

Smell and Taste in Health and Disease

Editors

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Raven Press

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RAVEN PRESS  NEW YORK

Raven Press, Ltd., 1185 Avenue of the Americas, New York, New York 10036

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Made in the United States of America

Library of Congress Cataloging-in-Publication Data

Smell and taste in health and disease / editors, Thomas V. Getchell
... [et al.].

p. cm.

Includes bibliographical references and index.

ISBN 0-88167-798-1

1. Smell. 2. Taste. 3. Smell disorders. 4. Taste disorders.

I. Getchell, Thomas V.

[DNLM: 1. Chemoreceptors—physiology. 2. Smell. 3. Taste. WV
301 S638]

QP455.S54 1991

612.8'6—dc20

DNLM/DLC

for Library of Congress

91-18608

CIP

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Foreword

I am pleased and proud to write a foreword to this extensive and thorough magnum opus on the chemical senses—smell and taste—that covers not only the basic science but rapidly developing clinical knowledge and practice. A multiple-authored volume is necessary to cover adequately the present status of smell and taste. The editors bring an unusual array of professional experiences to the task of formulating and integrating the available material. Dr. Thomas V. Getchell is Professor of Physiology and Biophysics at the University of Kentucky College of Medicine. He obtained his Ph.D. from Northwestern University and is broadly acclaimed for his studies of the fundamental molecular neurobiology of the olfactory system. Dr. Richard L. Doty is Associate Professor in the Department of Otorhinolaryngology—Head and Neck Surgery and is Director of the Smell and Taste Center at the University of Pennsylvania School of Medicine. He obtained his Ph.D. in Psychology from Michigan State University and is widely recognized for his studies of smell perception and human olfactory disorders. Dr. Linda M. Bartoshuk is Professor of Otolaryngology in the Department of Surgery at Yale University School of Medicine. She obtained her Ph.D. from Brown University and is highly regarded for her psychophysical studies of taste perception and human gustatory disorders. Dr. James B. Snow, Jr., is Director of the National Institute on Deafness and Other Communication Disorders at the National Institutes of Health. He obtained his M.D. from Harvard Medical School and is widely recognized as a leader in otorhinolaryngology—head and neck surgery.

As a student when I began my research in this area, although there did exist such masterpieces of scholarship as E. von Skramlik's "*Handbuch Physiologie der niederen Sinne* (1926)," I can recall my Professor of Psychology at Brown University, the late Leonard Carmichael's advice to me in choosing a subject for research that scientific knowledge of taste was relatively slim compared with scientific knowledge of vision and hearing. In the early 1930s, research in vision and hearing was undergoing an exciting and widespread development, due in part to the research of Wever and Bray and Stevens and Davis in audition and Hartline and Graham in vision, who had adopted electrophysiological recording methods in their research. Carmichael opined that a researcher making similar advances in the chemical senses, including psychophysics and behavior, would be sure to be noticed if not acclaimed. I am pleased to note that many of my former students and colleagues whose research I had the rewarding experience to direct or guide are among the contributors to this volume, in particular, Drs. Bruce Halpern and Linda Bartoshuk.

Among the events that marked the growing maturity of the field of chemoreception was the International Symposia on Olfaction and Taste (ISOT) that the late Ingve Zotterman, Lloyd Beidler, and I conceived of in 1959 during their visit to my lab at the Department of Psychology at Brown University following an international symposium on "sensory communication" at MIT under Walter Rosenblith. Ingve, Lloyd, and I felt that, instead of just being included among the other senses, taste and olfaction should have their own international meetings. Zotterman noted that an international Congress of Physiology was to occur in the Netherlands in 1962. Zotterman offered to arrange the first International Symposium on Olfaction and Taste (ISOT) at the Wenner-Gren Center in Stockholm where he was about to assume the position of Secretary and Scientific Advisor. The first ISOT did indeed meet in Stockholm in 1962 and since then it has met on a regular schedule. I had the pleasure of hosting ISOT III at the Rockefeller University in New York in 1968 at which Lord Adrian was our Honorary Chairman.

