

## DISCUSSION

### TONAL VOLUME AND PITCH

In J. G. Rich's paper: *A Preliminary Study of Tonal Volume* (this JOURNAL, February), he makes the assumption that "If they (pitch and volume), are two names of one and the same attribute, as Dunlap asserts, they will have the same limen." I have already pointed out (in my *System of Psychology*, pp. 143-4), that we may reasonably expect that the opposite principle will hold. It is very possible that the pitch-discrimination of the unmusical person, and sometimes of the musical person where the differences are large, is a pure extensity judgment, *i. e.*, based on the extent of the stimulation in the hair-cell series; but that the discrimination of the musical person, especially where the differences are small, is primarily a local-sign judgment, *i. e.*, based on the differences in the hair-cells at which the region of stimulation ends. Mr. Rich's results may therefore be more reasonably interpreted as supporting the extensity theory than as against it, although I can not as yet see that these results have any certain bearing on the theory. There are so many possibilities as to the contential nature of the judgment-reactions in these experiments that it seems hardly worth while speculating about them.

I had hoped that we would be able to exclude the extensity theory, as the frequency theory ('telephone theory') is so much simpler; but on the contrary the extensity theory becomes more and more plausible. The most vital objection to it has just been removed by the epoch-making work of Hardesty (*American Journal of Anatomy*, 1915, Vol. 18, 471-514), who has shown that a structure such as the tectorial membrane may be affected by vibrations of different periods in just the way indicated by the psychological facts; the slower rates affecting larger, the faster, smaller extents of the tectorial membrane, these extents coterminous at the 'vestibular' end.

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