

for the lower note. The greater part of the tracing (three feet long), however, shows a steady twelfth below the glottal note, d' , 287~.

Sir RICHARD PAGET investigated the same case and describes it in his book, *Human Speech*. He states there that the interval between the two tones was constant. It was always a twelfth, i.e. 17 semi-tones.

As you have seen, our results differ from his considerably. You can judge for yourselves from the tracings. This is a striking example of the value of the use of a simple recording instrument like the kymograph in phonetic investigation. Without the record, you probably would not take my word, and you would indeed be quite right.

GRÜTZNER reports that DONDERS could sing two notes simultaneously with the interval of a twelfth or an octave, while MERKEL could only manage an octave.

The following is a convenient empirical formula for the results obtained:

$$n + \frac{n}{m},$$

where n is the frequency of the glottal note in hertz or c.p.s. and m has the values 2, 3, 4. More values for m are evidently possible.

It is obvious, of course, that n is only the fundamental. The expression for the glottal note complex would be given by some such expression as:

$$\sum_{1}^{\infty} n \text{ } \text{♂},$$

$$\sum_{1}^{\infty} 2n \text{ } \text{♀}.$$

If you believe that the glottal note is a harmonic series, then n must be an integer. If not, n may have fractional values, but this does not concern us at present.

In every case the superimposed tone was a sub-harmonic of the laryngeal tone. This simple fact seems to imply a causal relation between the two and that the glottal tone is very probably the controlling factor.

Several investigators have attempted to locate this vicarious larynx which produces the second tone. Mr NEGUS, who examined me while I was producing double-voice, states that the note is produced by the constriction of the sphincteric band at the level of the ventricular bands, the rôle of which is somewhat passive and dancing attendance, as it were, on the active vocal cords. You will see an account of it in Mr NEGUS's book, *The Mechanism of the Larynx*. Prof. FLATAU, I know, has examined the phenomenon. We should very much like to have his opinion.

It is obviously not produced in the epiglottis, although the tracing of a voiced epiglottis trill bears a great resemblance to tracings of double-voice, as you will see from the following slide.

(Here slide 3 was shown, illustrating trills of the tongue tip, uvula and epiglottis, breathed and voiced.)

Other tracings show similarity, viz. those of creaky voice or knarrstimme, and those of the ʔ in Palestinian Hebrew, Arabic and Somali.

(Here slides 4 and 5 were shown, slide 4 illustrating creaky voice and ʔ , and slide 5 showing X-ray photographs giving the appearance of the laryngo-pharynx in normal quiet breathing, pronouncing a , h and ʔ .)

To conclude, I do not think, from observation of the more or less involuntary movements of the ventricular bands and surrounding soft tissue, that one is justified (except of course in the case of pharyngeals) in forming theories on their function in ordinary speech (i.e. distinction between whispered p —whatever that might mean—and whispered b). Someone has put it in this way—trouser legs flap, and sometimes flap vigorously when one walks or runs, but that garment has no physiological function in locomotion.

52. Dr C. B. MILLER (Berlin-Buch): *Accent: classes and variations.*

In seeking an explanation of accent, we find two theories which have received considerable attention from phoneticians. The first one supported by ROUSSELOT, that accent is the result of greater pressure by the organs of breathing, and the second, developed by FORCHHAMMER, that a closer approximation of the vocal cords utilizes the breath in a more efficient manner, and that the result is a tone of greater strength. The first assigns the cause to the organs of breath, the second to the organs of phonation. VAN GINNEKEN's opinion that the first theory is true for consonants and the second for vowels has in common with both theories the consideration of the relationship between the size of the physiological occurrence on the one side, and the resulting phenomenon on the other. Both assume a direct proportionality between muscle energy and accent, and neither has been thoroughly examined. For this purpose, among other methods, experiments with action currents would be required.

JESPERSEN says that the total energy is psychically indigenous to the speaker, and that the accent is often emphasized by motions of the head and arms. He says (the translation is my own): "The listener places himself sympathetically in the position of the speaker, as he can only understand what is said if he reproduce quietly the same articulation (weak innervation). In this manner he judges the syllable according to the amount of energy expended upon it, which does not always need to coincide with the objective physical intensity."

Both the theory that the listener places himself sympathetically in the position of the speaker and the procedure with action currents present difficulties. It was felt that more satisfactory results would be possible if a method were followed which would give and be based upon obtainable and measurable values. We have therefore recorded independently of each other the subjective impression of the accent, i.e. primary, secondary and unaccented vowels, and the physical intensity (molecular oscillation), and examined the relation between

the two. It should be emphasized here that these investigations do not render superfluous investigations by means of action currents.

