

even resolve some unanswered questions about the EEG.

The AEP recorded from the scalp is a complex wave, probably the result of a distinct number of spatially independent components of different latencies, whose amplitude depends on the position of the recording electrodes. This partly accounts for the variability in evoked responses recorded under seemingly identical conditions. Assigning and assessing the sources of this variability are discussed by Emanuel Donchin, the organizer of the conference. In his chapter "Data analysis techniques," he stresses the contribution that multivariate statistical analysis and the general purpose computer can make in AEP studies.

Jerome Cohen's chapter, "Very slow brain potentials relating to expectancy: The CNV," reviews research on this new phenomenon, first reported in 1964, which requires averaging in order to be detected.

Other research topics covered in the book are: "Cross modality comparisons of average evoked potentials," by W. R. Goff *et al.*; "Specification of psychological variables in an AEP experiment," by Samuel Sutton; and "Diagnostic uses of the AEP," by Enoch Calloway. The discussion that followed the presentation of each paper at the conference is included.

Although much of the material has been published in other sources, this volume is useful as an excellent, easy-to-read overview, with a comprehensive bibliography. It should appeal to psychologists, neurophysiologists, clinicians, biomathematicians, system engineers, and other researchers concerned with the AEP or EEG.

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Air-Sampling Methodology

The Analysis of Air Pollutants. W. LEITHE. Translated from the German edition (Stuttgart, 1968) by R. Kondor. Ann Arbor-Humphrey, Ann Arbor, Mich., 1970. x, 304 pp., illus. \$18.75.

There is a widespread demand for a reordering of national priorities in favor of tackling the problems of the human environment. However, for purposes of simplification the various types of pollution have been compartmental-

ized although the human environment is a single, interrelated system.

Air pollution is one of the important compartments of the environmental problem. Authoritative analytical books are needed in this field. The present volume is one of the first of many that will be appearing to fill this need.

The first few chapters consider the background of the problem. The definition of terms, meteorological effects, and the hygiene of air pollution are briefly discussed.

Air sampling for the gaseous components of the atmosphere is discussed in 12 pages. Considering the limitations imposed by the size of the book the subject is well handled. The main deficiency is the absence of discussion of methods and equipment for the collection of airborne particles that are to be analyzed for the chemical components. Since the components of the air that cause the most misery to human beings are in the particulates, it would be a good idea to include much of the work on particulate analysis available in the literature in the next edition of this book. However, a section is presented in a later part of the book on dust and its collection for the purposes of gravimetry, microscopy, or counting.

A well-balanced presentation is given of a wide range of pertinent topics, among them photometric analytical methods, gas detection devices, automatic devices, gas chromatography, mass spectrometry, odor analysis, and radioactive substances. Of these topics, continuously operating automatic devices and gas chromatographic methods are the most thoroughly discussed.

Analytical methods are given for the standard air pollutants that are present in the atmosphere in fairly large amounts. In most cases for each pollutant the physiological and toxicological properties, the available methods, and some working procedures are presented. Pollutants thus surveyed include hydrogen sulfide, the sulfur oxides, ammonia, hydrazine, nitrogen oxides, carbon oxides, halogens, arsenic, lead, mercury, aldehydes, aliphatic chlorinated hydrocarbons, monocyclic and polynuclear arenes, phenols, benzo(a)pyrene, and others.

A few minor errors are present. For example, on page 135, lines 23 and 24, "fluorescein" and "fluorescin" should be interchanged in the first part of the sentence, and on page 234 the determination of acetone is said to involve colorimetry when actually titrimetry is

used. Another point worth considering is the absence from the book of any discussion of the chromotropic acid method for formaldehyde. Simpler, faster methods are available for the determination of the polynuclear arenes than what is described. Much more selective methods are available for the determination of benzo(a)pyrene. In the method described benzo(k)fluoranthene would be a serious interference.

A table in the appendix on the conversion of aerotoxicant concentrations from ppm to mg/m³ and vice versa is a worthwhile portion of the book. Another table worth including in a future edition of the book would be one showing the range in concentration of urban air pollutants and the highest values that have been obtained.

I was favorably impressed with this book. I think it should be on the shelves of all people interested in the technical aspects of air pollution.

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High-Frequency Sound

Physical Ultrasonics. ROBERT T. BEYER and STEPHEN V. LETCHER. Academic Press, New York, 1969. x, 382 pp., illus. \$18.50. Pure and Applied Physics, vol. 32.

Physical Principles of Ultrasonic Diagnosis. P. N. T. WELLS. Academic Press, New York, 1969. viii, 284 pp., illus. \$12.50. Medical Physics, vol. 1.

Physical Ultrasonics is a veritable handbook of all the important interactions of matter and ultrasonic energy, especially as used to delineate the properties of matter. It is intended for the graduate and the advanced student, as well as for the worker in the field. *Physical Principles of Ultrasonic Diagnosis* pays due attention to the physical and engineering aspects of ultrasound but is intended chiefly for the medical specialist who would like to (indeed who should) know more about the tools he is using.

For its intended audience *Physical Ultrasonics* provides a ready reference to theory, description of experiments, and comparison of measurements and predictions. A good working knowledge of thermodynamics is required to derive maximum benefit from the book.

