Preface

The need for an English edition of these lectures has provided the original author, Michel Bruneau, with the opportunity to complete the text with the contribution of the translator, Thomas Scelo.

This book is intended for researchers, engineers, and, more generally, postgraduate readers in any subject pertaining to "physics" in the wider sense of the term. It aims to provide the basic knowledge necessary to study scientific and technical literature in the field of acoustics, while at the same time presenting the wider applications of interest in acoustic engineering. The design of the book is such that it should be reasonably easy to understand without the need to refer to other works. On the whole, the contents are restricted to acoustics in fluid media, and the methods presented are mainly of an analytical nature. Nevertheless, some other topics are developed succinctly, one example being that whereas numerical methods for resolution of integral equations and propagation in condensed matter are not covered, integral equations (and some associated complex but limiting expressions), notions of stress and strain, and propagation in thick solid walls are discussed briefly, which should prove to be a considerable help for the study of those fields not covered extensively in this book.

The main theme of the 11 chapters of the book is acoustic propagation in fluid media, dissipative or non-dissipative, homogeneous or non-homogeneous, infinite or limited, etc., the emphasis being on the "theoretical" formulation of problems treated, rather than on their practical aspects. From the very first chapter, the basic equations are presented in a general manner as they take into account the non-linearities related to amplitudes and media, the mean-flow effects of the fluid and its inhomogeneities. However, the presentation is such that the factors that translate these effects are not developed in detail at the beginning of the book, thus allowing the reader to continue without being hindered by the need for in-depth understanding of all these factors from the outset. Thus, with the exception of

Chapter 10 which is given over to this problem and a few specific sections (diffusion on inhomogeneities, slowly varying media) to be found elsewhere in the book, developments are mainly concerned with linear problems, in homogeneous media which are initially at rest and most often dissipative.

These dissipative effects of the fluid, and more generally the effects related to viscosity, thermal conduction and molecular relaxation, are introduced in the fundamental equations of movement, the equations of propagation and the boundary conditions, starting in the second chapter, which is addressed entirely to this question. The richness and complexity of the phenomena resulting from the taking into account of these factors are illustrated in Chapter 3, in the form of 13 related "exercises", all of which are concerned with the fundamental problems of acoustics. The text goes into greater depth than merely discussing the dissipative effects on acoustic pressure; it continues on to shear and entropic waves coupled with acoustic movement by viscosity and thermal conduction, and, more particularly, on the use that can be made of phenomena that develop in the associated boundary layers in the fields of thermo-acoustics, acoustic gyrometry, guided waves and acoustic cavities, etc.

Following these three chapters there is coverage (Chapters 4 and 5) of fundamental solutions for differential equation systems for linear acoustics in homogenous dissipative fluid at rest: classic problems are both presented and solved in the three basic coordinate systems (Cartesian, cylindrical and spherical). At the end of Chapter 4, there is a digression on boundary-value problems, which are widely used in solving problems of acoustics in closed or unlimited domain.

The presentation continues (Chapter 6) with the integral formulation of problems of linear acoustics, a major part of which is devoted to the Green's function (previously introduced in Chapters 3 and 5). Thus, Chapter 6 constitutes a turning point in the book insofar as the end of this chapter and through Chapters 7 to 9, this formulation is extensively used to present several important classic acoustics problems, namely: radiation, resonators, diffusion, diffraction, geometrical approximation (rays theory), transmission loss and structural/acoustic coupling, and closed domains (cavities and rooms).

Chapter 10 aims to provide the reader with a greater understanding of notions that are included in the basic equations presented in Chapters 1 and 2, those which concern non-linear acoustics, fluid with mean flow and aero-acoustics, and can therefore be studied directly after the first two chapters.

Finally, the last chapter is given over to modeling of the strong coupling in acoustics, emphasizing the coupling between electro-acoustic transducers and the acoustic field in their vicinity, as an application of part of the results presented earlier in the book.