

THE SENSES: A COMPREHENSIVE REFERENCE

THE SENSES: A COMPREHENSIVE REFERENCE

Volume 3 AUDITION

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Academic Press is an imprint of Elsevier
The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK
525 B Street, Suite 1900, San Diego, CA 92101-4495, USA

First edition 2008

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PSYCHOPHYSICS OF PAIN
TREATMENT OF HEARING LOSS: VIRAL TRANSFECTION
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British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Catalog Number: 2007939855

ISBN: 978-012-639482-5

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Printed and bound in Canada

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B W Ache

University of Florida, Gainesville, FL, USA

P J Albrecht

Albany Medical College, Albany, NY, USA

J M Alexander

University of Wisconsin–Madison, Madison, WI, USA

T S Alioto

University of California, Berkeley, CA, USA

M Alvarez

Universidad Nacional Autónoma de México, México

B L Anderson

University of New South Wales, Sydney, NSW, Australia

D E Angelaki

Washington University School of Medicine, St. Louis, MO, USA

V Anseloni

University of Maryland Dental School, Baltimore, MD, USA

A V Apkarian

Northwestern University, Chicago, IL, USA

K M Armstrong

Stanford University School of Medicine, Stanford, CA, USA

K Bowmaker

University College London, London, UK

A A Bachmanov

Monell Chemical Senses Center, Philadelphia, PA, USA

C A Bagley

Johns Hopkins Hospital, Baltimore, MD, USA

R Bandler

University of Sydney, Sydney, NSW, Australia

L A Barlow

University of Colorado School of Medicine, Aurora, CO, USA

R Baron

Christian-Albrechts-Universität Kiel, Kiel, Germany

L M Bartoshuk

University of Florida, Gainesville, FL, USA

K I Baumann

University of Hamburg, Hamburg, Germany

G K Beauchamp

Monell Chemical Senses Center, Philadelphia, PA, USA

O Behrend

Humboldt-University, Berlin, Germany

K W Beisel

Creighton University, Omaha, NE, USA

F Benedetti

University of Turin Medical School, Turin, Italy

S Bensmaia

The Johns Hopkins University, Baltimore, MD, USA

D A Bereiter

University of Minnesota, Minneapolis, MN, USA

J Bergan

Stanford University School of Medicine, Stanford, CA, USA

I L Bernstein

University of Washington, Seattle, WA, USA

D M Berson

Brown University, Providence, RI, USA

T Berta

University of Lausanne, Lausanne, Switzerland

K Bielefeldt

University of Pittsburgh, Pittsburgh, PA, USA

L A Birder

University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

F Birklein

University of Mainz, Mainz, Germany

J D Bohbot

Vanderbilt University, Nashville, TN, USA

R T Born

Harvard Medical School, Boston, MA, USA

J D Boughter Jr.

University of Tennessee Health Science Center, Memphis, TN, USA

S Bradesi

University of California, Los Angeles, CA, USA

R M Bradley

University of Michigan, Ann Arbor, MI, USA

A S Bregman

McGill University, Montreal, QC, Canada

K H Britten

University of California, Davis, CA, USA

M-C Broillet
University of Lausanne, Lausanne, Switzerland

S M Bromley
University of Pennsylvania, Philadelphia, PA, USA, UMDNJ-Robert Wood Johnson Medical School, Camden, NJ, USA

