BOOK REVIEWS


Algal cultures and culture collections play an important role in microbiology and phycology, providing authentic material for use in research. Although the number of cultured isolates has increased enormously within the last decades, many species remain to be taken in culture and/or have never been used for cultivation. However, not only has the number of cultivated algae increased but also techniques and methods have been developed. If we only compare, e.g. E.G. Pringsheim’s English version of his “Pure Cultures of Algae” (1946, 119pp.) and G.S. Venkataraman’s “Cultivation of Algae” (1969, 319pp.) with this new handbook edited by R.A. Andersen (578pp.), it is clear how culturing techniques, methods of isolation, purification and maintenance in collections have developed. Although such methods, media recipes or technological inventions can be found in thousands of publications, the necessity for a new comprehensive handbook that covers all possible fields of algal research with cultures was uncertainly given. More than 30 years after the edition of the Handbook of Phycological Methods, the Phycological Society of America again sponsored this important publication, which will surely be a valuable reference over decades for all phycologists. Among the list of contributors are curators of algal collections as well as experimental phycologists from nearly all continents. The editor himself, well experienced in marine phytoplankton cultures and cryopreservation, contributes in three chapters of the volume, which is composed of 25 chapters in total and an appendix. These 25 chapters cover all topics dealing with algal cultures, from freshwater to marine habitats in a wide range, from purely research to industrial biotechnology. Since the classical period in the late 1800s and early 1900s, the three main procedures of algal culturing have been the same: to isolate algal organisms from nature, to grow them for investigation and to keep them alive over long periods. But how to do this is now presented in Andersen’s handbook in a very impressive way. The two main cultivation lines – freshwater and marine algae and micro- and macroalgae – differ in many details, but operation techniques and cultivation methods overlap in many cases. So it happens that we found some technical instructions not only once in the volume, but this documents the broad range of applicability of some methods used since the beginning of algal cultivation.

Chapter 1 of the handbook presents a historical review of algal culturing techniques from Cohn’s Haematococcus cultures (1850) to the modern technology of cryopreservation, showing the development of phycology and algal culturing since that time. Informative data on prominent phycologists as founders of prominent algal collections can be found here. The following chapters (2–4) give a full account of freshwater and marine culture media and refer to the appendix of the book, where 55 algal medium recipes and 7 test medium recipes (to detect bacterial presence in strains) are listed. Comprehensive information is given on the trace metal ion buffer systems in algal cultures (Chapter 4). The reviewer missed here any note on their use for soil algae, in spite of the fact that Harold Bold introduced e.g. EDTA successfully since the 1950s for cultivating terrestrial algae. The next 5 chapters (5–9) deal with isolation and purification methods (including automated isolation techniques using flow cytometry) that are used for micro- and macroalgae, and present an enormous amount of technical help for scientists and technical staff. Useful descriptions of sterilization techniques as well as how to work with a laminar flow hood are described step by step, and instructive color pictures of laboratory equipment, etc. render it easy to follow in attempts to reproduce some of the instructions. Nevertheless, “learning by doing” will again be the best help for the beginner to develop sufficient skills. In Chapter 8, almost all the classical and new purification methods for microalgae are described. Worthwhile are comments on the application of antibiotics for pure cultures of algae, but the conclusion that “no realistic recommendations can currently be given regarding choice of antibiotic treatments” must be underlined. Chapters 10 and 11 are written by experts
who curate algal collections and deal with the success and problems of long-term maintenance of algae. Special attention is paid to the problems of contamination with bacteria, which can have negative or positive effects on the cultivated algal strain. The method of cryopreservation, which is successfully used in some culture collections, e.g. for cyanobacteria, unicellular green algae and heterokonts, is discussed in detail in Chapter 12. This method, which is less effective for filamentous and colonial algae, is useful when resources for long-term maintenance (staff, storage space, costs, etc.) are not available or are minimized.

Other advantages of cryopreservation to standard continuous culturing methods are genetic stability of cultures over long time periods and protection against microbial contamination. The following chapters (13–15) present data on mass cultures in fermentors, photobioreactors and outdoor ponds for growing algal biomass to produce commercial cell extracts, etc. The economics of biomass production favors fermentors over photobioreactors. For an economic production of ton quantities of microalgal biomass, open outdoor ponds are required and such systems have been in operation for more than 20 years. However, only a limited number of species, such as Spirulina, Chlorella or Dunaliella are of commercial value. Instructive data on design, construction and management of outdoor algal ponds are given and supported by instructive graphs and photos. In Chapter 15 an overview of the development and actual status of culturing of seaweeds (mariculture) is given; today China, Korea, Japan and the Philippines are leaders. Among the dozen seaweed taxa that are used in field farms, Porphyra and Laminaria are the most commercially cultivated genera for food and technical products, especially in eastern Asia. Interesting details on cultivation processes are provided, which coincide with sporulation and development of each of the taxa in their natural habitats. Graphics and instructive photos of cultivation and harvesting in field farms in China, Japan and Korea are added to this chapter. Chapters 16 and 17 are dedicated to quantitative research with cultures: cell counting with light microscopy and automated cell counting by flow cytometry. In both chapters, useful detailed information is given on sampling methods, equipment and calculations, and the two common counting methods with transmitted light and/or epifluorescence microscopy are dealt with. Fluorescent dyes for cytometry to detect contaminating bacteria or viruses are also elaborated. Although the method of flow cytometry is detailed for marine algae culture work, the information and protocols described can also be applied to freshwater algae.

