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

does not exhaust the present case. Yet we must ask ourselves what right we have to denote words as equal, the differences of which have been proved by measurement. Here we have a similar case to that of biometry, which also includes organisms in one class, the differences of which are settled by measurement. We do the same if we classify people, whose peculiarities are really known to everyone, in races, or include them all in one class in order to distinguish them from all other living beings.

These differences are not only a matter of biological science, but a principle of classification, which works itself out in daily life and

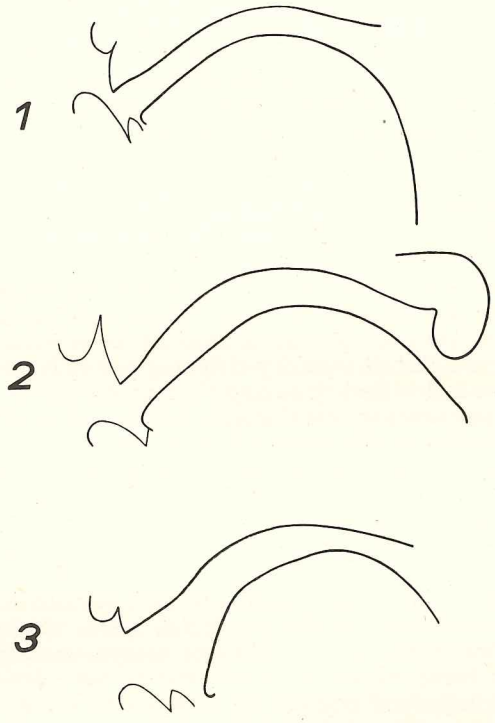

Fig. 1

is always under our consideration. In our case it is quite the same. It is not at all only a matter of pure linguistic science to consider the unequal applications of the same word as equal, but it is also a demand of daily life, on which depends every understanding by speech and which therefore must be considered by every speaker and hearer. For as people have different voices, they would not have one single word in common, if we did not succeed in overlooking these differences. And just as we can no more use our speech organs any more than our limbs even twice in exactly the same way, just as little is the same person able to pronounce the same word twice

in the same way. It would not be possible to make repeated use of the same word, but one would always be pronouncing new words, which would be more or less similar, but yet without a clear principle of classification. An unintelligible chaos would be the result, like the babbling of an infant, who cannot use repeatable words. And then communication would cease and language no longer be language. And the same as is said here about the limited possibility of repetition of the words can be considered also for the possibility of repetition of the single sounds of a language. No sound will be repeated in absolutely the same manner. A glance at several oscillograms of an uttered sound proves that without doubt. And yet there must be a reason for a repetition of the same sound in different words, otherwise a connexion between hearing and understanding would be impossible.

In the figure (Fig. 1) you see planned schematically the roof of the mouth, the tongue, the teeth and lips as median profile taken by the X-ray photographs of three persons, who have sung the German vowel "e" at the same pitch. Whether in this case the same vowel has been sung cannot be verified by these three pictures. It is possible to establish this if one has heard the persons sing, or as in our case the three persons' singing is fixed on a record which has been listened to by several persons. According to all accounts the German vowel "e" was heard. Only for this reason can the three positions of the tongue be regarded as variations of the same class.

You see in the next figure (Fig. 2) the oscillograms which were taken at the same time of the singing subjects.

You absolutely cannot recognize that all three cases deal with the same vowel. But even by the Fourier Analysis, which was carried out on the three oscillograms, and which shows more clearly the similarity of the three sounds, you cannot judge with certainty whether it deals here with variations of the same sound. The decision on this point depends upon the hearers, that is, upon the members of the language community and no one else.

Now I will show you (Fig. 3) the graphical presentation of the Fourier Analysis made from all twenty-four vibrations of the spoken German word *das*. You see in the first line the graphic representation of the pitch movement of a word spoken connectedly in a sentence, and fixed by a microphone on a record; in the second line you see the rapidly increasing and slowly decreasing intensity curve of the unaccented spoken word. Further you see the amplitudes of thirteen overtones represented graphically as a percentage of the highest amplitude. You see the endless varying possibilities of the one spoken sound. A mathematical analysis of the curve only will never give a proof of its being the German spoken a. But one can decide with the ear and recognize which variations of the sound a occur. With the assistance of the binomial formula the variation can be exactly understood. The precise comparison of the different languages can be attained in a statistically indisputable form.