R M Burger
Lehigh University, Bethlehem, PA, USA

H Burton
Washington University School of Medicine, St. Louis, MO, USA

M R Byers
University of Washington, Seattle WA, USA

A Büschges
University of Cologne, Cologne, Germany

S W Cadden
University of Dundee, Dundee, UK

J N Campbell
Johns Hopkins University, Baltimore, MD, USA

J Caprio
Louisiana State University, Baton Rouge, LA, USA

C E Carr
University of Maryland, College Park, MD, USA

J Carroll
Medical College of Wisconsin, Milwaukee, WI, USA

E Carstens
University of California, Davis, CA, USA

M J Caterina
Johns Hopkins School of Medicine, Baltimore, MD, USA

B Cerf-Ducastel
San Diego State University, San Diego, CA, USA

F Cervero
McGill University, Montreal, QC, Canada

L M Chen
Vanderbilt University, Nashville, TN, USA

J Christensen-Dalsgaard
University of Southern Denmark, Odense, Denmark

T A Cleland
Cornell University, Ithaca, NY, USA

T J Coderre
McGill University, Montreal, QC, Canada

D Copenhagen
University of California San Francisco, CA, USA

R M Costanzo
Virginia Commonwealth University, Richmond, VA, USA

E Covey

University of Washington, Seattle, WA, USA

A D Craig

Barrow Neurological Institute, Phoenix, AZ, USA

W Cronin

University of Maryland, Baltimore, MD, USA

C Darian-Smith

Stanford University School of Medicine, Stanford, CA, USA

R Davis-Taber

Global Pharmaceutical Research and Development, Abbott Park, IL, USA

J W Dawson

Carleton University, Ottawa, ON, Canada

Y De Koninck

Centre de recherche Université Laval Robert-Giffard, Québec, QC, Canada

V de Lafuente

Universidad Nacional Autónoma de México, México

I Decosterd

University of Lausanne, Lausanne, Switzerland

P H Delano

Universidad de Chile, Santiago, Chile

C D Derby

Georgia State University, Atlanta, GA, USA

S W G Derbyshire

University of Birmingham, Birmingham, UK

J A DeSimone

Virginia Commonwealth University, Richmond, VA, USA

J DeSimone

Virginia Commonwealth University, Richmond, VA, USA

M Devor

Hebrew University of Jerusalem, Jerusalem, Israel

R A DiCaprio

Ohio University, Athens, OH, USA

E Disbrow

University of California, San Francisco, CA, USA

J O Dostrovsky

University of Toronto, Toronto, ON, Canada

R L Doty

University of Pennsylvania, Philadelphia, PA, USA

A Dray

AstraZeneca Research and Development, Montreal, PQ, Canada

R Dubner

University of Maryland, Baltimore, MD, USA

G E DuBois

The Coca-Cola Company, Atlanta, GA, USA

- B Duchaine
University College London, London, UK
- V B Duffy
University of Connecticut, Storrs, CT, USA
- J D Durrant
University of Pittsburgh, Pittsburgh, PA, USA
- P L Edds-Walton
Parmlly Hearing Institute, Chicago, IL, USA
- E Eliav
UMDNJ-New Jersey Dental School, Newark, NJ, USA
- M Ennis
University of Tennessee Health Science Center, Memphis, TN, USA
- R S Erzurumlu
University of Maryland School of Medicine, Baltimore, MD, USA
- R T Eskew Jr.
Northeastern University, Boston, MA, USA
- T Euler
Max-Planck-Institute for Medical Research, Heidelberg, Germany
- A Faurion
Neurobiologie Sensorielle, NOPA-NBS, INRA, Jouy en Josas, France
- R R Fay
Loyola University Chicago, Chicago, IL, USA
- D J Felleman
University of Texas Medical School, Houston, TX, USA
- A S Feng
University of Illinois at Urbana-Champaign, Urbana, IL, USA
- K M Fenn
University of Chicago, Chicago, IL, USA
- R D Fernald
Stanford University, Stanford, CA, USA
- J Ferraro
University of Kansas Medical Center, Kansas City, KS, USA
- R B Fillingim
University of Florida College of Dentistry, Community Dentistry and Behavioral Science Gainesville, FL, USA
- T E Finger
University of Colorado School of Medicine, Aurora, CO, USA
- N B Finnerup
Aarhus University Hospital, Aarhus, Denmark
- M F Fitzgerald
University College London, London, UK
- J R Flanagan
Queen's University, Kingston, ON, Canada
- H Flor
Central Institute of Mental Health, Mannheim, Germany

