

Matthias Rieger

**The historicity of sound and hearing**  
Book Review of  
Patrice Bailhache Une histoire de l'acoustique musicale. Paris: CNRS  
editions, 2001

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For further information please contact:

Silja Samerski  
Albrechtstr.19  
D - 28203 Bremen  
Tel: +49-(0)421-7947546  
Fax: +49-(0)421-705387  
e-mail: piano@uni-bremen.de

## The historicity of sound and hearing

Patrice Bailhache *Une histoire de l'acoustique musicale*. Paris: CNRS editions, 2001, 199 pp., Illustrations, 23.90 € ISBN 2-271-05840-6.

Since over two thousand five hundred years, philosophers ask, why certain musical intervals are perceived as beautiful. The history of this reflections is treated by Patrice Bailhache in his *Une histoire de l'acoustique musicale*. Bailhache, professor for philosophy at the University of Nantes, is a well known author in the field of the history of logic, mechanics and music in France. After studies on the musical theory of Leibniz, Euler, Mersenne and d'Alembert he now presents his history of musical acoustics, published by the Councel Nationale de la Recherche Scientifique.

Bailhache's undertaking is ambitious. In less than 200 page he tells the 'history of acoustics' from Pythagoras up to contemporary researches on acoustical physiology. Being conscious that he cannot tell the whole story in one book, Prof. Bailhache restricts himself dexterously to historical key points of his choosing, a limitation that makes this book accessible to the general reader.

In his first chapter he deals with the discovery of the numerical ratios corresponding to the principal intervals of the musical scale by Pythagoras. This decisive event in the history of music defined the ratios of the first four numbers as the source of the musical consonances: 2:1 for the octave, 3:2 for the fifth and 4:3 for the fourth. The foundation of *consonantiae* was questioned some two hundred years later by Aristoxenos of Tarent, who objected to the privilege that Pythagoreans assigned to intelligible constructs over sense-perceptions. According to Bailhache it was Euclid, who in his *Division of the canon* argued against Aristoxenos returning to the axiomatic derivation of musical consonances.

Bailhache's account jumps from Antiquity right into the Renaissance, avoiding to get enmeshed in the gothic musicology of the Dark Ages. Neither the controversies on the nature of proportionality in musical *consonantia*, nor the incomparability of *musica sonora* within the modern notion of 'music' fall under his purview. Over thousand years after Euclid, Johannes Kepler's *Harmonices mundi* (1618) and Gioseffo Zarlino's *Istitutioni harmoniche* (1558) argue for the need to expand the Pythagorean scheme by the recognition of additional consonances. In the world of polyphony and counterpoint, the major and minor third and sixth had to be treated as instances of consonance, even though their proportions lay outside the Pythagorean tetractys. Bailhache illustrates the route by which these scholars proceed to prove the legitimacy of including the ratios not just of the first four but the first six numbers among the *consonantiae*. This new learned opinion was part of the assumptions held by Galilei, Beeckman, Descartes and Mersenne. It constitutes, for Bailhache, the foundation of the "classical age" of musical acoustics. During this epoch all reflections on the origin of consonances shift from "number to sound" (Paolo Gozza) as the point of departure for all reflections on the origin of consonance. The relationship between segments of a chord is supplanted by the relation between the frequencies of pulse. So Mersenne illustrates the

octave by comparing two birds, one flapping twice as fast as the other. The question of how to tune an instrument without ruining the beauty of the consonances highlights a particular aspect of the reflections on the origin of musical consonances. ‘Meantone temperament’, ‘irregular temperaments’ and ‘equal temperament’ are the key words for a tension in musical practice between the plea for cosmological purity and that for the freedom of artistic modulation.

The French encyclopedist Jean le Ronde d’Alembert denied any musical significance to proportionality. He rewrote Jean Jacques Rameau’s complicated *Treatise on harmony* in crisp prose and calls Pythagorean theory beside the point: “The notions of the Greeks and of all those who took their inspiration from them have to be abandoned now, that we have done away with all matters of proportions and progressions [...] whose mention, for us, seems useless [...] and completely irrelevant to music.”<sup>1</sup>

In the next chapter Bailhache condenses a whole century of acoustical research in the work of just one scientist. For him, only with Hermann von Helmholtz, ‘acoustics’ starts as a modern science. Neither Joseph Sauveur, who first used the term for a new field of research at the Académie Royale des Sciences, nor Ernst Florens Chladni who discovered the famous Chladni-figures have changed the understanding of consonances as radically as Helmholtz in his *On the Sensations of Tone as a physiological basis for the theory of music* (1863). Helmholtz, following Ohm, was the first to define a ‘tone’ as a combination of a fundamental and countless overtones. This new notion of sound was consistent with his physiological research on the ear as a device for analyzing such ‘sound’: “The end of every fibre of the auditory nerve is connected with small elastic parts, which we cannot but assume to be set in sympathetic vibration by the waves of sound.”<sup>2</sup> It was also Helmholtz who established for the first time a concise theory for ‘beats’ and for ‘combination tones’ as the acoustical cause for the origin of consonance and dissonance. After highlighting the lasting contributions of Helmholtz, Bailhache proceeds to stress the shortcoming of his attempt at a definite explanation of consonance: The beautiful explanation that Helmholtz gave for the ear as an analytic device, in retrospect appears flawed. The basilar membrane does not show the transversal tension that he assumed, but is in all directions equally soft.

