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The Effects of Noise on Man, 2nd ed. by Karl D. Kryter FREE

Karl D. Kryter; W. Dixon Ward

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BOOK REVIEWS

Robert T. Beyer
Department of Physics, Brown University, Providence, Rhode Island 02912

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The Effects of Noise on Man, 2nd ed.

Karl D. Kryter

Academic Press, Orlando, 1985.
xi+688 pp. Price $34.50.

In 1950, when Kryter first published a monograph of this scope, one individual could become completely conversant with all of the research dealing with the effects of noise, both confirmed and conjectural, on man. By 1970, however, when the first edition of the publication bearing the present title appeared, the 914 references that were reviewed had to be selected from over 4000. Now, in 1983 (the year of publication of the latest research to be reviewed), the exponential burgeoning of publications has reached the point that although this version is described as comprising "critical reviews and interpretations of original source research literature (primarily English language) on the measurement of the effects of noise on people and animals" (p. xi), a claim of completeness is conspicuously absent. So although the book is the closest approximation to a single-author "Handbook on Noise Effects" that exists, the subject matter consists only of those areas that are of interest to Kryter, generally because he has himself conducted research and generated controversy in the areas concerned. Even with this circumscription, however, it has clearly become impossible for any single individual to extract accurately, from the thousands of articles on noise that have been published (both as journal articles and as in-house publications) since 1970, those that are the most important, and then to evaluate critically each one and fit the result into a coherent picture. I suspect that Kryter will be the last to attempt it.

Following a couple of short introductory chapters on the basic physics of sound measurement, Chap. 3 (32 pp.) represents a perfunctory review of auditory physiology and basic psychoacoustics, with an emphasis on masking. Of the 77 references cited in this chapter, only 7 are new (i.e., since 1970), and these all deal with the action of the aural reflex. One must infer that neither of these fields has changed much in the last 13 years, although Kryter does not say so explicitly. Similarly, Chap. 4 (54 pp.), on speech communication in noise, is largely unchanged from the 1970 version, the majority of the 10 new references (out of 78) dealing with the effect of hearing protectors on speech intelligibility in normal and hearing-impaired individuals.

Chapter 5 (63 pp.), allegedly on "Loudness, Noisiness and Vibration Effects," is in truth almost completely concerned with the distinctions among the loudness of a sound, its noisiness, and its annoyingness (or its "annoyance," as Kryter calls it). The trouble is that the attribute of noisiness, which Kryter invented, was never unambiguously defined by him, so the field has been in chaos for years, a chaos not mitigated by the discussion in this chapter (86 references, 24 new). While he wishes that the words "unwantedness," "unacceptability," "annoyance," "objectionableness," and "noisiness" were synonymous (p. 125), it has become clear to nearly everyone else that this is not the case, although the difference is nowhere near as great as he mistakenly infers that other investigators have found (p. 127).

The next three chapters deal with noise-induced hearing loss (NIHL) and in this area about 60% of the references are new. Chapter 6 (43 pp., 48 citations, 32 new) deals with the problem of separating the effect of noise on the auditory threshold from the effect of age (presbyacusis) or from disease or head blows (nosoacusis), and then further sorting out the effects attributable to the noises of everyday life (sociacusis), so that what remains can be considered to be "pure" industrial NIHL. The process is made simple by assuming, *inter alia*, that sex and race are not "significant factors in determining the threshold of hearing sensitivity" (p. 214), that presbyacusis and NIHL are additive, and that because women have less sociacusic exposure than men they have none at all (p. 211). With these simplifications, the topic of Chap. 7 (111 pp., 146 references, 88 new), "NIHL and Its Prediction," almost becomes amenable to analysis, although, to arrive at his own predictive equations relating NIHL to exposure, he must make additional bizarre assumptions, such as that all sound levels above 60 dBA are potentially hazardous, that the rate of growth of NIHL with exposure level is independent of exposure duration (indeed, that NIHL at any audiometric frequency grows at the rate of 0.5 dB per decibel of SPL until the NIHL reaches 10 dB, and then at the rate of 1 dB of NIHL per decibel of SPL from 10 to 40 dB NIHL), and that the rate of growth of NIHL with time is independent of exposure level, being given by 10 log Y, where Y is years of exposure (pp. 278–279). The end result is a new (previously unpublished) but largely inscrutable exposure index called the DL (damage level?) that he relates to known values of NIHL from the literature with greater or lesser success, depending on whether or not one believes that the man with his feet in the fire and his head in the freezer is, on average, quite comfortable. A short chapter (10 pp., 27 references, 16 new) that attempts to justify Kryter's opinion of how much NIHL constitutes auditory handicap, one based on the assumption that all listening occurs at "ordinary levels" (ca. 65 dB SPL), rounds out this section.

