



## DEVELOPMENT OF ACOUSTIC RESEARCH AND ACTIVITIES IN ITALY IN THE LAST CENTURY

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### ABSTRACT

The origin of Italian activities in acoustics in the last century are described, as they matched with the general research going on in physics and engineering in the country and abroad. The development of a specific institute devoted to acoustics within the National Council of Researches is reported with its branches developed from previously assessed research themes. Parallel activities developed in university or private companies follow, together with the contemporary collaborations stemming on international bases. The development of acoustical activities and the increase of researchers in the field stimulated the foundation of the National Association and the strengthening of international relations, with the active participation of Italian researchers to congresses and research institutions.

**Keywords:** *Corbino Institute, 17th ICA, ancient theatres acoustics*

### 1. INTRODUCTION

On the Opening ceremony of the 17th International Congress in Acoustics in the Michelangelo square on the Capitol hill in Rome, I happened to state that that was not the first acoustical event in that place, since more than two thousand years before another event did take place, that

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**FIGURE 1.** The geese quacking on the Capitol hill, on a marble relief found during excavations at ancient Ostia.

should have been really considered as the first in the field of acoustics in Italy [1]. On one night, indeed, of the year 390 B.C. the Gauls, that were besieging Rome, tried a last assault to the hill of the Capitol, but the geese sacred to Juno quacked loudly and their acoustic message alarmed the soldiers that were guarding the rock, thus saving the power of Rome. That ICA Congress dates Sept 2001 (A.D., of course!) and this citation seems to be properly chosen for signing the final point of this acoustics resumé of mine in Italy, not so much as for its initial coordinate. Indeed, the gap from 390 B.C. to the few first decades of the last century is plenty of musical events and musical theatres in the country and few medical developments took place which, however, were not continuously developed in organic research structures.

## 2. THE INSTITUTE OF ACOUSTICS

A breakthrough in acoustical research in Italy dates 1936 when the *Istituto Nazionale di Electroacustica* was officially founded as an autonomous center of researches within the National Council of Researches, whose name successively changed to *Istituto di Ultracustica "O.M.Corbino"* (1949) and *Istituto di Acustica "O.M.Corbino"* (1969), to be finally suppressed in 2018 and became a section of *Acoustics and sensors* within a larger *Istituto di Ingegneria del Mare*. The Institute establishment was strongly supported by Orso Mario Corbino, the professor of physics at the Rome University that formed the famous group of young physicists led by Enrico Fermi, its see being at the very same place where that group did work. The see at the historical place of via Panisperna - where the first nuclear reactions did take place in the garden fountain and that was to be abandoned in 1943 under the commands of the occupation troops - and the first director soon changed because of the war conditions at that time and Amedeo Giacomini, the new and former vice director, wrote [2] the first report in 1942 (listing 36 publications of the Institute personnel up to that moment), commenting about the general change that the research activities had undergone in the first half of the century, from single to group studies that needed to be supported by formal institutions, where to work in community formats. The electroacoustics theme derived from the previous experiences that both the first appointed and the first nominated directors, Sacerdote and Giacomini, respectively, performed at the *Galileo Ferraris Istituto Elettrotecnico Nazionale* in Turin and at the *Institut für Schwingungsforschung* in Berlin, and is clearly coherent with the very first facilities available at the Institute: mainly radio generators and power banks for acoustic transducers. An anechoic chamber and a reverberant one were also available.

Twenty years later, in the Sixties, the Institute annual report documented an activity in matter physics, that was to extend later into the area of solids structure and liquids absorption. In the former field there should be mentioned the discovery and successive works on internal friction in solids, what is now commonly called the Bordoni effect [3], named from the researcher working at the Institute at the time. With regard to the physics of liquids, innovative researches were done by D. Sette on the cavitation effects produced by power ultrasonics, while the initial work by A. Giacomini on the visualization of ultrasonic fields in liquids was continued with the use of coherent light in holographic techniques.

