Preface

Flow cytometry is now a standard technique, with many applications in the biological and medical sciences, and much effort has been applied to advancing the instrumentation and techniques in both research and diagnostic fields. More recently this has led to growing interest in its use for the identification, characterization, monitoring, and control of microbial, plant, and animal cell bioprocesses. It is now possible to obtain information about cell populations unobtainable by other means and of a form and quality far superior to that available by conventional biochemical analysis and that can be available in a near on-line mode and timescale. With such information readily available, it should be possible to make significant progress in the optimization of large-scale cell culture for the successful manufacture of those many valuable products that are arising as a direct result of recent developments in molecular and cell biology, and even to consider the flow cytometer as a near on-line process sensor for control purposes. In particular, the increasing availability of fluorescing markers for the analysis of cell structure and function is likely to make significant contributions to the elucidation of the population dynamics and hence the development of sophisticated models of cell growth and product synthesis and secretion.

This book brings together the knowledge and experience of those who are applying flow cytometry to the investigation and monitoring of cellular processes for biotechnological purposes. Chapters review the state of the art with in-depth assessments that emphasize the practical aspects of efficient operation of flow cytometric techniques. The book indicates those aspects of cell variability encountered in cell culture processes and shows how the quantitative analysis of heterogeneous populations can help full realization of the potential of biotechnological exploitation of cells. Cell cycle analysis of animal cell cultures is of particular importance as an aid to the early estimation of process state and to the prediction of future culture performance. Many of the authors lay emphasis on such studies. The importance of cell line selection and product stability are now widely recognized, and information is presented here on the use of flow cytometry to monitor and improve the selection and enrichment of high-productivity cell lines. Analysis of baculovirus-infected insect cell culture is dealt with

as are a number of flow cytometry techniques of varying complexity that have been developed to detect cellular and subcellelular changes occurring during apoptosis.

Flow cytometry offers a rapid and versatile means to analyze the properties of hematopoietic cells. Its use to characterize ex vivo expanded human bone marrow is presented with detailed protocols. The applications of flow cytometry to studies of microbial populations are also described, including the determination of population structure and cell cycle progression in yeast and the analysis of bacterial growth and viability. The potential for flow cytometry to characterize plant cell populations together with the problems associated with analysis and sorting of plant cells are included to provide a sound basis for future developments in this newly opened area.

Individual chapters provide reviews by experienced practitioners of the specific methodologies available together with outlines of recent data obtained and insights gained. The material is addressed primarily to those interested in flow cytometry in microbial and cell culture processes, but many topics will also be of interest to microbiologists, biochemists, and other bioscientists as well as to biochemical engineers. The editors come from bioscience (Al-Rubeai) and engineering (Emery) backgrounds and are therefore well placed to ensure that the contents are addressed to and understandable by a wide range of disciplines. We are enthusiasts for the cause of flow cytometry—we hope that our readers find inspiration to explore further its potential themselves and that this work helps their rapid progress.

Mohamed Al-Rubeai
A. Nicholas Emery