

## LETTER TO THE EDITOR

TO THE EDITOR,

*The Journal of Laryngology and Otology.*

DEAR SIR,—In his letter published in your April issue, Mr. Lowndes Yates points out that, contrary to a statement appearing in my criticism of the Hearing Tests Committee's Report, there does exist in the Report a sentence in which reference is made to certain essential matters concerning the sensitivity curve of the ear for various tones. Since in spirit my criticism was a protest that a matter of importance had been dealt with inadequately, the existence of this mere sentence (which I must confess escaped my notice) cannot be said to invalidate my criticism.

Two facts emerge clearly from Mr. Lowndes Yates' letter :

(1) The decibel convention has been universally accepted by scientific bodies for dealing with sound intensity differences.

(2) With the calibrated forks supplied by the National Physical Laboratory the decibel notation will be available.

These two facts are of importance and should be noted as giving value to Mr. Lowndes Yates' letter.

The rest, however, of Mr. Lowndes Yates' letter is devoted to dealing in as controversial a manner as possible with matters which should be almost non-controversial.

Mr. Lowndes Yates is wrong in saying that I raise the question of whether tuning fork results should be expressed in seconds or in intensity difference units. No otologist of any intelligence now disputes that the latter method is to be preferred. The only question is the unit to be preferred.

As clearly explained in my review of the Report, the three possible systems are :

(1) Logarithms to the base 10 or common logarithms. This is the basis of the Bel system of which the decibel is a derivative.

(2) Logarithms to the base  $e$  or 2.7. This is the Napierian system still favoured by some German writers.

(3) Logarithms to the base 2. This is the Half Intensity Unit system.

The Bel system is the basis of the decibel convention which is now universally employed in describing sound intensity differences. It is also the basis of a hearing test chart which has long been the most widely used in existence. In wishing to supersede this system by that of logarithms to the base 2, Mr. Lowndes Yates naively urges as justification that otologists are already versed in multiplying by 2 as with octaves. Since octaves have nothing to do with sound intensity differences, it is clear that the mention of octaves in this

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connection has no value apart from a rhetorical one. Mr. Lowndes Yates also objects to the well-known decibel type of hearing chart which I venture to support, in that a large area of it covering the profounder losses of sensitivity are largely wasted ; relatively little being devoted to the more commonly used area of slight deafness. This is inevitable and on the whole necessary. The accurate testing of high grade deafness, as in deaf mutes, is not often attempted and is at present not easy owing to the technical difficulties in the way of producing tones of sufficiently high intensity, particularly at each end of the scale. Nevertheless, adequate testing of such high grade deafness is a matter of importance, and it is hoped that the technical difficulties referred to will before long be overcome. When they are, the necessity for a chart which will be universal enough in application to register the results must surely be apparent.

Mr. Lowndes Yates also objects to the decibel convention in that, although it is accepted, as he admits, by all authorities on acoustics in the world for work of precision, otological assessment of hearing is not " work of precision ".

This is as ludicrous as to insist upon weighing gold in kilograms and lead in pounds. " Work of precision " differs from other varieties only in the likely percentage of error. The question of employing different units can never be said to arise.

May I at this stage say something on the subject of the decibel, and state as a preliminary that though it would be a good thing if all otologists understood its true nature, a failure to do this need not debar them from employing it usefully, any more than failure to understand the history of a certain marked length on a ruler called an inch should debar anyone from employing such a ruler with precision and profit. A fair understanding of the nature of the decibel is, however, obviously to be encouraged, more so as no attempt has been made by the Hearing Tests Committee adequately to explain its nature and deal with the misconception that still exists at times that the decibel should be regarded primarily as a sensation unit.

The few brief footnotes upon the decibel to be found in the Report and the paragraph on the decibel by the National Physical Laboratory quoted in Mr. Lowndes Yates' letter cannot be considered adequate representation of the subject.

Let it be supposed that a sound at a certain moment has a definite value of acoustic energy in ergs per cm.<sup>2</sup> per second, and that following a certain logarithmic increment or decrement it increases or decreases in ten seconds to ten times or 1/10th respectively of its initial value. In the former case it is said to have undergone an increase of 1 bel in the ten seconds.

The decibel is 1/10th of the bel and indicates the change of intensity which occurs per 1 second.

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Representing the initial intensity as 1, the intensity at the end of one second will be 1.26. Thus 1 decibel is a change of energy in the ratio of 1.26 to 1.00 or 26 per cent.

And further, at the end of every second, the energy attained will bear a ratio to the energy at the end of the preceding second of 1.26 : 1.00. The actual values of intensity at the end of each of the ten seconds will be approximately as follows :

0	1	2	3	4	5	6	7	8	9	10	Seconds.
0.00	1.26	1.58	1.9	2.5	3.2	3.9	4.9	6.4	8.0	10.0	Intensity Values.

1 Bel.

Each of the ten decibel steps represented here amounts to an increase of 26 per cent (approximately) over its predecessor.

The decibel is still sometimes referred to as a sensation unit, since in certain intensity ranges it is the smallest intensity change which can be appreciated by the normal ear. Since this, however, applies only to certain intensity ranges, the conception of the decibel as a physiological unit is on the whole of little value and has done harm in causing misunderstanding of the true nature of the decibel as a physical unit (pure and simple) expressive of changes of intensity.

Better short explanations of the decibel are to be found in

(1) J. H. Shaxby and F. H. Gage. Medical Research Council. Special Report Series No. 166, p. 30.

(2) A. H. Davis, National Physical Laboratory. *Proceedings of the Physical Society*. (Discussion on Audition.) June, 1931, p. 136.

May I conclude by expressing my personal opinion that, if British otologists, forgetting for the time all question of the nature of the decibel and even regarding it simply as a certain interval on a piece of squared paper, would proceed to employ it without demur in the shape of the conventional decibel chart, they would be conferring a real and lasting benefit not only upon themselves but upon the science of otology all over the world.

I am, Sir,

Yours faithfully,

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