SOUND AND MUSIC

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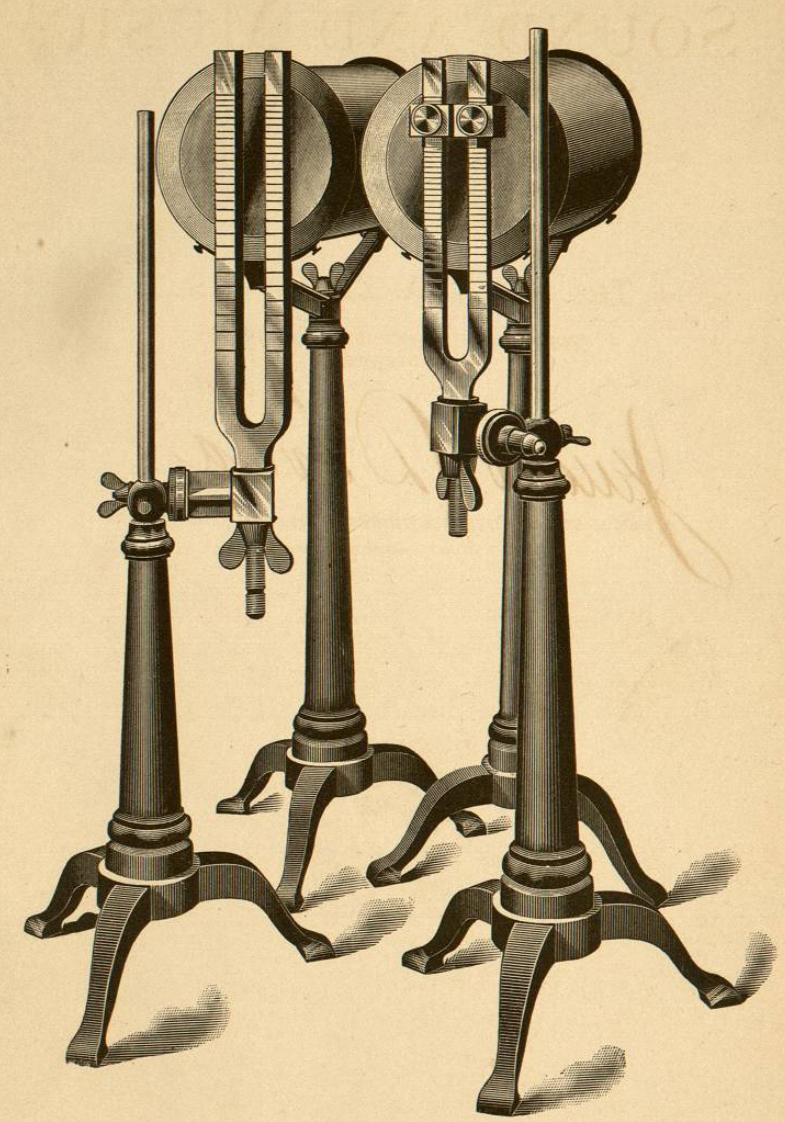
ZAHM



TWO OF THE LARGE FORKS AND RESONATORS OF KOENIG'S GRAND UNIVERSAL TONOMETER, — SEE CHAPTER II., PAGE 74, — ARRANGED FOR EXPERIMENTS ON BEATS.

SOUND AND MUSIC

BY

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Juan de Dios Dávila.

"THOU HAST ORDAINED ALL THINGS IN MEASURE AND NUMBER AND WEIGHT." — Book of Wisdom, xi. 21

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TO

THE VERY REVEREND E. SORIN, C.S.C.,

Founder of the University of Notre Dame,

WHO HAS BEEN
FOR MORE THAN FIFTY YEARS THE FRIEND AND PROMOTER
OF HIGHER EDUCATION,

AND WHO IN AN EMINENT DEGREE

Deserves well of Science and Art.

PREFACE.

THE present volume has grown out of a course of lectures given last year in the Catholic University of America at Washington, D. C. Yielding to numerous requests to have the lectures published, my first intention was to give them to the press substantially as they were first delivered. When, however, I came to revise them, I soon found myself making many alterations and additions; and by the time the task of revision was complete, I became aware that I had practically written a new work. The object in view was to give a more complete exposition of the subject treated than had been possible in the lectures actually delivered, and to make the volume now offered to the public embrace in greater detail all the latest results of acoustical research. I have been led to retain the lecture form, as being more animated and picturesque, and as being more in keeping with the character of a work which deals so largely with apparatus and experiments.

The main purpose of the book is to give musicians and general readers an exact knowledge, based on experiment, of the principles of acoustics, and to present at the same time a brief exposition of the physical basis of musical harmony. Both in Europe and in this country musical conservatories are beginning to exact of students a theoretical as well as a practical knowledge of music;

and hence a work like the present cannot be considered as altogether untimely.

To enable the reader more readily to understand the various topics treated, illustrations of many of the instruments used in the lectures have been inserted in the text. Some of these were prepared expressly for this work, while others are to be found only in some of the more recent French and German treatises on sound and music. For the majority of the illustrations, however, I am under obligations to Dr. Rudolph Koenig and M. G. Masson, of Paris.

My most grateful acknowledgments are due to my distinguished scientific friends Professor Alfred M. Mayer and Dr. Koenig for invaluable assistance in preparing the work for the press. The former made a critical revision of the manuscript of the entire work; while the latter read all that pertained to his own inventions and discoveries. I am also indebted to my brother, Professor Albert F. Zahm, for a careful reading of the manuscript, and for many useful and practical suggestions that have enhanced materially any merit the book may possess. I have likewise to thank Mr. Frederick E. Neef, one of my students, for many of the drawings which adorn the volume.

If this contribution to the Science of Music shall in any way lead to a better understanding of the art, or to a more intelligent appreciation of the beauties and wonders of musical harmony, I shall feel that I have achieved all that I had in view in its publication.

J. A. Z.

Notre Dame, Ind.
May, 1892.

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God spoke, and through the soundless realms of space
The keynote of created music rolled;
And time felt harmony within its hold,—
The pulse-beat of eternity's embrace.
The Infinite in finite hearts we trace,
As ages strike the chords by Love controlled;
The earth is vibrant, and with rhythm untold,
All sounds in Nature's orchestra find place.
O Sound! thou art the echo of a word
That broke the primal stillness by command,—
An echo, through whose strains our souls have heard
A promise of the choral raptures grand,
That, voicing love and praise, forever rise
In Music's natal home beyond the skies.

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CHAPTER I.

PRODUCTION AND TRANSMISSION OF SOUND.

AS a period of remarkable intellectual activity in every department of natural and physical science, the latter half of the nineteenth century must ever remain memorable. Never in the world's history has so much been accomplished in the same space of time. The fauna and flora of every continent and of every sea have been studied and compared; the forms of life of the dim and distant past have been unearthed and assigned their places in the scheme of creation. Aided by appliances he never dreamed of a few decades ago, the astronomer has penetrated the depths of stellar space, and can now literally unfold to us the story of the heavens in the light of the radiant orbs that are the constant objects of his nightly vigils. Worlds of untold magnitude and atoms of inconceivable minuteness — the infinitely great and the infinitely small — are alike the subjects of earnest quest and patient investigation. It would be difficult indeed to say in which department of knowledge the most work has been accomplished, and in which line of research the most energy has been expended. The facts observed and the discoveries made are almost incredible to one who has not made an attempt to keep abreast with the advance of science; and they show, in a most striking manner, what can be