Journal notes

Acoustically Coupled Rooms

Many useful engineering formulas in room acoustics can be obtained from the methods of "geometrical" acoustics which assume that sound travels as rays in a manner somewhat similar to that of light. However, these results, which are but an approximation, are sometimes quite misleading. A rigorous analysis of the behavior of sound waves in a room can be had by treating the acoustical system as a boundary value problem. In recent years, consideration has been given to rooms having nonuniform shapes and arbitrary wall materials. The present paper considers one such problem, that of two rooms which are acoustically coupled by a common window area.

In attacking such perturbation problems, the following procedure has been found useful. First, to determine the solution of the boundary value problem for individual normal modes of vibration; then, to check this theory experimentally for the individual modes by the use of scale-model rooms. More complex cases can then be treated in terms of summations of normal modes.

The analysis of the present paper for isolated normal modes of vibration explains some discrepancies concerning the acoustics of coupled rooms noted by earlier researchers between experiment and prediction from geometrical acoustics; for example, the dependence of absorption in a room on the position of the open area which couples the room to an adjacent one. The results of this paper show that where the window area is small compared to the partition which separates the two rooms, the effect of the coupling window depends on the square of the unperturbed pressure at the window; for the case where the window area is comparable in size with the partition which separates the two rooms, the disturbing effect of the partition will be least at a particle velocity node.

The results of this application of the wave theory are useful in understanding the limitations of similar results obtained from geometrical acoustics. C.M.H.

On the Acoustics of Coupled Rooms. By Cyril M. Harris and Herman Feshbach. *J. Acous. Soc. Am. 22: 572, September, 1950.*

The Trill Threshold

The major weapon psychologists have for their exploration of perceptual processes is the threshold, the breaking point at which an event stops being perceived one way and starts being perceived another. A threshold of detectability is the breaking point between present and absent; a differential threshold is the breaking point between change and no change, etc. Now a new breaking point in auditory perception has been added to the list—the point at which a pattern of tones stops being heard as a single melody and breaks into two. This threshold may open new research into our perceptions of music.

The threshold is determined most easily with a pattern of two tones. The tones alternate rapidly to produce a trill. More technically, an oscillator is modulated in frequency by a square wave of ten cycles per second. In this simple case the pitch is heard moving up and down between the two notes if the difference in frequency is small. As the frequency difference is increased progressively, a point is reached at which the trill breaks. Then one hears an intermittent high tone and an intermittent low tone, but the two seem unrelated and unsynchronized. It is as if a listener's melodic tracking cannot follow sudden changes in pitch larger than a certain critical amount. This critical amount, the trill threshold, increases as the average frequency of the two tones is increased.

Trill thresholds can be used to study more complex patterns. Listeners vary the frequency of one tone in a melody above or below the surrounding tones until they determine the point at which the variable tone sounds detached from the pattern. With the electronic equipments now available it should be possible to formulate laws of melodic organization analogous to those already known for visual perception. G.A.M.

The Trill Threshold. By George A. Miller and George A. Heise. *J. Acous. Soc. Am. 22: 637, September, 1950.*

Exchange Currents in Nuclei

The existence of exchange forces between nucleons, that is, of forces requiring the exchange of identity of a proton and neutron during an interaction between them, implies that electric charge must be transferred between the neutron and proton and therefore that electric currents flow in the intervening space between the particles. Such currents will in general give rise to a so-called exchange contribution to the magnetic moment of a nucleus and will also modify the cross sections for photonuclear processes. In the meson theories of nuclear forces the carriers of these exchange currents are the electrically charged mesons whose exchange by nucleons is presumed to be the origin of the nuclear forces themselves. Because of the difficulties inherent in meson theory at the present time, it is of interest to ascertain just how much information can be determined concerning the nature of these exchange currents without resort to any particular model of nuclear forces.

In the present paper, which is a generalization of earlier work on this subject (see A. F. Siegert, *Phys. Rev. 52: 787, 1937* and R. G. Sachs, *Phys. Rev. 74: 433, 1948*), it was found that a considerable amount of information concerning these exchange currents could be obtained simply on the assumption that electric charge was differentially conserved together with the validity of certain invariance properties of the Hamiltonian of a system of nucleons—invariance under translations and rotations and symmetry between all nucleons—which interacted only through static two-body forces. The exchange current density can be written as the sum of two parts. The first part, an irrotational charge-bearing current density characteristic of the potential flow between a source and a sink of charge, is completely determined by the condition of differential charge conservation and accounts for the actual transport of charge between the nucleons. The sec-