

Book Reviews

Spider Neurobiology

Neurobiology of Arachnids. FRIEDRICH G. BARTH, Ed. Springer-Verlag, New York, 1985. xii, 385 pp., illus. \$69.50.

Chelicerate nervous systems were last treated 20 years ago by Bullock and Horridge in their tome *Structure and Function in the Nervous System of Invertebrates*. Many of their data were distilled from Hanström's 1928 volume *Vergleichende Anatomie des Nervensystems der Wirbellosen*, which, for all its ground-breaking studies, contained neuroanatomy that was pretty rudimentary by modern standards. Thus it is gratifying that in the introductory chapter of *Neurobiology of Arachnids* the drawings of spider and scorpion nervous systems are convincing and the histological preparations show real structures. The editor has done a splendid job of recruiting many of the right names in arachnid neurobiology to write up-to-date accounts of their subjects. Most of the 18 chapters provide well-researched reviews as well as detailed accounts of each author's own work.

The book is distinguished by bountiful half-tone illustrations and a beautiful layout. It is divided into five sections, each dealing with a general topic such as sensory physiology, behavior, or motor control. The section on sensory systems is the most extensive. It contains some real gems, such as a chapter on physiological optics by Land and an impeccable chapter on retina organization by Blest that is ornamented by stunning electron micrographs of photoreceptor mosaics. Descriptions by Foelix and Barth (among others) of the various types of che-

moreceptors and the marvelous variety of mechanoreceptors are lavishly illustrated and lucidly written.

In a chapter on spider trichobothria, specialized vibration detectors, Reissland and Görner go to some lengths in describing the physical parameters of sound to support their contention that these sensilla are specialized for the kinds of airborne vibrations generated by a flying insect, the wind, and possibly predators. However, the paucity of relevant behavioral tests still leaves us in the dark about the significance of trichobothria in the life of the spider. By way of contrast, in a chapter on vibration perception Barth describes the role of the spider's most important receptor modality, which enables it to identify its mate, its prey, or its predator, and extends his description earlier in the book of the variety and significance of slit sensilla, which are placed at strategic areas of the body and limbs and which register substrate-borne vibrations or monitor the spider's self-generated strains and stresses during locomotion and so forth. What comes across very forcefully is not only the amount of research that has gone into morphological identification of the great variety of sensilla but also the ingenuity that has gone into the development of the biophysical methods that are used to identify and measure their function.

Forster nicely complements earlier chapters on spider optics and receptor organization with her chapter on the ethology of target discrimination by salticids. The chapter contrasts stylistically and philosophically with a chapter on spider navigation by Mittelstaedt, which represents the German school of behavioral cybernetics that employs the engineer's approach to predicting behavior and the construction of "wiring diagrams" in lieu of central nervous system analysis.

One obvious value of the book is that it lays a solid foundation for central nervous system research, which must in any event refer to the great quantity of data collected here on receptor organization. Until quite recently the major obstacle to such research had been the formidable problem posed by the internal pressure of the hemolymph, which is characteristic of this group. However, although not expressly stated in the book, Barth and his associates are making progress toward the kinds of electrophysiological studies that are commonplace on insects, using intracellular recording and dye filling. A chapter on circadian rhythms by Fleissner and Fleissner and one showing cobalt-filled neurons in scorpions by Root illustrate that arachnid nervous tissue is also amenable to standard tracer methods for neuroanatomy. The question is whether the

book will persuade an established researcher to start a program on spiders. For the editor one incentive to proselytize (apart from his love of the Araneae) was the desire to promote comparative neurobiology. The book indeed suggests at least three areas in which research on the spider central nervous system may be particularly useful for studying problems that cut across taxonomic groups: the functional neuroanatomy of visuomotor control, neurohormonal control of circadian rhythms, and the intersegmental control of muscle coordination (for which the condensed nervous system of arachnids may be ideally suited). In this context it is a pity that the book does not contain a chapter on Land's observations of the locomotion of jumping spiders. And in a book that stresses the desirability of comparative neurobiology a chapter on *Limulus* would not have been misplaced. This chelicerate is of evolutionary relevance to the arachnids, particularly with respect to the general organization of its central nervous system. Its visual system and peripheral synapses bear comparison with those of scorpions and whip spiders, respectively.

