organizers of the symposium. It had become apparent, however, to those interested in the control of disease that the behavioral mechanisms by which parasites reach and enter their hosts are often the most amenable to intervention. This is reflected in the fact that most nematocides affect the nervous system. The articles reflect the state of knowledge of animal behavior in general, a field in its infancy, and the current interest in the subject. In addition, they serve as a starting point for dealing with the neglected problems related to parasite behavior.

The papers cover subjects as diverse as the structure of sensory organs of trematode miracidia, monogeneans, and hematophagous insects; host-finding behavior of the tsetse fly; the behavior of specific groups of parasites; biological clocks; and human behavior in relation to the acquisition of parasites. As one begins to observe species of increased neuronal complexity, behavioral differences between individuals become more apparent. The problems these differences create for humans in relationship to their parasites are discussed in a review by G. S. Nelson that is not only comprehensive but highly entertaining.

Holmes and Bethel analyze the transmission of parasites from the intermediate host to the definitive host in terms of the predator-prey relationships. They suggest that parasites have evolved mechanisms by which they make intermediate host organisms more vulnerable to being consumed by the definitive host. Specific behavioral changes such as those exemplified in formicine ants when infected by metacercariae of the liver fluke suggest their use as a probe to investigate underlying neuronal function. Most of the cercariae ingested by the ant penetrate into its abdomen, where they encyst until the ant is eaten by the ungulate definitive host while grazing. However, a few of these worms, which appear to be specifically differentiated in that they are not infective for the ungulate and follow a different behavioral pattern from the abdominal forms, migrate to the subesophageal ganglion of the ant. The infected ants then display markedly different behavior from their uninfected counterparts, which retire to their dark anthills while the infected ants travel up and attach to blades of grass at the times of day appropriate to increase the probability of being ingested by a foraging ungulate. Experimentally, the behavioral change has been related to an opposite response to temperature or light, or both, on the part of the intermediate host specifically induced by the parasite. The *Polymorphus-Gammarus*-mallard system is also analyzed in detail. The tactic response of *Gammarus* to light is changed from negative to positive by *Polymorphus*, as a result of which *Gammarus* can be picked up off the surface of the water by the mallard, which thus becomes infected with *Polymorphus*.

The evolutionary processes leading to the meshing of behavior in the specific host-parasite relationships are illustrated by B. O. L. Duke in studies of the life cycle of the nematode *Loa loa*. Simian and human parasites can be hybridized under experimental conditions but are kept apart in the wild by two separate host-vector complexes.

The volume lacks information on the genetic basis of transmission, which is available at least on the snail intermediate hosts of schistosomes in the work of C. Richards and others. There is also little on parasites that have sedentary hosts such as plants and the special behaviors they must develop.

Many of the parasitic organisms have evolved such specific behavioral patterns that they offer interesting material for the basic study of structure and function underlying behavior and the relationship of behavior and development.

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Embryonic Field of Ecology

Insect/Plant Relationships. Proceedings of a symposium, London, Sept. 1971. H. F. VAN EMDEN, Ed. Halsted (Wiley), New York, 1973. viii, 216 pp., illus. + plates. $19.75. Symposia of the Royal Entomological Society of London, No. 6.

In the introduction to this volume Southwood establishes a framework for considering the evolution, nature, and mechanisms of the insect-plant relationship. Rothschild in "Secondary plant substances and warning colouration in insects" observes that out of four recent reviews of the subject, covering about 720 papers, only 0.5 percent of the citations occur in all four reviews and only 10 percent occur in as many as two. Van Emden and Way conclude that "a comprehensive review of the literature is not being attempted especially as much of it represents supplementary information rather than added illumination." Wood comments that "a variety of effects will undoubtedly be described in an increasing number of papers and the level of frustration in attempting to understand an already confused literature will continue to increase."

These four comments reflect what the symposium overall makes quite clear. The embryonic field devoted to animal-plant interactions is cripplingly cluttered with data and attitudes from a multitude of reductionist, descriptive, and nonevolutionary studies by the past three generations of physiologists, biochemists, agriculturalists, entomologists, behaviorists, and others. We must cease examining animal-plant interactions in the traditions of these fields, which were established for other purposes, and focus on the questions that derive their relevance directly from a wish to understand what animals do to plants and vice versa. This symposium volume with the references it includes is a good place for the uninitiated to begin such a focusing. In this small space I can offer only a few precautionary comments, and hope that the reader will take them firmly to mind in reading the entire volume.

Southwood offers the conclusion that "the foliage of seed plants is . . . often only marginally adequate nutritionally" for herbivorous insects. Such a conclusion avoids the questions of why there was selection for the structural parts of plants to be indigestible, why we would expect natural selection to produce insects with a physiology such that plants were more than marginally adequate nutritionally, and why nutrient-rich seeds are no more available to most insects than is foliage except where the seeds lack antimetabolites.

No fewer than ten of the authors indirectly warn that "the animal diet is subject to all the vicissitudes of changing chemical composition and hormone levels that result from the plant's interaction with the environment" (Osborne). For example, the larvae of *Lymantria dispar* "selectively fed upon leaves of alder which had been normally exposed to light, and avoided leaves of the same tree which had been kept for some time in the dark" (Schoonhoven). Equally, the symposium is dotted with examples of how the reaction of the plant to the insect is circumstance-dependent. "The boundaries drawn be-

tween plant and animal viruses, and which are based on the principal host, are probably artificial" (Tinsley). "It is a fallacy that consumption of leaves, buds, flowers and other plant tissue by insects necessarily reduces plant vigour or reproductive capacity" (Harris). Incidentally, such views expose the anachronistic and inadequate terminology we are forced to borrow from reductionist fields of biology, and the unintentional bias such borrowing produces.

