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Brian C.J. Moore
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Basic Aspects of Hearing

Physiology and Perception

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Preface

This volume constitutes the Proceedings of the 16th International Symposium on Hearing (ISH), held from 23 to 27 July 2012 in St. John's College, Cambridge, UK. As is traditional for the ISH series, the emphasis was on bringing together those performing basic research on physiological and perceptual processing by the auditory system, including modelling. All chapters were submitted and subjected to preliminary editing prior to the meeting, and all chapters were available to participants before the meeting started. The timetable of ISH 2012 allowed plenty of time for discussion, and synopses of some of the discussions are included at the ends of the relevant chapters. The chapters are organised according to seven broad themes, and their order reflects the order of presentation at the meeting.

We are most grateful to those who sponsored ISH 2012 with goods or cash. These were (in alphabetical order) GNResound (Denmark), MED-EL (Austria), The Eriksholm Research Centre (part of Oticon, Denmark), Phonak (Switzerland), Starkey (USA), St. John's College Cambridge (UK) and Widex (Denmark). We are also grateful to Brian Glasberg, Cathy Schneider, Shirley Bidgood, Jackie Clark, Etienne Gaudrain, Andrew Kolarik, Arek Stasiak, Sami Alsindi, Marina Salorio-Corbetto and Sara Madsen for their help with various aspects of the running of ISH 2012 and to Eleanor Turner for a superb harp concert.

Finally, we would like to thank all authors and participants for their scientific contributions and for the lively discussions.

Cambridge, UK — Brian C.J. Moore
Cambridge, UK — Roy D. Patterson
Cambridge, UK — Ian M. Winter
Cambridge, UK — Robert P. Carlyon
Cambridge, UK — Hedwig E. Gockel

List of Previous ISH Symposia

Previous meetings in the ISH series and their respective books are:

ISH 2009 – Salamanca, Spain: The Neurophysiological Bases of Auditory Perception. Edited by E.A. Lopez-Poveda, A.R. Palmer, and R. Meddis. Springer: New York.

ISH 2006 – Cloppenburg, Germany: Hearing - From Sensory Processing to Perception. Edited by B. Kollmeier, G. Klump, V. Hohmann, U. Langemann, M Mauermann, S. Uppenkamp, and J. Verhey. Springer: New York.

ISH 2003 – Dourdan, France: Auditory Signal Processing: Physiology, Psychoacoustics, and Models. Edited by D. Pressnitzer, A. de Cheveigné, S. McAdams, and L. Collet. Springer: New York.

ISH 2000 – Mierlo, The Netherlands: Physiological and Psychophysical Bases of Auditory Function. Edited by D.J. Breebaart, A.J.M. Houtsma, A. Kohlrausch, V.F. Prijs, and R. Schoonhoven. Shaker: Maastricht.

ISH 1997 – Grantham, England: Psychophysical and Physiological Advances in Hearing. Edited by A.R. Palmer, A. Rees, A.Q. Summerfield, and R. Meddis. Whurr: London.

ISH 1994 – Irsee, Germany: Advances in Hearing Research. Edited by G. A. Manley, G. M. Klump, C. Koppl, H. Fastl, and H. Oeckinghaus. World Scientific: Singapore.

ISH 1991 – Carcans, France: Auditory Physiology and Perception. Edited by Y. Cazals, L. Demany and K. Horner. Pergamon: Oxford.

ISH 1988 – Paterswolde, Netherlands: Basic Issues in Hearing. Edited by H. Duifhuis, and J.W. Horst, H.P. Wit. Academic: London.

ISH 1986 – Cambridge, England: Auditory Frequency Selectivity. Edited by B.C.J. Moore and R.D. Patterson. Plenum: New York.

ISH 1983 – Bad Nauheim, Germany: Hearing - Physiological Bases and Psychophysics. Edited by R. Klinke, and R. Hartmann. Springer: Berlin.

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ISH 1977 – Keele, England: Psychophysics and Physiology of Hearing. Edited by E.F. Evans, and J.P. Wilson. Academic: London.

ISH 1974 – Tutzing, Germany: Facts and Models in Hearing. Edited by E. Zwicker and E. Terhardt. Springer: Berlin.

ISH 1972 – Eindhoven, The Netherlands: Hearing Theory. Edited by B.L. Cardozo. IPO: Eindhoven.

ISH 1969 – Driebergen, The Netherlands: Frequency Analysis and Periodicity Detection in Hearing. Edited by R. Plomp and G.F. Smoorenburg. Sijthoff: Leiden.

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Part I
Peripheral Processing

Chapter 1
Mosaic Evolution of the Mammalian Auditory Periphery

Geoffrey A. Manley

Abstract The classical mammalian auditory periphery, i.e., the type of middle ear and coiled cochlea seen in modern therian mammals, did not arise as one unit and did not arise in all mammals. It is also not the only kind of auditory periphery seen in modern mammals. This short review discusses the fact that the constituents of modern mammalian auditory peripheries arose at different times over an extremely long period of evolution (230 million years; Ma). It also attempts to answer questions as to the selective pressures that led to three-ossicle middle ears and the coiled cochlea. Mammalian middle ears arose de novo, without an intermediate, single-ossicle stage. This event was the result of changes in eating habits of ancestral animals, habits that were unrelated to hearing. The coiled cochlea arose only after 60 Ma of mammalian evolution, driven at least partly by a change in cochlear bone structure that improved impedance matching with the middle ear of that time. This change only occurred in the ancestors of therian mammals and not in other mammalian lineages. There is no single constellation of structural features of the auditory periphery that characterizes all mammals and not even all modern mammals.

1 Introduction

Over the past 20 years, a number of dogmata and common ways of viewing the mammalian auditory periphery have been proven to be false, due to major new fossil finds and new ways of examining fossils that allow non-destructive

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