The differences in the pronunciation of the same word and sound are innumerable, or to put it more clearly, they are, strictly speaking,

endless. The number of sounds and words must be limited for every single language. The dictionary and the phonetical alphabet of every language show that clearly. With respect to the classification of

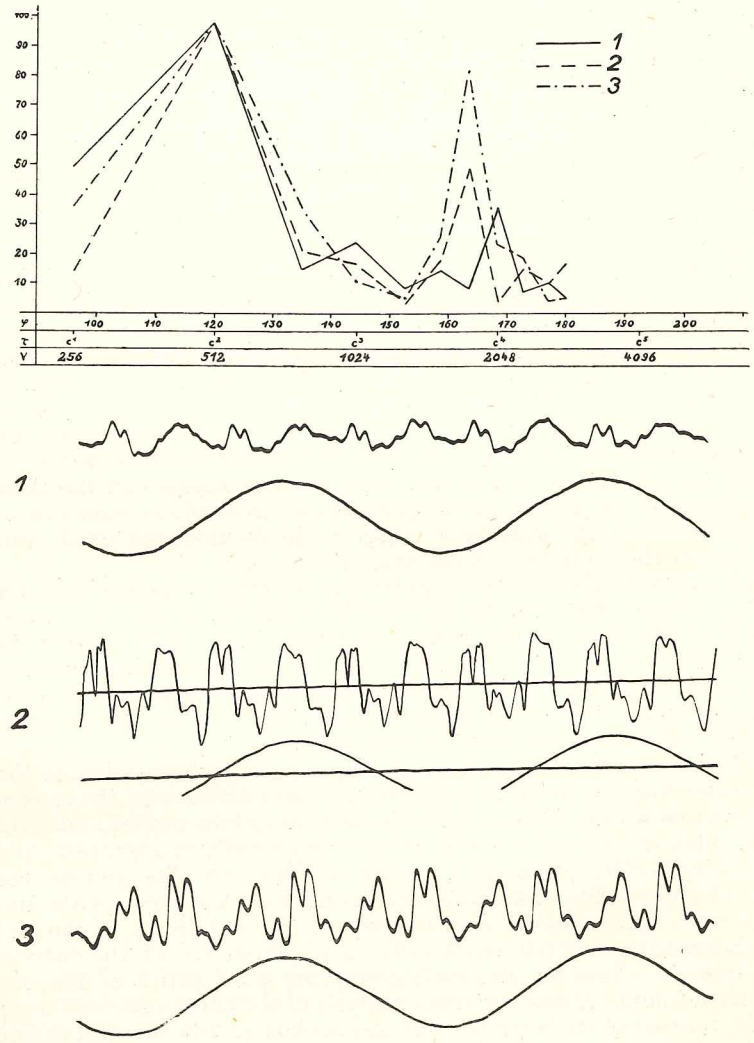

Fig. 2

endless different applications of words and sounds into a limited number of classes linguistic science does the same as speaker and hearer do. Differences are overlooked even if they can be recognized by the ear.

But linguistic science does not limit itself to such fixations. Since FRANZ BOPP in 1816 compared the system of conjugation of the Sanscrit language with that of the Greek, Latin, Persian and Germanic languages, it is part of its duty to bring the pronunciation already orally established into historical connexion. That is done by developing linguistic science to its foundation, in order to give it a higher grade of positiveness: the positiveness of research.

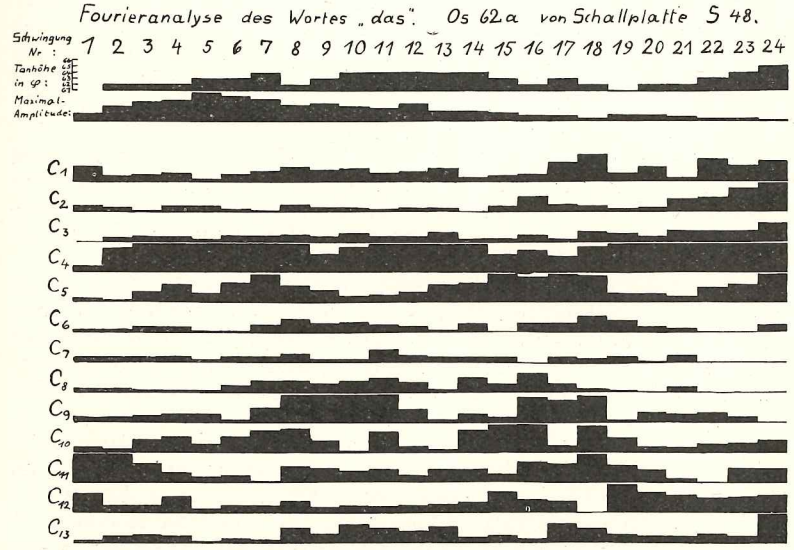

Fig. 3. Fourier analysis of the spoken German word "das".

Here the difference is clearer between the repeatable word or sound as a group, and the same sound when it is used only once. For the words that are used only once are without tradition. Sounds and words dropped from the lips of the speaker die away with the fading waves of the vibrating molecules and remain without connexion with the tone, which resounds and dies away in the course of conversation at other places and times. Tradition points out what the speaker thinks when speaking, and the hearer, when listening: the customary way and manner of pronunciation, which is at the same time the group, in which the endless varying uses must be classified, if speech and understanding are present.