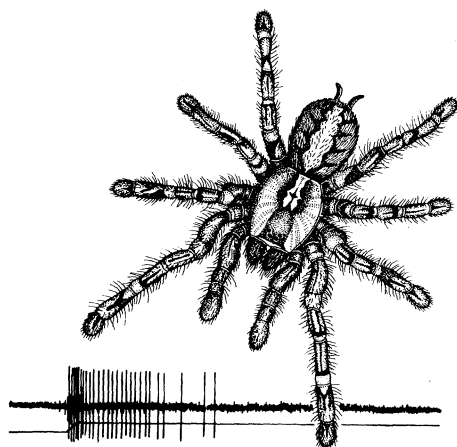
Clearly the book fills a very obvious gap on the library bookshelf. It is said that the popularity of a book on neurobiology is inversely proportional to the number of legs represented. I hope that this handsome volume proves to be an exception, for it contains excellent neurobiology and some jewels of research.

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Interspecific Associations

Gulls and Plovers. The Ecology and Behaviour of Mixed-Species Feeding Groups. C. J. BARNARD and D. B. A. THOMPSON. Columbia University Press, New York, 1985. xii, 302 pp., illus. \$30.

Every winter lapwings, golden plovers, and black-headed gulls meet in mixed-species flocks on the centuries-old pastures of Nottinghamshire to play a round in the survival game. Unlike the game of give and take Robin Hood played in a nearby forest when these pastures were young, gulls and plovers play a game of take and take in which giving is only coincidental. Recently another set of players has appeared on the scene. Armed with core samplers, event recorders, and binoculars, the new arrivals are not participants but observers; and their watching, recording, and digging have been aimed at finding out the rules of this annual



The Puerto Rican spider *Cupiennius salei*. Beneath it is a spike train from a central neuron responding to mechanical stimuli. [From *Neurobiology of Arachnids*]

game. The new arrivals are, of course, behavioral ecologists, and in *Gulls and Plovers* Barnard and Thompson summarize the results of six years' work on the winter association of these three species.

Behavioral ecology and its intellectual parents ethology and ecology have a long-standing fascination with flocking birds. Three central ideas have been used to explain virtually all of the great variety of flocking systems: a feeding benefit, an increase in protection from predators, and information gain of some sort. Flocks have been seen as adaptive for one or more of these reasons, and the benefits of flocking have been assumed to be shared among all the flock members, even if they belonged to different species. The basic ideas are so simple that it has been a perplexing problem to imagine how such a diversity of types of flocks has arisen. But as with so many other subjects, the study of bird flocks underwent a decisive change in the 1970's under the influence of "gene thinking," and it proved a powerful insight that members of single or mixed-species flocks need not share a mutual benefit but instead can often be expected to join flocks to exploit others. The recent literature has many papers that develop this theme.

Nowhere are these ideas and the manner in which they influence the main flocking themes of feeding, predation, and information as fully developed as in this book. The relationships between these species turn out to be largely parasitic, with golden plovers exploiting the food-finding abilities of the lapwings and gulls exploiting both plovers by stealing prey. In turn, plovers use the gulls as sentinels. Barnard and Thompson explore many facets of this association in extensive detail, using a combination of observational and experimental techniques.

My main criticism is over a matter of omission. The implicit idea of a game, in the sense that gulls and plovers are playing an evolutionary game against each other (and themselves), barely receives any mention. This is puzzling, for it was a major theme of a recent volume edited by Barnard (*Producers and Scroungers: Strategies of Exploitation and Parasitism*, Croom Helm, 1984). The idea of a game is important because what the scroungers do depends on what the producers are doing and vice versa. This seems a promising direction for further research, and it is a pity it has not been followed up here.

