cesses; the term "resonation" is intended to suggest a model of "continuous variation, reaction and response with no discernible beginning or end." Concepts of "cause" and "effect" are considered inappropriate in the model, emphasis being given instead to finding patterned relations and configurations of clustering variables in particular kinds of situations. Similarly, such "intervening" variables as emotion, stress, and motivation are regarded as not useful because they distract from consideration of the "dynamic wholeness of physiological and social activities."

Man is viewed as a biosocial being living in a social milieu of "resonating communication networks." These are composed of people transmitting and modifying a particular configuration of information consisting of language, values, and preferred patterns of interaction. Communication networks may be well defined or informal and may vary in size from a clique or a family to a whole society. Individuals participate sequentially and simultaneously in many different networks, whence they may experience conflicting, inaccurate, or incongruous information. Moss's interest is in the effects such experiences may have on the central nervous system, on the autonomic-neuroendocrine system, and on susceptibility to disease. He emphasizes that this process may produce a generalized susceptibility to a wide variety of diseases; he rejects a "one stress–one disease" model. Communication networks can also protect participants by preventing exposures to information incongruities in the first place, by assisting in resolving encountered incongruities, or by providing relief from symptoms of incongruities.

In developing this thesis, Moss covers a remarkably broad range of topics encompassing the role of the central nervous system in perception, stress research, autonomic and neuroendocrine responses to perceived incongruities, typologies of social participation, and theories of equilibrium, homeostasis, and social change.

This is not an easy book to read. The style is occasionally lucid and lively but more often is cumbersome and obscure, in part because of an overreliance on jargon. The presentation is essentially humorless and is virtually devoid of illustration to ease the heavy going. The argument is richly documented, with 427 references in 250 pages of text, but all the citations have been chosen to support the thesis offered; no antithetical citations are presented. Nevertheless, if the reader persists, he is assured of several worthwhile conceptual formulations and occasionally a brilliant and innovative insight.

This book addresses a significant and timely issue in an ambitious and imaginative manner. Unfortunately, the goal Moss seeks is not entirely achieved. In the end, the model he develops appears to consist of causes (perceived information incongruity), effects (increased susceptibility to disease), and mediating variables (social immunity, social cure, and social therapy). While one can aspire toward a model of dynamic wholeness with no discernible beginning or end, it may be inevitable that in any particular analysis one must still begin somewhere and end somewhere. Nevertheless, in looking for causes and effects, it is surely useful to maintain a broader appreciation of the context within which the analysis takes place. Moss has therefore made a fundamental contribution in providing a series of sensitizing concepts that alert us to the complexity of the relationships involved in the study of social behavior and disease. In doing so, he has also provided a thoughtful and provocative approach to the problem that will surely stimulate lively discussion, debate, and more vigorous research effort.

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Invertebrate Neurobiology

Information Processing in the Visual Systems of Arthropods. Proceedings of a symposium, Zurich, Switzerland, March 1972. RÜDIGER WEHNER, Ed. Springer-Verlag, New York, 1972. xii, 334 pp., illus. Paper, $11.50.

The visual system of arthropods has attracted a great deal of attention recently, and the reasons are not hard to find. The behavioral capacities of arthropods are rich and varied, including both relatively simple and stereotyped motor acts and learning and memory. A principal motivation for this interest in arthropods has been the hope, indeed the expectation, that their nervous systems, with several orders of magnitude fewer neurons than those of mammals, and their eyes and optic ganglia, with their exquisite organization of many repeating subunits, would, in the words of the editor of this volume, "provide a suitable model for the study of information processing in neuronal networks." Most of the experimenters who have risen to this challenge have quickly concluded, however, that an approach through systems analysis is largely unsatisfactory. Too much remains uncertain. As a consequence, recent efforts have also been directed at a more sophisticated understanding of the physiological optics of compound eyes, a detailed knowledge of the patterns of synaptic connectivity of the receptors and visual interneurons, investigation of the photochemistry of arthropod visual pigments, and studies at the single-unit level of both receptors and cells in the optic lobe.

This volume contains 45 papers presented at a symposium of European workers. Almost without exception the participants represented either Swiss or German institutions, so the prospective reader may well ask whether the book provides more than a limited sample of work now in progress in this field. The restriction is not serious. Several of the most active laboratories were represented, and the proceedings reflect a generous cross section of work in progress.

The book is organized into nine sections. The first three (containing 14 papers) deal with fundamental phenomena such as the paths of light in the eye, the visual pigments, and the neural wiring of the receptors and optic lobes. Particularly noteworthy for the reader new to these preparations is the chapter by Kirschfeld describing an integrated view of physiological optics, neurohistology, and optomotor behavior of flies.

The next two sections (11 papers) treat intensity- and wavelength-dependent functions. The pair of contributions by Kaiser and by Liske on the spectral sensitivity of the optomotor system of the bee and on the spectral sensitivity of directionally sensitive units in the optic lobes, although labeled preliminary, suggest an interesting story in the making. Although color vision is presumed to be present in many arthropods, heretofore only the honeybee has been subjected to quantitative behavioral analysis. Toggweiler's work on ants, which exploits the capacity of Hymenoptera to learn visual discriminations, is a welcome extension of this powerful technique.