A Fontanini

Brandeis University, Waltham, MA, USA

D H Foster

University of Manchester, Manchester, UK

M E Frank

University of Connecticut Health Center, Farmington, CT, USA

M A Freed

University of Pennsylvania School of Medicine, Philadelphia, PA, USA

A S French

Dalhousie University, Halifax, NS, Canada

R Friedman

Vanderbilt University, Nashville, TN, USA

B Fritzsich

Creighton University, Omaha, NE, USA

M Frot

INSERM U879, Bron France

T Fukushima

The University of Tokyo School of Medicine, Tokyo, Japan

D N Furness

Keele University, Keele, UK

G Galizia

Universität Konstanz, Konstanz, Germany

J L Gallant

Helen Wills Neuroscience Institute, Berkeley, CA, USA

P D R Gamlin

University of Alabama at Birmingham, Birmingham, AL, USA

E P Gardner

Department of Physiology and Neuroscience, New York University School of Medicine, New York, NY, USA

G F Gebhart

University of Pittsburgh, Pittsburgh, PA, USA

C D Gilbert

The Rockefeller University, New York, NY, USA

D Rodriguez Gil

Yale University School of Medicine, New Haven, CT, USA

J I Glendinning

Barnard College, Columbia University, New York, NY, USA

P J Goadsby

University of California, San Francisco, CA, USA

P Gochee

University of Kansas Medical Center, Kansas City, KS, USA

M S Gold

University of Pittsburgh, Pittsburgh PA, USA

A W Goodwin

University of Melbourne, Parkville, Vic, Australia

- J Gottlieb
Columbia University, New York, NY, USA
- R H Gracely
University of Michigan Health System, VAMC, Ann Arbor, MI, USA
- C A Greer
Yale University School of Medicine, New Haven, CT, USA
- M Gridi-Papp
University of California, Los Angeles, CA, USA
- M Grim
Charles University, Praha, Czech Republic
- S E Grossman
Brandeis University, Waltham, MA, USA
- B Grothe
Ludwig-Maximilians-University, Munich, Germany
- M C Göpfert
University of Cologne, Cologne, Germany
- T A Hackett
Vanderbilt University, Nashville, TN, USA
- C M Hackney
University of Cambridge, Cambridge, UK
- A Hajnal
Milton S. Ebersole Medical Center, Hershey, PA, USA
- Z Halata
University of Hamburg, Hamburg, Germany
- R Hallworth
Creighton University, Omaha, NE, USA
- R C Hardie
University of Cambridge, Cambridge, UK
- K M Hargreaves
University of Texas Health Science Center, San Antonio, TX, USA
- I A Harrington
Augustana College, Rock Island, IL, USA
- J P Harris
University of California, San Diego, CA, USA
- G J Hathway
University College London, London, UK
- S E Hausselt
Max-Planck-Institute for Medical Research, Heidelberg, Germany
- A Hayar
University of Arkansas for Medical Sciences, Little Rock, AR, USA
- J E Hayes
Brown University, Providence, RI, USA
- D He
Creighton University, Omaha, NE, USA

