With an emphasis on both theory and experiment, this text describes the behaviour of homogeneous and density-stratified fluids over and around topography. In examining the similarities between the flow of a river over a barrier or weir and the flow of the atmosphere over a mountain range, this book presents a comprehensive synthesis of this topic in terms suitable for scientists, engineers, teachers and students of fluid dynamics. Using the appropriate mathematics, experiments, and illustrations, the text describes the properties of stratified flows beginning with the simplest situations, such as the flow of a homogeneous layer with a free surface – the prototype system for conventional hydraulics, and proceeding to progressively more complex ones, such as the flow of stratified fluid over two- and three-dimensional topography. The book concludes with a discussion of how applications of the properties and principles of these diverse phenomena may be modelled in practical terms.

With this book, Professor Peter G. Baines makes a notable contribution to the fields of fluid mechanics and geophysical fluid dynamics. The text will be a great asset to graduate and advanced undergraduate students as well as research professionals.

CAMBRIDGE MONOGRAPHS ON MECHANICS

TOPOGRAPHIC EFFECTS IN STRATIFIED FLOWS

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To Adrian Gill

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Preface

This project was conceived about ten years ago, but the incentive to pursue and complete it was hampered until recently because of several fundamental unresolved questions about the nature of stratified flow around topography. Within the last few years it has become possible to answer these questions, as a result of the efforts of several people, and the answers are embodied in the synthesis presented here.

Who will benefit from purchasing, reading or thumbing through this book? It is primarily addressed to fluid dynamicists, meteorologists, oceanographers, engineers, physicists and mathematicians who wish to learn more about the dynamics of stratified fluids. Some background in fluid dynamics is probably necessary, but the subject is treated from first principles and is developed from simple situations toward more complex ones. Overall, the order of presentation is based on logic rather than the historical development. There is balance between theory and experiment, where the comparison is made whenever possible, and a consistent attempt has been made to provide a physical understanding of the phenomena involved.

I have gone to some length to make the material easily assimilable, as the number of figures testifies. As I see it, a book such as this is the next step in the scientific process of the documentation of a subject, following the initial "source" material in journals. It is a documented attempt to digest such material, and should therefore be easier to read. However, much of the material presented here is new, as part of the process of filling gaps and providing a (more) complete picture. A number of new experiments have been carried out at Aspendale specifically for this volume.

I have attempted to give an adequate list of references so that readers can delve deeper into the subject, but it is not exhaustive, and

some relevant work may have been omitted. I apologise in advance to any colleagues to whom due reference has not been given.

In its present form, this book has been made possible by the dedicated and professional efforts of several people at Aspendale: most notably David Murray, who has played a major part in most of my experimental studies over the past ten years; David Whillas, whose talents are evident in several photographs; and Sean Higgins, who has skillfully adapted and created many of the line drawings. Thanks are also due to others who have provided continual background support.

I am grateful to several colleagues who have contributed photographs or figures, and to various copyright holders for permission to use some figures, and these are acknowledged in the captions. I am also grateful to others who have taken the time to read and comment on drafts of chapters in varying degrees of imperfection, and specifically these include Jim Rottman in particular, and Ian Castro, Terry Clark, Jack Katzfey, Peter Killworth, Greg Lawrence, Mike Sewell, Bill Snyder, Larry Armi and Sharan Majumdar. Thanks are also due to numerous colleagues for informative discussion on the material of this book over many years, to George Batchelor for his advice and support, and to Alan Harvey, Brian Watts and the staff of Cambridge University Press for their cooperation and attention to detail.

Aspendale *Peter G. Baines*
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