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## Review of Irwin M. Brodo, Sylvia Duran Sharnoff, Stephen Sharnoff: Lichens of North America

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Lynn Margulis

## Irwin M. Brodo, Sylvia Duran Sharnoff, Stephen Sharnoff: Lichens of North America

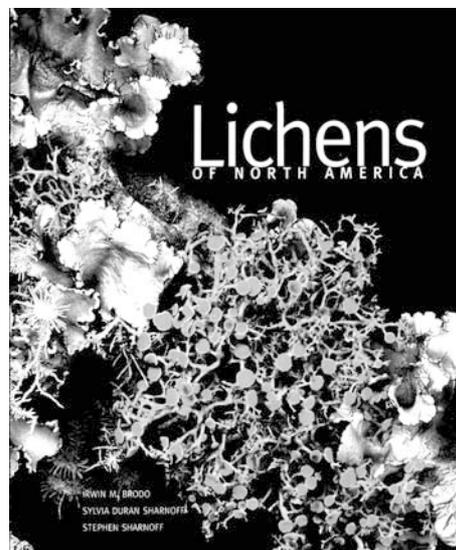
Yale University Press, New Haven CT, 2001. 828 pp 28.5×25 cm (ISBN 0-300-08249-5) \$69.95

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Nothing comparable to this gorgeously illustrated work exists. In spite of its “North America” appellation, this spectacular tome will serve as the standard to the worldwide field of lichenology for the next two centuries... or until the final demise of all books. Not only is it a comprehensive guide to virtually all lichen genera and species on the continent but the cosmopolitan nature of lichen cover and the transcendent beauty of the plates make the work of passionate interest to field naturalists, botanists, symbiosis biologists and hobbyists far beyond the borders of Canada, Mexico, and the United States.

The lichen body (crustose, foliose, or fruticose), the nature of its reproduction (sexual or not), its propagules (asci, blastidia, isidia, soredia) and their dispersal, as well as the unique chemistry (over 600 compounds, many limited to lichens, include depsides, depsidones, anthraquinones, pulvinic acid derivatives) are explained such that concepts of these erudite scholars are made clear to us non-specialists. The readers are provided with tools and standardized range maps to identify over 800 species. The glossary and other explanations, for example, of lichen coloration (Chap. 4), physiology (Chap. 5), “substrates” (the rocks, barks, shells, live insect carapaces and other materials upon which lichens grow, Chap. 7), productive pioneer roles in intertidal and forest ecosystems (Chap. 8), distribution from arctic to tropics (Chap. 9), as source of food, dyes, medicines, and poisons (Chap. 10) all are exemplary. The book, after Chaps. 12–15 provides advice on names, collection, and study techniques, centers on the key: a clear and comprehensive guide to the lichen species themselves.

The old insult: “this entire 828-page masterpiece is ‘Schwendenerist!’” is justifiably slung at all 1,700+ photographs and drawings. What? In 1869, the Swiss botanist of Basel, Simon Schwendener, writing his lichen treatise in German, opened himself to ridicule and ignominy that persisted in many corners until today. The



great Russian plant physiologist A. S. Famintzyn (in his 1870 report) admitted that “Schwendener’s discovery that lichens appear to be constructions of fungi and algae constitutes his merit.” By 1937, botanist K.A. Timiryazev could defend Schwendener’s conclusion: lichens are not plants at all. They are individualized symbiotic composites of photobionts (oxygenic photoautotrophs such as cyanobacteria or green algae) with mycobionts (heterotrophic fungi, usually ascomycota). He wrote “Some botanists still can not wake from the impression evoked by this startling discovery and prefer to close their eyes to the obvious... If I am not mistaken this curious subject has hardly been mentioned in our popular literature; nevertheless, it must be considered one of the most striking and unexpected discoveries of biological science of the last quarter century.” Microbiology, ultrastructure, biochemistry, and molecular biology unambiguously support the unappreciated Schwendener.

Brodo and the Sharnoffs remind us that lichens, nearly all of the 3,600 North American and perhaps 15,000 species worldwide, are polyphyletic, i.e., they

evolved separately... “every recognizable lichen is derived from a different species of lichenized fungus” (p. 94). Detailed data support this generalization. Only when they claim that lichens “can not be placed within the hierarchical systems of biological classification... kingdom, phylum, class... because they are dual organisms and each of the components has its own classification” do I disagree. Like any others, lichens can be classified since all visible organisms: plants, animals, protists and fungi, are at least dual composites. Indeed most evolved from triple, quadruple, and higher-order symbiotic associations.

These valiant authors who flaunt a wealth of detail, perhaps inadvertently, illustrate fundamental biological

principles worthy of Schwendener’s legacy but, we trust, their beautiful book will not suffer his fate. Polyphyly is more apparent in lichens than in other symbiotic associations, lichens do exemplify the details of complex individuality, the relations between syntrophic metabolism and morphogenesis in the emergence of novelty through physical association is made obvious in these colorful creatures, and so too the contribution of symbiogenesis to speciation and taxonomy in them is manifest. I recommend this book, a gift of world-class scholarship, without reservation. At its current artificially low price, I suggest all libraries, private and public, with even a remote interest in natural history obtain it now.