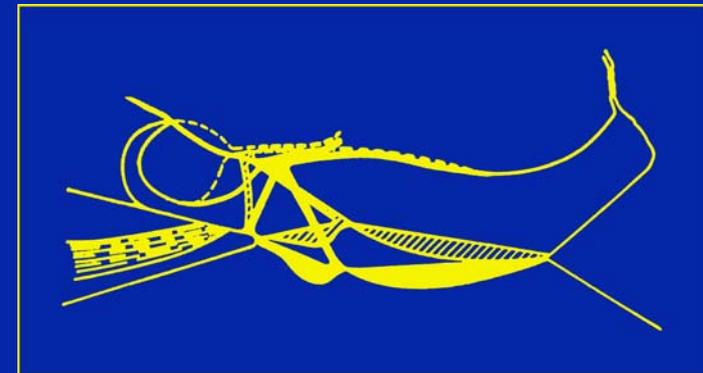


The Mechanics of Cochlear Homeostasis

Eric L. LePage



A compilation of the author's scientific articles
on cochlear mechanical measurements,
Ménière's disease and tinnitus

THE MECHANICS OF COCHLEAR HOMEOSTASIS

For over 100 years, progress in basic and applied hearing science has been slow and painstaking. The field has lacked any simple path through the complex maze to find an explanation of the subtle nature of the onset of hearing loss. Also lacking has been any tangible mechanism to explain the cumulative nature of noise trauma, as well as the origins of Ménière's disease and tinnitus with their disabling symptoms. Investigators and clinicians have, within their own disciplines, tried to deal with problems resulting from data variability in order to describe the many mechanisms responsible for the high level of cochlear performance and its maintenance.

In particular, researchers studying the origins of the fine tuning and wide dynamic range of the mammalian ear have tried to simplify the problem by focussing upon pristine ears as one means of limiting data variability. These pages show, by contrast, that understanding how the ear malfunctions may be the key to understanding its high performance. The best new clue for cochlear sound analysis has come from otologists interested in the origins of Ménière's disease - forced to try to understand the origin of pressure rises which rupture scala media causing debilitating attacks of vertigo. What has resulted in recent years is an biomolecular description of cochlear "homeostasis" - and centering upon "potassium intoxication" of the endolymph. Such studies have not yet included direct mechanical measurements of swelling of scala media when this happens.

As soon as *the mechanics of cochlear homeostasis* is considered, the set of basilar membrane measurements performed on living guinea pig cochleas between 1973 and 1989 (recompiled in this volume) yield a new level of appreciation of structure and function of cochlear activity. The extensive data describe basilar membrane sound-produced baseline drifts, even then recognised as vital to describing the "automatic gain control" of the cochlear amplifier, influenced by ambient sound level, noise trauma and aging.

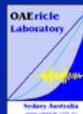
The unifying theory outlined in the last article goes a long way to explaining the origins of many biophysical and psychophysical phenomena as well as the cause of that universal vexation - huge data variability. In particular, *scala media* is now seen as a pressure vessel which normally swells and contracts with a diurnal variation in potassium concentration and resulting water movement, while the slow motility of the outer hair cells provides a feedback force to maintain normal outer hair cell transduction and to increase the dynamic range of the inner hair cells.



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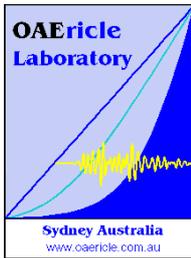
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**Eric LePage
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CONTENTS OF COMPILATION

Doctoral thesis	LePage, E. L. (1981). The role of nonlinear mechanical processes in mammalian hearing. Doctoral Thesis, The University of Western Australia.	1-99
	Summary, Forward to 2006 reprinting, Acknowledgements, Contents	i-xv
	Introduction	1
	Methods	4
	Experimental Results	13
	Discussion	65
	Epilogue	89
	Bibliography	91
Original Appendices		99
1	LePage, E. L., & Johnstone, B. M. (1980). Nonlinear mechanical behaviour of the basilar membrane in the basal turn of the guinea pig cochlea. <i>Hear. Res.</i> 2, 183-189.	App. 3
2	LePage, E. L., & Johnstone, B. M. (1975). An online sampled-data waveform control system. <i>Med.Biol.Engg.</i> (September), 637-643.	App. 11
3	Various abstracts and reports 1980 to 2001	App. 19
4	Extract from the basilar membrane impulse response database (Experimental series 1)	App. 32
5	Key result of Acetylcholine perfusion experiment	App. 67
New Appendices		
6a	LePage, E. L. (1987). The application of a capacitive probe technique for direct observation of electromechanical processes in the guinea pig cochlea. <i>J.Acoust.Soc.Am.</i> 82, 126-138.	App. 69
6b	LePage, E. L. (1987). Frequency-dependent self-induced bias of the basilar membrane and its potential for controlling sensitivity and tuning in the mammalian cochlea. <i>J.Acoust.Soc.Am.</i> 82, 139-154.	App. 83
7	LePage, E. L. (1987). A spatial template for the shape of tuning curves in the mammalian cochlea. <i>J.Acoust.Soc.Am.</i> 82, 155-164.	App. 101
8	LePage, E. L. (1989). Functional role of the olivo-cochlear bundle: a motor unit control system in the mammalian cochlea. <i>Hear Res</i> 38(3), 177-98.	App. 113
9	LePage, E. L. (1990) Helmholtz revisited: direct mechanical data suggest a physical model for dynamic control of mapping frequency to place along the cochlear partition. In <i>Lecture Notes in Biomathematics: Vol. 87. The Mechanics and Biophysics of</i>	App. 137

- Hearing (pp. 278-287). New York.
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 - 12 Zenner, H. P., Reuter, G., Zimmermann, U., Gitter, A. H., Fermin, C., & LePage, E. L. (1994). Transitory endolymph leakage induced hearing loss and tinnitus: depolarization, biphasic shortening and loss of electromotility of outer hair cells. *Eur Arch Otorhinolaryngol* 251(3), 143-53. App. 173
 - 13 LePage, E. L., Reuter, G., & Zenner, H. P. (1995). A threshold decrease for electrically stimulated motor responses of isolated aging outer hair cells from the pigmented guinea pig. *Eur Arch Otorhinolaryngol*, 252, 215-221. App. 185
 - 14 LePage, E. L. (1995). A model for cochlear origin of subjective tinnitus: excitatory drift in the operating point of inner hair cells. In Jack A. Vernon and Aage R. Moller *Mechanisms of Tinnitus* (Vol. Chapter 11pp. 115-148). Boston: Allyn and Bacon. App. 193
 - 15 LePage, E. L. (2003). The mammalian cochlear map is optimally warped. *J. Acoust.Soc.Am.* 114(2), 896-906. App. 229
 - 16 Various abstracts 2005-2006. App. 241
 - 17 LePage, E. L. (2006). A review of mechanical evidence for a servo-loop in the mammalian cochlea. *Acoustics Australia*, 34(3), 43-51. App. 244