B Hedwig

University of Cambridge, Cambridge, UK

H E Heffner

University of Toledo, Toledo, OH, USA

R S Heffner

University of Toledo, Toledo, OH, USA

M M Heinricher

Oregon Health & Science University, Portland, OR, USA

A Hernández

Universidad Nacional Autónoma de México, México

A Hirsh

University of Florida, Gainesville, FL, USA

J R Holt

University of Virginia School of Medicine, Charlottesville, VA, USA

P Honore

Global Pharmaceutical Research and Development, Abbott Park, IL, USA

S S Hsiao

The Johns Hopkins University, Baltimore, MD, USA

J W Hu

University of Toronto, Toronto, ON, Canada

J Iglesias

Cuban Center for Neuroscience, Habana, Cuba

F Imamura

Yale University School of Medicine, New Haven, CT, USA

S L Ingram

Washington State University, Vancouver, WA, USA

J Isnard

Lyon I University and INSERM U879, Bron, France

G H Jacobs

University of California, Santa Barbara, CA, USA

W Jänig

Physiologisches Institut, Christian-Albrechts-Universität zu Kiel, Germany

W Jänig

Christian-Albrechts-Universität zu Kiel, Kiel, Germany

L Jasmin

Neurosurgery and Gene Therapeutics Research Institute, Los Angeles, CA, USA

T S Jensen

Aarhus University Hospital, Aarhus, Denmark

R S Johansson

Umeå University, Umeå, Sweden

S J St. John

Rollins College, Winter Park, FL, USA

B A Johnson

University of California, Irvine, CA, USA

B Johnson

UC Berkeley, Berkeley, CA, USA

J I Johnson

Michigan State University, East Lansing, MI, USA

J H Kaas

Vanderbilt University, Nashville, TN, USA

T Kamigaki

The University of Tokyo School of Medicine, Tokyo, Japan

E Kaplan

The Mount Sinai School of Medicine, New York, NY, USA

H Kasahara

The University of Tokyo School of Medicine, Tokyo, Japan

D B Katz

Brandeis University, Waltham, MA, USA

B J B Keats

Louisiana State University Health Sciences Center, New Orleans, LA, USA

K Keay

University of Sydney, Sydney, NSW, Australia

V Kefalov

Washington University School of Medicine, St. Louis, MO, USA

D R Ketten

Woods Hole Oceanographic Institution, Woods Hole, MA, USA

R M Khan

UC Berkeley, Berkeley, CA, USA

M C Killion

Etymotoc Research Ltd., Elk Grove Village, IL, USA

J C Kinnamon

University of Denver, Denver, CO, USA

S C Kinnamon

Colorado State University, Fort Collins, CO, USA

K R Kluender

University of Wisconsin–Madison, Madison, WI, USA

E Knudsen

Stanford University School of Medicine, Stanford, CA, USA

T Kobayakawa

National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan

H Komatsu

National Institute for Physiological Sciences, Okazaki, Japan

M Konishi

California Institute of Technology, Pasadena, CA, USA

H G Krapp

Imperial College London, London, UK

B Krekelberg

Rutgers University, Newark, NJ, USA

R F Krimm

University of Louisville School of Medicine, Louisville, KY, USA

L Krubitzer

University of California, Davis, CA, USA

T Kurahashi

Osaka University, Osaka, Japan

M Kössl

Johann Wolfgang Goethe Universität, Frankfurt/Main, Germany

S Lacey

Emory University School of Medicine, Atlanta, GA, USA

R Ladher

RIKEN Centre for Developmental Biology, Kobe, Japan

A K Lalwani

New York University School of Medicine, New York, NY, USA

G J Lavigne

Université de Montréal, Montreal, QC, Canada

H C Lawson

Johns Hopkins Hospital, Baltimore, MD, USA

D Le Bars

INSERM U-713, Paris, France

B B Lee

SUNY College of Optometry, New York, NY, USA

S Lee

Korea Institute of Science and Technology, Seoul, Korea

T Leinders-Zufall

University of Maryland School of Medicine, Baltimore, MD, USA

A Lelli

University of Virginia School of Medicine, Charlottesville, VA, USA

L Lemus

Universidad Nacional Autónoma de México, México

F A Lenz

Johns Hopkins Hospital, Baltimore, MD, USA

M Leon

University of California, Irvine, CA, USA

A R Light

University of Utah, Salt Lake City, UT, USA

D Lima

Universidade do Porto, Porto, Portugal

C Linster

Cornell University, Ithaca, NY, USA

W Li

The Rockefeller University, New York, NY, USA

P-M Lledo

Pasteur Institute, Paris, France

E R Loew

