Preface

The vestibular and brain stem control of oculomotor and somatomotor function is a unique research field in the sense that it has been promoted by close interactions among such diverse areas as morphology, physiology, neurology, modelling and computational neuroscience. Many excellent symposia have been organized in recent years on various aspects of vestibulo-oculomotor functions, and a large number of symposium volumes have been published. However, recent progress in the study of vestibulo-oculomotor function has been extremely rapid. The field has recently been expanding, on the one hand, to embrace more basic aspects such as developmental neurobiology, neuropharmacology, and membrane physiology related to the integrative capacity of neurons and, on the other hand, to higher nervous functions such as vestibular perception that influence oculomotor control and coordinate transformation in the visuomotor system. With this in mind, we felt it would be pertinent and fruitful to organize an occasion for exchanging ideas and recent knowledge among researchers working in different fields within the vestibular and oculomotor research community.

In the late spring of 1990, the 16th meeting of the Bäräny Society was held in Tokyo. The Bäräny Society has traditionally been a forum for the investigation of normal and abnormal functions of the vestibular system. To take advantage of that opportunity, a satellite symposium was held to address the “Vestibular and brain stem control of eye, head and body movements” and bring together scientists of different backgrounds who are doing much of the contemporary work. From this satellite symposium grew the main contents of this book, which is divided into six sections. Sections I and II deal with the morphophysiological basis of vestibulo-ocular and vestibulo-spinal reflex organization and neural mechanisms of saccade generation. The neural control of orienting eye and head movements is one of the most extensively studied topics and Section III discusses the physiological and morphological bases for vestibular, collicular and other premotor control over orienting movements of the eyes and head. While great interest has long been focussed on the cerebellar involvement in visuomotor and vestibular functions (Section IV), interactions between the oculomotor control mechanisms in the brain stem and the higher nervous functions executed by the basal ganglia and the cerebral cortex are attracting much recent attention and await further analysis of their neural substrates (Section V). Vestibular disorders and mechanisms of functional compensation are of clinical importance and are discussed in Section VI. It is our hope that this book will provide a broad overview of current knowledge and also some insights into central themes which are currently under attack and being debated in this wide field.

Finally, we are extremely grateful for the generous financial support and encouragement provided by the Japanese Organizing Committee of the 16th Bäräny Society.
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Meeting. The success of the satellite symposium would not have been achieved without their kind support, especially on the part of the President of the Meeting, Dr. Tohru Matsunaga, in the Department of Otolaryngology of Osaka University, and the General Secretary, Dr. Jun-ichi Suzuki, in the Department of Otolaryngology of Teikyo University.

One of the pioneers in the field of oculomotor control by the cerebellum and a sincere friend of many scientists in this research field, Prof. Kyoji Maekawa, sadly did in the summer of 1990, a few months after this satellite symposium. His contribution to this book on the physiology of climbing fiber inputs to the cerebellum has become his last. For this reason, this book is dedicated to his memory.

Hiroshi Shimazu
Yoshikazu Shinoda

This book is an outgrowth of the meeting on “Vestibular and Brain Stem Control of Eye, Head and Body Movements” that was held in Tokyo in May 1990. The presentations and discussion at this satellite symposium of the Bäräny Society meeting provided an in-depth look at the current status of a rapidly-moving field. This excellent meeting, organized by Professors Shimazu and Shinoda, also contributed significantly to the success of the main Bäräny meeting that followed.

Over the years, investigations of the vestibular and oculomotor systems have evolved from straightforward electrophysiological and anatomical studies in reduced preparations to progressively more complicated paradigms involving behaving animals. This book contains examples of a wide spectrum of such approaches. At one end, working near the periphery, Goldberg and his colleagues have studied afferent input to second order vestibulo-ocular neurons. Electrophysiological results tell us that these neurons receive much of their vestibular input from afferents that discharge regularly, as might be expected from reflex dynamics. A significant contribution to the input, however, is made by irregularly firing fibers. Nevertheless, blocking the activity of these latter afferents has no effect on reflex behavior. Elegant studies such as these increase our knowledge of the neural circuitry that underlies reflex activity, but obviously raise new questions while doing so. The highest level of complexity is illustrated by the paper of Melvill Jones, which describes how the saccadic system’s intervention to aid adaptation of the vestibulo-ocular reflex depends on a conscious interpretation of the vestibular stimulus. This is reminiscent of the work of Gurfeinkel and his colleagues (for example see Neurophysiology (transi) 1989, 21: 159-164), who showed that vestibular perception influences the response to galvanic stimulation of the labyrinth. When the subject’s actual and perceived head orientation disagree, the pattern of motor activity evoked by
the stimulus is determined by the latter. Elucidating where this kind of interaction takes place presents quite a challenge.

It is a reflection of the field that whereas this book contains, among others, papers dealing with properties of vestibular neurons in vitro, vestibulospinal reflexes, eye-head coordination and organization of inputs to the cerebellum, it is dominated by work on various aspects of the control of eye movement. Interestingly, except for an up-to-date review of the floccular hypothesis of adaptation of the vestibulo-ocular reflex, there is relatively little in this book on the plasticity of this reflex. Several laboratories continue to work on this important problem, but perhaps enthusiasm has cooled somewhat as definitive evidence about the locus or loci of plasticity continues to elude us.

It is clear from looking at this collection of papers that although progress has been rapid, further understanding of brain stem control of movement requires continued experimentation at all levels of analysis. Finally, at a time when neurobiology is acquiring an increasingly molecular orientation, this book testifies to the fact that systems neuroscience is alive and well, and that there are important problems where this remains the most appropriate approach.

Victor J. Wilson

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