factor in more effective scale-up of mammalian cell reactors. The ability to control microenvironmental conditions in a spatially heterogeneous system will be essential. Bioprocess engineers can play key roles in developing the experimental tools and computational approaches required for functional genomics.

Improvements in the computer models of cellular populations will lead to new insights into bioreactor dynamics and appropriate control strategies. Although we have not talked much about structured and structured-segregated models, recent developments in this area promise significant rewards. Also, improved models, coupled with a better understanding of transport processes within bioreactors, suggest that rational scale-up of bioreactors may be achievable.

New ideas on the use of cells and enzymes in environments with low water activity (organic or gas phases) may open doors to wholly new bioprocessing opportunities. Substrates with low solubility in water may become increasingly important targets for bioprocesses.

In addition to the improvements in biocatalysts and our understanding of bioreactors, there will be improved understanding and development of bioseparation processes. Significant progress has already been made in affinity separation processes. New membrane materials are being rapidly developed. Ideas such as two-phase aqueous systems, reverse micelles, and gel swelling systems may become important tools for the engineer.

This discussion of future possibilities is in no way exhaustive. However, the reader must sense that the technological opportunities are expanding rapidly. The recent advances in genomics provide tools that will open new vistas for the bioprocess engineer. Much excitement exists, and rightly so. Now you have a better chance to participate in this excitement. The purpose of this book has been to give you a foundation. Build upon it and join the biological revolution.