probability of their survival is very low. Reiter's paper is noteworthy for two reasons. First, he integrates endocrine regulation with the natural history of the animal. Much of the early work on hamsters was performed without regard to season or to the photoperiod under which the animal had previously been kept, thus producing equivocal results. Second, this paper and several others bury the idea that the endocrine glands are not capable of functioning during hibernation.

Seven of the 11 papers in *Survival in the Cold* discuss some aspect of endocrine regulation in hibernation, leaving the reader with the correct impression, that hormones are very important during hibernation. Several of the papers are up-to-date reviews of current research in endocrine regulation. Two papers, however, stand out by providing new evidence concerning hibernation.

Barbara Cannon and co-workers present strong evidence that a protein, which they name thermogenin, is involved in heat production in brown fat tissue. The total amount of thermogenin in brown fat may determine the total amount of heat produced by nonshivering thermogenesis (NST) in the tissue and, consequently, the absolute amount of NST capable of being produced in the animal. An increase in the amount of thermogenin in a hibernator during the hibernation season may be an explanation for the increase in total NST reported by L. C. H. Wang and Bruce Abbotts in the preceding paper. The other paper that sheds new light on central nervous system problems in hibernation is that by H. Craig Heller and co-workers. Using ^{14}C-labeled 2-deoxy-D-glucose, they have begun to carefully explore the tremendous potential autoradiography has for elucidating changes in neuronal activity during hibernation. The advantage this technique holds for neuronal studies is that 2-deoxy-D-glucose is taken up by active neurons but is not metabolized once inside the cell. Therefore, the rate of accumulation is an indicator of relative activity. The amount of 2-deoxy-D-glucose inside the cell can be visualized by autoradiography. The autoradiographic studies by Heller and co-workers of neuronal activity in hibernating golden-mantled ground squirrels (*Citellus lateralis*) clearly suggest that sensory stimuli are very important to hibernating animals. Seven of the ten most active neuronal structures the authors report are sensory. For example, temperature fluctuations are important sensory stimuli even though an animal is several feet underground. Although there are many problems still to be worked out with the technique (as pointed out by Heller), this approach to hibernation studies will undoubtedly further our understanding of central nervous system function during all aspects of hibernation.

The book contains a wealth of information about endocrine function and thermogenesis during hibernation. Each paper is largely self-contained, well written, and thoroughly referenced. The book is an excellent reference for those working on hibernation, and I suspect that biochemists and ecological physiologists might also profit from a stroll through its pages.

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Coastal Ecology

The Shore Environment. Proceedings of a symposium, Portsmouth, England. J. H. PRICE, D. E. G. IRVINE, and W. F. FARNHAM, Eds. Published for the Systematics Association by Academic Press, New York, 1980. In two volumes. Vol. 1, Methods. xx pp. + pp. 1–322, illus., + index. $60. Vol. 2, Ecosystems. xx pp. + pp. 323–945, illus., + index. $116. Systematics Association Special Volume No. 17.

The concern of the symposium of which this book is the proceedings was with integrating studies of coastal ecology. The volumes offer a good mixture of zoology, phycology, and even meiofauna work. They also offer accounts of methods and many examples of the use of systems analysis to present data from large-scale monitoring programs. Evaluating the "well-being" or "stability" of shore communities is a recurrent theme.

Several papers in the volume consider the objectives and methods of coastal ecology as a scientific discipline, and others discuss the value and methods of monitoring. Bringing together these concerns may be the most important contribution of the symposium. Environmental protection programs are increasingly criticized by ecologists, regulatory and management agencies, and private business as being of questionable quality and value. Because regulatory agencies and many ecologists are uncomfortable with the highly probabilistic nature of ecology, there is a tendency, often a legal necessity, for impact studies to be very detailed and specific and to collect reams of data that have no underlying logic and defy generalization or test. This prevents the growth of coastal ecology as a science.

J. R. Lewis explicitly addresses these issues in a wonderful introductory essay on the questions and procedures of shore ecology. It begins with a strong statement supporting good observation and description as the basis of all good ecology. Lewis also considers the relationship between extensive but qualitative and intensive, quantitative approaches and argues persuasively that a certain amount of the former is necessary to give a proper perspective to the latter. Finally and most important, he reminds us of the commitment of science to understanding the systems in question. He argues that an understanding of ecological systems requires three broad phases of investigation: basic description, mechanistic understanding of the dynamics of communities, and, finally, appreciation of the importance of long-term, broad-scale climatic factors. Lewis's own research has clearly entered the third phase. In the essay he observes that many colleagues are stuck in the first phase and wonders what the continued descriptive research is really contributing. He observes also that many large-scale surveys and computer-produced relationships lack "natural history awareness." His essay is pulled together with a ringing call to shore ecologists to incorporate into phase two a better understanding of the biological and physical relationships along exposure shelter gradients and the role of larval recruitment, especially settling behavior.

