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HISTORY OF THE LABORATORY OF MECHANICS AND ACOUSTICS IN MARSEILLES (FRANCE): FROM THE SECOND WORLD WAR TO THE PRESENT DAY

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ABSTRACT

The Laboratory of Mechanics and Acoustics in Marseille (France) celebrated its 80th anniversary in 2021. It was created in 1941, under the name of *Centre de Recherches Scientifiques, Industrielles et Maritimes* (CRSIM) and was the successor of the French Naval Research Center created in Toulon by the French Navy, under the direction of François Canac, to work on submarine detection during World War I. It was the first laboratory of the National Center for Scientific Research out of Paris. In this laboratory, Paul Langevin developed the first high-powered ultrasonic transmitters for the detection of submarines. F. Canac headed the CRSIM until 1958. He was one of the founders of the journal *Acustica*. The acoustics service developed considerably under his leadership. The CRSIM became the *Centre de Recherches Physiques* (Physical Research Center, CRP) in 1962 and was directed by Théodore Vogel. In 1973, the laboratory had a Department of Mechanics and a Department of Acoustics. On July 10, 1973, the laboratory took the name of *Laboratoire de Mécanique et d'Acoustique* (LMA, Laboratory of Mechanics and Acoustics), a name that better describes its activities and which it still bears today. We present here the evolution of the laboratory's research themes over these 80 years.

Keywords: *Acoustics, Mechanics, history*

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1. INTRODUCTION

The Laboratory of Mechanics and Acoustics is, at its name indicates, specialized in mechanics and acoustics. It is composed of about 130 people (researchers and teacher-researchers, engineers, technicians, administrative staff, doctoral students). It is a research unit attached to *Aix-Marseille University* (AMU), the National Center for Scientific Research (Centre National de la Recherche Scientifique, CNRS) and the *École Centrale Méditerranée*. Its origin dates back to the beginning of the 20th century, but it has been a CNRS laboratory for “only” 80 years. This text is strongly inspired by the writings of Claude Gazanhes ([1], [2]).

2. THE VERY BEGINNING

The origins of the laboratory go back to the *Laboratoire de la Guerre Sous-Marine* (Submarine Warfare Laboratory), created in Toulon in 1917 by the French Navy. It was in this laboratory, among others, that Paul Langevin developed the first high-powered ultrasonic transmitters for the detection of enemy submarines by echoes.

At the end of the war, in 1920, the missions of this laboratory grew; it became the *Laboratoire du Centre d'Etudes de Toulon* (Laboratory of the Toulon Study Center, LCET) and its scientific direction was entrusted to François Canac who played a major role in the history of the laboratory of which he was the founder and then the director until 1958.

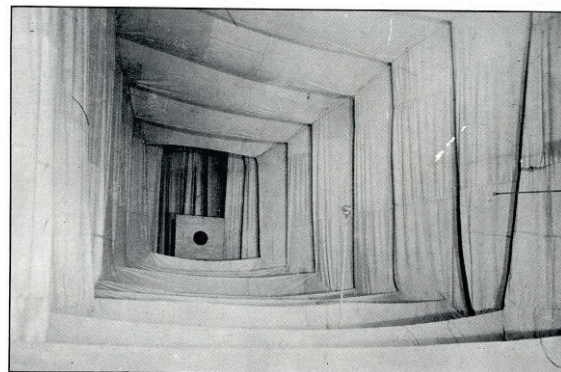
For F. Canac, inspired by the National Physical Laboratory, Teddington (UK), the objective was that the LCET, well beyond its missions for the French Navy, should be an organization of upstream research and “technology watch”,

capable of developing, for a government department or industrial sector, applications resulting from the latest discoveries, of building prototypes, what is called today “technology transfer”.

3. THE SECOND WORLD WAR

At the beginning of the Second World War, the laboratory was renamed *Centre de Recherches de la Marine* (CRM). At the end of June 1940, the CRM, staff and equipment, was hurriedly embarked on a ship to Oran and then a train to Algiers. It seemed that the CRM would disappear in the turmoil. But it was headed by an energetic man with a strong personality. In August 1940, F. Canac proposed that the laboratory be placed under the supervision of the Ministry of Public Instruction: "The working methods (of the laboratory) are precisely those which it is necessary to introduce (very thorough research, complete development in view of pragmatic problems). It would bring its specialists, its material, its documentation".

