Olfaction and Taste. A Century for the Senses

Edited by Giuseppe Salvadori

Published by Allured Publishing Corp., Carol Stream, Illinois (1997)

248 pages, US$140

ISBN 0-931710-60-X

To mark its centennial, Firmenich held an unusual celebration—a leading-edge scientific symposium in Geneva, Switzerland on September 3-5, 1995. Such an event is not unusual for Firmenich, a technology-driven company that has developed leading-edge science and technology and translated it into business success.

This book, a collection of the papers presented at the symposium, speaks not just to current knowledge. It also offers interesting insights into the future. In so doing, it follows its predecessor volume celebrating Firmenich's 75th anniversary. This earlier volume—*Olfaction and Gustation*, edited by G. Ohloff and A. F. Thomas, and published by Academic Press in 1971—was prescient in identifying concepts that have become part of today's leading edge; concepts such as membrane receptors and transduction through the "second messenger" cAMP. These ideas were introduced to the chemical senses at the 1970 symposium.

The 1995 gathering of international leaders in olfactory and taste research enabled a remarkably wide range of disciplines and approaches to be covered in only twelve papers. These express better than any marketing copy the breadth of interest of the sponsoring company. Although the formal presentations were limited to these twelve, the invited guests comprised a veritable "who's who" in the international science and technology community of taste, smell, flavor and fragrance. For that reason, it is regrettable that the interesting informal discussions were not included in the book.

The reader needs to be aware that there are widely differing styles of presentation in *Olfaction and Taste*. This reflects the diversity of approaches and perspectives, and the intellectual ferment, that made the symposium such an exciting event. On the other hand, the page layouts are sometimes distracting. For example, the way white space is used on some pages suggests that something has been forgotten or misplaced.

Giuseppe Salvadori, the editor, passed away prior to publication. In recognition of his lasting contribution, it seems a fitting tribute on the part of the organizing committee to memorialize him as the sole editor of the volume.

Now, here are a few words about each of the papers in the volume.

Diversity: Olfactory and immunological: This compact and lucid paper by G. K. Beauchamp et al. describes one of the most exciting developments in olfactory research during the past decade: the role of the major histocompatibility complex (MHC) in olfactory communication. The MHC genetic region is centrally involved in immune recognition. What has unfolded during the past decade, based on extensive experimental work with MHC-congenic mice, is the foundation for understanding its role in olfactory recognition. The evidence shows clearly that MHC-determined odortypes do indeed exist.

Chemistry of perfumes and flavors: Its evolution over the last 100 years: Expressing a century of history in a mere 11 pages is a daunting task. Yet G. H. Büchi succeeds admirably. His unabashed emphasis on successes at Firmenich provides insight into the company's strategic commitment to scientific advancement that underlies its business success. He also discusses noteworthy advances in laboratories of several other companies. Most of the paper is devoted to fragrance materials; the short section on flavors seems almost an afterthought.

New insights on the coding of the sweet taste message in chemical structure: G. E. DuBois' overly lengthy paper (63 pages) regrettably appears to have been untouched by any editorial hand. Essentially it is a highly detailed review of the chemistry of the multitude of sweet-tasting materials and the multitude of hypotheses to explain their sweetness.

Chemical sensors for olfaction: Following a brief general review of sensors, authors C. Hilsum and M. Byfield focus on two sensor types that are useful for detection of flavors and fragrances. These two are piezoelectric devices and conducting polymers. The emphasis on piezoelectric sensors reflects the authors' ongoing work to develop these to mimic the capabilities of the human olfactory system.

Olfaction and behavior: E. B. Keverne draws on work in several animal models to describe the fascinating, complex, behavioral-endocrine relationships and the influence of olfactory stimulation. The role of olfaction in rhesus monkeys is discussed, particularly on endocrine functions that affect the reproductive system, and the resulting social and sexual interactions. Keverne describes the importance of olfactory learning and behavior in mate recognition among mice and in a mother sheep's ability to recognize her offspring. The author also takes us into the first relay station in the central nervous system—the olfactory bulb—and analyzes important synaptic events by which olfactory information is processed.