In the last chapter the reader gets a taste of contemporary physiological research in musical acoustics. Based on his extensive acquaintance with the French literature on cognition that is “more enlightening about the march of science than on the history of science” (p. 169) Bailhache concentrates on recent research on the mechanics of the “basilar membrane” as well as “secondary beats” and “sound intensity”, discoveries of the twentieth century that built on the work of Helmholtz.

Patrice Bailhache has written a history of acoustics that is concise and well documented. He is the first author who succeeded to pack the whole story into a small volume. Neither the admired Helmholtz, who salvaged Pythagoras as the ancestor of musical

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<sup>1</sup> Jean le Ronde d’Alembert, *Éléments de musique suivant les principes de M. Rameau*, Lyon: 1779, xii, translation M. R.).

<sup>2</sup> Hermann von Helmholtz, *On the Sensations of Tone as a physiological Basis for the Theory of Music* (translated by A. Ellis, New York: Longmans & Co, 1885. Reprint with an introduction by Henry Margenau, New York: Dover Publications, 1954, p. 129).

acoustics, nor –a hundred years later – Frederick Hunt in his *Origins in Acoustics* (1978) tried anything like that.

One reason, why Bailhache seems to lack precursors might be that one just could not have spoken of ‘acoustics’ before the seventeenth century, when the science of sound took shape as an independent branch of natural philosophy. Although Joseph Sauveur in the beginning of the eighteenth century claimed paternity for acoustics as a science, acoustics as a discipline with laboratories, journals and scientific instruments did not exist before the time of Helmholtz. This is the reason why authors like Dieter Ullmann in his *Chladi und die Entwicklung der Akustik von 1750-1860* (1996) and Robert T. Beyer in *Sounds of Our Times* (1999) confine their historical references to musical acoustics to the time after Sauveur.

Bailhache focuses overwhelmingly on French sources and studies. This must be assumed the reason why he does not mention authors like Albrecht Riethmüller<sup>3</sup>, Paolo Gozza<sup>4</sup> and Charles Burnett<sup>5</sup>, all of whom explicitly question the possibility of a global history of musical acoustics. Albrecht Riethmüller argues that it is a fallacy to trace back to Antiquity a modern musical category, like that of sound. In his *Begriffsgeschichte of phthongos* (sonus) he demonstrates that ‘sound’ in the current sense, as a divisible object that consists of overtones has no equivalent to the world of *sonus*. Paolo Gozza makes an analogous point in his anthology *From Number to Sound. The Musical Way to the Scientific Revolution* (2000) that focuses on the notion of ‘sound’ in the seventeenth century. In the same vein, but with the opposite point of departure, Charles Burnett pleads for a history of hearing. In his contribution to this anthology, Alan Towey demonstrates that for Aristotle it is the relationship between the sense of hearing and its source that constitutes sound and does so in strict analogy to the two tones that constitute a consonance. For both relationships, he uses the same term *symphonia*.<sup>6</sup>

The contribution that Patrice Bailhache has made by this lively yet learned first attempted to stress the historical nature of musical acoustics does not lose its value by his failure to stress the incomparability of sound and hearing then and now. In fact, we dare to hope that this established and successful author will make precisely this history the subject of an equally readable book.

Matthias Rieger, Institut für Kulturforschung und Bildung,  
Universität Bremen; Germany

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<sup>3</sup> Albrecht Riethmüller, ‘phthongos’, in *Handwörterbuch der musikalischen Terminologie* (Wiesbaden, Verlag Franz Steiner, 1974, p.1-8).

<sup>4</sup> Paolo Gozza (ed.) *From Number to Sound. The Musical Way to the Scientific Revolution* (The Western Ontario series in Philosophy of Sciences, Volume 64. Dordrecht: Kluwer academic Publishers, 2000).

<sup>5</sup> Charles Burnett (ed.) *The second Sense. Studies in Hearing and Musical Judgement from Antiquity to the seventeenth Century* (London: The Warburg Institute University of London, 1991).

<sup>6</sup> See Alan Towey, ‘Aristotle on Hearing and Instantaneous Change’, in Charles Burnett (ed.), *The second Sense Studies in Hearing and Musical Judgement from Antiquity to the seventeenth Century* (London: The Warburg Institute University of London, 1991, p 7-18).

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