Cornell University, Ithaca, NY, USA

R Luna

Universidad Nacional Autónoma de México, México

D-G Luo

Johns Hopkins University School of Medicine, Baltimore, MD, USA

V Lyall

Virginia Commonwealth University, Richmond, VA, USA

H Machelska

Charité – Universitätsmedizin Berlin, Campus Benjamin Franklin, Berlin, Germany

E A Macpherson

University of Michigan, Ann Arbor, MI, USA

S F Maier

University of Colorado at Boulder, Boulder, CO, USA

H Maija

Helsinki University Hospital, Helsinki, Finland

P B Manis

The University of North Carolina at Chapel Hill, Chapel Hill, NC, USA

G A Manley

Technische Universität München, Garching, Germany

I Marc

Université Laval, Québec City, QC, Canada

D Margoliash

University of Chicago, Chicago, IL, USA

R F Margolskee

Mount Sinai School of Medicine, New York, NY, USA

G R Martin

University of Birmingham, Birmingham, UK

S C Massey

University of Texas Medical School, Houston, TX, USA

F Mauguère

Lyon I University and INSERM U879, Bron, France

M Max

Mount Sinai School of Medicine, New York, NY, USA

B J May

The Johns Hopkins University School of Medicine, Baltimore, MD, USA

E A Mayer

University of California, Los Angeles, CA, USA

C H McCool

University of California, Davis, CA, USA

D H McDougal

University of Alabama at Birmingham, Birmingham, AL, USA

P A McGrath

The University of Toronto, Toronto, ON, Canada

E M McLachlan

Prince of Wales Medical Research Institute, Randwick, NSW, Australia

D G McLaren

University of Wisconsin, Madison, WI, USA

L M Mendell

State University of New York, Stony Brook, NY, USA

J A Mennella

Monell Chemical Senses Center, Philadelphia, PA, USA

S Mense

Institut für Anatomie und Zellbiologie, Universität Heidelberg, Heidelberg, Germany

W Meyerhof

German Institute of Human Nutrition Potsdam-Rehbruecke, Nuthetal, Germany

R A Meyer

Johns Hopkins University, Baltimore, MD, USA

H J Michalewski

University of California, Irvine, CA, USA

J C Middlebrooks

University of Michigan, Ann Arbor, MI, USA

E D Milligan

University of Colorado at Boulder, Boulder, CO, USA

Y Miyashita

The University of Tokyo School of Medicine, Tokyo, Japan

J S Mogil

McGill University, Montreal, QC, Canada

T Moore

Stanford University School of Medicine, Stanford, CA, USA

T Moser

University of Goettingen, Goettingen, Germany

V Nácher

Universidad Nacional Autónoma de México, México

P M Narins

University of California, Los Angeles, CA, USA

J Ngai

University of California, Berkeley, CA, USA

M A L Nicolelis

Duke University, Durham, NC, USA

R Norgren

Milton S. Ebersole Medical Center, Hershey, PA, USA

P T Ohara

University of California, San Francisco, CA, USA

S Ohara

Johns Hopkins Hospital, Baltimore, MD, USA

K Okura

Tokushima Graduate School, Tokushima, Japan

- D Oliver
Universität Freiburg, Freiburg, Germany
- G A Orban
K.U. Leuven Medical School, Leuven, Belgium
- D Osorio
University of Sussex, Brighton, UK
- M H Ossipov
University of Arizona, Tucson, AZ, USA
- C C Pack
McGill University School of Medicine, Montreal, PQ, Canada
- G E Pickard
Colorado State University, Fort Collins, CO, USA
- R J Pitts
Vanderbilt University, Nashville, TN, USA
- G S Pollack
McGill University, Montreal, QC, Canada
- A N Popper
University of Maryland, College Park, MD, USA
- F Porreca
University of Arizona, Tucson, AZ, USA
- C V Portfors
Washington State University, Vancouver, WA, USA
- M Postma
University of Cambridge, Cambridge, UK
- R J Prenger
University of California, Berkeley, CA, USA
- T M Preuss
Emory University, Atlanta, GA, USA
- D D Price
University of Florida, Gainesville, FL, USA
- I Provencio
University of Virginia, Charlottesville, VA, USA
- A C Puche
University of Maryland School of Medicine, Baltimore, MD, USA
- S Puria
Stanford University, Stanford, CA, USA
- H-X Qi
Vanderbilt University, Nashville, TN, USA
- P Rainville
Université de Montréal, Montreal, QC, Canada
- S N Raja
Johns Hopkins University, Baltimore, MD, USA
- R Rajimehr
Massachusetts General Hospital, Charlestown, MA, USA