Magnetic source imaging of olfactory cortical activity in man: G. Kobal et al. discuss advanced techniques for recording chemosensory-event-related magnetic fields in the brain while the nasal mucosa is exposed to olfactory and somatosensory (trigeminal) stimulants. Functional magneto-encephalographic data were transformed into anatomical data obtained by magnetic resonance imaging (MRI). Using olfactory and somatosensory stimulants, the authors mapped the cortical areas involved and showed them to be different for the two classes of stimulants.

Molecular genetics of olfaction: Author R. R. Reed introduces this topic by reference to specific anosmias in humans. Reed describes experimental work on genetic analysis in mice using a strain of mice known to show a specific anosmia to isovaleric acid. The research has now led to identification of the involved chromosomes.

Olfactory and taste processing in the brain: In this paper E. T. Rolls emphasizes the primate brain and guides us through the unfolding knowledge—likely to be relevant to humans—of the central nervous

system architecture wherein taste and odor information is processed. He discusses not only the complexity of the "wiring" within the brain, but also some of the physiologically relevant inputs. He treats a topic rarely discussed elsewhere: the important convergence of taste and odor information to produce the perception of flavor. Though lengthy (34 pages) and densely written, this paper provides much of interest in assessing current knowledge by bringing together a wealth of information on the central nervous system, and it points to the future.

Neurobiology of taste: New dimensions and new directions: S. Roper presents a clear and concise discussion of transduction processes in taste cells, with attention to both ionic conductances and membrane receptors. Ionic conductances are characterized with respect to their specific roles in different taste modalities. For membrane receptors, the roles of G-protein-coupled receptors are emphasized along with involvement of cAMP and IP_3. It is noteworthy that cAMP was first discussed in relation to chemosensory receptors at the previous (1970) symposium. In this paper Roper pays particular attention to umami taste, typified by the taste of monosodium glutamate.

From odor molecules to odor images: Toward a molecular psychology of smell: In this contribution, G. M. Shepherd attempts to bridge the substantial distance between the knowledge of chemical structure of odorant molecules and that of the neural basis of odor perception. Shepherd describes the exquisite circuitry of the mammalian brain's olfactory bulb, where the initial processing of information occurs. By probing cells in the olfactory bulb and analyzing structure-activity relationships, a "molecular receptive range" of a cell can be delineated. Shepherd describes initial attempts to build molecular models of receptors from these data.

Modeling biological receptors: Author W. C. Still reports that odorant recognition is being studied using receptor-like synthetic small molecules. Under detailed investigation are the conformational and energetic requirements of the molecular interactions, including enantioselectivity. Use of small molecules designed as model receptors represents a new approach to study odorant-receptor interactions, and the author is aware of the formidable challenge presented.

The human axillary organ: Evolution of an olfactory adornment: In this lively paper, author D. M. Stoddart dazzles the reader not only with literary and artistic allusions, but with insights into the richness of the axilla as a source of olfactory signals during the course of evolution. The axillary organ is a human characteristic and, though it may have been relegated to "ornamental status" during evolution, Stoddart presents the idea that the axilla has served a role in *mutual* sexual selection.

A recommendation: This noteworthy volume, based on an exceptional event, enables the reader to savor the richness of the scientific leading edge. It is recommended for the bookshelf of the newcomer as well as the expert—those interested not only in the current state of the art but also in its future. Many of the topics treated here are poised to undergo a vigorous advance in knowledge. Those interested in the future of the field, and those dependent on its progress, would do well to both use this book as a catalyst for new ideas and preserve it as a memoir of a significant milestone.

—reviewed by Robert H. Cagan, PhD
Lawrenceville, New Jersey