make sure we are not arguing about the wrong things.

There are all kinds of trends—trends in variance, trends in the mean of a characteristic, anagenetic trends (those taking place in an unbranching evolutionary lineage), and cladogenetic trends (those describing the pattern and fates of branches in an evolutionary tree)—and each type requires different forms of measurement and analysis. McKinney provides an introduction to the measurement and classification of trends in his chapter. He discusses serial correlation among other techniques, but it is clear from his discussion that existing methods require assumptions that most empirical studies probably cannot satisfy. The reader will need to consult the cited literature in order to gain a full understanding of the statistics and their limitations.

How common are the various kinds of trends? This is a question about relative frequencies. It can be answered only if we have available a systematically compiled set of evolutionary patterns that can then be classified according to type, cause, direction, and so on. Among the empirical chapters in the book, those by Fortey on trilobites and Janis and Damuth on mammals stand out as thorough, carefully crafted contributions in which attempts are made to synthesize the available information rather than to document a few selected examples. I believe there are other groups in which the information required for a systematic survey—an abundant fossil record, good stratigraphical control, well-documented ancestor-descendant relationships, and a sufficiently long time interval for the detection of patterns—exists or is at least obtainable. Cretaceous and younger foraminifers, Mesozoic ammonoids, and Paleozoic graptolites and conodonts come to mind as examples.

One of the editor's requests to the contributors was that they consider the role of intrinsic as compared to extrinsic factors in effecting trends. Extrinsic factors include ecological agencies of selection—predation, competition, the weather, and so on—whereas intrinsic factors include those aspects of an organism's body-plan or pattern of development that channel change in particular directions. I believe that there is a false dichotomy here. Phenotypic change in response to selective agencies is accomplished within the established genetic and developmental system of the organism. To me, heterochrony (the change in relative timing of developmental events) and the incorporation of new traits within the established developmental framework are mechanisms by which change is achieved, not causes of it. Seen in this light, extrinsic and intrinsic factors are complementary rather than mutually exclusive. In order to understand how phenotypic change is channeled along particular pathways by heterochrony, it is instructive to consider the conditions that permit the established order to be violated. Sadly, no chapter in the book takes this tack. Lots of interesting examples of trends explicable by heterochrony are presented, and few observers could doubt that shifts in the timing of developmental events have been frequent in the history of life; but we have little to go on besides examples, and the dichotomy between extrinsic and intrinsic factors draws attention away from distinctions among different mechanisms by which trends could be brought about.

The study of trends and their relationship to heterochrony has traditionally been beset with complex terminology. This situation is exacerbated in the book by some pretty woolly writing. Consider, for example, the following sentence, which appears on p. 72: "Cladogenetic heterochronoclines, where ancestral species persist following the evolution of the descendant, may be considered to be *autocatakinetic* (Hutchinson, 1959)—in other words, self-generating in a particular direction." Given statements like this, how is one to appreciate the forest through the evolutionary trees?

In short, there is plenty of interesting work to be done on evolutionary trends. Readers will find good reviews in some of the chapters of this collection, but we are some way from a definitive treatment of the subject.

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LMCFs

Large Marine Ecosystems. Patterns, Processes, and Yields. KENNETH SHERMAN, LEWIS M. ALEXANDER, and BARRY D. GOLD, Eds. American Association for the Advancement of Science, Washington, DC, 1990. xiv, 242 pp., illus. Paper, $39.95. AAAS Publication no. 90-30S. From symposia, Boston, 1988.

This volume is the third of a series on its topic following on symposia at AAAS annual meetings. Subsequent symposia on the topic were held at the 1990 and 1991 AAAS meetings, and an internationally sponsored meeting on the same theme was convened in Monaco in October 1990. Hence more volumes may be expected.

The common thread connecting all these meetings is their primary organizer, Kenneth Sherman, who has popularized the term "LME" (large marine ecosystem). There are many other common threads, since several of the authors are to be found in two or more of the symposia.

LMEs are defined in this volume as "relatively large regions of the global EEZs [exclusive economic zones], generally on the order of 200,000 km^2, characterized by unique bathymetry, hydrography, and productivity, within which marine populations have adapted reproductive, growth, and feeding strategies." Many people (including myself) have considerable reservations about this rather pragmatic and mundane definition of what one might have hoped to be an enlightening new concept in theoretical marine ecology.

A glance through the accumulated contributions in the three existing volumes, however (as well as the definition quoted above), makes it clear that the topic is LMCFs—large marine coastal fisheries. The emphasis is on the description of coastal fisheries and any considerations that might be helpful in understanding how to manage them. These include legal, economic, and geographic considerations, but particularly important is the approach in which the fishery is set in the context of the whole ecosystem. One senses that this is the major point being made, and it is being made to the fisheries management community.

The list of LMEs reviewed during the course of the meetings to date now approaches 30. The first section of this volume contributes to this list, with descriptions of LMEs such as the Weddell, Caribbean, Banda, and Norwegian seas. A second section has chapters on topics in marine ecology (such as larval fish ecology, predator-prey relationships, and growth and feeding) as well as technological aspects (application of molecular and image-analysis techniques to zooplankton enumeration). The third section includes contributions concerned with ecological and management concepts such as scale interactions, modeling of ecological systems and other approaches to understanding fish biomass yields, and geographical and legal perspectives on LMEs. The second and third sections are mostly not specific to any particular LME.

Sherman himself, summing up, organizes LMEs on the basis of "predominant variables." This gives rise to hypotheses regarding major controlling factors, such as excessive fishing mortality, changes in upwelling systems, or pollution (such as in nutrient enrichment to the Baltic ecosystem from the surrounding land). Several of the chapters are well-prepared reviews of their subjects.

Inherent in the "LME concept" is the recognition of the importance of long-term data series collected for management purposes. These are necessary to measure trends and the changing health of the system. They

cannot provide predictive capabilities. The case is often made that most of the world's fisheries yield comes from coastal LMEs, and fisheries management is necessarily a localized activity for political if not strictly scientific reasons. However, events at times and places very distant from any single LME (such as an El Niño–Southern Oscillation event) may well control a fishery by modifying productivity and sequential timing of food chain events over thousands of kilometers. Ecologists, I believe, would prefer to subdivide the single world ocean ecosystem into its major component LMEs at the outset and not merely those readily recognizable as someone's fishery management problem at the ocean margins.

Coastal LMEs will be subject to the consequences of global climate change, concerning which much research is currently being planned and implemented. Programs such as GLOBEC (Global Ocean Ecosystems Dynamics) in the United States and its international counterparts are poised to begin process-oriented studies designed to understand and predict ecosystem change. It would be ideal if a network of LMEs could be developed to formalize a continuing program of background data collection and long-term observation to provide a historical context for such international research programs. It is high time to organize such a concerted program involving both LME managers and scientists of interested nations to make use of the massive influx of data and models on how the ocean works that will be forthcoming from global change programs.

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