R L Reed

University of Florida, Gainesville, FL, USA

B E Reese

University of California, Santa Barbara, CA, USA

L Rela

Yale University School of Medicine, New Haven, CT, USA

K Ren

University of Maryland, Baltimore, MD, USA

B A Revill

Brandeis University, Waltham, MA, USA

J Reynolds

The Salk Institute for Biological Studies, San Diego, CA, USA

A Ribeiro-da-Silva

McGill University, Montreal, QC, Canada

F L Rice

Albany Medical College, Albany, NY, USA

F Rieke

University of Washington, Seattle, WA, USA

M Ringkamp

Johns Hopkins University, Baltimore, MD, USA

H L Rittner

Charité – Universitätsmedizin Berlin, Campus Benjamin Franklin, Berlin, Germany

D Robert

University of Bristol, Bristol, UK

W M Roberts

University of Oregon, Eugene, OR, USA

M E Robinson

University of Florida, Gainesville, FL, USA

L Robles

Universidad de Chile, Santiago, Chile

V Rodríguez

Cuban Center for Neuroscience, Habana, Cuba

I Rodriguez

University of Geneva, Geneva, Switzerland

A W Roe

Vanderbilt University, Nashville, TN, USA

E T Rolls

University of Oxford, Oxford, UK

R Romo

Universidad Nacional Autónoma de México, México

E W Rubel

University of Washington, Seattle, WA, USA

I Russell

University of Sussex, Brighton, UK

- M A Rutherford
University of Oregon, Eugene, OR, USA
- K Saito
University of Pennsylvania, Philadelphia, PA, USA
- H Sakano
University of Tokyo, Tokyo, Japan
- A N Salt
Washington University School of Medicine, St. Louis, MO, USA
- J Sandkühler
Medical University of Vienna, Vienna, Austria
- K Sathian
Emory University School of Medicine, Atlanta, GA, USA
- R J Schafer
Stanford University School of Medicine, Stanford, CA, USA
- S S Schiffman
Duke University Medical Center, Durham, NC, USA
- M Schmelz
University of Heidelberg, Mannheim, Germany
- J Schouenborg
Lund University, Lund, Sweden
- B A Schulte
Medical University of South Carolina, Charleston, SC, USA
- I Schwetz
Medical University, Graz, Austria
- J E Schwob
Tufts University School of Medicine, Boston, MA, USA
- V E Scott
Global Pharmaceutical Research and Development, Abbott Park, IL, USA
- R V Shannon
House Ear Institute, Los Angeles, CA, USA
- A Sharma
Columbia University, New York, NY, USA
- L T Sharpe
University College London, London, UK
- S M Sherman
The University of Chicago, Chicago, IL, USA
- T Shimura
Osaka University, Osaka, Japan
- J Siegel
Northwestern University, Evanston, IL, USA
- C T Simons
Global Research and Development Center, Cincinnati, OH, USA
- W Singer
Max Planck Institute for Brain Research, Frankfurt, Germany

D V Smith

The University of Tennessee College of Medicine, Memphis, TN, USA

M T Smith

John Hopkins Medical School, Baltimore, MD, USA

R G Smith

University of Pennsylvania, Philadelphia, PA, USA

J B Snow Jr.

