the subject over chemical. But this emphasis is appropriate, since pheromones are typically unexceptional compounds of low molecular weight, while the physiology and behavior evolved to employ them are often unique and surprisingly complicated. The males of certain moth species, for example, can distinguish females of their own as opposed to similar species on the basis of a single optical isomer or even quantitative differences in blends of the same substances. In female *Pachygrapsus* and *Cancer* crabs, molting to the adult stage is mediated by the hormone crustecdysone, which upon being released into the water also serves as a pheromone attractive to males. To take one of a rapidly growing list of mammalian examples, female rhesus monkeys produce volatile aliphatic acids in their vaginas that function as potent sex attractants. These same substances are also produced in the vaginas of young women, reaching their highest levels in the late follicular phase and declining progressively during the luteal phase. Clearly we have much more to learn about pheromones, and there may even be surprises in store as the new understanding is extended to human biology.

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Developmental Neurobiology

Neuronal Recognition. SAMUEL H. BARONDES, Ed. Plenum, New York, 1976. xvi, 368 pp., illus. $27.50.

It is awesome that the neurons of the human brain make orderly connections with each other by means of approximately 10^{14} synapses. The orderliness of synaptic contacts is believed to involve "guidance" of neuronal processes toward the correct targets, followed by "recognition" of the appropriate targets by the processes. *Neuronal Recognition* describes some of the evidence for the formation of selective synapses and several biochemical and cellular models for how it may be mediated.

The book has 11 chapters, grouped into three sections: on specificity in synaptic development and regeneration, on the morphology and biochemistry of synapses, and on the molecular basis of neuronal recognition. The authors of the chapters have chosen between reviewing a field and summarizing their own contributions. Thus Fambrough offers an excellent detailed survey of work on the specificity of nerve-muscle interactions, Bunge a critical review of synapse formation in vitro, Pfenninger and Rees a summary of the anatomical changes that occur during synapse formation, Morgan and Gombos a survey of synaptosome biochemistry, and Toole a detailed view of acid mucopolysaccharides. The chapter by Toole, while pertinent to cell guidance, is not obviously related to the title of the book. The remaining authors—Jacobson; Cotman and Lynch; Moscona; Roth and Marchase; Merrell, Gottlieb, and Glaser; and Barondes and Rosen—for the most part offer summaries of the work in their own laboratories. Among these summaries, we appreciated Cotman and Lynch's discussion of reinnervation in the central nervous system, which stresses the lack of evidence for inappropriate reinnervation. Several of the other summaries give too little discussion of pertinent findings from other laboratories. In particular, the chapters by Jacobson on retinotectal specificity, by Moscona on embryonic cell recognition, and by Barondes and Rosen on cell surface carbohydrate-binding proteins are narrower in scope, and therefore less valuable, than they might have been. In general, literature is reviewed only through 1974.

The impression that remains after reading this book is that the more descriptive approaches of anatomy and physiology have already provided solid information on developmental processes in the nervous system but that the biochemical approach has so far told us relatively little. Much has been learned by observing the development of synaptic contacts in culture (Bunge; Pfenninger and Rees) and by examining the reaggregation of dissociated cells (Moscona). Likewise, we have benefited by studying the recovery of synaptic function and structure after partial deafferentiation in the central nervous system (Cotman and Lynch), after denervation of muscle (Fambrough), and after rearrangement of retinotectal projections (Jacobson). Such clear information has yet to come forth from the biochemical approaches, where the emphasis is still on finding an appropriate model system that embodies the key elements of neuronal recognition. Moscona argues for study of the reaggregation of trypsin-dissociated embryonic cells, Roth and Marchase argue for study of the interactions of dissociated retinal cells with intact optic tectum, Merrell *et al.* prefer to study membrane-neuron interactions, and Barondes and Rosen are willing to forgo neurons altogether and investigate aggregation of slime mold cells. While the experiments are often elegant and clever, their pertinence to neuronal recognition is not always apparent. Nor is it easy to compare one laboratory's data with another's. For instance, "adhesion" may be measured as an on rate or as an off rate; as an energy-independent phenomenon or as an energy-dependent one; immediately after mixing or after prolonged incubation at 37°C; with respect to the cell membrane or the extracellular matrix. The title of the last section of the book, Toward a Molecular Basis of Neuronal Recognition, is apt, since we still lack much specific information and have a great deal to look toward.

Though this book lacks a single author to organize the data and reconcile the observations, it is nevertheless a valuable summary of the state of developmental neurobiology; it demonstrates how little we know, as well as how much. The chapters are well chosen, usually well written, and consistently cautious in their interpretation of data. We enjoyed the book greatly.

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