Resonance in the External Auditory Meatus

IN investigations on the extent to which objective tests can be used to obtain information on the magnitude of the effective amplification hearing aids give to a deaf user, a knowledge of the extent to which resonance occurs in the auditory meatus is of value. In normal human beings such a resonance occurs in the region of 2,000–3,000 cycles per second and to some extent accounts for the shape of the minimum threshold hearing curve as the frequency is varied. It is possible to calculate the magnitude of the resonance from results of mechanical impedance measurements at the opening of the meatus and to demonstrate its existence by means of a probing pressure microphone which indicates increase of pressure as the probe approaches the tympanic membrane. The method has limits, however, and in addition to being inconvenient can cause damage if extreme care is not taken.

Recently a method has been used which permits the measurement of the magnitude of resonance without the introduction of a measuring device into the meatus. It consists in replacing the air in the meatus by some other gas in which the velocity of sound V differs from that in air ($V = 332$ metres per second). The method uses a moving coil telephone receiver which has two tubes of narrow bore inserted through the periphery of the earcap. The receiver is held comfortably in position on the ear by means of a springy headband, the cap of the receiver being covered by rubber to reduce leakage to the external air. One of the tubes is connected to a cylinder of hydrogen ($V = 1{,}261$ metres per second) and the other tube left free to the external atmosphere. When hydrogen is allowed to pass at a slow rate, by means of a reducing valve, the air in the meatus can be displaced by hydrogen in quite a short time (a minute or so). If the receiver is connected to an attenuator operating on the output of an audio-frequency oscillator, hearing measurements can be made either at threshold or by aural balancing, and the effect of interchange of air and hydrogen quickly determined.

It is found that at frequencies below about 2,500 cycles per second the introduction of hydrogen reduces the intensity level of the sound, the reduction reaching a maximum of about 12 decibels at 2,500 cycles per second. As the frequency is raised further it is found the intensity level first increases as the hydrogen enters, reaches a maximum and then diminishes, while at a frequency in the region of 6,000 cycles the final level is equal to that with air in the meatus. At a frequency of about 9,000 cycles per second, the introduction of hydrogen raises the sound-level by about 9 decibels and at higher frequencies the effect diminishes rapidly to that of a reduction again. The resonant frequencies are not quite in the same ratio as that for the two velocities of sound (3·8/1) nor is the increase in level at 9,000 so high as the decrease in level at 2,500 cycles per second. This may indicate that the substitution of a lighter gas in the ear disturbs what might be an optimum reduction factor for the ossicular chain between the tympanic membrane and the oval window, so that there is an overall loss of efficiency due to the change. The initial increase and final decrease in the sound-levels shown in the region from 2,500 to 6,000 cycles indicate that resonance is occurring for air-hydrogen mixtures having values for the velocity of sound intermediate between those for air and hydrogen.

Similar results have been obtained with coal gas ($V = 500$ metres per second), where the two resonant frequencies are closer together, except that the reduction at the air resonant frequency is only about 10 decibels.

The experiments show that there is quite an appreciable pressure magnification (about three times) due to meatus resonance. The flatness of the resonance indicates that energy is absorbed by the material and mechanism of the ear. Undoubtedly some of this energy is consumed in overcoming viscous forces in the middle and inner ear and some of it may be transformed into electrical form in the inner ear.

In addition to the above usage, filling the meatus with hydrogen suggests the possibility of reducing hearing by air conduction near the resonant frequency without corresponding reduction in bone conduction, so far as distant sounds are concerned.

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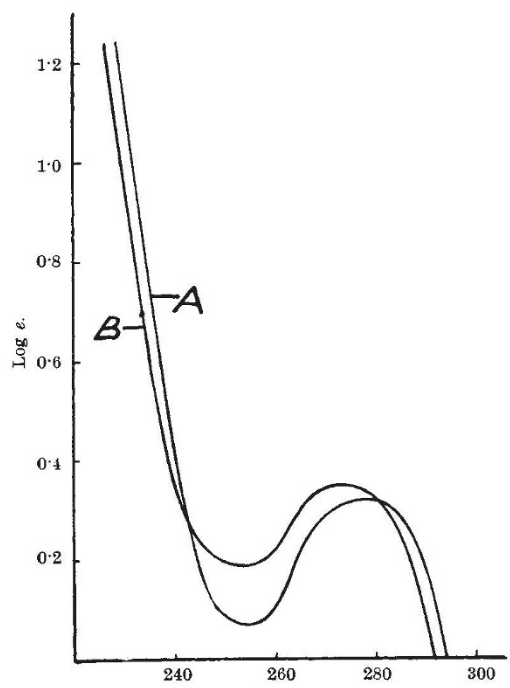
Ultra-violet Absorption of Genuine and Hydrolysed Protein

ACCORDING to the classical theory of protein structure, the carboxyl and amino groups found after hydrolytic splitting of a protein come from –CO–NH– bonds. According to the cyclol hypothesis (Wrinch[1]), however, the free carboxyl and amino groups must be formed, during the splitting, from bonds of the



structure >C(OH)–N<. The classical theory would predict on hydrolysis no great change in the absorption spectrum below 2400 A. because the CO groups of the amino acids and of the peptide bonds both are strongly absorbing in this region[2]. On the other hand, the cyclol hypothesis would predict a