of *Ambio* dedicated to the subject (1976), which have headed the list of essential reading in this field.

Many of the contributors to the volume are European, and there is some awkwardness in the translation of some of the papers. In the main, however, the papers are well presented and the meaning and intent are clear.

The papers range from excellent to average. In a well-done paper Grennfelt *et al.* evaluate the sulfur and nitrogen budgets for coniferous forests in southwestern Sweden. They make the important point that many substances that enter the ecosystem may have an acidifying effect, perhaps with some delay after deposition. Some of the substances, of course, reach the ecosystem by means other than simple snow or rain. Eaton *et al.* give a sulfur budget for the northeastern United States that is surprisingly close to that given by Grennfelt *et al.* for southwestern Sweden. Ulrich dwells on the minutest details concerning sources of and sinks for hydrogen ions, which makes reading laborious. A paper by Anderrson *et al.* on forest ecosystem responses ranks among the best in the book owing to its ecological context and conceptual basis.

One matter that requires a great deal more research is chemical change that occurs in rainfall or other precipitation as it is intercepted by forest or other vegetation canopy, litter, and mineral layers of soil and moves through the watershed into streams and lakes. The two papers dealing with this subject, by Likens *et al.* and Gorham and McFee, represent significant steps in looking at watershed dynamics. The former paper presents new data that build upon data from previous years at Hubbard Brook, New Hampshire. The latter paper is excellent in its contribution to the conceptualization of the factors that must be taken into account in quantifying or modeling the dynamics of precipitation input and runoff.

Recent data might tend to cast some doubt on some of the conclusions reached by the editors in 1978 or provide a more penetrating understanding of some of the phenomena. In general, however, their conclusions and recommendations can still stand. Many of the matters on which they recommend further research are now being investigated intensively.

Scientists with an interest in atmospheric deposition, particularly its ecological effects, will find the book to be of great value.

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Adaptation to Cold

Comparative Mechanisms of Cold Adaptation. Proceedings of a meeting, East Lansing, Mich., Aug. 1977. LARRY S. UNDERWOOD, LARRY L. TIESZEN, ARTHUR B. CALLAHAN, and G. EDGAR FOLK, Eds. Academic Press, New York, 1979. x, 380 pp., illus. $24.

Opportunities for research on cold adaptation are numerous and diverse. Because of the multitude of processes involved, however, many of the researchers in the field are specialized and communication across disciplines has been lacking.

The purpose of this book is to stimulate such communication. The 12 chapters and seven "discussions" are the products of a two-day symposium and workshop. The subject matter is about evenly divided between plants and animals, and the coverage is unusually broad. In addition to direct effects of temperature on specific processes, whole plant and animal mineral nutrition, the energy balance of a vegetation canopy, and even some population dynamics and reproductive biology are discussed.

The book is too short to provide detailed reviews. Instead, by juxtaposing diverse topics, from hibernation in homeotherms to ice formation in plant cells, it serves mainly to stimulate new questions. The last chapter of the book is devoted to future trends in cold adaptation research, and the next-to-last chapter describes research support facilities north of the Arctic Circle. Those interested in an encyclopedic treatment of a specific topic can look up the many review papers cited in the text. The emphasis here is on what is not known, why it is important to know, and how it can be found out.

Overall, the book is a success. In part, the success is due to the implicit ecological perspective of the editors and many of the authors. The word "ecology" is rarely used, but the environmental context is clear enough that diverse, specialized topics are almost unavoidably seen as part of an overall pattern of adaptation. Also the individual papers are concise and well-written enough that most readers can pull them together themselves, and they do not present more detail than nonspecialists can absorb. For these reasons the book will be stimulating to students and to a general scientific audience as well as provide inspiration to workers in the field.

Although there is no summary chapter, several common themes are apparent. Perhaps the most frequent are those of acclimation vs. acclimatization, hypothermia vs. hibernation, and the difficulty of interpreting in vivo or laboratory results in terms of the whole organism in the field. Uncertainty about the role of membranes, particularly membrane phospholipids, in cold adaption is mentioned in at least five papers, with widely differing approaches.

Botanists tend not to distinguish between acclimation (adaptation to a specific environmental factor) and acclimatization (adaptation to a whole environmental complex). Zoologists are much more aware of the distinction but are unable to explain why, in the case of body fat accumulation, for example, the acclimation response to lower temperature is opposite to the acclimatization response to the onset of winter. Similarly, the peak in the photosynthetic response curve may vary with environmental temperature, but the photosynthetic rate at that temperature occasionally decreases to below the unacclimated rate. Clearly, both botanists and zoologists are trying to interpret such data in terms of single limiting factors when it is likely that direct and indirect effects of temperature are interacting. A mechanism for dealing with such interactions is suggested in a chapter by Miller *et al.* on simulation modeling, and the chapters on mineral nutrition by White and by Chapin suggest alternative pathways.

The emphasis on questions, rather than answers, conveys an excitement about cold adaptation research that is rare in such broad reviews. Certainly, enough questions are raised to keep researchers busy and communicating for years to come.

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Protein Chemistry

Protein Methylation. WOON KI PAIK and SANGDUK KIM. Wiley-Interscience, New York, 1980. xviii, 282 pp., illus. $27.50. Biochemistry, vol. 1.

Enzymatic methylation is one of the mechanisms by which nature can alter the structure and thereby the biological activity of proteins. During the last 15 years, interest in the subject has grown tremendously. In this book, Paik and Kim, who have carried out much of the pioneering work on protein methylation, review our knowledge of these reactions and document their diverse nature and