University of Pennsylvania, Philadelphia, PA, USA

D J Snyder

Yale University, New Haven, CT, USA

N Sobel

UC Berkeley, Berkeley, CA, USA

P J Sollars

Colorado State University, Fort Collins, CO, USA

A C Spector

The Florida State University, Tallahassee, FL, USA

H Staecker

University of Kansas Medical Center, Kansas City, KS, USA

A Starr

University of California, Irvine, CA, USA

R Staud

University of Florida, Gainesville, FL, USA

E A Stauffer

University of Virginia School of Medicine, Charlottesville, VA, USA

G C Stecker

University of Washington, Seattle, WA, USA

C R Steele

Stanford University, Stanford, CA, USA

C Stein

Charité – Universitätsmedizin Berlin, Campus Benjamin Franklin, Berlin, Germany

L J Stein

Monell Chemical Senses Center, Philadelphia, PA, USA

A Stockman

University College London, London, UK

R Storms

Veterans Administration Medical Center, Kansas City, MO, USA

E Strettoi

Neuroscience Institute, Pisa, Italy

H Takeuchi

Osaka University, Osaka, Japan

E Thomson

Duke University, Durham, NC, USA

N Tian

Yale University, New Haven, CT, USA

- D J Tollin
University of Colorado Health Sciences Center, Aurora, CO, USA
- M Tominaga
National Institutes of Natural Sciences, Okazaki, Japan
- R Tootell
Massachusetts General Hospital, Charlestown, MA, USA
- K Touhara
The University of Tokyo, Chiba, Japan
- S P Travers
The Ohio State University, Columbus, OH, USA
- R D Treede
Johannes Gutenberg-University, Mainz, Germany
- R D Treede
Ruprecht-Karls-University Heidelberg, Heidelberg, Germany
- N F Troje
Queen's University, Kingston, ON, Canada
- L O Trussell
Oregon Health and Science University, Portland, OR, USA
- A Tsuboi
University of Tokyo, Tokyo, Japan
- M J Valdés-Sosa
Cuban Center for Neuroscience, Habana, Cuba
- D I Vaney
The University of Queensland, Brisbane, QLD, Australia
- M Vater
Universität Potsdam, Golm, Germany
- M Vorobyev
University of Queensland, Brisbane, QLD, Australia
- E T Walters
University of Texas at Houston, Medical School, Houston, TX, USA
- M E Warchol
Washington University School of Medicine, St. Louis, MO, USA
- E Warrant
University of Lund, Lund, Sweden
- W H Warren
Brown University, Providence, RI, USA
- L R Watkins
University of Colorado at Boulder, Boulder, CO, USA
- L A Werner
University of Washington, Seattle, WA, USA
- U Wesselmann
The Johns Hopkins University School of Medicine, Baltimore, MD, USA
- G Westheimer
University of California, Berkeley, CA, USA

K N Westlund

University of Texas Medical Branch, Galveston, TX, USA

H E Wheat

University of Melbourne, Parkville, Vic, Australia

M C Whitehead

University of California, San Diego, La Jolla, CA, USA

M C Whitman

Yale University School of Medicine, New Haven, CT, USA

M Wicklein

University College London, London, UK

M C Wiest

Duke University, Durham, NC, USA

J C Willer

INSERM U-731, Paris, France

M A Willis

Case Western Reserve University, Cleveland, OH, USA

W D Willis Jr

University of Texas Medical Branch, Galveston, TX, USA

J F Willott

University of South Florida, Tampa, FL

D A Wilson

University of Oklahoma, Norman, OK, USA

M Wilson

University of California, Davis, CA, USA

J M Wolfe

Brigham and Women's Hospital & Harvard Medical School, Cambridge, MA, USA

J N Wood

University College London, London, UK

H Wässle

Max-Planck-Institute for Brain Research, Frankfurt/Main, Germany

J E Yack

Carleton University, Ottawa, ON, Canada

T Yamamoto

Osaka University, Osaka, Japan

R Yang

University of Denver, Denver, CO, USA

K-W Yau

Johns Hopkins University School of Medicine, Baltimore, MD, USA

R P Yezierski

Comprehensive Center for Pain Research and The McKnight Brain Institute, University of Florida, Gainesville, FL, USA

