JOURNAL NOTES

Focusing Sound

In his investigations on the scattering of energy from objects small compared to the wavelength, Lord Rayleigh often applied his results interchangeably to sound waves and electromagnetic waves. With this in mind, several artificial dielectric lenses originally designed for microwave use were experimented with and found to focus acoustic energy of similar wavelengths. As a result, two novel types of sound refracting media have been developed, both delay mechanisms. One is an obstacle type in which the advancing wave is retarded by rigid objects —spheres, disks, or strips—arrayed in an open latticework. The other utilizes a path-delay principle, the wave being forced by tilted guide plates resembling a venetian blind to travel a longer path than that normally taken in free space.

The frequency dispersion inherent in the obstacle array allows a prism of this type to be used as a sound spectrum analyzer. The path-delay construction, however, is nondispersive so that convergent lenses exhibit sound-beaming directional effects over very broad frequency bands. On the other hand, divergent lenses are diffusers of sound, and, when placed in front of loud speakers that are too directional, provide more uniform angular distribution of energy, especially at the high frequencies.

The exchange of information between the acoustic and electromagnetic areas continues to grow. For example, acoustic tests on some microwave lens and prism structures have provided information on their microwave characteristics. F.K.H.

Refracting Sound Waves. By W. E. Kock and F. K. Harvey. *J. Acous. Soc. Am. 22: 471, September, 1949.*

Motion in a Magnetic Field

Classically a charged particle in a constant magnetic field moves in a circle whose plane is perpendicular to the magnetic field. The center of this circle, which remains constant throughout the motion, is determined independently of the energy by the initial conditions.

The present paper is concerned with finding the analogue, in both nonrelativistic and relativistic quantum theory, of this simple description. It turns out that quantities corresponding to the center of the circle can be introduced which are constant and independent of the energy. These quantities satisfy uncertainty relations peculiar to the quantum theory. As a result, although the particle can be said to describe a circle, in contrast to classical theory, the center of the circle can no longer be located exactly.

The remainder of the paper is devoted to the mathematical details of various solutions. Well-known techniques are applied based upon the resolution of circular into simple harmonic motion. General solutions for the nonrelativistic and relativistic equations are found from which forms given by other authors can be obtained by specialization. The emphasis, in the present treatment, on the quantities representing the center of the circle, greatly simplifies the physical interpretation of the mathematical formulas. M.H.J.

Motion in a Constant Magnetic Field. By M. H. Johnson and B. A. Lippmann. *Phys. Rev. 76: 828, September 15, 1949.*

Skin Heat

Knowledge of skin temperature is important because the heat lost from the body is determined by the rate of temperature change between the deep body tissues and the body surface. The thermal gradient between the skin and the external environment determines how much heat will be lost by convection, conduction, vaporization, and radiation. Also, the sensations of heat, cold, and even burning pain depend upon the skin temperature, and a knowledge of these factors is essential in understanding the mechanisms of the control of body temperature in health and disease. Further, it has been seriously proposed that the level of average skin temperature be used as the most dependable index of comfort for air-conditioning purposes.

The temperature of any surface is measured with difficulty and this is particularly true when measuring skin temperature. If a thermometer is placed against a surface, the temperature of the surface is altered by the flow of heat into the thermometer and by the interruption locally of the passage of heat into the normal environment of the surface. For skin, which is warmed by the flow of blood from the interior of the body, there is also interference with the supply of heat to the surface.

Many types of thermometers have been developed for measuring skin temperature, including ordinary clinical thermometers rolled on the skin under a notched cork, mercury thermometers with flattened bulbs, thermocouples, resistance thermometers, and low temperature radiation pyrometers (radiometers). All of these instruments, except the radiometer, require contact with the skin. As the skin (white or black) has been proved to be almost a perfect black body for infraradiation, the radiometer can be used as a precise instrument for skin temperature measurement, and is generally accepted as such. Fine wire thermocouples under carefully standardized conditions agree closely with the radiometer. Any skin thermometer which has much mass or which covers much of the skin surface gives quite misleading readings.

Comparison of the various skin thermometers was carried out under a variety of conditions (simulating the out-of-door environment) against a leather surface of known t mperature. It was found that the radiometers gave the most dependable readings, fine wire thermocouples next, and other types of thermometers were unsuitable for measurements of this sort. J.D.H.