The introductory material includes a clear exposition of Eulerian and Lagrangian formulations, in which the

stage is set for a later discussion of nonlinear effects. The impedance concept is developed, chiefly for use later in treating the piezoelectric resonator. The near field of a Rayleigh piston, a special study of the Williams group at Brown University, is concisely discussed. An especially useful presentation is that on the variety of waves and mode conversions in isotropic and anisotropic solids.

The piezoelectric resonator is the chief ultrasonic source discussed. A section on bonding techniques at low temperatures will be invaluable to the experimenter plagued with this problem. The treatment of the construction of thin film transducers for acoustoelectric amplifiers is not very detailed, however.

Among the several detection and measurement techniques discussed are the radiation pressure, reverberation, pulse-echo, sing-around, interferometric, and optical diffraction methods. Information on the fields of usefulness of each is given, albeit somewhat buried in the text.

The enthusiasm of the authors for their subject is clear in their treatment of propagation and absorption. The relaxation concept binds all together, and furnishes a common language of description. Because symbols are not standardized, the reader must be cautioned to be sure he can locate first definitions. The expression of relaxation fundamentals in terms of irreversible thermodynamics is treated in a particularly lucid fashion. Among other topics on relaxation in gases, the Cole diagram for distinguishing multiple processes is treated concisely.

The complex and still developing theories for relaxation in liquids are treated at length, with sobering comments on our lack of comprehension of the cause and the significance of bulk viscosity. The phenomenological theory of viscoelastic liquids and the Maxwell models are presented at some length. Useful data on the speed of sound in homologous liquids are developed in a discussion of Rao's rule. Binary mixtures get special attention, with liberal use of reaction rate theory.

The behavior of liquid helium is accorded an all too brief treatment. Use of the Gibbs free energy provides an illuminating (if semiphenomenological) insight into the origins of second sound. A graphical presentation nicely summarizes the qualitative results. Discrepancies between predictions and measurements are explained as being due to the change in the proportions of

normal and superfluid helium as temperature changes.

The chapter on nonlinear acoustics reviews the many approaches, most of which employ the useful concept of discontinuity distance, until the wave "shocks up." The universal appeal of solutions in closed form is revealed in attempts to describe nonlinear phenomena in ways that can be cast into the form of Burgers's equation. One nonlinear phenomenon, cavitation, is treated mostly by reference to the classical papers. Of course, a satisfactory treatment would require a full book.

In phonon-lattice interactions the authors again speak with an enthusiasm founded on long intimacy with the topic. The importance of third-order elastic moduli and of dislocations in these interactions is fully appreciated. Spin- and electron-phonon interactions are used to introduce a wide variety of attenuation, resonance, and amplification phenomena associated therewith.

The book is written in a felicitous style and with an evident eagerness to impart knowledge. Errors discovered are few and small. References go to 1967, representing the usual two years that a book takes out of an author's life. However, that part of their lives that the authors have transferred to this book should help to make it a concise reference on the state of the art for all workers in the field of physical ultrasonics.

To use the information in *Physical Principles of Ultrasonic Diagnosis* to best advantage, the medical specialist must also have had at least some beginning courses in acoustics and electronics.

The abbreviated treatment of wave motion with which the book starts places much emphasis upon the concept of impedance, which is used extensively later on. With few preliminaries the author supplies pertinent data on the velocity, absorption, and impedance for a wide variety of tissues of interest in ultrasonic diagnosis. A useful table provides information on the reflection, referred to a perfect reflector, at the interfaces between tissues (and other materials). The few graphs that show the frequency dependence of tissue properties have linear abscissas, presumably to assist physicians who are not familiar with the logarithmic presentation that physicists use.

The chapter on transducers provides many practical data on the probe construction required for producing short pulses. Impedance concepts provide a common language of description. Dy-

namic range is defined with reference to the situation obtaining with a perfect reflector normal to the ultrasonic beam. The near-axial field of a Rayleigh piston source is presented in the classical manner, with notes on electroding for reduced side lobes. Gain from focusing transducers is discussed, with data on optimizing the usual water coupling bath commonly employed in ultrasonic diagnosis. It is pointed out that focusing systems minimize transient buildup time because all the energy arrives at the focus simultaneously.

Information acquisition by microphone, schlieren, and radiation pressure methods is discussed briefly. However, the major portion of the book is devoted to the pulse-echo system that is used so extensively. The swept-gain method for increasing dynamic range by increasing gain as echo delay increases is explained in detail. This procedure partially offsets the attenuation that echoes undergo in transmission through human tissues. The author is very much at home with electronic techniques, and discusses them in depth. Emphasis is on vacuum tube systems. Extremely useful data are given on typical echo amplitudes (referred to a perfect reflector) for many human body structures. Typical references are tabulated on the clinical experience with both A- and B-scope presentations.

The discussion of Doppler flowmeters is, with its many references, an excellent summary of the state of this developing field. Several other topics receive lesser attention, including the ultrasonic microscope, Sokolov tube, and ultrasonic holography.

An important concluding chapter deals with the possible hazard from ultrasonic energy. On the basis of the experience of many workers, the author concludes that no biological effects should be observed at irradiation intensities of less than 0.1 watt per square centimeter, provided that radiation times do not appreciably exceed that for obtaining a satisfactory record.

Some 25 pages of references are provided, extending through 1967. On the whole the book should be of great help to the medical specialist. It should also make life easier for the biomedical engineer who may be called upon to devise a specific and special ultrasonic diagnostic system.

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