Preface

Olfaction, the sense of smell, plays a key role in the daily life of humans and animals. Its functions include selecting palatable and nutritious foods and rejecting spoiled foods, avoiding dangerous predators or poisonous gases, searching for a mate, and engaging in a variety of social interactions. The olfactory system of the vertebrate brain contains neuronal circuits that translate external odor information into appropriate behavioral responses. One of the most basic functions of the brain is to perceive and evaluate sensory information obtained from the external world to induce adequate motivational and behavioral responses. Thus, exploring the basic functional logic of the neuronal circuits in the olfactory system appears to be crucial in understanding the workings of the complex neuronal circuits of the brain, particularly those in the cerebral cortex.

Olfactory sensory neurons project axons directly to the telencephalon, the most rostral segment of the embryonic brain that gives rise to the cerebral cortex. Given that the cerebral cortex is the most prominently evolved structure in the human brain, the olfactory system has long been considered critical to an understanding of the cerebral cortex. When I began my study of the olfactory system 39 years ago, few researchers in Japan had selected the central olfactory system as a major area of investigation. Although olfactory research was a minor field at that time, I was encouraged by the words of senior researchers who predicted the importance of olfactory research in understanding the workings of the human brain. For example, Sir Wilfred Le Gros Clark, a professor of anatomy at Oxford who was interested in human evolution, mentioned in the Ferrier Lecture that

> There are certain reasons why the study of the olfactory connections offers particularly favourable opportunities for the study of the neural basis of sensory discrimination in general.—I should perhaps emphasize that the olfactory bulb, in which the olfactory nerve fibers terminate, is developmentally an extension forward of the cerebral hemisphere, and is taken to be an expression of the fact that, from the evolutional point of view, the cerebral hemispheres were initially developed in the vertebrate series in relation to the olfactory sense (Le Gros Clark 1957).

These words convinced me that studies of the olfactory system are relevant to important questions of the brain and mind.

Despite the numerous important findings of the pioneers of olfactory research, progress was relatively slow and the number of researchers was small compared with those engaged in research into the visual, auditory, and somatic sensory systems. Triggered by discovery of the odorant receptor gene family by Linda Buck and Richard Axel in 1991, however, understanding of the basic biological mechanisms of the olfactory system has advanced enormously in the last two decades. The first objective of this book is to summarize recent advances in understanding of the mammalian and fish olfactory systems, with particular regard to the basic neurobiological mechanisms of neuronal circuit function in the olfactory system. Fortunately, several researchers working in or around the Tokyo area of Japan—Hitoshi Sakano, Kazushige Touhara, Yoshihiro Yoshihara, and Masahiro Yamaguchi—have collaborated on workshops on the olfactory system, which included a guest speaker, Noam Sobel. I took this opportunity to ask each of them to write a chapter of this book to describe recent developments in olfactory research for the coming generation of scientists: undergraduates, graduate students, and postdoctoral researchers in the fields of neuroscience, neurobiology, chemical senses, food and nutritional sciences, medical science, sensory psychology, and behavioral sciences.

We humans enjoy the flavor of delicious foods, as well as wonderful music and beautiful scenery. To understand the neural mechanisms by which we enjoy this world, an essential part of our daily life, studying the neuronal basis of flavor perception in the olfactory and gustatory system, that of music perception in the auditory system, and that of fine art perception in the visual system would appear to be good and valuable ideas. Despite rapid progress in understanding the olfactory system, however, it remains unclear how odor information is processed at levels beyond the olfactory bulb, which include many areas of the olfactory cortex, olfactory tubercle, amygdala, entorhinal cortex, and orbitofrontal cortex. Indeed, it is only recently that we have begun to understand the brain mechanism for flavor perception (Shepherd 2012). Much current research on the olfactory system is focused on the functional logic at these higher centers of the olfactory system, and I predict that progress in understanding the olfactory system will soon accelerate at an even greater pace. The second purpose of this book is to provide perspectives on future directions in olfactory system research to next-generation scientists. As knowledge of higher olfactory centers advances, we might even come to understand the secret of how our brain allows us to enjoy foods and wine.

Tokyo, Japan Kensaku Mori

References

Le Gros Clark WE (1957) Inquiries into the anatomical basis of olfactory discrimination. Proc R Soc Lond B Biol Sci 146(924):299–319

Shepherd GM (2012) Neurogastronomy. Columbia University Press, New York

http://www.springer.com/978-4-431-54375-6

The Olfactory System
From Odor Molecules to Motivational Behaviors
Mori, K. (Ed.)
2014, VII, 206 p. 69 illus., 46 illus. in color., Hardcover
ISBN: 978-4-431-54375-6