Most of the final 20 chapters describe a variety of behavioral experiments on pattern recognition, orientation to visual cues, and learning. The longest and perhaps most lucid contribution is the chapter by M. F. Land on orientation and pattern recognition by jumping spiders. The account by Heisenberg of the use of behavioral mutants of *Drosophila* to dissect neurophysiological mechanisms of behavior provides a glimpse of an experimental approach that will become increasingly important in the next few years.

The authors' command of the English language varies considerably. Even more important, an occasional casualness in defining symbols and units in the figure captions makes a critical reading of some of the chapters an exasperating exercise. Considering the soft cover, the price of the book seems high and a potential barrier to wider dissemination. On this last point I should be pleased to be wrong.

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Movement and Response

Behaviour of Micro-Organisms. Proceedings of a congress, Mexico City, Aug. 1970. A. PÉREZ-MIRAVETE, Ed. Plenum, New York, 1973. xviii, 302 pp., illus. $19.50.

This book contains updated papers presented at a symposium held during the 10th International Congress of Microbiology. The papers are excellent—either discussions of recent research by the authors and others, or reviews. The topics include chemotaxis, phototaxis, circadian rhythms, ciliary and flagellar structure and function, and ameboid and ciliate response and behavior. Some papers are updated from those given at the conference on motility of algae held in Santa Barbara in 1969. It is good to see them in print.

The book shows that research on behavior of microorganisms must be and is being pursued to the molecular-genetic events that determine the motility of the cell and its organelles.

The author-list bristles with veteran bwanas of symposial safaris, but also lists some new hunters. It is good to have a few new bwanas and porters, lest the safari tend to traverse the same old (sometimes barren) territories. Some new territories and new hunting techniques are revealed, among them Adler's patient spoor-tracking of chemoreceptor sites on bacteria; Davenport's new elephant gun, the elegant TV-computerized "bugwatcher"; the powerful binoculars of Satir and of Dimmitt *et al.* in their electron micrographs; the game-beating spectronic techniques of Nultsch, Diehn, and Tollin; and the jungle magic of cyclic adenosine monophosphate in Konijn's work inducing the trek of the acrasian grex.

Habituation and responses of ciliates are discussed by several authors. Inferences concerning the molecular bases of function are presented, and doubt is expressed about the durability of learning. The role of cations in ciliary movement is elucidated by Eckert and Naitoh.

I regret, with Adler (who organized the symposium), the absence of many important workers in the field. A supplementary list of recent reviews is a partial compensation. The lack is especially evident in the limited presentation on ameboid behavior—Allen and Haberey being the lone contributors. These authors correctly say that movements and behavior of one kind of ameba do not represent those of another and that although contraction is involved there is no agreement on how that mechanism is employed. Even Allen's own theory is perhaps applicable to only one or two kinds of amebas.

The book contains excellent, up-to-date material and deserves a place alongside Jennings's early classic in the field on the bookshelf of anyone interested in the topic.

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Biophysics

Mathematical Physiology. Blood Flow and Electrically Active Cells. H. MELVIN LIEBERSTEIN. Elsevier, New York, 1973. xvi, 378 pp., illus. $19.50. Modern Analytical and Computational Methods in Science and Mathematics, vol. 40.

Lieberstein's book differs from most texts on biomathematics in that it aims at providing general discussions of physiological principles in sufficient detail to supply the reader with the necessary background for evaluating the assumptions underlying the mathematical treatment. Rather than covering the entire spectrum of physiology, the author has limited the book to two systems (blood flow and electrically active cells) that have been subjects of his research over the past decade. The book is well written, the expositions are clear and concise, but the physiological concepts are sometimes unrealistic and the mathematics is probably too advanced to make the book suitable as a text except for students in mathematics.

The first part treats blood flow and wall tension problems on the basis of the thesis that arterial hemodynamics, including wall motion, can be completely determined from three simultaneous pressure measurements. It includes an interesting, albeit somewhat unrealistic, discussion of noninvasive measurement techniques for the evaluation of arterial disease, in which problems associated with pressure measurements are clearly and critically evaluated while dimensional measurements from roentgenograms are accepted at face value. However, all assumptions are clearly stated and the mathematical treatment is elegant and includes a variety of rather sophisticated methods (for example, the solution of nonlinear boundary value problems from converging solutions of sequences of linear boundary value problems, using nonlinear operators mapping one real Banach space into another). It is indeed unfortunate that the author seems unaware of the more recent experimental evidence that indicates that many of the assumptions made (shear-rate-independent viscosity, isotropy and nonviscous behavior of the arterial wall, extent of wall motion, the Windkessel model, and unmeasurability of flow profiles) are not valid. This section would have been significantly improved if some numerical investigation (as in the second part) and an updated bibliography had been included.

In the second part the author proposes a mathematical formulation of electrophysiology that is conceived as a unified description of the electrical activity of cells. Since one set of equations with various but reasonable changes in parameters is sufficient to describe all the known gross differences in electrical behavior, he considers each of the electrically active cells as modifications of the same design, despite widely varying functions, with only one common membrane mechanism. The entire section is based on the Hodgkin-Huxley equations. After a delightful history of the investigation of the electrical properties of membranes and cables, the system of Hodgkin-Huxley equations is reformulated. A numerical instability is removed by introducing the effects of inductance, which already contains Huxley's assumption of the propagation constant being a real number. The treatment is