The increasing scientific activity in the field resulted in the organization of the Japanese Association for the Study of Taste and Smell (JASTS) in 1967, the Association for Chemoreception

Sciences (AChemS) in the United States in 1978, and the European Chemoreception Research Organization (ECRO) in 1970.

The chemical senses in flavor and nutrition has also been a continuing component of the U.S. Army Quartermaster Research Laboratory at Natick, Massachusetts and in certain laboratories of the food industry. Increasingly, the clinical aspects of chemoreception malfunctions and disorders in health and disease have been receiving greater attention. Ph.D.s have joined with M.D.s in Otorhinolaryngology departments and in clinical chemosensory research centers, in a program supported by the United States National Institutes of Health and other local institutions. All of these influences are reflected in this book, which stands as another landmark in the development and sophistication of chemosensory science.

—*Carl Pfaffmann, Ph.D., D.Sc.*

Foreword

Carl Pfaffmann has already expressed his pleasure and pride in writing a foreword for this important volume. I share these feelings, and also value the opportunity to write jointly with Professor Pfaffmann. The laboratories of Carl Pfaffmann and of Lloyd M. Beidler have had a fundamental role in shaping and training several generations of chemosensory scientists. They began their research careers aware that little was known of the chemical senses, but believing that much could be learned. Taste and smell had been topics of discussion for thousands of years, yet experimental studies were still rare, and very few scientists devoted themselves to these sensory systems. They were often characterized as minor or primitive senses. Pfaffmann's laboratory at Brown University and Beidler's at Florida State University soon became major centers for the education of chemosensory investigators, as well as sources of fundamental discoveries. This continued when Dr. Pfaffmann moved to The Rockefeller University. Their students, or their student's students, often received postdoctoral education with Lloyd Beidler or Carl Pfaffmann. This interchange helped continuity and breadth in the widening circle of chemosensory investigators.

Participation in meetings has long been an important form of scientific education. A number of eclectic national and international meetings that contain presentations by chemosensory scientists occur on an annual or multi-year basis. However, as a scientific discipline matures and the number of researchers devoting themselves to it increases, focused meetings become necessary. The Gordon Research Conference on Chemical Senses: Taste and Smell, which was added to the Gordon Research Conferences in 1969 with Lloyd M. Beidler as the organizer, has provided a venue for extensive in-depth reports and discussion of frontier chemosensory research. Professor Pfaffmann has already described the initiation of the triennial ISOT meetings. This important forum is now administered by the International Commission on Olfaction and Taste of the International Union of Physiological Sciences, with the cooperation of the major regional chemosensory organizations, AChemS, ECRO, and JASTS. These organizations hold regular regional scientific meetings and jointly sponsor the journal, *Chemical Senses*. These meetings and scientific organizations are a significant medium for communication among and education of scientists. Their existence is an important index of the level of development of research and scholarly activity in smell and taste.

Diseases that affect olfactory or gustatory function can significantly impair communication between organisms and their chemosensory environment. Consequently, the chemical senses were included in the communicative disorders component of a set of seven studies done for the National Advisory Neurological and Communicative Disorders and Stroke Council of the United States National Institutes of Health in the late 1970s. The ten-member Panel on Communicative Disorders, established in 1977, was chaired by Professor Paul H. Ward, of the University of California School of Medicine at Los Angeles. As a member of this panel, I was able to assist in the organization and operation of its eleven-member subcommittee on chemical senses. The panels prepared reports relevant to a national research strategy for neurological and communicative disorders. Contained in the 1979 *Report of the Panel on Communicative Disorders* (NIH Publication No. 79-1914) was a section on chemical senses. After summaries of current information and problems, and proposed future directions in taste and smell, several recommendations were made. These included specification of a range of therapeutic and intervention goals that could be pursued including: the development of strategies to manage appetite loss during disease, chemotherapy, and older age; the exploration of relations between chemosensory function and obesity, hypertension, and malnutrition; the exploitation and use of chemoreceptors as models of development, trophic function, and regeneration; and the prevention of the chemotoxic consequences of pollu-

tion. An action recommendation stated, "Present support for laboratory and field research should be increased so that all worthwhile studies can be supported, and regional clinical centers for the chemical senses should be established at, initially, two existing medical centers. Understanding chemical sense-dependent behavior also requires a knowledge of the anatomy, biochemistry, physiology, development, and genetics of the systems." A number of NIH-funded clinical chemosensory centers now exist, as well as several other more specialized groups. They have contributed substantially to knowledge of the incidence and prevalence of chemosensory disorders, to explorations of therapies and interventions for chemosensory disorders, and to basic understanding of smell and taste.

