ics in one place and becomes a proponent in another; Churchill undergoes the same transformation; speakers before the society are referred to as "Dr. Clouston" or "Dr. Mott" with their first names never proferred; and unidentified abbreviations abound, leaving the unfortunate reader to decide what it could possibly mean to "call an A.G.M." or "work for the L.C.C." The weaknesses of the book are unfortunate, for its strong parts are sufficiently sophisticated to warrant the judgment that if the author (and the editor) had spent more time on it it could have been the definitive work on the subject.

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Vertebrate Structures

Problems in Vertebrate Evolution. Papers from a symposium, London, Jan. 1976. S. MAHALA ANDREWS, R. S. MILES, and A. D. WALKER, Eds. Published for the Linnean Society of London by Academic Press, New York, 1977. xii, 412 pp., illus. $36.10. Linnean Society Symposium Series, No. 4.

If this symposium has a less apparent overall theme than is usual in the Linnean Society's symposia it is perhaps a tribute to the breadth of researches undertaken by T. S. Westoll, the dedicatee. Westoll's interests have spanned a wide range of primitive fishes, and he has given special attention to the fish-tetrapod transition. Because Westoll's contributions have been fundamental it is unfortunate that a bibliography of his papers is not included in this volume. The quality of the papers presented in the book is high, however, and some are fundamental contributions. They may be grouped by subject into four categories: the nature of calcified tissues, the anatomy of Paleozoic fishes, the postcranial skeleton of coelacanths and tetrapods, and relationships of placoderms, acanthodians, lizards, and birds.

The papers dealing with calcified tissues should find a wide audience, for they are all important summaries. Bobb Schaeffer demonstrates the importance of interactions between epithelial and mesenchymal tissues in the dermal skeleton of fishes. The differences between cellular and acellular bone, enamel and enameloid, and bone and dentine arise from shifts in the timing and duration of particular morphogenetic processes; past speculations on which member of each of these pairs is the more primitive are weakened. Of particular interest is Schaeffer's discussion of the involvement of neural crest material in (probably) all dermal calcifications.

Tor Ørvig summarizes knowledge of odontodes, discussing the ontogeny, function, derivatives, and phyletic history of these toothlike structures of the dermal skeleton (often called dermal denticles). Ørvig believes odontodes to be the precursors of the dermal skeleton, as well as one of its major components.

Keith Thomson discusses the biology of cosmine, a hard tissue of the skeleton found in a variety of fossil fishes. He shows that in crossopterygians cosmine is an active tissue undergoing extensive resorption and deposition related to such phenomena as mineral storage and protection. Cosmine also contains the minute network of the pore-canal system, which appears to have been electroreceptive, differing from electroreceptors of living fishes in being integrated primarily within the canal network rather than being under more direct control of the central nervous system.

Colin Patterson has studied the relationships between endoskeletons and exoskeletons of vertebrates and found no instances of interchangeability between the two. He reviews delamination theory and finds most applications of it to be unspecific; the only direct attempt to apply it cannot withstand criticism. Patterson's overall conclusion is that the dermal and endoskeletons have always been distinct, as far as is documented in known animals, and that theories postulating the induction of one by the other are readily falsified.

One of the most extensive summary papers in this book is by Alec Panchen, who reviews the complexities of tetrapod vertebrae. Although Panchen's results are essentially negative, his approach is explicit and the paper is a classic review of this difficult problem; a clear discussion of the differences in ontogenetic, anatomical, and serial homology among various vertebral structures is given. Panchen concludes that there is phylogenetic continuity between vertebral structures of osteolepid crossopterygians and those of temnospondyl labyrinthodonts and postulates a separate origin, within crossopterygians, for the anthracosaur-reptile groups. Microsaurs are not lepospondyls; the vertebral structure of living amphibians provides no evidence concerning their affinities with Paleozoic groups.

The other papers are all of interest to vertebrate morphologists and paleozoologists but in general deal with more specific problems of anatomy and relationships. H. P. Whiting reidentifies cephalaspid cranial nerves and modifies Stensiö's classic account of them somewhat; the result is that the cephalaspids show an even closer similarity to petromyzontid lampreys, the pride stage in particular. Brian Gardiner and A. W. H. Bartram demonstrate homology in cranial anatomy of primitive palaeoniscoids and crossopterygians; these two major groups of bony fishes thus seem more closely related than some workers (notably Jarvik) have supposed. Roger Miles and G. C. Young revise the curious placoderms, Erik Jarvik sees similarities of acanthodian fishes to elasmobranchs, S. M. Andrews reinterprets the axial skeleton of *Latimeria* and compares it with that of tetrapods, Alick Walker provides an alternative to the currently well-documented theropod origin of birds, Robert Carroll finds the origins of lizards within particular eosuchians but sees *Sphenodon* as a separate issue of that group, and F. R. Parrington interprets retention of neck intercentra in reptiles as providing the kind of flexibility offered by opisthocoelous or flattened cervicals in later mammals.

There are few typographical errors in this satisfying volume, and the overall enthusiasm of the articles, surely due in part to the authors' pleasure in honoring Westoll, makes it one of the more interesting and readable recent volumes in the field of vertebrate morphology and evolution.

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Membrane Biology

Electrical Phenomena at the Biological Membrane Level. Proceedings of a meeting, Orsay, Oct. 1976. E. ROUX, Ed. Elsevier, New York, 1977. xvi, 566 pp., illus. $65.50.

Most of the material in this collection of papers is available elsewhere in published form, and some has been superseded by more recently reported work. On the whole, however, the juxtaposition of diverse, loosely connected topics is useful, particularly for someone trying to survey several fields of current interest quickly. I found the volume introduced me to interesting lines of work relevant to my own interests, and I suspect it will serve the same purpose for others. That, after all, is one of the things a good symposium should do.