Direct Experimental Comparison of Several Temperature Measuring Devices. By Alice M. Stoll and James D. Hardy. *Rev. Sci. Inst. 20: 678, September, 1949.*

Nucleons

The Dirac theory describes correctly the spin of the proton and neutron, but attributes to them magnetic moments of 1 and 0 nuclear magnetons, respectively. This is in conflict with the experimental values of 2.79 and —1.91. In 1938, Fröhlich, Heitler, and Kemmer attempted to explain this difference by taking into account the interaction of the nuclear particles with the meson field of the vacuum, but obtained infinite results. Schwinger has recently been able to circumvent the infinities in the analogous problem of an electron interacting with the photon field of the vacuum and has obtained excellent agreement with experiment. This success raised the hope of accounting similarly for the anomalous magnetic moments of the proton and neutron.

A relativistic calculation leads to the following results: the anomalous neutron and proton moments are found to be finite, of the right sign, and correct order of magnitude, but their ratio is —7 compared to the experimental value of —1.08. However, in view of the approximations necessary to carry through the analysis, qualitative agreement is all that can be expected. A further conclusion is that in high energy processes, the effective anomalous moments are considerably smaller than under usual conditions.

The interaction of nucleons with the meson vacuum also gives rise to a small electrical force between a neutron and an electron. This is due to the fact that part of the time the neutron is dissociated into a proton and a meson. The magnitude of this force was calculated and compares reasonably well with experiment.

Similar calculations have recently been carried out by Luttinger, Case, and Slotnick, and by Heitler. S.B.

On the Electromagnetic Properties of Nucleons. By Sidney Borowitz and Walter Kohn. *Phys. Rev. 76: 818, September 15, 1949.*

Catalysis

Many gas reactions are accelerated when they take place at the surface of a finely divided solid, a "heterogenous catalyst." In the process of adsorption it is recognized that gas often does not adhere uniformly to the surface of a catalyst. In many cases it has been possible to stop the reaction by the adsorption of an extremely small quantity of a foreign gas, a "poison." The amount of poison used is much less than the amount necessary to cover the entire surface of the catalyst, showing that only a small portion of the surface is catalytically active. Because of this nonuniformity, one cannot assume that a given step in a catalytic process determines the reaction rate, since at one part of the surface one process (say, rearrangement) may be slow, while at another, a second part of the catalysis (say, desorption) may be slow.

The part of the surface which will catalyze the reaction most effectively will be where the reaction itself will take place with sufficient speed, while at the same time the products will be able to break away and escape. The location of the optimum site will depend upon the rates of these two reactions being equal and upon the pressure of the reactants. A quantitative treatment of these notions is applied to the decomposition of ammonia.

It appears that adsorption data are only vaguely related to catalysis, because sites of overwhelming catalytic importance may not contribute appreciably to adsorption. G.D.H.

Catalysis on Non-Uniform Surfaces. By G. D. Halsey, Jr. *J. Chem. Phys., 17: 758, September, 1949.*

Golf Ballistics

The trajectory of a golf ball is determined by the force with which the club strikes the ball and by the forces which act on the ball during its flight through air. In a study of the latter, spinning balls, rotating up to eight thousand revolutions per minute, were dropped through a horizontal wind stream with a wind speed of one hundred and five feet per second. For convenience the force may be described as "drag" in the direction of the wind, and as "lift" perpendicular to it.

The drag of a standard golf ball increases almost constantly from six to eight hundredths of a pound over this speed range, and it reduces the distance of a drive by about one-third. The lift increases exponentially with the rotational speed, levelling off at a value of about six hundredths of a pound. Generally there is under spin and the lift is upward, increasing the height and distance of the drive, although rotation about an inclined axis can result in large horizontal sidewise forces. Accordingly, with precise swinging, the expert has remarkable control of the ball, while the frequent and often disastrous hooks and slices of the average golfer are to be expected.

The performance of a smooth ball emphasizes the importance of surface markings. The drag is about the same as for a standard golf ball, but the lift is entirely different. Below five thousand revolutions per minute the lift is negative; above that speed it is positive, but less than for a standard ball. In driving tests, as the club head speed increases, the smooth ball curves downward more rapidly, resulting in driving distances about half those obtained with a standard ball. J.M.D.

The Aerodynamics of Golf Balls. By John M. Davies. *J. App. Phys., 20: 821, September, 1949.*

The Tortoise and the Hare

A United Press dispatch from Cincinnati reports that science fiction writers are lamenting the fact their thunder is being stolen by the scientists who are coming up with things fiction writers had never even imagined. They're not alone: scientists are lamenting the fact that some of the science fiction writers' thunder *could* be stolen.