An Influence in Psychobiology

Brain Circuits and Functions of the Mind. Essays in Honor of Roger W. Sperry. COLWYN TREVARTHEN, Ed. Cambridge University Press, New York, 1990. xxxviii, 410 pp., illus. $69.50; paper, $37.50.

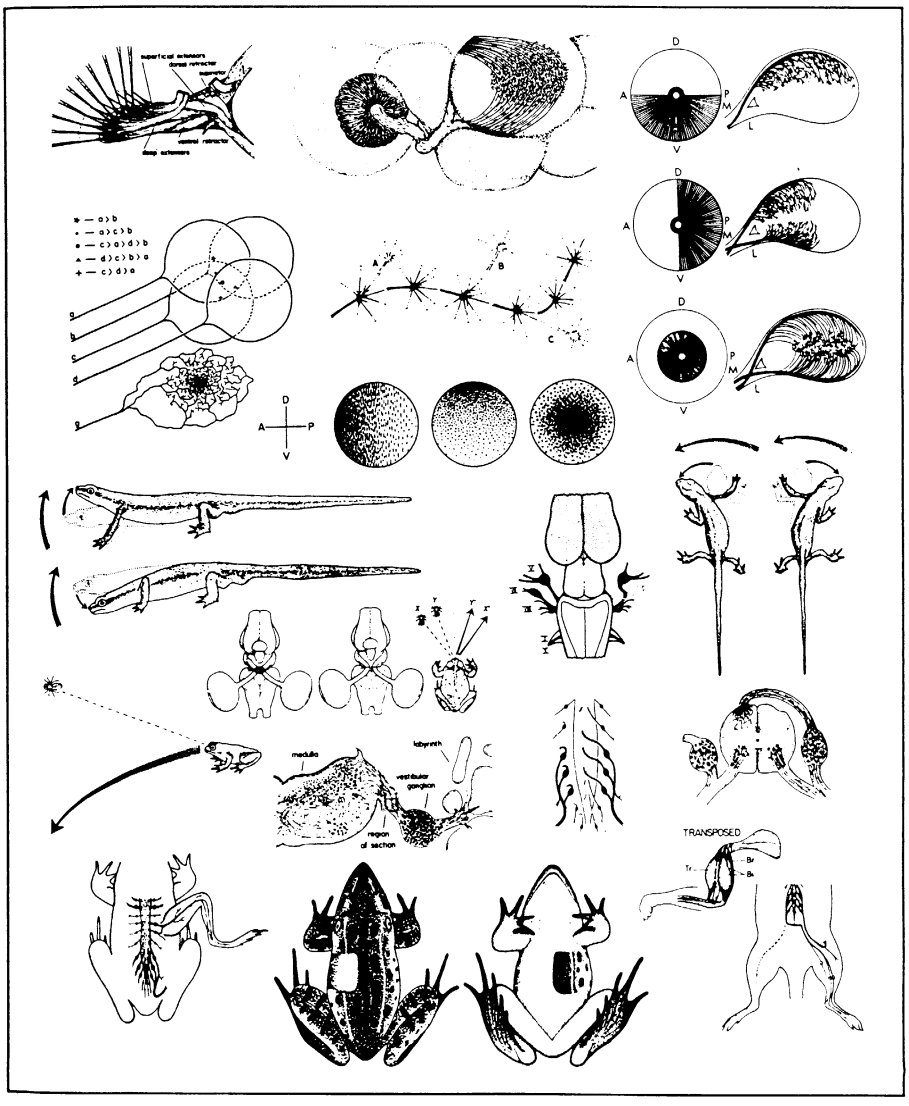
In the last century no one has contributed more to our understanding of the development and cognitive functions of the brain than Roger W. Sperry (emeritus professor of psychobiology at the California Institute of Technology). Beyond science, the impact of Sperry's work on popular culture today seems more widespread than that of any other psychologist since Freud and any other biologist since Darwin.

