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.

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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.

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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-

chondrial interactions. As the author points out, the development of new technologies within the last ten years has rendered obsolete most of the old data on these subjects, and these chapters are filled with new information of great interest. The title of this book, as compared to that of the 1973 volume, reflects the current view of the sea urchin embryo; it is now the system of choice for many cell and molecular biologists as well as developmental biologists.

Giudice is particularly well qualified to take on the enormous task of reviewing the literature of the last 12 years of research on the sea urchin embryo, for his own work covers a wide range of topics. The 67 pages of references are themselves a valuable resource. Indeed, so assiduously did the author pursue his task of bringing us up to date that even as he was correcting proofs he was also writing an addendum of 15 pages of text and six pages of references, making the coverage complete through 1984.

The editors of the volume, however, have not served the author well. Over half the pages have typographical errors, figure labels do not always correspond to figure legends (arrows, letters, or numbers are sometimes missing), and references to figures and tables are occasionally missing in the text.

Nevertheless, this book is a valuable resource for all those who work with sea urchin embryos, including the specialist who wishes to be informed of work in related areas and the graduate student who is new to the field.

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Copper Chemistry

Biological and Inorganic Copper Chemistry. KENNETH D. KARLIN and JON ZUBIETA, Eds. Adenine, Guilderland, NY, 1986. In two volumes. Vol. 1, xii, 273 pp., illus. $65. Vol. 2, xii, 298 pp., illus. $65. Vol. 2, xii, 298 pp., illus. $65. Based on a conference, July 1984.

These are exciting times for copper chemists. Fired by discoveries that in living systems copper performs such diverse functions as oxygen transport, electron transfer, dismutation of superoxide ion, hydroxylation of dopamine and tyrosine, reduction of dioxygen, and oxidation of amines to aldehydes and by industrial applications ranging from hydroquinone production to catalytic carbon-carbon bond formation, bioinorganic, coordination, and organometallic chemists have focused attention on the chemistry of this element to an unparalleled degree. In order to facilitate communication among scientists in this fast-moving area, K. D. Karlin and J. Zubieta organized conferences in 1982 and 1984 at the State University of New York at Albany. The present two-volume work houses contributions from participants in the second conference.

Volume 1 begins with 12 papers on copper proteins, in which most of the important systems are discussed, including the blue copper proteins plastocyanin and azurin, copper-zinc superoxide dismutase (SOD), cytochrome c oxidase, hemocyanin, galactose oxidase, and laccase. A highlight of this section is the spectacular 300 MHz ^1H NMR spectrum of copper(II)-cobalt(II) SOD, Cu_2Co_2SOD, obtained by Bertini and Luchinat, in which sharp, isotropically shifted resonances arise for ligands bound to the copper chromophore. The next section devotes four papers to medicinal aspects of copper chemistry, including a valuable survey by Crouch *et al.* of the use of copper complexes to treat (inter alia) arthritis, acute rheumatic fever, and cancer. This interesting area would benefit from incisive research at the molecular level. The volume closes with eight contributions on the physical characterization of copper complexes, including magnetic studies by Hatfield and Kahn, who direct two of the leading groups. Other papers in this section cover applications of electron spin resonance and optical spectroscopy and Hendrickson's pioneering work on electron transfer in binuclear mixed valence copper complexes.

The second volume leads off with nine papers describing the interactions of copper complexes with dioxygen, without question the highlight of the series. This work, inspired by the known biological functions of copper, reports small copper complexes that bind dioxygen reversibly (Karlin, Zubieta *et al.*), stabilize copper(II)-superoxide and -peroxide linkages (Thompson), catalytically oxidize phenol (Lyons and Hsu), and convert acetonitrile to 3,5-dimethyl-1,2,4-triazole (Nelson, Drew, *et al.*). It is astonishing that so much progress in this difficult area of chemistry has been made in only two years since the previous Albany conference. The remaining two sections of volume 2 are devoted to coordination chemistry and nonfunctional protein models (eight papers) and to organometallic copper complexes (three papers). The latter section includes the very nice studies of Doyle *et al.* on metal-metal bonded copper clusters and of Caulton *et al.* on polyhydrides, most notably $Cu[H_5ReL_3]_2^+$, where L is diphenylmethylphosphine.

The editorial and production work is of the generally high quality that one has come to expect from the editors and publisher, although there are some annoying lapses. In volume 1 the paper by Bertini and Luchinat has text missing at the top of p. 25, p. 121 displays a gel electrophoresis figure that is useless owing to unlabeled lanes and a scanty caption, and p. 125 tells us that "the search for antitumor agents has been eminated [sic] by studies of organic compounds." Volume 2 reveals some unevenness in the type of material presented. In one chapter we find a table of analytical data, whereas other chapters present their subjects more superficially. On the whole, however, the papers are incisive and well written.

In summary, I recommend these volumes to all bioinorganic and coordination chemists. Anyone working with copper will find it a handy compendium of much of the important work through 1984, and students especially will profit from the overview approach taken by most of the authors. This reviewer hopes that the Albany copper conferences will be continued (there was none in 1986) and that their legacy will include further volumes such as these.

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Some Other Books of Interest

Biology of New World *Microtus*. ROBERT H. TAMARIN, Ed. American Society of Mammalogists, [no place], 1985 (available from Gordon L. Kirkland, Jr., Vertebrate Museum, Shippensburg University, Shippensburg, PA). xiv, 893 pp., illus. $55. ASM Special Publication no. 8.

This treatise on the rodent genus *Microtus* (voles), commissioned and published by the American Society of Mammalogists, is modeled on the Society's 1968 volume *The Biology of Peromyscus*. In this case coverage has been limited to New World forms to keep the work to a manageable size. The volume consists of 21 chapters, mostly by single authors. It begins with accounts of the fossil record, taxonomy, zoogeography, macroanatomy, microanatomy, and ontogeny of the genus. Habitats, community ecology, behavior, activity rhythms and spacing, and dispersal are then reviewed. Further chapters cover parasites and predators, population dynamics, and management in the wild and in the laboratory. Finally, endocrinology, reproductive patterns, nutrition, energetics and thermoregulation, and genetics are discussed. The chapters were subjected to review prior to publication. According to the editor "there is some repetition and fragmentation, but each subject is self-con-