Pollination biology (Yeo) is given a short, classical treatment and should not have been included in the symposium. Concerned with interactions in which the animal raises the fitness of the plant, pollination biology is finally coming into its own as the ecology of foraging strategies welded to gene flow.

Sensory physiologists often marvel that in choice tests herbivorous insects sometimes prefer "the odour of some non-host plant . . . over their natural food" (Schoonhoven). The problem vaporizes if we accept an evolutionary-ecological approach to tastes and odors. Considering the immense diversity of compounds and herbivores present in any specific habitat, there is no reason to expect tastes (and odors) of plants to be intrinsically correlated with their value to the animal (with the obvious exception of fruits and flower nectars, which, we may note, have converged strongly with respect to attractant—sugar—and receptor). Two-thirds of the papers in this symposium unconsciously emphasize the futility of a strictly physiological approach to animal-plant interactions. Attractant, repellent, stimulant, inductant, tasty, distasteful, and other such terms do not refer to properties of chemicals but rather are descriptions of reactions in context. To view the matter otherwise is like expecting the word "la" to mean the same in Arabic, Chinese, Spanish, and French.

Aphids are popular subjects for agriculturalists and entomologists and therefore provide many of the data used in this symposium. However, the collection and analysis of such data are in need of a solid dose of evolutionary biology. For example, aphid biologists appear to have overlooked the fact that the aphid "colony" produced parthenogenetically by a single female is no more a collection of individuals than are the leaves on a tree or the worker ants in an ant colony. The parthenogenetically produced aphid is not the unit of selection, and the fitness of the founding female is measured by her genetic contribution to later generations rather than the number of aphids surviving in her clone. The pseudoevolutionary discussions of aphid fitness vis à vis such phenomena as crowding, effect on the plant, and alate transformation are badly in need of overhaul.

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Sedimentation

Shelf Sediment Transport. Process and Pattern. Proceedings of a symposium, Washington, D.C., Nov. 1971. DONALD J. P. SWIFT, DAVID B. DUANE, and ORRIN H. PILKEY, Eds. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 1973. xiv, 656 pp., illus. $35.

One result of continental shelf and estuarine studies during the past 40 years has been the evolution of concepts regarding shelf sedimentation and dynamics. D. W. Johnson's "shelf-at-grade" model, which was popular during the early part of the century, was shown to describe the exception rather than the rule in the 1930's and '40's. Subsequent studies during the '50's and '60's have shown that shelf sediments can be at various stages of textural equilibrium while either in or out of compositional equilibrium with their environment.

Questions regarding the extent and mode of modern shelf sedimentation and sediment transport, however, remain. Is the shelf at grade or in disequilibrium? What are the main transporting agents—wave-induced activity, wind drift, or some other mechanism, such as tides or internal waves? Does sediment movement occur mainly during storms or is it more or less continuous? How much stream-derived sediment is being deposited on modern shelves and how much remains trapped within the estuaries and coastal marshes or bypasses the shelf and is deposited in the deep sea?

The answers to these and other questions were sought during a symposium held during the 1971 annual meeting of the Geological Society of America. This book includes most of the papers presented at the symposium. It is divided into three sections. The first, containing nine papers, deals with the processes of sediment transport as seen through theoretical models and derived from field data. The second contains six papers which concern themselves primarily with the transport of fine sediment, mostly in suspension and in nearshore areas. The third section, consisting of 12 papers, deals with the transport and dispersal of coarse sediments on shelves.

Papers range greatly in length, from the expansive (75-page) paper of Swift, Kofoed, Saulsbury, and Sears to the cryptically short (3-page) paper by Stride. Similarly, in style and content the papers range from nearly incomprehensible and trivial to well-written and fundamental. Perhaps the uneven editing reflects the relative speed with which the papers were published after the symposium.

A more serious complaint is the overemphasis on the continental margin of the eastern United States; 65 percent of the papers and fully 75 percent of the total pages in the second two parts of the book deal with this area. Although it is true that a disproportionate amount of shelf research is being done (and has been done) off the eastern United States, the fact that the book is predominantly domestic in scope seriously restricts its worldwide applicability. One would hope that future symposia will place greater emphasis upon worldwide processes and phenomena.

Fortunately the book's good points outweigh the bad ones. Not only is the subject matter timely, but many of the papers present valuable new observations, insights, and models. Most notable are the papers by McCave (on the transport of fine-grained sediment onto and across shelves) and Duane and others (on the morphology, structure, and origin of linear shoals along the central and southern Atlantic shelf). Despite the turgid prose, the study by Swift and others is an extremely valuable contribution to our knowledge of shelf morphology and processes. The book also contains several thought-provoking discussions of other papers within it. Not only do these discussions make interesting reading, they also expose many of the present controversies and problems concerning shelf sedimentation and in the process give the reader a feeling for the dynamic state of the art.

The book is probably too specialized and too expensive for use by students, but the timely discussions and new data make it a necessary reference book for those working on shelf sediments and processes.

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