Sperry has been concerned with three major issues about the brain and behavior. The first of these is how, during development, the sense organs make specific connections with the brain and the brain makes specific connections with muscles. The second is how movements are centrally controlled and how the processing of sensory information is adjusted for the organism's own movements. The third issue is the role of the connections between the cerebral hemispheres and what cutting them can reveal about the functions of each hemisphere. These "split-brain" studies provided powerful tools for studying cognitive functions of the brain, captured the popular imagination, and were the basis for Sperry's being awarded the Nobel Prize in 1981. Many would argue that the earlier work on the development of neural connections deserved a Nobel as well. For Sperry these three interests are closely integrated and have led to his current major concern, the interaction between consciousness and brain matter.

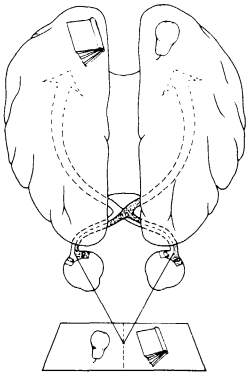
Many of Sperry's experiments have all the hallmarks of truly great science. Before they were carried out the rationale behind them often seemed unclear. For example, on hearing of the plans for a now classic experiment, a colleague asked, "Why are you cutting the optic nerve of that newt and twisting its eye in the socket?" Afterward, the far-reaching implications of Sperry's experiments usually became obvious. The results of this 1943 eye of newt experiment overturned the embryological wisdom of the day (that experience plays a major role in the development of neural connections), set the central question for the next 50 years of developmental neuroscience (how do growing neurons find their targets?), provided the most widely used preparation for answering it (the connections between the retina and optic tectum), and offered what is still the best answer (chemoaffinity, the idea that biochemical specification of growing axons is crucial in leading them to their specific targets).

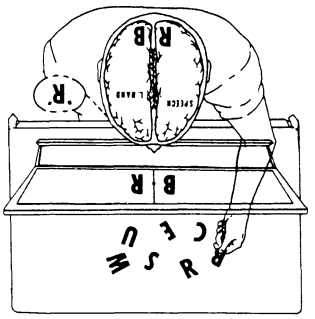
Brain Circuits and the Functions of the Mind, edited by Colwyn Trevarthen, a former student and long-time collaborator, is a festschrift for Sperry. It is an unusually fine job in several ways. First, each of the 23 contributions is closely related to Sperry's own work rather than simply describing the author's latest research. This reflects both the persisting influence of Sperry and the desire of the editor and authors to celebrate this influence. Second, the volume is enriched by several contributions from eminent neuroscientists who were not Sperry's actual collaborators. A third and unusual touch is starting each section with a composite of figures from Sperry's papers, many of which also grace introductory psychology and biology textbooks and form part of the iconography of modern neuroscience.

Trevarthen's preface provides an overview of Sperry's career and contributions. Evarts's



Composite figure made from illustrations in Roger W. Sperry's papers on specification of nerve connections. [From *Brain Circuits and Functions of the Mind*]





Illustrations from Roger W. Sperry's papers on split-brain patients. [From *Brain Circuits and Functions of the Mind*]

foreword shows the intimate connections among the different strands of Sperry's work. The chapters by Levi-Montalcini (a Nobel laureate herself), by Hunt and Cowan, and by Zangwill and Wyke place Sperry's achievements in their historical context. Berlucchi and Antonini review how the corpus callosum, which connects the two hemispheres, brings a representation of both visual fields to each hemisphere as Sperry had predicted it should. Glickstein shows how the cerebellum may provide for the bimanual coordination that Sperry and his students found to survive section of the corpus callosum in their early split-brain studies on monkeys. The papers by Mishkin and Phillips and by Milner, Taylor, and Jones-Gotman each demonstrate the power of Sperry's methodology in revealing brain mechanisms of attention, imagery, and memory. Levy argues for the role of unilateral activation in the functional specialization of the hemispheres. Trevarthen draws on many aspects of Sperry's work, as well as work described by several of the other authors, in his discussion of the development of language and communication in the human infant. The final chapter is a 1977 article by Sperry himself that provides an account of his human split-brain work from its beginning and how it led to his current interest in the reciprocal interactions of mind and matter.