New fields of research were to flourish together with the enlargement of the Institute in the successive decades, including surface acoustic waves technologies and medical ultrasonics, together with the noise evaluation and abatement in industrial sites and street traffic.

It is interesting to mention that at the same time the Institute began to act at the international level [4]. In 1951 the *International Union of Pure and Applied Physics* (IUPAP) decided to create the International Commission on Acoustics (ICA) as one of its subcommittees [5], and A. Giacomini was one of its members, together with R.H. Bolt, F. Canac, F. Ingerslev, E. Meyer, W.M. West. One of the first questions the Commission was called to debate was one relative to regulate the succession of the congresses organized the year around. The year before the Commission foundation, a meeting on ultrasonics took place in Rome and two years later the International Congress on Electroacoustics in Delft opened the series of the ICA congresses on international scale. It may be interesting to report the presence of the papers at the conference from the various countries participating to it: Germany 19, USA 13, UK 15, Netherland 9, France 9, Denmark 5, Italy 4, Belgium 4, Austria 1, Finland 1, Norway 1, Sweden 1, Switzerland 1. Successively, a delegate from Italy was constantly member in the persons of D.Sette and the author. In 2001 the 17th ICA conference took place in Rome with 2000 participants [6].

## 3. ACOUSTICAL RESEARCH IN NATIONAL INSTITUTIONS

The *Istituto Elettrotecnico Nazionale* devoted to research in electrotechnics was founded in 1934 in Turin for the specific purpose to link the work of the university laboratories with the needs of the rising industry. Within its activities, metrology was a leading point, such as to give rise in 1968 to a new *Istituto di Metrologia*, dedicated to G.Colonnetti (from 2006 *Istituto Nazionale di Ricerca Metrologica*), where acoustics metrology was particularly cultivated. A sector was devoted to maintaining acoustics and ultrasonic calibration services, in participation with few international standard committees. From this area, there stemmed various researches on calibration procedures and technologies, as

well as on noise in working places, architectural acoustics and physical acoustics.

University research in acoustics found its natural growth in places where researchers from the above described institutions had had previous or successive experiences. At Trieste university a small group worked on acousto-optics and at the Perugia university a group was active, working on ultrasound in nonlinear and fractal materials and seismic vibrations; a line of research originated from the Bordoni group on solid state acoustics was also present. Sapienza university in Rome was a natural seat where several researchers from the Institute Corbino finally established, working on nonlinear acoustics and the Bordoni effect, and opened new lines on bioacoustics and medical acoustics, in addition to working on the audio frequencies range for characterization of microphones and building acoustics. At Ferrara and Bologna universities there have been lively groups active on the acoustics of ancient and modern halls and theatres and noise abatement and control, respectively. Similar fields of research were cultivated at Napoli, signing the general Italian interest for acoustics as cultivated and developed in ancient times. At Padova there were present activities in the field of phonology, at Milano of audiology, in Palermo of noise, in Firenze of architectural acoustics, in Messina of cavitation acoustics.



**FIGURE 2.** The cities where activity in acoustics was present in Italy in the last century.

It should be recalled that the main characterization of all the above mentioned activities, mainly connected with the two institutions founded in the Thirties, were in the fields of the physical acoustic, while noise research, as well as speech and architectural acoustic research, stemmed autonomously in few different places and

found a natural development within the acoustical association, that was founded as *Associazione Italiana di Acustica* (AIA) in 1972 [6]. At the international level, AIA very soon joined FASE and ICA and in 1992 was one of the 12 national associations to found the *European Acoustics Association*. In 1977 AIA started the publication of the national journal, *Rivista Italiana di Acustica*, still active today. By the end of the century AIA was structured in several thematic groups on environmental acoustics and musical acoustics, that were to proliferate in the years to follow.

A final comment should be also given on the acoustics legislation, just to recall that a final decree on noise control and pollution dates the end of last century (1997), while noise as a social problem disjoint from health problems was earlier considered (1984), with the establishment of a specific *Ministry of Environment*.

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