BOOK REVIEWS

Limnol. Oceanogr., 46(6), 2001, 1579–1580

KAWANABE, HIROYA, GEORGE W. COULTER, AND ANNA C. ROOSEVELT [EDS.]. 1999. **Ancient lakes: Their cultural and biological diversity.** Kenobi Productions, Ghent, Belgium. ix + 340 p. US$76. ISBN 90-804341-2-4.

ROSSITERM, A., AND H. KAWANABE [EDS.]. 2000. **Ancient lakes: Biodiversity, ecology and evolution.** Advances in Ecological Research, Vol. 31. Academic Press. xlvii + 624 p. US$85. ISBN 0-12-013931-6.

Ancient lakes, which range in age from 100,000 to >20 million yr, are exotic and extremely valuable ecosystems. Limnologists eagerly lower sampling devices into their deep, clear waters knowing that they are likely to capture strange creatures found nowhere else. Outstanding examples are Lake Baikal's ''candle'' fish (Comephoridae)—so called because their oil content is so high that they burn like candles when dried!—and nerpa (the only freshwater seal). Like their terrestrial equivalent (the Galapagos Islands), ancient lakes contain species flocks—huge numbers of closely related taxa developed from single ancestral forms (e.g., amphipods in Baikal and cichlid fishes in the East African Rift Valley lakes). In fact, ancient lakes contain the highest known density of species in the world.

The two books reviewed here offer a lot of information about these wonderful lakes, providing summaries of their importance both to science and to the peoples who depend on them for their livelihoods. The main themes that these books address are the lakes' origins, the mechanisms that regulate speciation in them, the particular phylogenetic groups that have diversified in them, and how humans interact with them.

Origin—Most ancient lakes are grabens—i.e., they are located where tectonic plates are converging over subduction zones (e.g., Lake Titicaca) or where they are diverging, forming rifts in the earth's crust (Lake Tanganyika and Lake Malawi). The Baikal Rift System basins are unique because they result from the collision of two continental plates, India and Eurasia.

Speciation mechanisms—Rossiter and Kawanabe's book includes several interesting articles on speciation in groups of various endemic taxa (diatoms—Cocquyt; ostracods—Mourguiart, Park, and Downing, Cohen; Onychopoda—Dumont; copepods—Boxshall and Jaume; amphipods—Morino et al., Takhteev, and Mashiko; gastropods—Geary et al., Michel, Nishino, and Watanabe, West and Michel; and fishes—Biro, Chen, Kuusipalo, Northcote, Seehausen, Sideleva, Snoeks, Turner, Verheyen and Ruber, Wanink and Witte). Both allopatric (i.e., temporarily separated populations inhabiting sub-basins in a larger lake) and sympatric (i.e., populations in continuous contact) mechanisms are proposed. Takhteev argues for ''nomogenesis'' (predetermined directions) in the evolution of Baikal amphipods; this concept was originally proposed by L. S. Berg but has not gained favor outside of Russia. In contrast, Mashiko argues that changes in the ''premating system'' produce reproductive isolation among populations, especially changes in specific mate-recognition systems, as proposed for the haplochromine fishes. In gammarids, water-borne pheromones serve as a key signal in all stages of mating activities (location, pairing induction, exact pairing, and copulation). The specificity of these signals is unclear.

The species flock that has received the most attention is the haplochromine cichlid fishes of the East African lakes (Malawi, Victoria, and Tanganyika). Malawi and Victoria each have an estimated 500–600 taxa, with only half of this number having been described. This line of research is now turning to hypothesis testing and experimental studies to explain speciation. Seehausen goes into great detail to develop and justify a hypothesis of sympatric speciation based on assortative mating and disruptive selection in polygynous fish populations. Ernst Mayr has argued elsewhere that a ''microallopatric'' mechanism is more likely involved. Both sides in this debate are convinced that most of the taxa formed within the main lake basins, although each species flock is not necessarily monophyletic. The probable formation of so many taxa in Lake Victoria during the last 14,000 yr is most remarkable, because this lake apparently dried at least partially during the late Pleistocene; the implication is that speciation required no more than 3,000 yr in some cases—far shorter than previous estimates. Much obviously remains to be learned about the mechanisms of speciation in these lakes, and the results will constitute a major contribution to understanding how evolution works.

Phylogenetic diversification—It is a fascinating fact that different groups have undergone diversification in the different lakes. Of the lakes with >20 endemic fish species, Baikal has cottoids, Titicaca has orestiids, and the African lakes have cichlids. In the crustacea, Lake Baikal has >300 taxa of Gammarid amphipods, Titicaca has 25 species of the Hyallelid amphipods, and Tanganyika has 10 endemic Decapod crabs (but no amphipods). Another striking feature is that there are few endemic higher plants or insects, presumably because these groups have good dispersal stages (the insects that have formed species flocks often have flightless adult stages).

Cultural heritage—Humans have been associated with ancient lakes for thousands of years. One hundred years ago, our impacts on these unique ecosystems were minimal, but at the beginning the 21st century, almost all are threatened by eutrophication, overfishing, exotic fish introductions, and pollution. Kawanabe, Coulter, and Roosevelt's book presents information on the myths created by local peoples about the origin of these lakes, as well as the unique types of boats, homes, pottery, and fishing nets that they developed. It also documents their dependence on the lakes for transportation, shelter, food, and water, which, unfortunately, are rapidly giving way to modern hotels, paved walks, thick growths of algae, and the loss of fisheries.

Exotic fish introductions have irreversibly changed Lake Victoria, where the Nile perch has extirpated at least 100 endemic cichlid fishes, and Lake Titicaca, where trout introductions have caused the loss or significant decrease of orestiid species. Eutrophication and pollution (including dioxins and PCBs) are threatening lakes Biwa, Baikal, and Victoria. Lakes Baikal, Malawi, and Ohrid are World Heritage sites, which provides some shelter and pressure to maintain their pristine condition, but all ancient lakes in developing countries are threatened as a result of the poor economic conditions the local people suffer.