In 1988, the National Institute on Deafness and Other Communication Disorders (NIDCD) was created, and responsibility for the support for research in the senses of smell and taste was transferred to the new institute. The NIDCD convened scientific panels in hearing, balance, the chemical senses, voice, speech, and language in January 1989 at Hunt Valley, Maryland. Professors Bartoshuk and Snow served as co-chairpersons of the panel on the chemical senses. The resulting publication, *Report of the Task Force on the National Strategic Research Plan* (NIDCD Publication, April, 1989), presented a thoughtful and comprehensive set of research goals and priorities for the chemical senses for the next 3 years and the decade. This section of the National Strategic Research Plan will be updated by a newly-constituted expert panel during 1992–93.

As suggested above, behavioral, anatomical, biochemical, physiological, developmental, genetic, pathological, therapeutic, and epidemiological considerations must be brought to bear to achieve progress in this rapidly developing field of study. The editors have gathered a broad group of distinguished experts who represent these areas and have integrated their contributions. This important volume represents a significant contribution to the education of both chemosensory clinicians and chemosensory investigators. It will be useful to all students of smell and taste.

—Bruce P. Halpern, Ph.D.

Preface

Substantial advances have been achieved during the last decade in our understanding of the biological bases of the senses of smell and taste, as well as in the clinical identification, diagnosis, and management of chemosensory disorders. The purpose of this book is to provide an advanced text-reference book for two audiences: first, for medical students, residents and practitioners in otorhinolaryngology, neurology, and related health professions as an introduction to the fundamental knowledge of the chemical senses; and second, for graduate students, postdoctoral fellows, scientists, and scholars in related disciplines as an introduction to the expression and management of diseases affecting the chemosensory systems. This book will provide both audiences with an integrated approach that will yield insight for the development of clinical research protocols and basic scientific experiments, leading to additional fundamental understandings of smell and taste in health and disease.

The book is divided into seven sections. The first section summarizes the fundamental neurobiology of the sensory systems subserving smell and taste with focus on the olfactory, gustatory, and trigeminal sensory systems. The second section addresses the psychophysical and neural correlates associated with the sensation, perception, and integration of smell and taste experiences. The third section examines the development of human chemosensory preferences and describes the mechanisms by which behavior, including food intake, is regulated. The fourth section categorizes chemosensory disorders and identifies the known causes of olfactory and gustatory disorders. It also details the four basic components in the clinical evaluation of a patient with a chemosensory disorder and presents the differential diagnosis of transport and sensorineural disorders. This section is pivotal in that it establishes the bases for the remaining three clinical sections. The fifth section focuses on the causes of transport disorders, which may range from viral and bacterial infections to mechanical obstruction such as polyposis; current therapy including surgical interventions required to manage these problems is also delineated. The sixth section identifies several causes of sensorineural disorders of the senses of smell and taste that result from genetic determinants, infection, ionizing radiation, chemical exposure, and trauma. This section also describes several coping strategies that can be utilized by patients with these disorders and by their physicians and psychophysicists. The last section identifies and examines how certain systemic diseases and drugs can affect the senses of smell and taste. The chapters in each section are organized to establish a logical sequence within each section as well as to serve as independent sources of information.

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Acknowledgments

As editors for the book, we are especially appreciative of the expertise and dedicated efforts that the authors have brought to its publication. Without their willingness, together with the editorial guidance of Mary Martin Rogers at Raven Press, this effort could not have been brought to fruition. We also appreciate the use of the artwork on the book's cover provided by the Medical Arts and Photography Branch, National Institutes on Deafness and Other Communication Disorders, the National Institutes of Health.

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