W A Yost

Loyola University Chicago, Chicago, IL, USA

J M Young

Fred Hutchinson Cancer Research Center, Seattle, WA, USA

G Yovel

Tel Aviv University, Tel Aviv, Israel

A Zainos

Universidad Nacional Autónoma de México, México

H U Zeilhofer

University of Zurich, Zurich, Switzerland

D M Zeitler

New York University School of Medicine, New York, NY, USA

F G Zeng

University of California, Irvine, CA, USA

J-K Zubieta

University of Michigan, Ann Arbor, MI, USA

F Zufall

University of Maryland School of Medicine, Baltimore, MD, USA

L J Zwiebel

Vanderbilt University, Nashville, TN, USA

Introduction to Volume 3

Producing a handbook, indeed any compendium that purports to represent the state of the art, is a perilous undertaking. Never mind prospective authors who are reluctant to write yet another review, or contributors who enthusiastically accept an invitation but fail to deliver, or the perennially late. Such perils of editorship are expected. The real culprit is the task itself. If a field or subject is mature enough to afford definitive summary, the likelihood is high that it is already stale. If, however, the subject is vibrant and still evolving, trying to summarize it is akin to chasing a mirage. While one writes the gospel according to Peter, Paul is sure to publish a bit that makes Peter's tome somewhat dated. Auditory neuroscience is vibrant and not all the questions are answered. So, as with most books of this sort, this volume provides a glimpse of a field in transition. The reader will find that many chapters hint at some tentativeness. We hope that a lack of final conclusions on some topics will inspire further work.

When we entered the field 35–45 years ago, it was not difficult to master most of what was known about the subject in relatively short order. Then, hearing science was largely the domain of engineers, physicists, and psychologists, and practitioners were few. The subject has meanwhile flourished and expanded to become an integral part of mainstream biology. Relying on all the powerful techniques developed for cell biology and neuroscience with the full incorporation of molecular and genetic approaches, and often introducing some that have been borrowed from the physical sciences, hearing research has emerged as one of the most interesting and complex subjects in all of biology. It is hoped that this volume conveys some of this interest as well as the palpable excitement that permeates the field.

The ear is a remarkable organ. It is a multistage transducer and nonlinear feedback system that conducts mechanical vibrations, slow and fast, first from air to fluid and then from fluid to cells that can convert minute movements to electrical signals that are recognized by the nervous system. The ear could not be more sensitive; if it were, sound would be drowned by thermal noise. It produces a frequency resolution akin to placing 29 new keys between each two adjacent keys of the piano. This book describes some of the special features that allow the ear to perform these feats.

The brain does not receive complete information from the ear directly but uses input from the cochlea to compute what it really cares about, namely where sounds emanate and what they mean. These computational tasks are complicated and are only just beginning to be understood. It is no accident that our external ears sit far apart on our heads; we use the difference in time of arrival to compute the sound's angle of incidence. Those tiny time differences can be used only if the firing of neurons can encode them. Neither is it an accident that our ears are asymmetrical top–bottom and front–back; differences in the way the ears reflect sounds into and away from the ear canal distinguish sounds coming from front or back, up or down. As the head and ears grow, the brain has to keep recalibrating its computations. Perhaps most remarkable, and least well understood, is how a human being uses an onslaught of rapidly changing sounds to learn what another is thinking.

Like the field, the volume evolved too during its planning and production stages. Some subjects were split into smaller chunks, some cameos were added, and several were removed. We allowed, even encouraged, a degree of multiple coverage of certain subjects, particularly those very lively ones where different viewpoints and orientations could be instructive. It is our hope that we have produced an accurate compendium of the field in the first decade of the third millennium that will inspire others to take up the job of discovering how animals hear and understand what is going on in their acoustic environment.

Peter Dallos and Donata Oertel