Chapter 19, one of the most fascinating chapters in this book, deals with the use of cultures for the investigation of the physiological ecology of microalgae (= eukaryotic single-celled algae and cyanobacteria). Experiments dealing with growth rate, photosynthesis, chlorophyll and nutrient content, effects of UV radiation, etc. need cultures and will remain central to our understanding of algal reactions to habitat and ecosystem. Results from the laboratory can elucidate at least some of the environmental factors that influence microalgal organisms in nature, but needs the controlled conditions in cultures. Most of the data in this chapter are taken from marine and brackish water, but the principles of culturing marine microalgae to study their ecophysiology are also applicable to freshwater organisms. The clear and comprehensive information on experimental methods is supplemented with graphs, diagrams, tables and a very complete list of references (the most comprehensive of all chapters!). Chapter 20 describes the methods of high-performance liquid chromatography (HPLC methods) based on a former protocol published in a NASA technical memorandum. Details from sample extraction until data management are presented, and different HPLC methods with similar results discussed, which could familiarize the reader with all aspects of this analytical technique. According to the literature, more than 20 different types of HPLC methods have been published to date. Chapters 21–23 deal with methods of visualizing the action of endogenous rhythms and effects of photoperiodism on macroalgae, discuss viral contamination of algal cultures (Chapter 22) and present data on controlling stages of sexual reproduction in culture (Chapter 23). Sexual reproduction in eukaryotic algae with all steps from gametogenesis to zygotes to their germination has been intensively studied, primarily in Chlamydomonas strains. However, many processes are still unknown. To understand the biology and life history of an alga, it is necessary to investigate and cultivate strains through their complete life cycle from germlings to reproduction. In Chapter 24 dinoflagellates are used to study these processes (such life cycles have been also observed in cultures of many unicellular green algae (Chlamydomonas, Chlorella, etc.) and are well documented in the literature). The last chapter (Chapter 25) provides data on the ex situ conservation of threatened algal species, which should be complementary to in situ strategies of protection of algal biodiversity in nature. Japan has made impressive efforts to protect its biodiversity, e.g. of freshwater Charophyceae and Rhodophyta,
and 22 threatened taxa of Charophyceae and 3 of freshwater Rhodophyceae are kept in culture collections. The next 103 pages of the book present recipes for freshwater and seawater media with some notes for which taxa a medium has been used successfully. I missed among the notes on BBM (Bold’s basal medium) that it is very useful for most of aero-terrestrial algae and also many lichen algae (e.g. Trebouxia) can be cultivated with this medium when solidified with agar. Also, Ahmadjians TOM 1 organic medium for lichen algae could be mentioned in the catalogue of recipes. A glossary of five pages, and a name and subject index complete this handbook, a milestone in phycological literature. Printing, diagrams and photographs are of high quality, every chapter is completed with a superb list of references, altogether a comprehensive reference on all aspects of the isolation and cultivation of freshwater and marine algae. Also, for its reasonable price it is highly recommended for phycologists, microbiologists and laboratories all over the world.

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The editors present a book that has long been awaited. The third edition of "Photomorphogenesis in Plants and Bacteria" is a follow-up of the first two, edited by Kendrick and Kronenberg and published in 1986 and 1994.

Photomorphogenesis is understood as light-induced morphogenic changes in living organisms, i.e., the control of “light over growth, development, and differentiation”, and includes all processes that are independent of photosynthetic activity. This book, even more than the preceding editions, is introduced as an advanced textbook. In fact, due to the remarkable extension of our knowledge on light-regulated processes in plants and (now included) in bacteria since the second edition, it represents a well-balanced counterpart to photosynthesis research. The study of photomorphogenesis was dominated over the past decades by the red-/far red-absorbing photosensory pigment phytochrome, which was long believed to be present only in plants. Phytochrome investigation and the processes initiated by its photochemical reactions in plants is still a keystone of this book. However, the discovery that phytochrome function has extended into the prokaryotic kingdom during the last decade, initiated by the finding of phytochromes in cyanobacteria, and the molecular identification of blue light-sensitive photoreceptors, again first identified in plants and later followed by very similar systems in the prokaryotes, now provides this book with a very broad collection of light-stimulated physiological processes to describe.

The book is subdivided into five parts (General Introduction, The Phytochrome, Blue-light and UV-Receptors, Signal Transduction in Photomorphogenesis and Selected Topics). Each part has between four and eight chapters, written by expert scientists who contributed comprehensive and up-to-date overviews of the various topics.

This book now extends the reports on photomorphogenic research over more than 20 years, covering more than 60 years of original publications. It is thus of importance, as the editors outline that clearly “the novel observations do not erase the validity of – old – data”. But they state (which is even more important) that the knowledge of what is known should not become lost in the new generation of researchers. Such continuity and the balance of entirely novel and continued research on research areas already in progress is well done here.

The four chapters of Part One are all presented by the editors, commencing with a “historical overview” that includes a fine collection of classical papers on photomorphogenesis and on the discovery of phytochrome in the 1950s and 1960s. This first chapter is kept to a minimal but essential length, and is followed by the “Physiological basis of photomorphogenesis” (Chapter 2), giving a few required definitions (action spectroscopy, correlation between in vivo-spectroscopy and physiological responses), and also introducing important terms describing phytochrome properties such as VLFR, LFR, HIR (very low fluence response, low fluence response, high irradiance response). These basic definitions of phytochrome