Acoustics in the competition for the construction of the opera house
“La Fenice”: 1789-1790

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Abstract: From the analysis of the projects presented for the competition of “La Fenice” in Venice (1789-1790) and from the judgments of the commission, this paper attempts to synthesize the knowledge of opera house acoustics at the end of the 18th century, so important for the history of music and of opera houses.

BACKGROUND

The fire at the “La Fenice” opera house in Venice on 29 January 1996 and the immediate decision taken by the city municipality to reconstruct the theater “as it was and where it was”, gave rise to studies and investigations on the origins and history of the theater. The acoustics of “La Fenice” was praised since its opening on 16 June 1792 with the opera “I giochi di Agrigento” by Paisiello. As a consequence, when the theater was reconstructed by Tomaso and Giambattista Meduna after the fire of 13 December 1836, it was decided to keep the same shape of the hall designed by Gianantonio Selva, the first architect entrusted with the construction of this theater. The Medunas left a precise description [1] of the design and the materials they used in the reconstruction of the theater.

These considerations support the idea that the values of the acoustics of this theater must be sought in its primitive design.

THE COMPETITION FOR THE CONSTRUCTION OF “LA FENICE”

In 1789, in Venice, a group of nobles, members of “La nobile Società”, decided to build a large new theater in the center of the city, between San Marco and the Accademia; the chosen area was rather small and had an irregular shape, with water on two sides. The competition for the construction of the new theater later called “La Fenice” was opened on 1 November 1789 and was addressed to “national and foreign” architects. The requirements were collected in 14 articles. The 7th article gives precise indications for the main hall which must have 5 orders of boxes, each one with 35 boxes; they must be equal, with the exception of the central and the proscenium ones which may be wider. None of the articles in the competition program contains acoustic requirements; only in the introduction it is said that “the theater must have as its main quality that of being most satisfactory for the eyes and for the ears”. The program asks for drawings, a model and a report with all the necessary indications for the understanding of the project. In the span of 4 months, as indicated in the program (later increased to 5), 29 projects were presented: 23 complete with drawings and reports, eleven also exhibited the model; 6 architects presented only the drawings. Recently the manuscripts of 15 projects have been found in the Archives of the theater “La Fenice” at the moment at the Ugo and Olga Levi Foundation in Venice. A commission was established to judge the projects: Simone Stratico, Benedetto Buratti and Francesco Fontanesi were the members of this commission. Simone Stratico had the task of evaluating the acoustic aspects of the projects; he was professor of physics and mathematics at the Padova University and he was well known as an acoustician in that period.

It seems important to mention the important role played by Andrea Memmo in the course of the competition. He was an authoritative member of the political life of Venice and an expert in theater constructions. From the beginning he was the mind behind the organization of the competition, establishing the requirements for the construction of the new theater; he knew Simone Stratico and had with him many discussions and exchanges of letters and ideas about the acoustics of theaters. He was the anonymous Author of a publication entitled “Semplici lumi…” where he gave suggestions to the members of the commission for the judgments of the projects. It is noteworthy to remark also that this publication was quoted by the commission in its final report to support its evaluations and decisions. A detailed and complete description of the projects and of the final judgments of the commission is in the book by Maria Ida Biggi “Il concorso per la Fenice 1789-1790” [2]. The competition was closed after many discussions and polemics: the architect Gianantonio Selva was entrusted with the construction of
the new theater, but the prize for the best project was given to Pietro Bianchi. The study and the analysis of the projects and particularly the judgments given by the members of the commission are of particular interest as they give an idea of the knowledge of opera house acoustics at the end of the 18th century.

**OPERA HOUSE ACOUSTICS AT THE END OF THE 18TH CENTURY**

At the end of the 18th century, it seems that there is not agreement on the best shape of opera halls; there are still very authoritative architects who propose the bell, like Riccati [3]; the ellipse, like Pierre Patte [4] or the semicircular, like Stratico. His ideas regarding opera house acoustics are clearly exposed in the manuscript of the examination and opinions concerning the competition of “La Fenice” published after the end of the judgment and in the manuscript dealing with the shapes of opera halls where he analyses three kinds of curves: elliptic, semicircular and oval; he expresses his preference for the semicircular. All these manuscripts are now at the Marciana Library in Venice. From the table of comparison between the 29 projects arranged by the commission itself, it is possible to observe that 21 propose the semicircular curve, 5 the elliptical one and only 3 the oval curve. Moreover, four of the five reference theaters indicated in the same table of comparison, i.e. the Argentina in Rome, the “La Scala” in Milan, the theater in Berlin and the “San Benedetto” in Venice, have a semicircular curve; only the hall of the “Regio” in Turin has an oval shape. This analysis shows a clear preference for the semicircular curve.

More agreement is found in the use of materials: wood is indicated as the most convenient in order to obtain a “resonant” theater. Because of the fire, many authors propose an extensive use of brick stones which also increase the sound reflections from the walls of the theater. The use of soft materials, such as carpets, is discouraged. Paintings are proposed for decoration. The surfaces exposed to the sound must be as smooth as possible in order to allow the propagation and reflection of the waves without distortion. Curved surfaces are preferred; F. Riccati [3] proposes curved walls also between the boxes. The angle of the incident wave is equal to the angle of the reflected wave: on this hypothesis geometrical acoustics is extensively used to investigate the sound reflections in the hall.

Some Authors consider of some importance the delay time of the reflected sound in order to avoid echo. Generally it is established that small rooms have better acoustics. An empty volume under the orchestra floor and under the stall is considered to be essential, the same applies to a hall elevated over a ground floor.

Disagreement still exists regarding the ceiling shape and construction: flat or concave, airtight or with a plenum which may be open or closed to the main hall. Proscenium boxes are believed to be dangerous because they absorb sound; some Authors propose the use large columns and an architrave in the proscenium in order to improve the sound propagation from the stage and the orchestra toward the audience. The dimensions of the stage and of the proscenium seem very critical for the visual conditions and for the acoustics: for example, many projects were rejected by the commission because they were too large or too small in comparison with a proscenium width of 40 “Venetian feet” considered to be an optimum value.

Holes in the ceiling are dangerous for the acoustics of the hall because of sound absorption. If they are necessary for air ventilation and for the movement of the chandeliers, it is proposed to have these holes laterally in the ceiling and not in the center [3]. The movement of the air in the theater improves the acoustics if the air moves from the stage towards the audience. Worse acoustics is expected if the air moves from the audience towards the stage.

In spite of the efforts made by many Authors in order to justify, from a scientific point of view, all the proposals and the options to obtain good acoustics in the theater, many of them conclude their report with the consideration that this goal is often the result of common sense, of comparison with other tested and good solutions, and of experience. It could be observed that this conclusion is still acceptable today.

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**REFERENCES**