The means of our investigation was the gramophone record, which permits one to pass from the study of isolated words to the psychological and physical elements in connected discourse. This is as necessary for the study of accent as for that of melody or quantity. In this regard it may be mentioned that ROSENGRENS has assumed that the primary accent is identical with quantity. This view is very definitely denied by JESPERSEN, GUTZMANN and PANCONCELLI-CALZIA. The possible relationship, however, between quantity and the accent of intensity, remains a question which deserves empirical and quantitative treatment, but will not be considered in this paper. I will state briefly certain facts regarding the material which was investigated by Fr. MATZ of Stockholm and myself, and also something regarding the method of procedure.

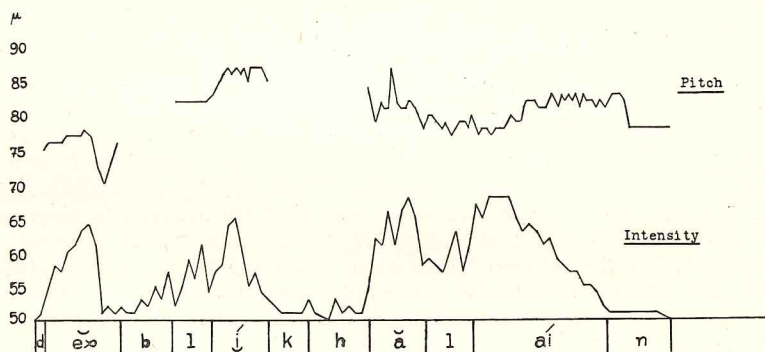


Fig. 1

The speakers, two in number, were members of the same linguistic group, hochdeutsch of Schlesien. The text was from NADLER, being the first part of the Leitgedanken to his *Literaturgeschichte der deutschen Stämme und Landschaften*. The records were heard by different listeners, each one of whom prepared one or more texts giving primary, secondary and unaccented values according to his judgment. These texts were combined, and the dynamic value most frequently assigned was given to the sound in question. The resulting list was taken as the linguistic determination of the classes of accent.

The intensity curve was obtained from the neurograph, and the values measured for each sound to which dynamic values had been assigned. This was done according to the method described by FLETCHER in *Speech and Hearing* in the chapter on Speech Power. Three values were computed, *Peak*, the maximum intensity shown by the vowel, *Total*, obtained by measuring the area under the curve, and *Average*, the result obtained by dividing the total intensity by the duration.

It is self-evident that a sound to which a primary or secondary accent has been assigned must receive this consideration through

being heightened in attention by contrast with a neighbouring sound or sounds of lesser significance. These unaccented sounds both precede and follow the accented sound, save where two or more accented sounds (primary or secondary) occur in sequence, or where the discourse is interrupted by a pause. As a result, not every sound has both a preceding and a following contrast immediately adjoining, and we have therefore examined these contrasts separately.

The first four syllables should serve to indicate the procedure. No. 2 (primary accent) being preceded by an unaccented vowel, has a superiority in attention. We find that the Peak values, 14 for no. 1 and 15 for no. 2, are in accord with the subjective impression, and give to this preceding contrast of no. 2 the value of plus 1. In

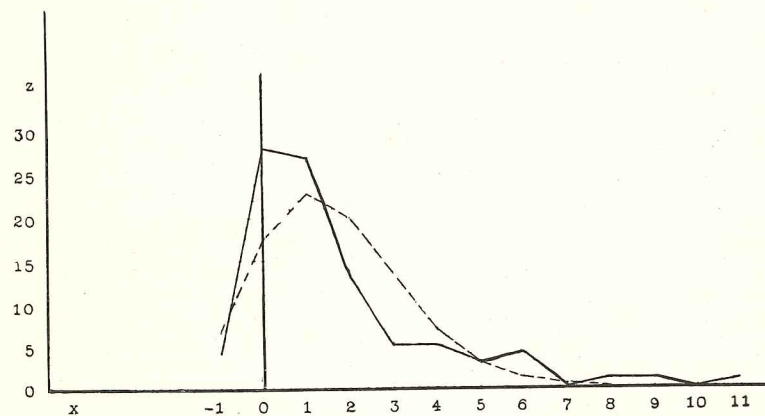


Fig. 2. Distribution of differences in average speech power between accented and preceding vowels.

Empirical value ————— Theoretical value - - - - -
Average of theoretical and empirical values 1.6 ± 0.17
Measure of dispersion 1.8

syllable no. 3 the vowel is heard as unaccented, but the objective record of the intensity shows a greater Peak value (18) for the unaccented vowel than for the primary accent immediately preceding. The contrast following the accent is therefore rated as minus 3. In syllable no. 4 the vowel receives a primary accent (a glide is treated as a vowel), but the objective record shows the Peak values to be equal. The preceding contrast of no. 4 is therefore rated as zero. Due to the pause, it has no following contrast.