It is one of the linguist's tasks to compare these standard forms, that is, sounds and words, the exact representation of which is given by phonetical spelling. To settle by measurement and number the variation of the uses of these sounds and words is the task of a science, which we shall call "phonometry" in respect to the similar task of "biometry". In order to solve this problem, phonometry makes use of all possible technical means which are at its disposal and which are offered by psychology and physiology, physics and

mathematics. The object of phonometry remains the comparison of languages.

And here it takes a different direction from that of experimental phonetic science, which now seems to be physical acoustics, now physiology, now psychology, and now linguistic science, and likes to call itself a boundary science, a term by which it expresses the uncertainty of its mission.

Experimental phonetic science since the researches of ROUSSELOT has never made a difference between the standard word that has descended from generation to generation, and the word or sound which is made use of in a conversation. It has never considered that the first only is the object of linguistic science and that it only succeeds in dealing with the second.

For where speech is heard and registered, the occasionally used word of a speaker is registered and phonetic science can register also a second and third word from different speakers, but it never succeeds in getting the customary pronunciation, which does not consider the individual differences of the speakers.

It has been shown in what cases one is justified in disregarding the endless variations of pronunciation: for instance, if one compares the usual pronunciation, if one takes intelligibility as a matter of course. But he that works with curves, and is obliged to measure and analyse the curves, must not overlook these variations, the determination of which is his task.

Through such considerations the aim of experimental phonetic science is destroyed to the advantage of descriptive phonometry, an ambition which it has had since Hofrat WOLFGANG VON KEMPELEN in 1791 described his talking machines, the ambition to construct sounds of speech analogous to physics. Since GALILEO, analysis has existed for a phenomenon of nature, if its conditions are thoroughly examined. But the sound of speech is no phenomenon of nature in this sense. To be sure, it will be formed with organs, and certainly it will be conveyed by the movement of the molecules. But not every tone and not every noise made by the organs of speech is a sound of speech. The babbling of a baby is as little speech as coughing, sneezing, whistling, and as the word combinations of a sensoric aphasic patient, who after the destruction of his speech centres can only express himself by unintelligible sounds. One can only speak of language and of language sounds when the historically fixed and classified norms of a community are fulfilled for the purposes of personal communication.

The objections made by experimental phonetic science are always the same. It says, that one could recognize a stop, a nasalized vowel or a non-nasalized vowel by curves that are registered by a funnel, a nasal olive or a larynx recorder, and the problem would be gradually to recognize all sounds in this way. But what is meant here by recognizing? I will not mention here the physical technical lack of these registering methods, which are altogether out of date. I will not consider that one binds the mouth of the speaker with the funnel in accordance with the proverbs of Salomo. It is enough to show

that there is nothing but a vague analogical conclusion, a conclusion which is not strong enough to found a science. We have shown on several occasions that the curves gained by registration are never identical. If a sound is recognized by its curves as a stop, it is because the curves are similar to others, which are already known as curves of stops. And in point of fact one knew this, because the speaker had said that he had spoken a stop, that is on account of the uncontrollable muscle sensation of a speaker. And further similarity between such curves has not yet been defined and never will be. To speak of similarity between two angles in mathematics is clear from a mathematical point of view. It is quite correct to speak of the identity of two curves from which the one can be transformed into another according to a rule, even if these curves look very dissimilar. But a similarity, which is only justified by an optical impression, has from a scientific point of view absolutely no sense. In addition to this comes the linguistic uncertainty of a statement like that of a stop.

No linguistic realities correspond to these ideas, as they lack the historical classification that is necessary for every language. And if the recognition of speech curves is founded on nothing else but on similarity of impression, then no scientific criterion can be given, as to whether we have the pronunciation in one or another dialect—differences which can be noticed with certainty by the ear, and which are necessary for communication as well as for linguistic science.

As surely as language exists, if the speaker uses the customary language of a community to express himself by, just as surely is there a possibility of examining the variation of speech, if the highest aim of this research is the positiveness of language. The research of speech by measurement and number must have an historical purpose.

54. Prof. R. H. STETSON (Oberlin, Ohio): *The relation of the phoneme and the syllable.*

The current phonology has always defined the "phonemes" (sounds) for the experimental phoneticians. It is the experimentalists, however, who have given the more consideration to the syllable. For an adequate account of speech both phonologists and phoneticians must recognize the interaction of the traditional phonemes and the chain of syllables.

The recent consideration of the phoneme makes it an articulation, or an image of an articulation. It may be an ideal or type articulation, but the basis is always a movement pattern. The properties which are often emphasized in the special case of the phoneme hold for the simplest possible movement which can be defined or indicated. A circular movement, a ballistic movement, a posture are all of them Gestalten, and can be considered with Prof. BRØNDAL as "Platonic Ideas"; they can be transposed, they show endless variations from a type. In fact *all* habits, human and animal, have the attributes so often claimed for the movement pattern of the phoneme. Whatever is peculiar to the phoneme must be due to its social function,