

BOOK REVIEWS

Thais C. Morata, Ph.D., Derek E. Dunn, Ph.D., (Eds). Occupational Hearing Loss, Volume 10, #3, July - Sept. 1995, Hanley and Belfuss, Inc., Philadelphia, PA.

This text is one in a series devoted to issues in Occupational Medicine. The publication comes during the 25th year since occupational noise standards were established in the United States.

The 23 contributors to this volume represent researchers from the United States, Canada and Europe. Each of the 13 chapters presents a critical aspect of occupational hearing loss. Consistency in chapter organization and style is maintained with all but three chapters containing either a summary or conclusion.

A broad range of related and inter-related areas are provided. The scope of research clearly underscores the fact that occupational hearing loss is not limited to or synonymous with the presence and effects of noise.

The first chapter, the impact of OHL on the lives of workers, is followed by the biologic bases of noise induced hearing loss, use of animal models is studies of

the effects of noise on hearing, endogenous factors, ototoxic effects of chemicals and solvents, combined effects of noise and age on the auditory system, presbycusis and OHL, epidemiologic considerations, hearing conservation for underserved groups and systems of compensation. The final chapter looks back at historical assessment and at future directions in the prevention of OHL. Programs in exposure assessment and hearing protection devices are highlighted.

Each chapter presents an eminently readable, unique component of the OHL issue. Collectively, they represent an important contribution to the literature.

This work should have wide appeal and relevance to a target audience of otologists, audiologists, physiologists, epidemiologists, toxicologists, union/labor/industrial personnel and all who have a commitment to hearing conservation.

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Jack A. Vernon and Aage R. Møller (Eds). Mechanisms of Tinnitus, 293 pp., Allyn and Bacon, Needham Heights, MA 02194.

Jack Vernon, one of the world's most distinguished and respected figures in the field of tinnitus and Aage Møller, an auditory and neurophysiologist, have made an important, watershed contribution to our understanding of tinnitus. They invited 23 experts in different aspects of tinnitus "to muse and be speculative about the mechanisms of tinnitus." The contributors represent various disciplines - otology, audiology, anatomy, psychology, pharmacology, biophysics, neurology, and neurophysiology among others. Their chapters vary in length, style, detail and disciplinary orientation. But they individually and collectively present the present state of our understanding (or lack thereof) of this widespread and anguishing condition. This is the kind of book that needs to be updated every five years as knowledge increases understanding and as new investigators enter this field.

The editors suggest that one of the reasons there is no existing cure for tinnitus is "our lack of knowledge about the mechanisms of tinnitus." But will an understanding of the mechanisms necessarily lead to a cure or cures? How complete must our understanding be? Effective relief and treatment is possible for many arthritics, diabetics and those with cancer without a total understanding of the mechanisms underlying these

diseases. Aspirin worked well before we reached our present, not yet complete understanding of its mode of action.

Some of the highlights as viewed by this reviewer will be mentioned. Brix, an otoneuropsychologist, speculating on the psychophysiological dimensions of tinnitus, states that most patients suffer from low-intensity tinnitus. However, the loudness of tinnitus must be related to the recruitment phenomenon which most patients experience. For a recruiting ear, a sensation level of 5-10 dB can be extremely loud and difficult to accept. He postulates that the central type of tinnitus will never be treatable unless the specific memory in the brain is completely erased. Brummett, a pharmacologist suggests that all drugs which benefit tinnitus sufferers owe their mechanisms of action to an ability to enhance Gamma Amino Butyric Acid in the CNS. Most contributors believe that tinnitus has **many** possible mechanisms depending on which **cause** produced the tinnitus. Does this mean when "cure" is discovered there will be a different cure for each type of tinnitus depending upon etiology? Coles suggests that prevalence and amount of cochlear damage will determine the demography and severity of the accompanying tinnitus. There is some arrogance in his approach to counseling as he tells us how he explains the condition

to his patients. He predicts that one day when we fully understand all aspects of tinnitus generation, it will be too complicated to explain to patients. I believe that **all** phenomena, regardless of how complex, can be explained to patients and some of them understand certain aspects of the problem better than we do. When we cannot communicate a concept, it is usually because **we** do not understand it well (or because we are inadequate communicators) and not because of any inherent limitation in the patient's ability to understand.

