BOOK REVIEW

Brain Architecture: Understanding the Basic Plan, 2nd Edition

by Larry W. Swanson
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Neuroscience has entered an era where the molecule reigns supreme. Biochemical and molecular genetic tools have opened up opportunities to understand cascades of chemical processes that mediate fundamental processes of the normal and pathological nervous system. At the other extreme, the explosion of functional magnetic resonance imaging has provided a flood of data involving macro analyses of brain systems involved in cognitive processes. In our fascination with these important approaches and the new understanding that they promote, it is easy to ignore some of the fundamental foundations of brain organization that provide the basis for the topic that we seek to understand. It is in this context that Swanson's *Brain Architecture* (2nd Edition, 2012) fills a void and provides a highly valuable contribution.

Swanson's *Brain Architecture* is a beautifully written book that reminds us of the historical discoveries that laid the foundations of our understanding of the structure and function of the nervous system. The mixture of historical framework, including scientific controversies and the personalities behind them, with contemporary understanding of brain structure/function maintains a lively narrative. In addition, Swanson is refreshingly candid about our ignorance of the role of some brain areas in behavior. He provides an eloquent narrative of embryological development that obeys fundamental rules as the nervous system takes its shape. The book clearly shows the value of comparative neurology in understanding the development of nervous systems, taking the reader through descriptions of simpler invertebrate nervous systems followed by a careful analysis of the basic organization of vertebrate systems. This provides a cogent explanation of basic neural circuitry that contributes to the insight of our understanding of the evolution of complex systems. This is especially interesting in the context that basic nervous system organization may have arisen evolutionarily more than once (Moroz, 2012). Swanson emphasizes that neuronal excitability and synaptic communication are of ancient origin, and it is the architectural evolution of nervous systems that has lead to brain complexity and more sophisticated behavior.

The book proceeds to address motor, behavioral state, cognitive, and sensory systems, ending with some comments regarding nervous system modifiability as the result of learning, modulatory responses to physiological purtubations such as stress, and brain damage. Chapter 9, *The Behavioral State System*, is a reminder that internally generated brain states control our responses to the environment. When we are asleep, we cycle through sleep states, and in wakefulness our arousal and attention are dynamically changing; layered on top are longer term changes in brain state influenced by circadian, reproductive, and seasonal cycles. This helps mitigate the unfortunate impression commonly seen in introductory anatomy/physiology that the brain is a black box, input/output machine. The earlier edition of this book (Swanson, 2003) has contributed to changing this unenlightened simplification in some recent human physiology texts (for example, Silverthorn, 2012). Three helpful and interesting appendices that follow the main text are entitled: *Describing Position in the Animal Body*, *The Naming and Classifying Nervous System Parts,* and *Methods for Analyzing Brain Architecture*.

The clarity of thought and expression with which Swanson presents the comparative, embryological, and anatomical principles is impressive. The observations are often presented in somewhat schematic form with simple illustrations; older illustrations that emphasize the roots of our contemporary understanding are frequently revived; the focus is on concepts and not volumes of background literature. This book provides the historical background of the important ideas and gives the reader a perspective that is not available in current textbooks. Although the beginner will find the book stimulating and worthwhile, the discussion is often at a level that assumes some knowledge of the basic brain areas, and thus it would be most meaningful for readers with some familiarity with basic neuroanatomy and neurophysiology.

Some exciting points of the text could be emphasized by Swanson for even greater reader interest and impact, and other points could be clarified and even corrected for accuracy. For example, in Chapter 8 the discussion of the neuroendocrine motor system could highlight the importance of the hypothalamic modulators in human social behavior (Young and Alexander, 2012). Students of motor systems physiology may find Swanson's description of central pattern generators (CPGs), also in Chapter 8, a little confusing. The physiological definition of a CPG is more specific and refers to rhythmic motor networks that do not need patterned descending or sensory input to produce a network's basic rhythmic motor pattern (Marder and Calabrese, 1996). The discussion of synaptic sites for learning does not acknowledge changes in neuronal excitability as an important site for learning in neural

networks (Mozzachiodi and Byrne, 2010). Psychologists will disagree with Swanson's comment that behaviorists were undermined by discoveries of brain function; in fact, behaviorists avoided neural explanations for behavior and considered brain function irrelevant to their approach. Another error is in his explanation of instrumental conditioning, where his use of the term negative reinforcement is confused with punishment.

The first edition of this book (Swanson, 2003) contains much of the excitement found in the new edition. A major improvement is the added figure colorization which illustrates the text points better. In the 2nd edition, there is a new first chapter describing the themes of the book and the author's approach; a new Chapter 6 entitled "*Neurogenesis"* extends the discussion of the brain embryology from Chapter 5, *The Vertebrate Plan;* and the last chapter is re-titled *Genome and Connectome* and tweaked a little from the earlier *Gene Networks*. The three appendices in the new edition are similar to those in the first except for a new Figure 1 in Appendix 1 that more clearly demonstrates anatomical positions in animals.

Overall, *Brain Architecture* is recommended reading for upper level undergraduates and for graduate students. It would be a particularly effective supplement to textbooks on neurophysiology and neuroanatomy.

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