various initiatives, such as the one that led to the 1st Luso-Spanish Congress on Environmental Acoustics, which was followed by two others in the same series.

Currently, fully recognized, SPA is an effective member of the European Acoustics Association (EAA), the International Commission for Acoustics (ICA), the Ibero-American Federation of Acoustics (FIA) and the International Institute of Noise Control Engineering (I-INCE), in whose structures it has assumed relevant positions.

It should also be mentioned the involvement that SPA has in the normative field, since it is a Sectorial Standardization Organization, by delegation of the Portuguese Institute of Quality, representing Portugal in the European and ISO standardization committees (for example the CEN's Standardization Technical Committee).

It should also be pointed out that SPA assumed the Presidency of the Ibero-American Federation of Acoustics and the European Acoustics Association, materialized by the Chairman of the Board Doctor Jorge Patricio, which earned this Society an international recognition that will forever constitute a relevant component of its history, that is, the history of the development of the study and practice of Acoustics in Portugal.

5. CURRENT SITUATION IN THE COUNTRY

Nowadays, acoustics had spread all over the Country, bringing together multiple groups of engineers, companies, post-graduate courses, mainly in environmental acoustics and Building Acoustics, accredited laboratories to perform assessments, evaluations, tests on materials and construction solutions, promotion of good practices in projects, constructions, assessments, standardization, etc. Acoustics is now a matter to deal with in environmental studies, in comfort in restaurants, quality of audithoria, theatres, and a strong motivation for students, professors, and community as a whole.

6. ACKNOWLEDGMENTS

The authors would like to thank all the colleagues who have contributed to this overall history, with the information they personally have and the “stories” they have been gone through.

7. REFERENCES

[1] Archives of acoustics, Portuguese Acoustical Society, 2022