considered by any means dangerous for people in general. This hemorrhage first appeared in the Appleton family, who brought it with them from England. *None but males are bleeders, whose immediate children are not so, and whose daughters, only, have sons thus disposed.* As to the precise proportion of these, who may resemble their grandfathers, in bleeding of this kind, past observation furnishes no data.

The italics are mine.

GEORGE E. LADD

CHEVY CHASE, MD.

QUOTATIONS

THE MELLON INSTITUTE

THE formal dedication of the Mellon Institute's huge new building, a temple of science in outward appearance and inward spirit, is an event of national magnitude. And properly so when it is recalled that the institute has served some 4,000 firms, developed 650 processes and products and created ten new industries since Andrew W. Mellon and the late Richard B. Mellon founded it in 1911. The new structure is a monument not only to the generosity and far-sightedness of the two brothers who made it possible but of the late Professor Robert Kennedy Duncan, who conceived the industrial research fellowship system which has been such a brilliant success.

When the small manufacturer hears of the millions spent annually for research by great companies he wonders how long he will last—wonders how he, without even a testing laboratory, can compete with trained crews of Ph.D.'s hired to improve yarns, telephones, lamps, radio sets, tins for foods and foods themselves. The Mellon Institute is his salvation. Here for a few thousand dollars science doffs its coat, rolls up its sleeves, solves his problem, creates values for him, and what is more important, opens his eyes to the rich return that research pays.

Though this social aspect of the work done in accordance with Robert Kennedy Duncan's policy needs to be stressed, it would be wrong to regard the Mellon Institute merely as an industrial life preserver. As a non-profit-making enterprise it plows back for the public good the excess moneys that may not remain in its bank account. So we find it concerning itself with more than skinless frankfurters, soapless soaps, flaked coffee, shoes that can be polished merely by rubbing a cloth over them, razor blades, unbreakable dishes of new plastic compounds. It draws on its own scientific and financial resources to solve the problem of smoke and dust, to arrive at better ways of diagnosing tuberculosis, to study methods of treating pneumonia, to illuminate the dark subject of dental decay. Nor is it unmindful of its obligation to advance science as such. Its work in theoretical chemistry and biology, for which new facilities are provided, promises to be even more distinguished in the future. Under Drs. Robert Kennedy Duncan and Raymond Bacon, and latterly under Edward R. Weidlein, the institute has become not only the technical first-aid of big and little business, but a training school for future laboratory directors, an experiment station for the advancement of science, a clearing-house of information for the public. As such it deserves not only the good wishes and congratulations of the manufacturers whom it has served, but of a wider public that may not be fully aware of its high place in industry and science.—*The New York Times.*

SCIENTIFIC BOOKS

THEORY OF SOUND

Vibration and Sound. By PHILIP M. MORSE. New York: McGraw-Hill Book Co., 1936, pp. xv + 351, $4.00.

THE outstanding advances in acoustics during the last two decades have been made chiefly in physiology and in engineering rather than in the physics of sound. Most of the recently published books on the subject have reflected this trend, but this one by Professor Morse is written almost entirely from the point of view of the classical physicist. It emphasizes the physical principles underlying all engineering applications.

I have used the term "classical" advisedly, as from a casual reading of the announcement of the book one might get the quite erroneous impression that at least certain phases of the subject are treated by quantum mechanics. While it is true that some acoustical phenomena, such as the abnormal attenuation of sound in gases discovered by Knudsen, can not be satisfactorily explained without resort to quantum physics, these particular matters are not discussed.

