Preface

In their origins, hydrodynamics and acoustics were sciences largely mathematical. In them during the eighteenth century originated, and for them was developed, much of the theories of partial-differential equations and the kinematics of continuous media. From them in the early nineteenth century grew most of the theory of elasticity and, later, electrostatics and electrodynamics. Until the end of the period closed by the First World War, every mathematician and every physicist inclined to theory mastered their elements as a matter of course, and most research journals in mathematics or physics published research enlarging them. For outlines of what a beginner in physics was expected to learn about continuum mechanics, some ninety or more years ago, we may look at Part III of Webster's *Dynamics*, 1904, and Joos's *Theoretical Physics*, 1932 correct, simple, clear, immortal.

As applications and experimental studies grew more numerous, and as publication rather than mastery became essential to nutrience of multitudes of employees, specialists proliferated, their abcdarians were trained more and more in their specialties alone, and the old science of continuum mechanics was silted over by an alluvium of verbose, intricate ramifications, each said to be a profession. After the Second World War, "applied mathematicians" arose to provide in ever increasing, baffling abundance precise, rigorous theorems of existence, uniqueness and failure of it, regularity, stability and instability. To comprehend the very statements they announce, advanced knowledge of modern analysis is required. Often these difficult analytical researches, which employ a setting in one or another function space claimed natural to the problem studied and solved, are products of some institute.

In this book we have endeavored to provide a compact and moderately general foundation of the mechanics of continua, turning aside now and then to particular applications that rise to hand as illustrations of some general principles. Here, we proffer some applications special to fluids, first of rather general kinds and then for the classical fluids named after Euler, Navier, and Stokes. Certainly we do not denigrate approximate theories and numerical work, but since they dominate most recent books on hydrodynamics, aerodynamics, and acoustics, we have chosen to set before the student a bit of mathematically exact work, if only to let him see that some of it formerly studied is still good, and that some more recent progress in that old-fashioned way may yet enlighten and serve.

No mathematical analysis beyond that commonly taught to undergraduates who have learn mathematics in mathematics departments is needed.

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