Some of the most interesting chapters in Kawanabe, Coulter, and Roosevelt's book (Orlove-Titicaca, Geheb-Victoria, Hashimoto-Biwa, Coulter-East African lakes, Witte et al.-Victoria, and Ribbink-Malawi) describe how small self-regulating communities were able to sustainably exploit the fisheries of ancient lakes. Political changes during the last 100 yr disrupted these local controls, and governments are now groping to find ways to restore the balance. A return to the old ways is intellectually appealing, but this is impracticable because of the much higher numbers of people now inhabiting these basins. Outsiders, including limnologists, can help by providing in-

formation and advice and by encouraging economic developments that exploit resources in sustainable ways. It is fashionable to criticize tourism, but it is one way that local people can benefit from being associated with these amazing ecosystems without threatening their unique biodiversity.

These excellent books bring working scientists and students up to date on the character and perhaps the sad ultimate fate of ancient lakes. Both would be a fine addition to any limnological library and will serve admirably to stimulate research on, and concern for, these precious ecosystems.

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Limnol. Oceanogr., 46(6), 2001, 1580

ALLEY, RICHARD B. 2000. **The two-mile time machine: Ice cores, abrupt climate change, and our future.** Princeton University Press. 229 p. US$24.95. ISBN 0-691-00493-5.

Ice core research during the 1990s has provided some of the most significant and exciting paleoclimate discoveries of the past decade (as a sedimentary paleoceanographer, I say this somewhat jealously). Richard Alley is one of the brightest and most interesting speakers in the business of ice core research, so what could be better than to have a book from him that brings the ice core research news to a wide audience?

Subtitled *Ice cores, abrupt climate change, and our future*, this book tells the story of recent ice core climate research: the tools, data, theories, and conclusions. The task is broken into stages, beginning with a discussion of the stratigraphic character and the types of climate indicators preserved in ice sheets and the difficulties and joys of research in a cold remote region. This is followed by the ice core data and its deduced paleoenvironmental information, which segues into theories that attempt to account for the changes seen in the ice core evidence. The final section discusses the implications of paleoclimate research for the prediction of future climate change and its likely effect on our lives.

The book is resolutely directed at nonspecialists. The text is remarkably free of jargon, and although Alley can't completely escape phrases like ''Dansgaard–Oeschger coolings between Heinrich events,'' these terms are properly introduced in nontechnical language. I don't expect that readers of the *National Enquirer* will be picking this book up, so perhaps the level of writing should be described as aimed at the literate person with an interest in science and the earth. By using traditional English units (Fahrenheit, feet, inches) Alley makes the book more accessible to the American public but, unavoidably, less accessible to the rest of the world. He deals with common but incorrect concepts in a fashion that informs the reader without insult. For example, many people know that World War II airplanes that were abandoned in Greenland are now buried under a couple of hundred feet of ice; if this is so, how can the ice a mere 9,000 feet down be 100,000 years old? The answer is found by understanding the deposition and flow patterns of ice sheets, as Alley patiently explains.

Ice core specialists will not discover new science here, but there is something for them: Alley has a marvelous knack for communication, and this book can help us improve as public speakers and teachers. I particularly enjoyed his ''molasses in a water bed'' analogy for the crustal response to glaciation and deglaciation. This is just one of many great analogies.

Scientists interested in climate history, but not personally involved in ice core research, can use this work to catch up on the progress of the past decade. All of us can give it to friends and relatives who are interested in global climate change. I gave it to my 12-year-old son to read; he found it interesting once he overcame his disappointment that it was not about an H. G. Wells' time-traveling machine.

The science is solid and you can trust what you read here. However, not even Richard Alley can satisfy everyone. At one point, he writes as if Dansgaard–Oeschger (D-O) stadial/interstadial events are the same as the 1,500-yr climate cycle. They are not; the D-O events are broadband, whereas the 1,500-yr cycle is remarkably narrow-band. Subtracting the 1,500-yr band from the climate record leaves the D-O events intact. But this is a pretty small bone to pick, and the only one I found in the whole book.

The final portion of the book, which considers the issue of human climate perturbations, is handled in a remarkably evenhanded and calm way. Alley blends scientific, economic, moral, and political considerations into the discussion and gives one a better understanding of why this is such a difficult matter to resolve. I particularly enjoyed the ''agreeing to disagree section,'' which properly acknowledges the greenhouse skeptics' role while nevertheless emphasizing the mainstream consensus.

As suits its person-on-the-street orientation, the book does not have footnotes and citations. It does includes a fine bibliography that goes beyond being a mere list of books and papers—it also talks about what the cited works are about and their significance.

The book is strictly black and white, no doubt a decision made to keep the book affordable—a laudable goal. But color images would help make some things more understandable (such as the famous backlighted snowpit photo showing the annual laminations). I hope that the publisher will put color versions of a few of these figures on a Web site.

The closest book I can compare this to is *Ice ages: Solving the mystery* by John and Katherine Imbrie, which recounted the personal exploits of the heroes who established the link between ice ages and changes in the earth's orbit. That book documented research up through the late 1970s and emphasized individual contributions toward the science. Although Alley's book does touch upon the personal heroics, most of those comments are placed in an appendix that gives credit where credit is due, reserving the main text for the scientific story. It brings us up to date on the quest to understand the earth's climate swings, proving Wally Broecker's prediction (in his Nature review of Imbrie's book) that there was room for more heroes on the climatic stage. Richard Alley is one of these heroes, and I recommend this book highly.

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