Preface

In the opening sentence of the Preface to the First Edition of *An Introduction to Metabolic and Cellular Engineering*, almost ten years ago, we stated: "Metabolic and Cellular Engineering, although as yet only at the beginning, promises huge advances in all fields of the life sciences." Needless to say, this statement passed the test of time; Metabolic and Cellular Engineering (MCE) still promises huge advances, new discoveries, and new avenues of research. MCE also produces new expectations by becoming the vibrant and exciting reality of a quickly diversifying and multidisciplinary research field.

We also wanted our book to promote interest in the MCE endeavor by attracting researchers and the attention of the scientific and technological communities at large from academia and industry. Hopefully, the First Edition contributed to the fulfillment of that aim. It is with the same inspirational theme, and thanks to the initiative of World Scientific, that we updated and enlarged the Second Edition of *An Introduction to Metabolic and Cellular Engineering*.

Today, MCE is more than an exciting scientific enterprise; it has become the cornerstone for coping with the challenges ahead for mankind. Continuous developments, conceptual and technological innovation, deal with new challenges, as well as those present ten years ago. Challenges are still everywhere — from unraveling fundamental aspects of cellular function to the increase in energy and food demand that rises in parallel with population growth. Then there is the ongoing shift between a fossil fuel and a clean energy-based world economy as a reflection of the mounting recognition of global climate change. These topics are treated in Chapters 1 and 10.

In charting the progress of MCE during the last decade, we could but feel in awe of the enormous strides of progress made from nascent Metabolic Engineering to the Systems Bioengineering of today. The burgeoning availability of genomic sequences from diverse species has been spectacular. It has become the engine that drives genetic means for modification of existing organisms and in the generation of synthetic, manmade, ones. From the initial attempts at purposeful genetic modification of a cell for the production of valuable compounds, we have now moved on to change microbes genetically or metabolically. This progression is treated through specific examples from bacteria to plant cells in Chapters 3, 4, and 7. Additionally, Chapter 7 details the actual potential of MCE as applied to microalgae and plant cells, highlighting their photosynthetic capacity and metabolic versatility.

The arsenal of experimental and theoretical tools available for MCE has expanded enormously, driven by the re-emergence of Physiology as Systems Biology. The revival of the concept of networks fueled by new developments has become central to Systems Biology. This is now focused on the study of their topological and dynamic properties. Networks represent an integrative vision of how processes of disparate nature relate to each other and as such is becoming a key analytical and conceptual tool for MCE. The combination of high throughput technologies with computational modeling and data mining are among the tools being utilized for handling and interpreting massive amounts of data. These developments and improvements are reflected mainly in Chapters 5 and 6 on Modeling Networks and Dynamic Process Behavior, respectively, which together with Chapters 2 to 4 give the essentials on concepts and analytical tools underlying the whole book.

Our initial focus was the organism, and its performance in a specific biotransformation and this continues to be so in this Second Edition. During industrial scale-up, when most microbial modifications become necessary, we stress that process robustness is a dominant feature (Chapter 9).

At the time of this Second Edition, researchers from independent laboratories around the world have been able to induce pluripotency in somatic cells to obtain inducible Pluripotent Stem cells (iPSCs). These findings open enormous possibilities for organ regeneration and their engineering. Chapter 10 briefly reviews this nascent field, and Chapter 8 contains a brief introduction to cell culture techniques.

For the Second Edition of this book we would like to gratefully acknowledge the following people, whose work and expertise have translated into fruitful and long-term collaborations, enlightening and enriching the authors: Brian O'Rourke (Johns Hopkins University, MD, USA), Raimond Winslow (Johns Hopkins University, MD, USA), Gordon Tomaselli (Johns Hopkins University, MD, USA), Eduardo Marbán (Cedars-Sinai Heart Institute, CA, USA), Nazareno Paolocci (Johns Hopkins University, MD, USA), Fadi G. Akar (Mount Sinai Hospital, NY, USA), Christoph Maack (Universitätsklinikum des Saarlandes, Homburg, Germany), Katey Lemar (Treorchy Comprehensive School, Wales, UK), Douglas Murray (Keio University, Tsuruoka, Japan), Marc Roussel (Lethbridge University, Alberta, Canada), Lufang Zhou (Johns Hopkins University, MD, USA), Ting Liu (Johns Hopkins University, MD, USA), Gabriele Tocchetti (National Cancer Institute, Naples, Italy), Brian A. Stanley and Vidhya Sivakumaran (Johns Hopkins University, MD, USA), Hannah Sivak (Arizona, USA), Jack Preiss (Michigan State University, MI, USA), Miguel A. Ballicora (Loyola University Chicago, IL, USA), Florencio E. Podestá (CEFOBI, CONICET, Argentina), Diego F. Gomez Casati (CEFOBI, CONICET, Argentina), Diego M. Bustos (INTECH, CONICET, Argentina), Sergio A. Guerrero (IAL, UNL-CONICET, Argentina), Alejandro J. Beccaria (IAL, UNL-CONICET, Argentina), Mabel Aleanzi (IAL, UNL-CONICET, Argentina), Claudia V. Piattoni (IAL, UNL-CONICET, Argentina), Raúl Comelli (INCAPE, UNL-CONICET, Argentina).

Sonia Cortassa
Miguel Antonio Aon
Alberto Alvaro Iglesias
Juan Carlos Aon
David Lloyd