The rest of volume 1 emphasizes methods and includes an elementary paper on how to teach a field course (W. E. Jones) and a lengthy discussion of how to use photography (J. D. George), both of which seem misplaced in a symposium volume such as this. There follow discussions of monitoring and exposure scales (D. H. Dalby), monitoring intertidal systems (W. E. Jones *et al.*), classification and ordination of intertidal vegetation (G. Russell), and the use of permanent quadrats in salt marshes (P. J. Polderman) and a demonstration of how to use cluster analysis to show that the vegetation on porous chalk cliffs differs from that on hard, impervious material (I. Tittley and K. M. Shaw). Coulson *et al.* advocate remote sampling by means of aerial photography, and John *et al.* discuss still another ordination exercise, this time of subtidal vegetation. Papers by R. C. Earll and by S. J. T. Knight advocate the use of computers to summarize large bodies of data.

The second volume focuses on ecosystems and, at best, on the processes organizing them. It includes several descriptive but thoughtful papers, such as a description and classification of sublittoral habitats by K. Hiscock and R. Mitchell and an account by E. Coppejans of phytosociological studies of Mediterranean algae, based on the Braun-Blanquet approach and thorough consideration of physical characteristics of the habitat. One of two reports of North American work is that of R. G. Hooper *et al.* on a 12-year descriptive study of the algae of northern Newfoundland, which is presented with a barrage of cluster analyses. The other study is that of M. M. Littler, who describes the second year of a four-year monitoring program of southern California rocky intertidal systems. This paper relies on permanent quadrats and photographs, but it emphasizes questions and processes. Another rather descriptive study is that of free-living nematodes by H. M. Platt and R. M. Warwick, which emphasizes the abundance and diversity as well as the morphological variation of nematodes. The authors argue that in energetic terms nematodes are the most important metazoans in many shore systems. Still another descriptive survey by R. L. Fletcher is of algal communities on floating structures; it follows but does not go beyond the habitat approach of Lewis's 1964 book. In fact, the views expressed in the descriptive components of these volumes reflect the views held by Lewis in his "naive youth," when he thought there was an important message in descriptive work.

The second volume also includes excellent reviews by A. Wilkinson on estuarine benthic algae; A. Wheeler on relationships between fish and algae; P. J. Hayward on invertebrate epiphytes of marine algae, which he, Knight-Jones, Stebbing, Ryland, and others have exploited well; A. Fletcher on maritime lichens; W. F. Farnham on introduced flora; and K. Lüning on the importance of day-length and temperature on algal life history patterns. J. J. P. Clokie and A. D. Boney offer a long and interesting assessment of changes in an intertidal habitat following a large disturbance resulting from the construction of a terminal in the Firth of Clyde. In addition, they discuss the evolution and value of particular questions relevant to monitoring programs and the criteria for good questions and methods. They argue for the importance of understanding the source of propagules or inoculum as well as the successional processes and stress, with Lewis, the value of understanding seasonality and an adequate temporal framework. Most important, experimental tests of hypotheses are an integral part of their program. This is one of the best papers of its genre I have seen.

Almost as though from a different world are the valuable synthetic papers of J. H. Price and R. H. Hughes. Though Price refers to his paper as a review, it is much more, because he focuses on many interesting and unresolved questions, such as the value of the niche concept. Perhaps he reviews too many papers, especially as many are of marginal value; nevertheless, this is an excellent essay on shore ecology. Hughes's paper goes well beyond the admonitions of Lewis to study processes, as Hughes suggests that there have been sufficient experimental studies demonstrating the importance of competition and predation and that it would be profitable to look beyond these questions to new and more interesting evolutionary ones. He suggests that optimal foraging theory offers a useful paradigm for future intertidal research.

Though the editors have been successful in presenting integrated holistic studies and many of the papers are current and innovative, explicit recognition of the importance of attempting to falsify hypotheses as a scientific method is generally lacking. Assuredly, emphasis on rigorous testing can be overdone when the hypotheses are trivial. Nevertheless, I would have hoped to see more evidence of the use of the experimental method and an explicit recognition of the scientific futility of testing general hypotheses with computer analyses of data collected without concern for mechanistic questions. Granted that some systems are so poorly understood that the use of cluster analyses yields new insights into relationships, these shore systems are relatively well understood, and I find the emphasis of many papers on cluster analyses depressing. One gazes at the maze of lines and wonders about the meaning and relationships. Do the organisms in clusters have a common habitat? settling surface? planktonic history? predators? food? Or do the analyses simply reflect similarity in size? Perhaps the organisms have common life histories, physiological tolerances, behavior, or color? All or none of the above might be true. What have we learned? Once again this brings us back to Lewis's challenge to ask "why" particular patterns and processes are observed. He points out that a survey remains a static, incomplete, and often misleading picture, and he bemoans the lack of an understanding of mechanisms important to the dynamics of populations and their communities.

In summary, all the papers are well written and the result of much careful thought. There are several excellent reviews that summarize past work and offer valuable direction for the future. The systems analysis papers as such are well done and cover a broad range of approaches. It is to be hoped that increasing sophistication of regulatory agencies and decreasing funds will soon result in a merger of mechanistic science and environmental monitoring. These volumes should contribute importantly because they have excellent examples of a wide diversity of philosophies and methods.

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