been achieved—but it is extremely useful for evaluating substantive differences in policy.

To conclude, in *Loading the Dice* the author presents an excellent case study in which the central thesis is supported with copious observations and differences in policy outcomes are well documented. The focus on networks within and across organizations is useful in helping to explain different approaches to the regulatory process.

The comparison of regulations across political boundaries is an important vehicle for gaining insight into the politics of the regulatory process. Such comparisons can also serve as guides to building a better regulatory process. It is intriguing to speculate on what this process might look like. The authors of these two books present an interesting argument in support of a cooperative approach. At this point, there is a need to examine carefully how different regulatory approaches to the environment directly affect our well-being—specifically our pocketbooks and the quality of the environment in which we live. With the addition of this knowledge, we will be able to make a more informed assessment about the relative efficacy of the cooperative and adversarial approaches.

HADI DOWLATABADI
ROBERT W. HAHN
Department of Engineering and Public Policy, Carnegie-Mellon University, Pittsburgh, PA 15213

Invertebrate Phylogeny

The Origins and Relationships of Lower Invertebrates. S. CONWAY MORRIS, J. D. GEORGE, R. GIBSON, and H. M. PLATT, Eds. Clarendon (Oxford University Press), New York, 1985. xii, 397 pp., illus. $69. Systematics Association Special Volume 28. From a symposium, London, Sept. 1983.

So far as is now known, all animal phyla began as marine invertebrates, diverging from a common ancestor of late or perhaps middle Proterozoic age. There must be some pattern of branching that describes the pathways of descent of the major animal groups, but evidence to demonstrate these pathways has proven to be elusive. The fossil record, with perhaps 3% or so of marine invertebrate species known, is spotty enough that the pathways have not yet been discovered there; the missing intermediate and ancestral forms appear to include those which would tell us how the branching occurred. Invertebrate relationships, and the general character of the missing intermediates and ancestors, have therefore been inferred chiefly from studies on living organisms. Some progress has been made; many early groupings proved untenable (such as brachiopods with tunicates or mollusks) and have been disbanded; attempts to verify new groupings have been less successful. The field is characterized by an abundance of phylogenetic hypotheses, most of which seem highly invulnerable to disproof. On the other hand, none of the hypotheses is without its important detractors.

The Origins and Relationships of Lower Invertebrates contains 23 papers that consider the relationships among the invertebrate phyla, either comparing phyla or searching within phyla for primitive characteristics to aid in constructing a plausible ancestor. Sponges, cnidarians, ctenophores, platyhelminths and gnathostomulids (six papers), some pseudocoelomates (three papers), annelids, sipunculids, and pogonophorans are covered. There are also contributions on possible phylogenetic clues from reproductive traits and larval lives, a welcome survey of the fossil record of soft-bodied lower invertebrates by Conway Morris, and a concluding overview by Barnes. A special feature of the volume is that many papers incorporate results of a recent round of ultrastructural studies on these organisms; indeed, the authors include some of the leading practitioners of such research. This is the first time the results of the electron microscopists have been synthesized and assessed phylogenetically for a broad spectrum of lower invertebrates so as to be readily accessible to the nonspecialist. Some of the authors have applied formal cladistic methods to evaluate the evidence, and others simply contrast and compare. The emphasis is on morphology; there is little use of biochemical criteria, and molecular systematic approaches that involve estimates of genome similarities are not discussed.

This new evidence and the accompanying analyses form an important contribution; chapter after chapter contains rich food for thought. However, the ultrastructural work has not yet led to any startling reduction in hypotheses or to any consensus concerning relationships. Instead the tendency is for the ultrastructural studies to emphasize the distinctiveness of the phyla and to disband some common groupings. For example, Harbison indicates that ctenophores, which lack nematocysts but possess colloblasts and have mesodermal tissues, are significantly more distinct from cnidarians than systematists have assumed. Rieger finds considerable heterogeneity in parenchymal tissues among the acoelomate phyla. He interprets this to suggest a possible convergent evolution from coelomate ancestors during body size reduction associated with an ecological shift, perhaps through progenesis. If this is the case the primitive bilaterian may have been coelomate. However, Smith and Tyler produce evidence that turbellarians are not reduced coelomates, and some authors (Ax, Mettam) continue to employ an acoelomate as a primitive bilaterian. Land and Nørrevang show that priapulids lack peritoneum and not only are not coelomates but do not seem closely allied to any living pseudocoelomate clade either, and Clément suggests that some pseudocoelomate alliances have arisen from markedly different ancestors and are only distantly related.

These studies indicate that many of the major characters (such as type of mesoderm or body cavity) that have usually been keyed into schemes of metazoan phylogenetics either are not homologous across phyla or, if homologous, have commonly undergone such changes, reaching back into early development, as to make them difficult to use as guides to evolutionary pathways. Perhaps workers have consistently overinterpreted evidence of homology, or perhaps evolution has involved more developmental repatterning than has been supposed. In any event, ultrastructural and developmental evidence is telling us something important about the evolution of the major metazoan grades and ground plans, and here is an excellent introduction to the evidence for the lower invertebrates.

JAMES W. VALENTINE,
Department of Geological Sciences, University of California, Santa Barbara, CA 93106

A Biological System

The Sea Urchin Embryo. A Developmental Biological System. GIOVANNI GIUDICE. Springer-Verlag, New York, 1986. viii, 246 pp., illus. $49.

This book was written as a sequel to, rather than as a new edition of, the author's *Developmental Biology of the Sea Urchin Embryo* (Academic Press, 1973). The advantages of this are the avoidance of repetition of accounts of the older literature, except in a few instances where it is necessary to provide a frame of reference, and the opportunity to present a concise overview of the most recent work. These aims have been admirably accomplished.

The book is divided into two sections. Part 1, Development, includes chapters on fertilization, morphogenesis, and energy metabolism. Research on the last of these subjects has declined, but the first two have been vigorously pursued. Part 2, Nucleic Acids and Proteins, includes chapters on DNA, RNA, protein synthesis, and mito-