Preface

The 15th century printing revolution in Europe introduced new standards of accuracy and speed in the dispersal of textual and graphical information when compared to earlier methods of copying manuscripts and drawings individually by hand. Twenty-first century electronic publishing will also have profound effects on scholarship, though for different reasons. For example, vocabulary standardization and indexing render database queries more accurate and efficient, computer graphics allow data to be presented and retrieved in fundamentally new and better ways, and the World Wide Web provides immediate access anywhere in the world to a wide variety of information.

The brain atlas presented here is a hybrid of the print and electronic media. It is, on the one hand, a second revised edition of the larger, more ambitious book, *Brain Maps: Structure of the Rat Brain* (Swanson 1992a); and, on the other hand, an improvement on the less sophisticated template files on floppy discs, *Brain Maps: Computer Graphics Files* (Swanson 1993). The need for a smaller book at the side of the microscope or monitor is obvious—so long as laptop computers are larger with less resolution. Further advantage has been taken of better hardware and software to design more useful computer graphics templates.

The core of this work is a series of 73 computer graphics maps or templates, which are drawings traced from photomicrographs of thin, approximately transverse histological sections down the longitudinal axis of the adult brain. The original files contained a series of unilateral drawings in Adobe Illustrator 3, which did not feature the use of layers (transparent overlays). The new files are more sophisticated, and were created in Adobe Illustrator 7, although they can

be used with other professional drawing applications, as well as a basic drawing tool kit included on the CD-ROM.

Each complete electronic template has a bilateral drawing with two sets of coordinates (stereotaxic and physical), a list of abbreviations, and a fiducial rectangle for database registration—features on various layers that can be viewed in any desired combination. New layers are created for mapping neuroanatomical data, and data summaries from different experiments may be compared readily in a layer manager at any of the 73 levels. In addition, different features of the atlas level map itself (abbreviations, outline, fiber tracts, cell groups, mask) can be placed by the user into different layers, a useful feature when trimming and modifying the templates for publication.

Flatmap templates have also been added. Like wall maps of the earth, they are schematic and distorted, but do contain all of the major cell groups and fiber tracts of the central nervous system in a standard arrangement that will be improved over time. These flat, two-dimensional maps are especially useful for comparing gross expression patterns (like a series of footprints) and for bilateral circuit diagrams.

I would like to thank colleagues who have used and provided invaluable feedback on version 1.0 of the computer graphics files, especially Drs. Newton Canteras, Pierre-Yves Risold, Richard H. Thompson, Gorica Petrovich, and Alan Watts. I am particularly indebted to Dr. Nello Spiteri of Elsevier for his continuing encouragement and help. And once again I dedicate this work to Neely and Reid.

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I. Overview

The core of this book is an atlas of 73 drawings prepared from transverse Nissl-stained sections through the adult male rat brain, and based on our earlier large format work *Brain Maps: Structure of the Rat Brain* (Swanson 1992a). Of course these drawings can be studied to appreciate more deeply the basic gross anatomy of the rat brain: the fundamental arrangement of the various neuronal cell groups and readily identifiable fiber tracts that make up the rostral end of the central nervous system (CNS) of this intensively studied mammal. However, they are even more useful as templates for the standardized representation of neuroanatomical data. In other words, they can be used as maps or templates to present in a schematic way, and then compare, results based on the application of various neuroanatomical methods—summaries that can be incorporated into computer graphics databases.

The intelligent use of these templates requires a critical evaluation of their benefits and limitations. Therefore, the text begins with a brief overview of the rat brain itself (section II), followed by an account of how the atlas brain was prepared and the drawings made. This section (III) also contains a discussion of brain coordinate systems and the related problems of using them for stereotaxic surgery and for the definition of structure location within the brain.

Next, we consider the important problem of how to map experimental results onto the templates, and how these maps can be used in neuroanatomical databases, eventually at the level of 3-D computer graphics models. For this, it is important to discuss strengths and limitations of the various common neuroanatomical methods, as well as problems associated with transferring data to the templates. In section V, a more abstract level of data summary is considered: the use of a standardized flatmap to display circuit diagrams and overall gene expression patterns. Here

it will be shown that all of the various functional systems of the CNS can be displayed on a single map where the major fiber systems have been assigned a standard location. And finally, critical problems associated with neuroanatomical nomenclature, which has not yet been standardized (as has long been true for most other parts of the body such as the muscles, bones, and vascular system), are dealt with in section VI, and references in the primary literature for the nomenclature adopted here are given in section VIII (following the atlas drawings in section VII).

As will become apparent, there are many limitations associated with the use of standardized atlases, which must not be viewed as static, authoritative representations of the brain. Instead, they are convenient starting points, based on current understanding, and will be modified for ever more accurate views. Fortunately, the use of the maps provided here as computer graphics files renders their modification trivially easy. Alternative interpretations of underlying structure can be displayed in overlying layers, or the templates themselves can be modified however desired. Nevertheless, experience has shown that one major benefit of using an atlas such as that presented here for data summary is that it forces the beginner to consider systematically where labeling is present in relationship to the borders of all of the various brain structures dealt with critically in the primary literature to date. The process of mapping can thus be accelerated, more accurate, and related more easily to the previous neuroanatomical literature.