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SOME INDIVIDUAL FACTORS IN LOW FREQUENCY NOISE COMPLAINANTS

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At least 1000 - probably many more - people in England complain of hearing a virtually constant humming noise. They deny tinnitus and blame the hum on large-scale engineering works. But typically only the complainant hears the hum; neighbours and others do not. Why is the hum so selective? Do these people have ultra-sensitive hearing or do they have a form of tinnitus?

Many letters from complainants were studied through the courtesy of the "Sunday Mirror". 18 writers were asked to undergo tests which (a) matched their memory of the hum against laboratory-made hum, (b) estimated the field strength of this hum and (c) compared their hearing thresholds with those of a control group. Additionally 8 subjects underwent a new "earmuff battery" test which it is claimed distinguishes between tinnitus and objective hum.

A wide-range oscillator equipped with frequency-modulation circuits generated the artificial hum. Matching against subjects' memory of their natural hum was done carefully and repeatedly with subjects encouraged to be critical of all aspects of the matching. Although some changed their initial choice by exactly one octave downwards final matches were in all cases repeatable within 1 or 2 Hz over a period of 1 or 2 hours.

Matching frequency was constant for each subject, ranging between 31 to 63 Hz - typically 40 Hz - for 14 subjects, with others choosing 186 Hz, 2,2 kHz and 2,6 kHz. All except the last 3 demanded frequency-modulated tones, 10 settling on exactly 1,6 Hz and the remainder on 1,0, 1,4 and 2,6 Hz. The three high-tone subjects did not call for modulation of their hum-matched tones.

Loudness matching was not precise. Most subjects appeared to judge loudness by modulation swing rather than pure-tone sound pressure. However guesses of hum loudness matched against subject thresholds suggest that hum fields are about 10 to 70 dB higher than ISO 226-1961 low-frequency thresholds. "Natural"hum at these high levels remains undetected by any but hum complainants.

Complainants' hearing thresholds were compared with those of 19 control subjects. A standard monaural audiometer was used between 125 Hz and 8 kHz, and a low-frequency pressure chamber provided audiometric fields between 20 Hz and 80 Hz.

Complainants' mean thresholds are seen to be poorer than controls' at all frequencies above 40 Hz; in particular most complainants had thresholds at their own hum frequency some 10 to 45 dB less sensitive than the mean of controls. An intriguing oddity is that a few complainants who chose hum-matching frequencies coinciding with audiometric frequencies had exact measurements of thesholds at these hum frequencies as good as (in 2 cases

better than) controls. Does this support the "spike" theory - that complainants have an ultra-sensitive patch of hearing coinciding with their hum frequency? But most complainants had thresholds so far below those of ISO 226-1961 at frequencies near, but not exactly on, their hum frequency that it is unlikely that any spike could provide the 30 to 70 dB of extra sensitivity required.

The final test was that named the "earmuff battery", which functions thus:

(a) the subject's hum is accurately matched;
(b) the subject is asked if a given pair of earmuffs significantly reduce the artificial hum. if yes, then:
(c) the subject is placed in a quiet room and asked if the natural hum is present. If yes, then:
(d) does it match the artificial hum. If yes, then:
(e) does the same pair of earmuffs alter the natural hum.

Since test (a) shows that the particular earmuffs attenuate that kind of signal, then if the natural hum is objective it will also be reduced in test (e). If it is internally generated by the subject it will not be reduced and will almost certainly be made louder. Hence, a subject who replies "louder" to (e) is indicating tinnitus. Of the 8 subjects who took this test, 5 failed to complete it (the natural hum could not be heard in the quiet room) but the remaining three heard the hum and indicated tinnitus.

The combination of very loud hum fields unheard by any save the complainants, the poor thresholds and the positive (in 3 cases) results of the earmuff battery test, combine to suggest that at least some hum complainants suffer from low-frequency tinnitus of the form of a near-40 Hz tone modulated at 1,6 Hz. The mechanism of the tinnitus may be muscular tremor in the middle ear.

The nature of the 1,6 Hz modulation is unclear. It is definitely not linked with heart rate. It is so characteristic of these hum complainants that one is tempted to use it as a descriptor which distinguishes tinnitus-sufferers from those who complain about objective low-frequency noise. The economically-interesting implication is that use of the earmuff battery test plus measurement of a subject's hum modulation may obviate the present necessity of working through expensive noise-control exercises in certain cases of hum complaints. It is also suggested that relief of some hum complainants' present discomfort lies in medical, not acoustical, treatment.

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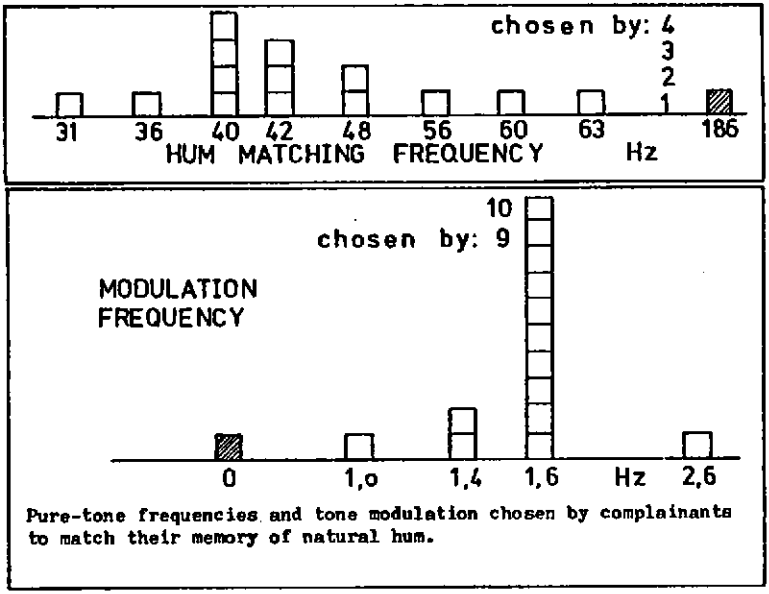
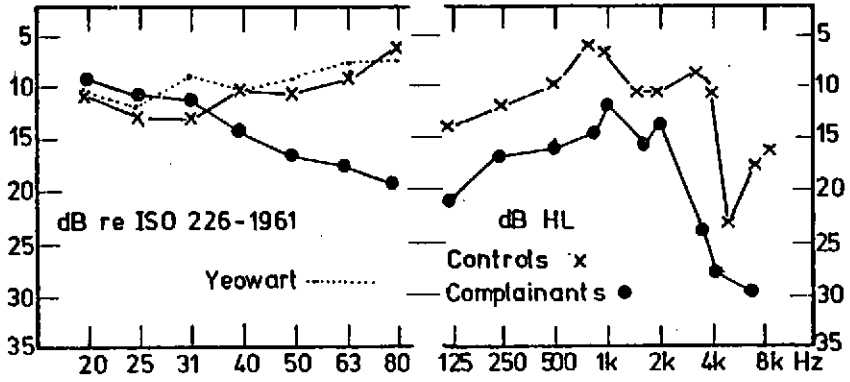


Pure-tone frequencies and tone modulation chosen by complainants to match their memory of natural hum.



Comparison of hearing thresholds of 18 complainants and 19 age-matched controls.

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