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# Developments in Applied Phycology 6

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Editors

# The Physiology of Microalgae

 Springer

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## Preface

Algae play an enormously important role in ecology and, increasingly, in biotechnology. Microalgae in the world oceans, for instance, are responsible for nearly half of the CO<sub>2</sub> fixed (and O<sub>2</sub> released) by photosynthesis annually and form the basis of most marine and other aquatic food chains. With the potential of global warming and associated ocean acidification, the effects of these changes on phytoplankton communities and the flow-on effect on the marine ecosystems are of major interest. The impact of anthropogenic activities on aquatic environments, especially the effects of eutrophication and associated algal blooms and their mitigation, is of great importance. Through their application in wastewater treatment, microalgae are also part of the solution to reduce the detrimental effects of the discharge of wastewaters.

Microalgae are also of significant commercial importance. A number of species are important for the growing aquaculture industry, serving as critical food for larval fish and abalone and for shellfish. Since the early 1980s there has been a growing microalgal-based biotechnology industry, producing natural pigments such as  $\beta$ -carotene and astaxanthin and long-chain polyunsaturated fatty acids. More recently, microalgae have, once again, become the focus for the development of renewable biofuels, and this has also reinvigorated interest in the commercial production of other microalgal products and new applications of microalgae. A deep understanding of algal physiology is one of the most important factors in the development of new species and products for commercialisation.

In 1962 the first book to comprehensively review the research on the physiology and biochemistry of algae edited by Ralph Lewin was published (Lewin 1962), following on from the earlier small, but important, monograph on algal metabolism of Fogg (1953). Both of these books are still worth reading. The next major volume on this topic was *Algal Physiology and Biochemistry* edited by WDP Stewart published in 1974 (Stewart 1974). All of these books covered both the microalgae and the macroalgae.

Stewart in the preface to his volume noted:

Ten years ago it would have been possible to include in a book of this type, over 90 per cent of the relevant aspects of algal physiology and biochemistry but this is no longer the case.

It has now been 41 years later, and clearly it is impossible to include in a single book all relevant aspects of algal physiology, and it is therefore not surprising that since the publication of Stewart's book, no comprehensive book on algal physiology has been published, only reviews on particular topics and general chapters in a number of broader ranging books on algae. However, we strongly feel that there is a need for a reasonably comprehensive up-to-date reference work on algal physiology and biochemistry for the use of researchers in the field, both old and new. Such a reference work is probably now more important than ever, as few people have the time and capacity to keep up to date with the massive literature that has accumulated on algal metabolism and related topics. The days of generalist phycologists are past, and for a variety of reasons, researchers have needed to become more specialised. However, whatever the specific field of algal research, it is often important and instructive to consider one's work in a broader context.

Given the mass of knowledge on algae and their physiology and biochemistry that has been accumulated in the last 40 years, we had to make two decisions in the planning of this book. First, we decided to limit the scope to the microalgae, i.e. those algae one generally needs a microscope to see. Second, as it is impossible to cover all possible topics, we selected what we consider the major aspects of microalgal physiology. There are many important topics which are not covered, but we hope that these will be part of future volumes.

We invited a range of leading researchers to write authoritative review chapters on critical aspects of algal physiology and biochemistry. These range from the studies on the cell cycle and advances in our understanding of cell wall biosynthesis, through fundamental processes such as light harvesting and assimilation of carbon and other nutrients, to secondary metabolite production and large-scale cultures of microalgae and genomics. We also tried to ensure that all species names used were those currently accepted, and we have included a chapter which lists both the old and new names (as well as a plea to provide adequate information on strains used when publishing) to help researchers in finding all relevant literature on a particular species. The authors were given a relatively free hand to develop their topic, and we feel that the variety of approaches leads to a more interesting and useful book. We are very grateful to all those people we have cajoled into contributing to this enterprise and the many people who aided by reviewing particular chapters.

Our intention is that this book serves as a key reference work to all those working with microalgae, whether in the laboratory, in the field, or growing microalgae for commercial applications. The chapters are intended to be accessible to new entrants into the field (i.e. post-graduate students) as well as being a useful reference source for more experienced practitioners. We hope that the book thoroughly deals with the most critical physiological and biochemical processes governing algal growth and production and that any omissions do not disappoint too many readers. It is our hope that you find the information here as stimulating as we do – microalgae are exciting organisms to work with!

Murdoch, WA, Australia  
Clayton, VIC, Australia  
Dundee, UK  
June 2015

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