There are papers on lipid monolayers and bilayers, theoretical discussions of

ion transport, experimental papers on nerve membranes and photoreceptors and on membrane noise and fluctuations, and papers both theoretical and experimental on photosynthesis. Several papers struck me as worth commenting on separately.

M. J. Sparnaay provides an excellent introduction to the physical chemistry of thin films at interfaces. He makes a logical, step-by-step progression from submonolayer films (films in which the molecules at the interface are far apart) through coherent monolayers of rod-shaped molecules (such as lipids) to bilayers. At each stage the appropriate formalism is clearly introduced. The paper deserves careful reading.

J. Garnier and S. J. Singer discuss the "bilayer couple hypothesis." They cite evidence that membrane components are asymmetrically distributed and note that changing the area of the inside monolayer of a red cell (or other) membrane relative to that of the outside monolayer can cause the membrane to change shape. True enough, but the authors do not introduce even the most elementary quantitation to support their geometric interpretation of the investigation of the shape changes they find induced by different drugs. In fact, as has been shown by E. A. Evans (*Biophys. J.* **14**, 923 [1974]) and others, anything that alters either the compressibility or the surface tension of one monolayer with respect to another will cause a shape change. Failure to consider this point of view considerably reduces the value of the interesting data provided by Garnier and Singer.

W. W. Webb's paper on the lateral diffusion of molecules in various types of bilayers and cell membranes is a fine introduction to an important line of work that will be vigorously pursued for some time. The complementary techniques of fluorescence correlation spectroscopy and photobleaching get good introductory treatments, but readers wanting the details will have to dig further (a voluminous list of references is provided). Useful summaries of important numerical results for the diffusion constants of various molecules, including acetylcholine receptors, appear in several tables, but some of the numbers, especially for lipid bilayers, have been updated since Webb's paper was written.

Of the several papers on fluctuations, that by C. P. Bean and D. C. Goliber-such is particularly elegant and novel. It takes a different point of view from that current in neurophysiological literature, where fluctuations in conductance are used to deduce properties of conducting channels. Bean and Golibersuch use physically well-characterized systems and show how the properties of the system explain the observed noise. The paper should be read by anyone working on fluctuations. J. de Goede and A. A. Verveen comprehensively review fluctuations in biological membranes.

Photosynthesis is well covered. J. J. Hopfield provides a lucid discussion of electron transfer in biological membranes and points out exactly why the process is important. H. T. Witt discusses the role of the electric field in photosynthesis. He cites evidence that light can generate an electric field across the membrane and that an electric field, induced externally, can generate adenosine triphosphate.

There are a number of other interesting papers, including several on conductance mechanisms in lipid bilayers (especially that by G. Boheim, H.-A. Kolb, E. Bamberg, H.-J. Apell, H. Alpes, and P. Läuger) and several on nerve membranes (notably those of E. Rojas, B. Neumcke, and C. Bergman and J. M. Dubois). These and the others mentioned are worth reading.

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Developmental Biology

The Cell Surface in Animal Embryogenesis and Development. GEORGE POSTE and GARTH L. NICOLSON, Eds. North-Holland, Amsterdam, 1976 (U.S. distributor, Elsevier, New York). xxiv, 766 pp., illus. $89.95. Cell Surface Reviews, vol. 1.

The series this volume inaugurates will, the editors envision, be different from other, more eclectic review series in that each volume will be a coordinated collection of articles concerned with a well-defined topic. In the first volume, a coherent and heuristic survey of the cell surface in development, this goal has been achieved.

Composed of 13 chapters, the book reviews fertilization, cleavage, implantation, placentation, and three selected examples of organogenesis. There are also three outstanding chapters on more general developmental topics—cell motility, induction, and positional information.

The chapter on metazoan cell movements by Trinkaus provides a comprehensive account of observations of motility in vivo. Although the chapter is over a hundred pages long, the reader's interest is maintained by the author's clear and insightful presentation. Similarly, Saxén and co-workers provide an extensive and lucid review of the many inductive tissue interactions that characterize embryonic development. Although these chapters are both predominantly phenomenological, their value may well be greatest to prospective biochemists who are able to discern the direction that such imposing arrays of observation may suggest.

The most speculative chapter, by McMahon and West, not only reviews observations and ideas relevant to positional information, but provides a new perspective from which to view the establishment of patterns during development. The authors propose that the transduction of cell surface events, such as cell-to-cell contact, results in temporally and spatially specific variations in the concentrations of simple "metabolic messengers." They then suggest that these messengers (adenosine triphosphate or *S*-adenosylmethionine, for example) determine modifications in a cell's macromolecules by, for instance, phosphorylation, acetylation, or methylation. Some of these modifications, they propose, are permanent enough to provide a "memory" of a cell's developmental experiences. The ultimate pattern of genetic expression might then result from an interpretation of this macromolecular repository.

The volume has few scientific weaknesses, although speculation and fact seem confusingly mingled in the chapter on fertilization. For the most part, the chapters are freshly conceived and do more than rehash previous reviews. The reference lists are slightly dated, generally not extending beyond early 1975, but they are exhaustive—more than half contain over 200 citations. The book has a detailed table of contents and an adequate index.

These attributes are severely undercut, however, by the price of the volume. The book is carefully produced but sparingly illustrated, except for the chapters by Ede on limb development and Manasek on heart development. The price, more than four times that of the 1120-page 1977 *Annual Review of Biochemistry*, seems unjustified. It will clearly limit the distribution of a book that might otherwise have become a valuable addition to graduate students' reading lists and researchers' personal libraries.

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