The remainder of the book, dealing with the nonauditory effects of noise, is the most up to date. In Chap. 9 (44 pp., 100 citations, 75 new), he reviews briefly the inconclusive evidence bearing on effects of noise on task performance, both concomitant and poststimulatory, ascribable to physiological "arousal," irritation, or preemption of neural channels. The salient point he makes here is that statistically significant adverse effects found in one experiment are only seldom confirmed in repeat experiments. Essentially the same conclusion is reached in Chap. 10, the longest in the book (135 pp., 244 references, 171 new) entitled "Nonauditory-System Response to Noise and Effects on Health," in which the most relevant contradictory literature bearing on the effects of noise on the autonomic system, on sleep, on senses other than auditory, on the cardiovascular system, and on mental health is competently dissected. His assessment of all this experimental and epidemiological evidence is that, although it fails to show consistently any direct permanent aftereffect of noise exposure other than to hearing, there is still reason to believe that noise may act indirectly, through the stress it generates in some people by "psychological factors"—viz., annoyance—to produce "an increase in the number of people with psychological and physiological health problems requiring the increased use of certain types of drugs and visits to physicians...(and) admissions to psychiatric hospitals" (p. 506). (This faith appears to be based on results from a single group of investigators.) This theme is pursued in Chap. 11, "Reactions to Community Noise" (92 pp., 121 references, 111 new), which proclaims aircraft noise to be the major source of the annoyance that presumably leads to these dire ends, as it is 10 dB worse, he concludes, than other traffic noise, and an additional 5 dB worse when it occurs during the evening or night. Support for these contentions, however, comes from some rather strange manipulations of published data, including equating the average degree of annoyance expressed by a population to the average number of annoyances felt by them (pp. 594–595).

Chapter 12, "Guidelines for Assessment and Control of Noise" (38 pp., 29 references, 25 new), discusses some of the present regulations and directives governing noise levels and durations and, finally, Chap. 13 constitutes a 7-page summary of the entire book.

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There is no question that this monograph provides much excellent critical analysis of data dealing with many facets of the effects of noise, and can therefore serve as an introduction and bibliographic source reference for any contemplated more thorough study of such facets. However, the coverage is far from complete: Besides the exclusion of literature in foreign languages, and of most animal studies, topics mentioned only briefly, if at all, include auditory effects other than loss of pure-tone sensitivity (e.g., changes in differential thresholds, tinnitus, etc.), the physiological substrate of even pure-tone loss, individual differences in susceptibility to damage, and the whole field of hearing protectors. In addition, the level of critical insight is not uniform, nor is the accuracy of the presentation: All too often experimental parameters are misstated, graphs and equations are reproduced without enough accompanying information to permit them to be understood, or experiments are misinterpreted. Indeed, some studies are ignored whose results challenge the validity of assumptions that Kryter makes in order to support his idiosyncratic recommendations for noise regulations. So although this book will be an indispensible asset to any future investigator concerned with one of the effects of noise on man, it is only a starting point, not a final authority: It will still be necessary to study original sources in order to achieve a balanced view of the state of knowledge about the noise effect under consideration.

W. DIXON WARD
Hearing Research Laboratory
University of Minnesota
2630 University Avenue S. E.
Minneapolis, Minnesota 55414

An Introduction to the Theory and Design of Sonar Transducers

Oscar Bryan Wilson

U. S. Government Printing Office, Washington, D.C., 1985.
xvi+187 pp. Price $5.60.

This book was written as a text for a course that has been given by the author at the Naval Postgraduate School, Monterey, for a number of years. The author expresses the hope "that it will also be useful for engineers who have some background in acoustics and electrical engineering and are beginning to work in the area of transducers for underwater sound." It will indeed be more broadly useful than just a course text, providing a good treatment of the fundamentals of transducer theory and design using equivalent circuit techniques. Although the emphasis is understandably on piezoelectric ceramics in the conversion mechanism, other mechanisms are not neglected.

The book contains ten chapters, each ending with a list of literature references and, except for the last two chapters, a set of problems for the student. The front matter is agreeably complete, with lists of figures, tables, and symbols, as well as the usual contents, preface, and acknowledgments.