Although most of the papers by Sperry's former collaborators begin or end with hagiographic incantations of how much the authors were taught, inspired, and influenced by Sperry, there is a paucity of description or even anecdotes about how he accomplished this—about what actually went on in Sperry's lab.

Another curious lacuna is the reluctance of any contributor to comment on the tremendous impact that Sperry's split-brain research has had on the contents of popular magazines, talk shows, New Age bookstores, and even how we talk about one another as being "right- or left-brained." Although much of this pop spin-off has little support in the research of Sperry or others in the field, it would seem valuable to look into the contemporary Manichaeanism of right and left that this work has spawned, however illegitimately. Why is science put in the left hemisphere along with such supposedly "bad" things as logic, linearity, and "Western thinking," whereas the right hemisphere is associated with "good" things such as creativity, intuition, and art? Now that we have this superb account of Sperry's science, it would be valuable to examine the sociology of its popular impact.

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Beyond the Sting

The Biology of Scorpions. GARY A. POLIS, Ed. Stanford University Press, Stanford, CA, 1990. xxvi, 587 pp., illus. $85.

Few organisms rival scorpions for their impact on the human psyche. The archetypal body plan, nocturnal behavior, and potentially lethal sting of this ancient arachnid lineage have elicited fear and revulsion throughout history. In folklore and mythology, scorpions hold the dubious distinction of being omens of evil and harbingers of death. However, it is evident from the 12 chapters of this authoritative new volume that the order Scorpiones has received very short shrift. Of the 1400 extant species, only about 20 inject a venom sufficiently toxic to kill *Homo sapiens*, and these few deadly species are restricted to a single family, the Buthidae. Indeed, the book's ten contributing authors make a compelling case for scorpions as model organisms for research into topics ranging from neurotoxin electrophysiology to community ecology. As Polis forcefully argues, scorpions are without doubt "fascinating animals."

The origin of the book can be traced back to the mid-1970s. At that time Polis was a graduate student, embarking on fieldwork in the California desert. Community ecology was entering a phase of intellectual ferment. As Daniel Simberloff and colleagues were challenging the relevance of ecological theory based on strong interspecific competition, empiricists were coming to recognize the need to study systems amenable to both field observation and experimental manipulation. Polis was quick to appreciate the tremendous potential of scorpions for investigating species interactions. Scorpions are both species-rich and highly abundant in desert and subtropical habitats throughout the world. In one study of scorpion guild structure, for example, Polis and co-workers were able to remove some 6000 *Paruroctonus mesaensis* individuals from 300 experimental quadrats. A convenient aspect of scorpion biology is the habit of digesting prey externally in a process that may span hours. This behavior greatly simplifies the study of diet and opens the door to quantitative analysis of resource utilization and optimal foraging. Paradoxically, their nocturnal behavior facilitates observation of scorpions in the field. Under ultraviolet light the scorpion epicuticle fluoresces, making these otherwise cryptic animals visible as an eerie glow in the darkness.

Despite the great opportunity provided by scorpions, Polis soon encountered obstacles in carrying out his research. Much basic information on scorpion biology was either lacking altogether or published piecemeal in a bewildering array of often obscure journals. This book was "conceived out of need" for an accessible and comprehensive source on scorpions. It begins with a useful overview of scorpion morphology and anatomy (Hjelle). The next chapter, by Sissom on systematics, biogeography, and paleontology, is outstanding. Important taxonomic characters are clearly described and expertly illustrated, so that keys to families and genera are intelligible to anyone interested in scorpions. Data on fossil forms are equally well presented, although the discussion of phylogeny should be supplemented with a recent paper by Shultz (*Cladistics* **6**, 1 [1990]). Four chapters focus on the whole organism in its natural environment and cover life history (Polis and Sissom), behavior (Warburg and Polis), ecology (Polis), and predators and prey (McCormick and Polis). Comparative biologists will especially appreciate the numerous, well-referenced tables. Hadley's chapter on environmental physiology provides considerable insight into how scorpions cope with the stresses of a desert existence. Neurobiology is treated in extensive detail by Root, and Simard and Watt discuss venoms and toxins. The aspiring scorpion biologist will benefit