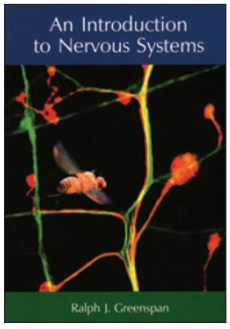
Dr. Strangeslug, or how I learned to stop worrying and love the brain



An Introduction to Nervous Systems

by Ralph J Greenspan

Cold Spring Harbor Laboratory Press, 2007
200 pp, paperback, $45
ISBN 0879698217

Reviewed by Stefan R Pulver and Leslie C Griffith

All living things need food, and most need sex. We all share space on a planet that rotates with a 24-h periodicity, and regularly encounter conditions that, if we do not learn to deal with them, could kill us. These commonalities mean that, for survival, all organisms need to generate a set of similar basic behaviors. Looking for food and mates, responding to the daily changes in light and temperature by foraging and sleeping at appropriate times, and learning to recognize things that predict danger or potential profit are essential activities, whether you are a jellyfish, a fly or a human.

Given the similar tasks, how do the brains of these disparate organisms generate behavior? On the face of it, looking at the huge variation in neural structures across phyla, one might conclude that each has solved the problem in a unique way. In his book, *Introduction to Nervous Systems*, Ralph Greenspan takes that reflexive conclusion and turns it on its ear. This beautifully crafted book embraces the structural diversity of brains and distills out the important operational common ground on which all nervous systems function. In the process, the reader is both entertained and educated.

Greenspan lays the foundations for discussion of higher-order brain function by starting at the ion channel. Readers who have become habituated to this type of introduction by virtue of overexposure to the squid giant axon will be pleasantly surprised. The author builds his basic neuron from a different set of tinker toys, using bits of *Paramecium*, barnacles and jellyfish to illustrate the basic workings of neurons and how they sense the outside world. The beauty of this approach is that in the first model systems that Greenspan introduces, ion channel and synaptic activity are directly coupled to moving and wiggling, squishing and squirming. Readers can see how ion channels opening and closing can turn a *Paramecium* around. Readers can imagine histamine being released from a photoreceptor as a barnacle responds to a passing shadow. Humans like to watch stuff wiggle around out in the world, so anytime we can connect an abstract concept (such as channel gating or synaptic release) to a wiggle, we will almost certainly remember it better.

Greenspan works his way through more and more complex invertebrate behaviors as the book proceeds. He focuses several chapters on what he knows best, namely *Drosophila* behavior. Greenspan delves into how the fly keeps time, how it flies, and even into its love life. It is clear that the author has a soft spot for his animal. He introduces the fruit fly not just as a powerful model system, but as an animal with an endearing personality ("nature's hippies," p. 91). Greenspan contrasts the abilities of flies with those of their more sophisticated relatives, the honeybees, giving readers a taste of the honeybee's amazing cognitive powers. In doing so, he nudges readers toward one of the great animal behavior stories: the story of the bee, as told by Karl Von Frisch and his brood. For the reader who wants to delve deeper into the literature, this book serves as a gateway to the classics.

As Greenspan explains how sea slugs, flies and bees make sense of their world, he is careful to always put the animal in its own ecological and evolutionary context. The author constantly reminds us of where animals actually live and what evolutionary arms races have shaped their nervous systems. It's easy for biologists in today's highly molecular scientific world to lose sight of this; we begin thinking about our animals as existing only in the bland confines of our laboratories. Greenspan urges us to go outside every once in a while, and to take a look at what our animal 'models' really have to cope with.

The publication of this book is also very timely. With the decoding of so many genomes and the appearance of relatively species-independent methods for gene manipulation, there are an increasing number of neurobiologists tackling complex behavioral questions at the molecular genetic level. Most have begun by interrogating the usual suspects: flies, worms and mice. Greenspan's book should be a wake-up call for neurobiologists. Even though it only skims the surface of the behavioral landscape, *An Introduction to Nervous Systems* reminds readers that there are, in fact, more than three or four species of animal available for biologists to study. In particular, there are many bizarre and beautiful invertebrate behaviors; some of these top even the cleverness of the honeybee. Many are already well characterized; many more have yet to be fully documented. With the range of genetic tools becoming available, it is now possible to move beyond the standard model systems. We can begin to choose animals with interesting behaviors first and foremost, and then wiggle our way into the animals' genes. Greenspan's book is a perfect vehicle for getting such a message out, and should be of interest both to working neuroscientists and to the next generation of biologists. He makes it clear that climbing around on the branches of life's phylogenetic tree is something we should be doing as biologists. After all, we may find some strange crook or knothole out on a gnarled limb that helps us to better understand our own brains and behaviors.

The authors are in the Deptartment of Biology, Volen Center for Complex Systems and National Center for Behavioral Genomics, Brandeis University, 415 South St., Waltham, Massachusetts 02454-9110, USA.
e-mail: griffith@brandeis.edu

COMPETING INTERESTS STATEMENT
The authors declare no competing financial interests.