F. Canac's appeal was heard. The CNRS had just been created; its administrative and financial situation was still under study but everything happened very quickly. On January 1, 1941, the CRM became the first “Laboratoire Propre” (i.e. with a unique supervision) of the CNRS out of Paris and took the name of *Centre de Recherches Scientifiques Industrielles et Maritimes* (Center for Scientific, Industrial and Maritime Research, CRSIM). The research at CRSIM was divided into five major themes: Acoustics, Optics, Chemistry-corrosion, X-rays, Psychotechnics. The Acoustics part was strongly developed, notably under the influence of F. Canac who was passionately interested in the Acoustics of the Ancient Theaters [3]. It included electroacoustics, vibrations, architectural acoustics, ultra-sounds in air and water. The CRSIM already had many facilities: a large anechoic chamber (13 x 5 x 5 m³), a small anechoic chamber (4 x 2 x 2 m³), a reverberation room (10 x 2.6 x 2.6 m³), a ripple tank for the study of room models, a 18 m channel with an absorbing basin. Figure 1 presents a view of the large anechoic chamber and reminds us of the difficulties of the time: the absorbing walls were made of pyramidal trunks covered with blankets supplied by the Health Service (Figure 1).



Chambre sans écho.

Figure 1: the anechoic chamber of the CRSIM

4. THE CRP (PHYSICAL RESEARCH CENTER)

In 1962, the CRSIM became the *Centre de Recherches Physiques* (Physical Research Center, CRP) with 4 departments: Mechanics Physics and Acoustics, Wave Visualization, Automation, Structures of crystalline bodies. The laboratory moved to the *Joseph-Aiguier* site, still in Marseille, where it joined other CNRS laboratories. Thanks to this operation, the laboratory grew and benefited from the installation of new important and powerful equipment for acoustics: among others, a large anechoic chamber for the wave propagation, a smaller anechoic chamber for psychoacoustic tests, a station for architectural acoustics built according to international standards and including two adjacent reverberant rooms for studying the acoustics transparency walls, a music studio with a piano, several tanks dedicated to underwater acoustics and ultra-sound propagation.

5. THE LABORATORY OF MECHANICS AND ACOUSTICS

In 1975, the laboratory refocused on Solid Mechanics and Acoustics and became the LMA. Mechanics of continuous media, computer science, and real time techniques has developed from this time as well as experimental facilities for mechanics.

The acoustics department was composed of 5 teams: acoustic theories, applied acoustics, aerodynamic acoustics, musical acoustics and propagation in liquid media. Later, new themes would appear like ultrasounds, protection of environment, active noise control and psychoacoustics (which was part of the research themes of

the CRP but has been abandoned for more than 10 years), submarine acoustics.

In 2012, the *Laboratoire de Contrôle Non Destructif* (Non-Destructive Control Laboratory, LCND), based in Aix-en-Provence (at Aix-Marseille University), joined the LMA. Since then, the LMA has a branch and premises at the IUT in Aix-en-Provence (Mechanical Engineering Department). At that time, the laboratory was restructured into 3 teams (described below) which continue today.

In 2015, the LMA moved to the *Technopôle de Château-Gombert* where the fluid mechanics and physics laboratories, as well as the engineering schools *École Centrale Marseille* (now *École Centrale Méditerranée*) and *Polytech-Marseille*, were already present.

The new laboratory offers an exceptional experimental environment, that was designed by its staff during the construction project. In particular, a set of 3 anechoic rooms represents a rare equipment in the community: an anechoic room equipped with the necessary cabling for the study of active anechoicity at low frequency (Figure 1); a semi-anechoic room coupled with an excitation room underneath it (where complex sounds are made), designed to accommodate large-scale projects directly related to industrial applications; an anechoic room that can receive participants for psychoacoustic experiments.

Today the LMA is composed of 3 teams: *Materials and Structures*, *Waves and Imaging*, *Sounds*. The work of the *Materials and Structures* team concerns solid mechanics, with experimental, theoretical and numerical aspects. The objectives of its activities range from the characterization of materials or structures (fatigue behavior for example) to the establishment of models or innovative modeling tools to simulate solid media (materials, structures or interfaces). The research conducted in the *Waves and Imaging* team aims at developing acoustic methods for modeling, characterization and/or imaging of heterogeneous media with fundamental and applied approaches. The research carried out in the *Sound* team concerns audible sounds: their production, propagation, control, synthesis and listening. Since the studied sounds are audible, Human remains an important element of the scientific context, either he/she participates in the production of the sound (sung voice, musical instruments), or he/she undergoes its nuisance (transport noises), or he/she uses it on purpose (communication). And the human being is also the object of the research (perception, hearing).

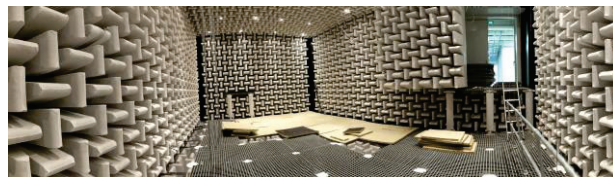


Figure 2: the large anechoic room of the LMA at *Château-Gombert*

6. ACKNOWLEDGMENTS

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