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Beyond hot-spots

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A book review on
A combined MRI and histology atlas of the rhesus monkey brain in stereotaxic coordinates

by Kadharbatcha S. Saleem and Nikos K. Logothetis, Academic Press, 2006, 336 pages (spiral bound), $250.00, EUR 168.
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Fifteen years ago, Crick and Jones (1993) commented on the "back- wardness of human neuroanatomy," and the great need for detailed knowledge in this field. The interim years have seen a veritable explosion of neuroimaging studies; but, except for a few labs, neuroanatomical expertise has barely advanced, and even the relatively basic skills eg, accurate localization of structures in relation to global landmarks, "macroanatomy" (Devlin and Poldrack, 2007) have been seriously eroded. The need for basic neuroanatomical literacy, especially as a support to neuroimaging, is now widely acknowledged as urgent ("…neuroimagers should remain mindful of the daunting complexity of attaining a deep understanding of brain function. Simply describing hot spots of task-related activations is only a begin ning" Van Essen and Dierker, 2007a).

All too often neuroanatomy has been perceived as intimidating, boring, or frustrating. In fact, it should be as gratifying and invigorating as 3-dimensional chess or football. The basic skills need not be difficult to acquire; and a few hours with a good atlas can build up, relatively painlessly, 3-dimensional mental models of neuroanatomical structures (Devlin and Poldrack, 2007). The recently published Saleem and Logothetis atlas is well designed to help individual researchers develop or hone a 3-dimensional spatial sense. Reflecting the respective expertise of the authors, the atlas achieves an almost miraculous combination of detail and clarity.

The "how to read" text for coronal and horizontal sections is non-intimidating, and allows the beginner to quickly learn to navigate within and across the coronal and horizontal planes, relating these to the 3-dimensional brain. An added plus is that the atlas is attractive in format. Uniform lay-out makes it easy to find or follow specific structures. There is an abundance of information on each page, but this is logically and aesthetically presented.

At the core of the atlas are matched data sets of MRI, histology slides, and schematic section diagrams. Two complete sets are given, for the coronal and horizontal planes. The histology sections are prepared in two (for coronal slices) or three (for horizontal slices) different stains, and the user can easily compare the detailed annotations on the section diagrams with the actual histology data. The horizontal series will be particularly useful for the interpretation of functional imaging data, where several activation foci are often identified within a single horizontal section. Chapter 5 presents all three standard MRI planes for selected structures, both cortical and subcortical. The selection strategy, as throughout this atlas, is informative without overburdening.

A major issue for cortical studies is accurate placement of area boundaries. In the neuroimaging world, software is already available for automatic registration of coordinates and landmarks. Desirable and even necessary, however, is that this be interpreted and evaluated against the experimenter"s own knowledge base. In this regard, the authors observe a careful transparency in explaining their criteria for boundary determination. Figure 2.3 provides a useful example of three different schemas for subdividing the agranular frontal cortex. Chapter 2, "Cytoarchitectonic and Chemoarchitectonic Organization of Cortical and Subcortical Areas," is in effect a mini-tutorial on these issues, and an excellent demonstration of one way of working with what can be a contentious and frustrating literature.

In comparison with existing monkey atlases, this atlas stands out by reason of the two planes of sections, the matched datasets (MRI and histology), and the meticulous preparation of the histology in several parallel series (Nissl, parvalbumin, and SMI32 for neurofilaments). For researchers primarily working on the human brain, it can still be useful in a comparative framework (Orban et al., 2004). The simpler organization of the macaque cortex is a valuable learning tool, especially for beginners. There has been considerable interest in digital atlases, as a "key component which can provide an objective and accessible spatial framework for representing complex experimental data sets" (Van Essen and Dierker, 2007b; and see review in Toga et al., 2006). While the Saleem and Logothetis atlas is not digital, it will be a useful reference and guide for many, and an excellent primer in the language of neuroanatomy.

Neuroanatomy is much more than a list of names or disputed nomenclatures, static and descriptive; but it has suffered from several serious handicaps. The current nomenclature, jerrybuilt at best over the years, is certainly a problem. "The thalamus," to take one among many examples, will have very different meanings, depending on which subdivision, which species, which contextual state; and "connections" as a term has too much the connotation of an electrical cord and wall power plug. Hopefully, this will change rapidly. One might predict a "neuroanatomics" along the lines of genomics or proteomics. Something like this is already in place, at the microanatomical level, for cortical interneurons (Baraban and Tallent, 2004). Ideally, neuroanatomy should develop as "interactome": not just what structures are (and where), but how and why they interact.

Any language, in order to be alive, must be used competently and comfortably by

an engaged community. The Saleem and Logothetis atlas, which itself has resulted from an active interdisciplinary dialogue, is an excellent example of what can be done across levels and should become a standard classic.

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