

Preface

The purpose of this volume is twofold. First, it offers an in-depth analysis of current approaches and issues in the study of the auditory system. By concentrating on one structure, the inferior colliculus, a focused and coherent treatment of many aspects of auditory neural processing is possible. The position of the inferior colliculus is unique, as its study offers insights into the influence of the peripheral auditory system and at the same time reveals the initial stages of central processing principles. By providing, in the first chapter, an overview of auditory system function and structure, a framework is given that guides the interpretation of operational mechanisms and rules. Second, the book provides a state-of-the-art reference tool for researchers working on the inferior colliculus. The last such treatment appeared in the mid-1980s (Aitkin 1986) and was 246 pages long with 507 citations; since then, more than 1900 articles on the inferior colliculus have been published, and there has been no inclusive summary of facts and ideas about this critical junction in the auditory pathway. In this period, there has been substantial progress on the many facets of inferior colliculus function that constitute the subject matter for this volume. The mere accretion of publications alone would not in itself justify a new volume devoted to the auditory midbrain. The rationale, then, is to summarize recent advances in this discipline from the perspective of some of the many researchers who have engendered this progress. As a case in point, consider the growing body of data on the role of the inferior colliculus in seizure genesis and as a model system for the study of epilepsy (Chapter 21), an area that has grown considerably since 1986 and that has had a significant impact on diverse areas including sensory-to-motor transformations and the possible role of GABAergic neurons in kindling and seizure control. Any consideration of GABAergic neurons, of course, must include their role in local processing as putative interneurons (Oliver et al. 1991) as well as their ascending projection to the medial geniculate body (Winer et al. 1996), the differential, subdivision-specific concentration of GABAergic neurons and axon terminals (Oliver et al. 1994), and the maturation of GABAergic transmission (Yigit et al. 2003); each of these topics is of moment, each crosses interdisciplinary boundaries that can range from development to pathology, and none could have received the appropriate attention in prior synthe-

ses. Because we could not in conscience exclude a particular subject, we attempted to include all that seemed to us to capture best the sense of flux and excitement of current approaches. There remain, of course, many gaps: for example, the subject of synaptic organization has received less attention than might have been expected, and it remains an area that will require further scrutiny if we are to understand how signals arising from the many medullary auditory centers and converging onto the inferior colliculus are transformed locally before they ascend to the auditory thalamus or descend within the brain stem. Likewise, developmental studies are at their earliest stage other than the purely descriptive, and we have little knowledge of how closely the cellular ontogenetic molecules and migratory processes that shape the midbrain follow principles established in the cerebral cortex (Molnár and Blakemore 1995).

Other conceptual approaches that have not been included explicitly are those that can be subsumed under the umbrella of computational neuroscience. There are a few modeling approaches to aspects of temporal coding or binaural processing that were designed to reflect properties specific to the inferior colliculus (e.g., Hewitt and Meddis 1994; Cai et al. 1998; Shackleton et al. 2000; Borisjuk et al. 2002). But it is difficult, and perhaps premature, to assemble a coherent theoretically oriented treatment of inferior colliculus properties, mechanisms, and function.

Where it was possible, we asked that authors propose an agenda for the future in which the salient questions for their discipline are enumerated as an organic part of their exposition. To keep the reference list within manageable limits, we requested that authors cite only the most recent work when this was possible; this strategy acknowledges the historical and intellectual value of Aitkin's (1986) volume.

The conceptual framework for this volume is integrative and reflects a systems perspective. In this context, integrative implies that we sought authors who would collaborate with peers who often held a different perspective, thus producing what we hope are balanced accounts of a given area that are free of parochialism. Where there is only one author, it was our view that the consensus of opinion (or the limited knowledge) in that particular area could be captured by the author we chose. Likewise, chapter length was guided by the literature available and whether the issues at hand were perceived as volatile or matters of settled opinion. The systems viewpoint construes the brain in terms of interacting neural networks whose separate elements contribute to the abstraction of larger entities related to hearing, perception, and binding the disparate streams from independent neural channels into a coherent experience. Perhaps the next volume devoted to the auditory midbrain can realize that goal.

Berkeley, California
San Francisco, California

JEFFERY A. WINER
CHRISTOPH E. SCHREINER

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