Feldmann elucidates the pathology and pathophysiology of well-known diseases associated with tinnitus. He explains the tinnitus which follows acute acoustic trauma as "a leak in the hair cell membrane or a defect of the submicroscopical ion-channels." In a fascinating review of tinnitus in children with hearing loss, Graham, a British pediatric otolaryngologist identifies a major difference between tinnitus in children and adults. "Adults usually have constant tinnitus while in children tinnitus is almost always intermittent." Hazell, a London otologist now associated with Jastreboff at the university of Maryland in Baltimore, believes that "regardless of the generator, tinnitus always involves the final common pathways of central auditory processing." He and his associates have developed a process of retraining using **low levels** of broadband white noise from portable ear-level devices. Tinnitus to Jastreboff is a phantom perception resulting from unbalanced activity of a subpopulation of nerve fibers and neurons. With his **habituation** training approach, he believes that tinnitus can be controlled **but not cured**.

In a lengthy and complex chapter, Lepage, an auditory physiologist from Australia, describes a model for the cochlear origin of continuous, subjective tinnitus. He relates tinnitus to an "excitatory drift in the operating point of the inner hair cells."

Kiang of Massachusetts Eye and Ear Infirmary, believes the clinically important cases of tinnitus appear to involve breakdowns in coping mechanisms more than auditory sensations per se. He considers the central and still unanswered question to be: "Is disabling tinnitus the elevation of a relatively innocuous everyday experience into a malignant obsession, or is it a symptom that arises when the perceptual machinery signals overload when there is no overload at the sensory input end?" Martin, from Temple University Medical School, believes that the spectral analysis of neural activity provides a means to study continuous low amplitude normal and abnormal auditory activity in animals and humans and opens the door to noninvasive work in multiple species and provides a quantitative tool for evaluating what looks and acts like tinnitus. Meikle of the Oregon Health

Sciences University, proposes a model which emphasizes the role of central neural mechanisms in the generation of tinnitus while at the same time suggests ways in which peripheral auditory damage might induce or interact with central mechanisms.

A. Møller, one of the book's editors, discusses some hypotheses about how specific changes in the function of the ear and the auditory nervous system may cause tinnitus. He also discusses patients with incapacitating tinnitus based on intracranial neurophysiological recordings from the eighth nerve and on BAEP made during microvascular decompression. He believes that, "the physiological abnormality that generates the tinnitus in many cases is located in the central nervous system." Møller and his group believe that some forms of incapacitating tinnitus can be alleviated by moving a compressing blood vessel off the eighth nerve and placing a soft implant between the nerve and the vessel. This invasive form of treatment is controversial and some tinnitus sufferers who have undergone this procedure have experienced a significant increase in their SNHL and a worsening of their tinnitus. The use of the term "cure" for these patients needs to be qualified and lay readers of this text should not be led to believe that a "cure" for some cases of intractable tinnitus has been found.

Penner and Bilger believe that tinnitus associated with SNHL originates in cochlear malfunction, i.e., an imbalance in the tuning and suppression regions give rise to excess activity. They open the door to applying prototypical psychophysical data of cochlear functioning to the study of tinnitus. The late and great Juergen Tonndorf with whom this reviewer has had the honor of a long and productive association, analogies between tinnitus and pain. The causes of both tinnitus and intractable pain, he believed, involved **deafferentation** of nerve fibers. Control of tinnitus involves an interplay between large inner and small outer-hair-cell fibers provided they are **deafferented**. Finally, Zenner and Earnst, research otolaryngologists from Tübingen summarize possible molecular and cellular mechanisms which might contribute to some forms of tinnitus. These mechanisms constitute a part of a highly integrated network in sensory transduction which they divide into three different models: active motor tinnitus, transduction tinnitus and signal transfer tinnitus.

This important text summarizes recent thinking on tinnitus mechanisms from 23 important investigators. It should be part of the reference library of all serious workers in this challenging area. The editors' objective of asking the contributors to speculate on their perceptions of the mechanism(s) of tinnitus has been gloriously fulfilled.