A preliminary group of 3 cats and 3 guinea-pigs was exposed to 600 c.p.s. at 85 db above human threshold for durations up to 2 months. They were tested electrically, and the guinea-pig ears were examined histologically. None of them showed significant deviations from normal or recognizable histological lesions.

A second group of 5 guinea-pigs was exposed to 800 c.p.s. at 95 db for 16 hours a day for durations up to 74 days. All these animals were equally normal by electrical test.

A third group of 13 normal guinea-pigs was exposed to 600 c.p.s., 9 at 65 db and 4 at 95 db for 70 and 75 days, respectively. They were tested by the conditioned-reflex method (Kemp[3]) at frequencies 400, 500, 600, 700 and 800 c.p.s. before and after exposure. One of the first 9 and all the second 4 animals showed slight losses of sensitivity amounting to not more than 20 db at most in this range. The other 8 remained normal. The animal most affected showed by the electrical method an average deficiency of 12 db over the entire range from 15 to 1,500 c.p.s., but was practically normal from 1,750 to 10,000 c.p.s. There was no specific loss at or near 600 c.p.s. Histological examination of this ear revealed degenerate external hair-cells in the organ of Corti scattered through the second, third and fourth turns. In no region were more than 25 per cent. of the cells abnormal.

Seven guinea-pigs, 3 exposed to a d_4 whistle (about 2,400 c.p.s.) at 97 db for 15 hours a day for 40 days and 4 to 2,500 c.p.s. at 106 db for 45 days, all showed loss of sensitivity electrically and degeneration of external hair-cells histologically. Three of the most severe cases showed maximal losses of 76 db, 52 db and 50 db, and also distortions of wave form in the response. The zone of greatest loss lay in each case between 1,200 and 1,800 c.p.s. Two of these animals on histological examination each showed in both ears extensive degeneration of external hair-cells and also a rupture of Reissner's membrane in the second and third turns. The animal with greatest loss showed similar degeneration of cells and also hemorrhage into the scala media. The remaining 4 guinea-pigs showed losses of sensitivity, varying in degree from 20 to 56 db, in the range from 750 c.p.s. to 1,500 c.p.s. In the mildest case the loss involved only this range, while in the most severe the entire range tested (60 to 10,000 c.p.s.) was involved. The loss in the latter case averaged 37 db from 70 to 250 c.p.s., 52 db from 375 to 1,500 c.p.s., 40 db from 1,750 to 5,000 c.p.s., and 20 db from 6,000 to 12,000 c.p.s. The other 2 were intermediate in degree, but essentially similar in type. Histologically all showed more or less severe degeneration of external hair-cells in a wider or narrower zone of the organ of Corti, centering in each case in the middle third of the second turn of the cochlea. The severity and extent of the lesion correlated closely with the degree and extent of abnormality of the audiogram. The transition from normal to abnormal was gradual, both in the audiogram and in the histological picture.

[3] E. H. Kemp. In press.

These results indicate that the frequency as well as the intensity of the exposure tone may be an important factor in determining whether or not the inner ear is damaged. Considerable individual differences in susceptibility are also indicated. Intense exposure may apparently cause extensive loss of hearing, although we have not yet encountered the type of extreme loss affecting the entire range equally, as described by Finch and Culler.[4] The gross internal damage to the inner ear in some of our cases shows that interpretation is impossible without proper histological examination. In experiments now in progress we hope to extend the correlation of losses shown by the electrical method with loss of response by the method of conditioned reflexes. It is somewhat surprising and difficult of explanation that the zone of greatest loss of sensitivity as determined electrically does not necessarily coincide in frequency with the exposure tone. The losses and also the pathological lesions are wide-spread, indicating that the resonance of the basilar membrane is not sharp, but the more favorable cases of moderate damage support the "place" theory of pitch perception and relate the frequency 1,200 c.p.s. with the middle of the second cochlear turn in the guinea-pig. This is approximately the middle of the audible range and also approximately the middle of the basilar membrane.

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[4] G. Finch and E. Culler, "Effects of Protracted Exposure to a Loud Tone," SCIENCE, 80: 41–42, 1934.

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