A study of this book does, however, reveal that there is an interesting parallel in the relationship between electrical engineering and acoustics, on the one hand, and wave mechanics and acoustics, on the other hand. To the beginning student the general principles of electrical circuit phenomena are most easily explained by means of acoustical analogies, but in the electrical engineering art there have been developed theories and formulae covering many combinations of circuit elements with which the practicing engineer has become much more familiar than with the theories relating to corresponding mechanical and acoustical systems. Because of this familiarity, it has become the custom to describe various acoustical phenomena in the language of the electrical engineer by reference to corresponding electrical circuits. In presenting the principles of wave mechanics, Schroedinger and subsequent expositors of the subject made use of acoustical analogies, showing particularly the similarity in the problems of finding the allowed energy levels in atomic physics and the normal modes of vibration of mechanical and acoustical systems. Because of the extraordinary interest in atomic physics in recent years, the former class of problems has become more familiar to the theoretical physicist than the latter. In this book, therefore, some of the mathematical techniques used in wave mechanics and particularly the idioms which there have become familiar are applied to problems in acoustics.

The book deals most particularly with those parts of acoustics to which the mathematical methods used in wave mechanics are especially applicable, that is, those in which normal modes of vibration are determined from a differential wave equation and the boundary conditions and in which the resulting motion under a given force is determined by expansion of the force in a series of terms characterizing the normal modes of motion. The extent to which this method of treatment dominates the discussion throughout the book is indicated by the fact that nothing or little is said about velocity potential, the dynamical equations of Lagrange or the principle of reciprocity. The author devotes considerable space at the beginning of the book to the vibrating string, as this is admirably adapted for priming the student in the mathematical methods used in most of the succeeding chapters, which deal with bars, membranes, plates, radiation, propagation and scattering of sound, speech and hearing, and the acoustics of rooms.

The engineer may not find this book entirely convenient if he is looking for information of the kind which is customarily given in engineering handbooks. Some of the notation, which is often at variance with that adopted by the American Standards Association, may be unfamiliar to him, *e.g.*, ν is used instead of f for frequency and a clockwise instead of the conventional counter-clockwise rotation of the positive time vector is adopted. On the other hand, the student who wishes to become thoroughly grounded in certain methods of the theoretical physicist as applied to acoustical problems and at the same time to obtain a comprehensive picture of the physical relationships involved, will here find an excellent introduction. Although the discussion throughout the book is based on well-established principles, the presentation is refreshingly original as well as clear. A set of well-chosen, illustrative problems is given at the end of each chapter.

It has long been customary to consider the problems in the acoustics of rooms from the standpoint of wave propagation and the mean free path of the wave. This method has been fruitful in dealing with practical problems. More recently a number of investigators have studied the subject analytically by the more conventional methods of mathematical physics whereby the normal modes of vibration together with their periods and rates of decay are determined from the field equation and the boundary conditions. This is the method of treatment adopted in this book. Although it may not as yet have been of great direct help in the acoustical design of rooms because of the difficulty of obtaining even an approximate solution of the equations in practical cases, it is extremely valuable in that it affords a clear physical picture of the nature of the acoustical phenomena in rooms. The discussion by Professor Morse is, I think, more illuminating than anything presented heretofore from this point of view.

The particular forms of the apparatus and instruments chosen as examples for the application of the mathematical methods are not of a kind that have come into commercial use, nor perhaps of a kind that any one should want to build for purposes of study. They apparently have been idealized to illustrate more effectively the points the author wishes to emphasize. This procedure is in line with the whole plan of the book, which is to discuss and bring out those principles that are physically fundamental to the science rather than to give a description of things which may be here to-day and gone to-morrow.

E. C. WENTE

SPECIAL ARTICLES

FUNDAMENTAL THEOREMS OF TRIHORNOMETRY

(1) A *horn angle* is the figure formed by two curves having a common tangent at a common point. Only the case of first order contact is considered here. The unique conformal invariant of a horn angle I have shown to be

$$M_{12} = \frac{(\gamma_2 - \gamma_1)^2}{\frac{d\gamma_2}{ds_2} - \frac{d\gamma_1}{ds_1}}$$

where γ represents curvature and s arc length. This combination of the two curvatures and the two rates of curvature is therefore called the *natural measure* of the horn angle. It is a real abstract number.