Preface

Ludwig Prandtl, with his fundamental contributions to hydrodynamics, aerodynamics, and gas dynamics, greatly influenced the development of fluid mechanics as a whole, and it was his pioneering research in the first half of the last century that founded modern fluid mechanics. His book *Führer durch die Strömungslehre*, which appeared in 1942, originated from previous publications in 1913, *Lehre von der Flüssigkeit und Gasbewegung*, and 1931, *Abriß der Strömungslehre*. The title *Führer durch die Strömungslehre*, or *Essentials of Fluid Mechanics*, is an indication of Prandtl's intentions to guide the reader on a carefully thought-out path through the different areas of fluid mechanics. On his way, the author advances intuitively to the core of the physical problem, without extensive mathematical derivations. The description of the fundamental physical phenomena and concepts of fluid mechanics that are needed to derive the simplified models has priority over a formal treatment of the methods. This is in keeping with the spirit of Prandtl's research work.

The first edition of Prandtl's *Führer durch die Strömungslehre* was the only book on fluid mechanics of its time and, even today, counts as one of the most important books in this area. After Prandtl's death, his students Klaus Oswatitsch and Karl Wieghardt undertook to continue his work, and to add new findings in fluid mechanics in the same clear manner of presentation.

When the ninth edition went out of print and a new edition was desired by the publishers, we were glad to take on the task. The first four chapters of this book keep to the path marked out by Prandtl in the first edition, in 1942. The original historical text has been linguistically revised, and leads, after the *Introduction*, to chapters on *Properties of Liquids and Gases*, *Kinematics of Flow*, and *Dynamics of Fluid Flow*. These chapters are taught to science and engineering students in introductory courses on fluid mechanics even today. We have retained much of Prandtl's original material in these chapters, but added a section on the *Topology of a Flow* in Chapter 3 and on *Flows of Non-Newtonian Media* in Chapter 4. Chapters 5 and 6, on *Fundamental Equations of Fluid Mechanics* and *Aerodynamics*, enlarges the material in the original, and forms the basis for the treatment of different branches of fluid mechanics that appear in subsequent chapters.

The major difference from previous editions lies in the treatment of additional topics of fluid mechanics. The field of fluid mechanics is continuously

growing, and has now become so extensive that a selection had to be made. I am greatly indebted to my colleagues K.R. Sreenivasan, U. Müller, J. Warnatz, U. Riedel, D. Etling, and M. Böhle, who revised individual chapters in their own research areas, keeping Prandtl's purpose in mind and presenting the latest developments of the last sixty years in Chapters 7 to 14. Some of these chapters can be found in some form in Prandtl's book, but have undergone substantial revisions; others are entirely new. The original chapters on *Wing Aerodynamics*, *Heat Transfer*, *Stratified Flows*, *Turbulent Flows*, *Multiphase Flows*, *Flows in the Atmosphere and the Ocean*, and *Thermal Turbomachinery* have been revised, while the chapters on *Fluid Mechanical Instabilities*, *Flows with Chemical Reactions*, and *Biofluid Mechanics of Blood Circulation* are new. References to the literature in the individual chapters have intentionally been kept to those few necessary for comprehension and completion. The extensive historical citations may be found by referring to previous editions.

Essentials of Fluid Mechanics is targeted to science and engineering students who, having had some basic exposure to fluid mechanics, wish to attain an overview of the different branches of fluid mechanics. The presentation postpones the use of vectors and eschews the use integral theorems in order to preserve the accessibility to this audience. For more general and compact mathematical derivations we refer to the references. In order to give students the possibility of checking their learning of the subject matter, Chapters 2 to 6 are supplemented with problems. The book will also give the expert in research or industry valuable stimulation in the treatment and solution of fluid-mechanical problems.

We hope that we have been able, with the treatment of the different branches of fluid mechanics, to carry on the work of Ludwig Prandtl as he would have wished. Chapters 1–6, 8, 9, and 13 were written by H. Oertel Jr., Chapter 7 by K.R. Sreenivasan, Chapter 10 by U. Müller, Chapter 11 by J. Warnatz and U. Riedel, Chapter 12 by D. Etling, and Chapter 14 by M. Böhle. Thanks are due to those colleagues whose numerous suggestions have been included in the text.

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Karlsruhe, June 2003 *Herbert Oertel*