Chapter 1 begins with a brief history of electroacoustic transduction and sonar. Five conversion mechanisms are then defined that fulfill the criteria of linearity, passivity, and reversibility to which the treatment in this book is limited. Next, brief notes on the underwater operating environment and symbology are given. Finally, the impedance analogy and the mobility analogy, used in electromechanical equivalent circuits, are introduced.

Equivalent circuit analysis is discussed in Chap. 2, starting with the general four-terminal network and a definition of reciprocity. Two simple examples are given, an electrostatic transducer and an electrodynamic (magnetic field) transducer. It is shown that the former is reciprocal and is conveniently represented by the impedance analogy, while the latter is antireciprocal and is best represented by the mobility analogy. Detailed admittance and impedance analysis of a simple piezoelectric transducer is given, using an impedance analogy circuit. Electroacoustic efficiency and electromechanical coupling factor are discussed.

Chapter 3 deals with properties of materials, beginning with the dielectric, magnetic, and elastic properties of ordinary solids, then developing the piezoelectric, piezomagnetic, and pyroelectric relations from a thermodynamic basis. The relations are simplified to include only the piezoelectric effect and the concept of a piezoelectric coupling coefficient is introduced. Finally, a brief note on elastic waves in solids is given.

Chapter 4 describes the properties of some common piezoelectric materials, including piezoelectric crystals, poled ferroelectric ceramics, ceramic composites, and piezoelectric polymers. Nonlinearities, stress effects, and aging of piezoceramics are discussed briefly.

Chapter 5 analyzes equivalent circuits of four simple piezoceramic vibrators, while Chap. 6 deals with more complex vibrators and introduces the acoustic loading of the water to the equivalent circuit. A simple Tonpilz sonar element is discussed in some detail and used to illustrate many of the design considerations that are important in a sonar transducer. Some special considerations applicable to very low-frequency projectors are discussed and a few existing designs are described briefly.

Chapter 7 discusses the properties of magnetostrictive materials, including the rare earth-iron compounds and the new metallic glasses.

Chapter 8 deals with hydrophone design. Two piezoceramic configurations are treated in some detail, a ceramic block in hydrostatic mode, and a ceramic tube with various poling and stress conditions. An analysis of noise in a piezoelectric hydrophone with a preamplifier is given.

A brief treatment of transducer arrays and directivity is presented in Chap. 9, beginning with a redefinition of reciprocity as applied to arrays. Directivity patterns of small line arrays of point elements are then used to demonstrate the effects of element amplitude, phasing, spacing, and the array length. Chebychev shading and superdirective arrays are mentioned briefly.

Chapter 10 covers some miscellaneous items, starting with a description of the array element interaction problem. Then there is a comparison of the maximum stress attainable from various conversion mechanisms. Next is a note on the need for tuning or matching a transducer to maximize power conversion. The unique requirements of laboratory or calibration transducers are then discussed and brief descriptions of some nonreversible conversion mechanisms are given. Finally, some problems of passive materials used in sonar transducers are considered and tables are presented on corrosion rates in sea water and properties of various alloys, elastomers, and transducer fill fluids.

This book should be useful not only to the sonar transducer designer, but also to underwater acousticians, sonar systems engineers, and others who would like to gain some appreciation for the problems of the transducer designer. The author covers a lot of material in a small introductory text and there is a good selection of references for further study. Some important areas that are computationally intensive are not treated, such as bond-graph analysis, finite-element techniques, and nonlinear programming; accessible references in these fields might have been provided.

The book contains several minor errors, mostly of a typographical nature; an Errata sheet notes a dozen errors and this reviewer has found at least as many more. At present, the book seems to be out of print. It deserves to be reprinted and perhaps the author could take the opportunity to correct its minor deficiencies.

GARFIELD W. McMAHON
Defence Research Establishment Atlantic
P.O. Box 1012
Dartmouth, Nova Scotia B2Y 3Z7, Canada

Adaptive Methods in Underwater Acoustics

Heinz G. Urban, Editor

D. Reidel Publishing Company, Hingham, Massachusetts, 1984.
xiv+785 pp. Price $89.00.

This book is a collection of papers from a NATO Advanced Study Institute (ASI), which is considered to be primarily a teaching experience for senior level industrial, university, and research institute professionals from different countries. The ASI consists of tutorial lectures, research papers, and workshops on selected topics. The first ASI concerned with signal processing was held in Grenoble, France, during 1964 and the resulting proceedings were titled "Signal Processing with Emphasis on Under-