The underlying story in this book is how the approach to questions about behavior has changed in the past decade. "In one way, this book is about three species of bird feeding on some fields in Nottinghamshire. In another, it is about the interaction be-

tween ecology, social behavior and predation. That a study of the former can lead to conclusions about the latter is a reflection of the recent, dramatic increase in our understanding of the evolution of animal behavior, an increase which stems from an integration of ideas from population biology, evolutionary theory and ethology." Those are the first three sentences of the book, and they sum it up very concisely.

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Letters about Science

Gentlemen of Science. Early Correspondence of the British Association for the Advancement of Science. JACK MORRELL and ARNOLD THACKRAY, Eds. Royal Historical Society, London, 1984 (distributor, Boydell and Brewer, Woodbridge, Suffolk, U.K.). viii, 382 pp. £10. Camden Fourth Series, vol. 30.

Scientific institutions, once they become established and successful, tend to acquire a spurious inevitability. The "British Ass.," forerunner of and model for the AAAS, is no exception. Founded in 1831, the BAAS grew in its first decade or two into such an influential scientific forum that in retrospect its success seemed natural and predictable. In reality, its foundation and the shape it took in its early years were the result of intensive argument and negotiation among a group of men with widely divergent aims and interests. Its course of development and even its survival were anything but predictable.

The story is one that has immense intrinsic interest for an understanding of the scientific enterprise and of the social role of the scientist in the modern world. It has been analyzed in fascinating detail by Morrell and Thackray in their earlier book, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford University Press, 1981), which has already become a classic of its kind in the history of science. The present book has the same title, but its subtitle indicates its complementary character. It prints nearly 300 private letters, the most revealing of the thousands utilized in the earlier book, to illustrate the processes of social interaction by which the BAAS came into existence and developed its distinctive pattern of activities.

It would be difficult to exaggerate the importance of correspondence as a medium of scientific exchange in an age without telephones; and it is fortunate that fluent

and forceful letter-writing was a routine accomplishment at that time in the social strata from which science drew its strength. The letters printed here are not only valuable source material for the historian of early 19th-century science; they also make fascinating reading for anyone who is sensitive to the way things get done in the modern scientific world. For on the human level the contrasts between the 1830's and the 1980's are much less striking than might be expected. In these letters we find traces of many familiar tensions: arguments soaked in self-interest or expressed in terms of high-minded altruism; conflicts between the entrenched individualism of established leaders and the collectivist visions of lesser mortals; arguments about the proper qualifications of those with authority to speak and decide in the name of science; and conflicts over the desirable degree of patronage, direction, or even control of science by the state.

What gives piquancy to our reading of these issues, as they were debated among Morrell and Thackray's British "gentlemen of science," is that the explosive expansion of science and technology in the subsequent century and a half was not inevitable to them. The issues were still wide open, or at least were felt to be; there appeared to be many alternative directions that the scientific enterprise might take; and the "cultivators of science"—even the word "scientist" in its modern anglophone sense had yet to be coined when the BAAS was founded—believed with good reason that their actions could influence those directions decisively.

These letters should perhaps be required bedside reading for those responsible for modern science policy; certainly any practicing scientist with a sense of history will find them entertaining, instructive, and absorbing.

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Books Received

Collisionless Shocks in the Heliosphere. A Tutorial Review. Robert G. Stone and Bruce T. Tsurutani, Eds. American Geophysical Union, Washington, DC, 1985. viii, 115 pp., illus. \$18. Geophysical Monograph 34.

Collisionless Shocks in the Heliosphere. Reviews of Current Research. Bruce T. Tsurutani and Robert G. Stone, Eds. American Geophysical Union, Washington, DC, 1985. vi, 303 pp., illus. \$36. Geophysical Monograph 35.

The Coming Revolution in Agriculture. Harold Willis. Published by the author, P.O. Box 692, Wisconsin Dells, WI, 1985. xii, 223 pp., illus. \$8.95.

An Ecosystem Approach to Aquatic Ecology. Mirror Lake and Its Environment. Gene E. Likens, Ed. Springer-Verlag, New York, 1985. xiv, 516 pp., illus. \$49.

Elementary Particles. I. S. Hughes. 2nd ed. Cambridge University Press, New York, 1985. xvi, 349 pp., illus. \$49.50; paper, \$19.95.