Books

A Contemporary Theory

Theory of Hearing. By Ernest Glen Wever. 484 pp. John Wiley and Sons, Inc., New York, 1949. $6.00.

In this day of preoccupation with information theory and with the role of the sense organs in the impedance-match of machine to man (or should we say man to machine?) a book with the title *Theory of Hearing* is assured of an eager public. Those who are familiar with Professor Wever's work know that he and his teammates have been among the most prolific contributors to the field of audition for the last two decades, i.e., ever since the discovery of the Wever-Bray phenomenon.

The present book extends, amplifies, summarizes, and crystallizes these researches by attempting to present them in the unifying framework of the volley theory. The book is subdivided into three main parts. After a guided tour through the history of the so-called *Classical Theories,* there follows a section on *Modern Developments,* which deals mainly with the audioelectric response of the cochlea and which culminates in an exposition of the volley principle of nerve action. The third and by far the largest part of the book is given over to the *Volley Theory.* The basic evidence in its favor is cited and its ability to account for certain facts of auditory experience is tested (here the critical reader might want to argue with the author for not assigning their due share to data that have become available during the last decade, in particular data on the mechanical properties of the ear and experiments making use of stimuli other than pure tones). The author feels that his theory, which on occasion he calls the volley-resonance theory in order to accent its dual character, represents the logical compromise between the two main explanatory principles for auditory phenomena. He is convinced that he has impartially called upon the resonance and frequency principles since "it is only in their harmonious combination that we come to a full realization of our explanatory purpose". Wever admits freely however that "there may still be a degree of uncertainty as to the particular spheres of operation of these principles . . ." So there is room for disagreement and some of Wever's colleagues will probably feel disinclined to subscribe to his particular formulation of the two principles and to the roles he assigns to them in his explanatory scheme.

But this is neither the place to discuss the details of Wever's presentation of his case nor the place to argue the merits of his particular form of a dual theory. In his introduction Wever warns us that his treatment is not exhaustive: evidence is selected, marshaled, and weighed in terms of relevance to theory. For the research worker in hearing, the main value of the book lies then in its coherent presentation of the work of the Wever group and in the systematic exposition of an admittedly controversial theoretical viewpoint. The nonspecialized reader will find in this book a highly readable account of *a* contemporary theory of hearing by a man whose stature in the field is universally recognized.

To this reviewer the book touches, however, upon an issue of more general interest in this model-conscious age. In his introduction Professor Wever states that he has "given little attention to mechanical models of the cochlea" and "little credence to mathematical formulations of theories". He feels that at present both types of models are quite as likely to confuse as to inform. This is a serious accusation that can hardly be shrugged off by physicists, applied mathematicians, and engineers whose interest in the ear transcends mere curiosity. Some of them might be inclined to retort that Professor Wever's treatment of mathematical and physical concepts is not always successful. But this leaves the central issue still wide open.

Too many writers of college physics texts (or of introductory texts in physiology and psychology for that matter) are satisfied with waving a harplike basilar membrane into their students' faces as a definitive explanation of the phenomena of hearing. We should therefore not blame Professor Wever for repeatedly slaying this bare-fact saddle-riding ghost of a resonance theory.

Many workers have contributed to progress in hearing in different ways. Psychologists and physiologists have had to learn how to handle physical instruments and concepts, and sometimes have even had to acquire competence in new mathematical techniques. The physical scientists have had to realize that no off-hand invocation of general laws or principles would yield valuable results without a first-hand understanding of the experimental realities of biological structures, or of behaving organisms. Neither group of scientific workers wants to mislead or confuse the other, and both groups are making use of formal—mathematical, physical or verbal—models or principles of some sort. We know that it is possible to transform a physiological model into a logically equivalent mathematical model. This, however, does by no means abolish preferences for certain types of models, preferences that will be determined by the Zeitgeist and one's own training. Everyone is by now agreed that problems in borderline areas can be successfully attacked from the vantage point of different disciplines. The usefulness of a model, and in particular of a radically new one, is easily enough measured in terms of its ability to account for a broad spectrum of experimental material. Out of the richness of his own experience Wever has come forth with what to him are the most valid generalizations on the sense of hearing. By sharing his knowledge with others, Wever is bound to act as a catalyst in the making of new models.

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Biological Effect of Cosmic Rays

Cosmic Radiation and Its Biological Effects. By Victor F. Hess and Jakob Eugster. Second edition, revised and augmented. 173 pp. Fordham University, the Declan X. McMullen Company, Inc., Distributors, New York, 1949. $4.00.

This volume was originally published in German in 1940 under the title *Die Weltraumstrahlung und ihre biologische Wirkung,* Orell Fussli Verlag (Zurich-Leipzig). The book has now been partially rewritten and translated into English. It is an interesting document dedicated to the collaboration of the physicists and biologists.

The first part of the book was written by Hess and is a lucid and up-to-date (1948) presentation of the physics of cosmic radiation. There is an interesting chapter on the history of cosmic rays followed by essays on methods of measurement, the distribution of cosmic ray intensity in the atmosphere and below the earth's surface, and the interaction of cosmic rays with matter and the origin of cosmic rays.