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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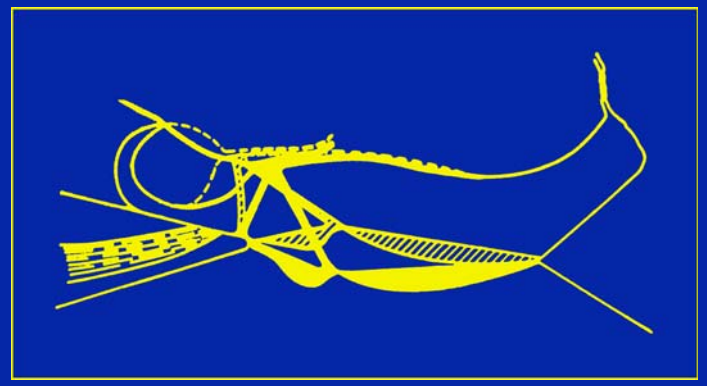

A compilation of the author's scientific articles on cochlear mechanical measurements, Ménière's disease and tinnitus

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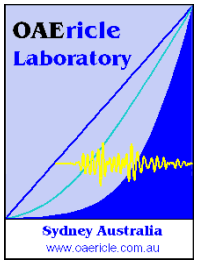

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