Where two accents, primary or secondary, occur in sequence, a value is recorded only where the psychological distribution shows that the listener has heard one. For instance, in a sequence consisting of four sounds, unaccented, primary accent, secondary accent and unaccented, the primary accent would have both a preceding and a following contrast, the secondary accent would have no preceding contrast which heightens it in attention as it is judged less

significant than its predecessor. It would in this case have only a succeeding contrast.

The values plotted were the amounts by which the sound of greater significance exceeds that of lesser significance. For instance, the second vowel, accented with a Peak value of 15, exceeds the first, Peak value 14, by one. The increase is $1/14$. In the following contrast the unaccented vowel, psychologically considered, shows not less but more energy, 18. The value of the following contrast is therefore minus $3/18$. Out of a total of 800 sounds examined we have 92 occurrences preceding and 91 following. This is a relatively small selection from the total population of sounds examined.

Previous experiments at the Kaiser-Wilhelm Institute have shown that such groups, when graphed, bear a likeness to the Gesetz der Kleinen Zahlen, which might be translated as the Law of Infrequent Occurrences. Of the six groups of values, all of which have been treated statistically by Dr RITZOW, the second figure shows the curve obtained by plotting the average values of the preceding contrast. The solid line shows the empirical, the dotted line the theoretical values. The five points at which the theoretical and empirical values coincide show a fairly close approximation considering the amount of data at our disposal. The other curves showed varying and greater degrees of deviation.

This deviation may come from three main causes. First: the number of occurrences is too small to give the best results. For a study of this nature one would feel safer with 200 values. Second: the subjective impression has been compared only to the physical element. There remain to be considered, on the one side the physiological element, i.e. the activity in respiration and articulation, which according to JESPERSEN may be sensed by the sympathetic attitude of the listener, and on the other side, the possible effect of the different vowels on the ear, through the formant peculiar to each vowel. The greater significance in audition produced by a given energy at three octaves above middle *C*, for instance, as contrasted with the effect produced one octave below, may be one of the contributing factors.

A study of the chart in the exhibition shows some interesting examples of primary accent resulting from a relatively low intensity. This intensity may be as low as one-half that given by a neighbouring unaccented vowel. Instances of this nature, which constitute the minus values of the curve, should be sufficiently numerous to be subjected to an examination as a separate class. The third cause which is not considered in this paper is the rhythmical element.

The object of such a treatment, which is not limited to accent, is briefly as follows: given a sufficient number of occurrences, which are infrequent as compared to the total population from which they are drawn, we may compare both actual performance and the curve which the values should give theoretically. If in a number of speakers, drawn from the same linguistic group, we find a close agreement between the theoretical and empirical values, the average of these curves would give a representative distribution of accent in that particular speech family. Such records taken in different localities

offer a more accurate picture of the language, and when repeated at intervals would show both the amount and rate of change of the various phonetic phenomena involved. Undertaken in search of a norm by which to measure deviations in pathological cases, it offers to the linguist a more comprehensive and I believe a more accurate view of his subject-matter than is to be had by the selection of individual instances, no matter how convenient these may be for illustrative purposes.

53. Dr E. ZWIRNER (Berlin-Buch): *Speech and speaking.*

When a conversation takes place between two people, for instance *A* and *B*, it is to be expected that in this conversation certain words will be frequently repeated. Although this is so natural, it is worth while to consider a little what linguistic conditions come under consideration. Suppose *A* utters the German article *das* several times in the same manner, because the course of the conversation renders it necessary, and *B* cannot distinguish any difference between this repeated *das*, which he hears several times. Suppose this conversation is fixed on a record, without the persons taking part in the conversation being conscious of it. By means of amplifiers such records have become possible, and for years we have been producing such records ourselves.

Differences between the various uses of the repeated article *das* will not be established even by listening carefully to our record. Therefore one is justified in saying that these various applications are equal to one another. On the other hand, even in this short word some peculiarities of the speaker's voice must be contained. For everyone knows by experience that he can often recognize the voice of an acquaintance even at the first word at the telephone. And also when listening to our record we shall be able to distinguish *A* from *B*, even if they are from the same locality and of the same social standing.

In spite of this the linguist will have no hesitation in saying that the different uses made of the article *das* by the two speakers deal with the same word. For he has not to consider the differences between the vocal organs of people, but to regard the differences between languages and dialects. If he proceeds so, he will overlook these differences, although he can observe them and will limit himself to regarding the similarity between the various uses made of the same word.

If we go a step further and take measurements of the record curves which result from the different application of the same word, we find regularly that not even one of these applications is the same as the other, although they are regarded as equal. And the more exact our curves are, the more sensitive the registering oscillograph, and the greater the speed of the revolving registering paper, the clearer will be the differences.

We could satisfy ourselves by saying that our senses are not sensitive enough to distinguish these fine differences. But this fact