

treatment plants); this chapter could have been expanded, but community ecology is not the intended focus of the book. The references are current for the book's original 1992 publication and contain enough diversity and depth to introduce a serious student to the detailed protozoan literature.

It is unfortunate that many of the students or amateurs that will use this book will not have access to the high-quality phase contrast and differential interference optics that produced this book's fine micrographs. These are as close as still photography can come to capturing the beauty of protists at the microscopic level. This compact book is an excellent choice for anyone interested in these fascinating microorganisms.

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NATIONAL RESEARCH COUNCIL. 1996. **Freshwater ecosystems: Revitalizing educational programs in limnology.** National Academy Press, Washington, D.C. 364 p. + xiii. \$49.95, ISBN 0-309-05443-5.

This is an important book for those who recognize the importance of freshwater aquatic ecosystems to global ecological welfare, deal professionally with aquatic systems, or are concerned that limnologists might not be prepared to meet future academic and applied challenges. Authored by the Committee on Inland Aquatic Ecosystems of the United States National Academy of Science, it addresses two basic concerns: (1) that "limnological educational programs are inadequate for the training of future professional limnologists, resource managers and the informed public"; and (2) that "there is poor linkage between academic programs and the practical application of limnology in the protection, management and restoration of aquatic ecosystems." (Limnology is defined as all aspects of freshwater aquatic and wetland physics, chemistry, biology, and ecology).

The book offers a succinct Executive Summary, 170 pages of main text, and 180 pages of background papers and appendices. The main text is organized around five themes: (1) "Overview: Status of Inland Waters," documenting the increasing need for information and informed management on our degraded aquatic systems; (2) "Limnology, the Science of Inland Waters: The Evolution and Current Status of Limnology," a surprisingly detailed chapter on the history of limnology; (3) "Contemporary Water Management: The Role of Limnology," emphasizing the importance of qualified limnologists to applied aquatic problems; (4) "Education in Limnology: Current Status and Recommendations for Improvement," a provocative chapter outlining the present diverse, and fragmented approach to limnological education, with specific alternatives for future education scenarios; and (5) "Future of Limnology: Linking Education and Water Resource Management."

The book is well written, reads easily (despite the potentially dry subject matter), and contains numerous inserted boxes with interesting examples that amplify and reinforce the text. The historical section is especially good, tracing the history of limnology from the days of Forel and Forbes through to the present. This sets the stage for the main theses of the book—that education in limnology is haphazard and uneven and that fundamental changes will be required if we are to provide the limnological expertise and leadership

that will be needed to successfully deal with problems in applied limnology.

There is no question that the lack of systematic, visible limnological curricula is hindering the production of people whose decisions and actions affect aquatic ecosystems. Unlike other disciplines, such as oceanography and forestry, limnologists in North America are trained in a variety of academic departments. Consequently, good ones have usually been jacks-of-all-trades, whose training was more a matter of luck than good planning. I am reminded of when a zoology master's student of mine was to defend his thesis on winter circulation of arctic lakes. Beneath his thesis defense announcement on the examination room door, a faculty member had written "What does this have to do with Zoology?" Indeed, very little—which is exactly the point made in this book. The book then goes on to detail the need for core limnological programs at both the undergraduate and graduate levels, the options for identifiable departments and interdisciplinary programs, and ways to expose undergraduates to limnology.

Most graduate programs in limnology focus on the production of a thesis on a narrow subject. Such programs are the legacy of a time when the primary employer of graduating limnologists was academia. But nowadays, most limnological jobs are in applied fields like impact regulation, lake management, consulting, and conservation organizations. And frankly, our profession is not doing a good job of preparing people to meet this demand. The current situation in northern Canada (a region of burgeoning resource developments that affect aquatic ecosystems) is a case in point. The few regulatory and consulting biologists who were trained in institutes designed specifically to produce resource managers have broad, if sometimes superficial, exposure to the social and physical issues confronting modern limnologists. But most practitioners—even those with Ph.D. degrees—have had woefully incomplete exposure to the physics, chemistry, and biology of inland waters (not to mention the sociological and communication skills that so often make the difference between a good and not so good limnologist).

Freshwater Ecosystems proposes specific solutions to this problem. The one that especially appeals to me is continuing education. This can take various forms: coursework specifically designed to update practicing limnologists (timed to fit in with the busy schedule of such professionals), collaborative programs between industry, government, and universities (there is nothing like a harried front-line regulatory manager presenting the latest environmental horror story to grab the attention of an undergraduate limnology class), and adjunct professorial programs. The latter is an excellent way to expand the expertise available in universities, allowing students to learn from limnologists who are responsible for dealing with real problems, as well as providing opportunities for government and consulting limnologists to refresh themselves academically. My own experience with this arrangement has been very positive: I am a government scientist with an adjunct professor position at a nearby university, and I direct the thesis work of a person employed by a government agency that is responsible for regulating industrial activities that affect arctic lakes. Her thesis topic is a specific problem important to this agency (which grants her time off to pursue her academic work), and funding comes from a joint industry/native organization concerned with long-term aquatic resource management in the region. Being her supervisor keeps me abreast of the latest developments in limnology, which influences my own research.

Another topic discussed at length in the book is the question of certification. Engineers do it; hydrologists do it; why don't limnologists? I have come across people who called themselves limnologists, who were not qualified to row a boat, never mind testify as an expert in a hearing. Granted, it will be difficult to develop certification standards in a diverse field like limnology, but it seems to

me that certification is the lesser of two evils. If we are going to be professionals, especially for increasingly important matters that involve regulation and litigation, we should be certified as such, at more than one level if necessary. *Freshwater Ecosystems* offers cogent arguments for both sides of this debate.

In summary, this is important reading for all freshwater scientists who are anxious about the future of limnological research and practice. Everyone reading this book will be stimulated to think, “That’s

the truth” or “I think this way would be better.” If it serves as the catalyst to improve our science and the results it generates, this book will have done its intended job.

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