INSTRUMENTAL PHONETICS. ITS VALUE FOR LINGUISTS

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INTRODUCTION [1])

Allow me to start with a few quotations.

E. Sievers, *Grundzüge der Phonetik*; Vorwort zur vierten Auflage, 1893: „Auch bekenne ich, dass ich den Enthusiasmus nicht ganz theile, mit dem die Experimentalphonetik auch von philologischer Seite begrüsst worden ist... bezweifle ich auf Grund langjähriger Erfahrung im phonetischen Unterricht, dass es ohne schwerste Selbstzucht jemandem gelinge, in einen Apparat dasjenige hineinzusprechen oder mit einem Mess-apparat im Sprachorgan dasjenige hervorzubringen was er sonst unter normalen Bedingungen spricht. Ich bin also vor der Hand geneigt zu glauben, dass die Abweichungen von der Sprechnorm die durch die psychische Befangenheit vor dem Apparate entstehen im Durchschnitt mindestens ebenso häufig und ebenso gross sein werden, als die Fehler

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[1]) The draft of the following pages was originally intended to serve as a programme for instrumental researches at the University of Amsterdam. In its present form it may illustrate my proposition at the First International Congress of Linguists of starting a periodical of Experimental Linguistics, in order to further the cooperation of Experimental Phonetics, Experimental Psychology, and Linguistics.

I am much indebted to Miss Dr. L. Kaiser, in Amsterdam (with whose assistance all experiments were made), to Mr. L. P. H. Eykman, in The Hague, and to Prof. Dr. D. C. Hesseling and Prof. Dr. N. van Wijk, in Leyden, for a number of suggestions; to Prof Dr. G. van Rijnberk, in Amsterdam, for admitting me into his laboratory; to the Amsterdamsche Universiteitsvereeniging, for the use of the Edison Phonograph.

die einem gut geschulten Phonetiker bei der Beobachtung naiver Sprecher ohne Apparat mit unterlaufen."

Sweet: „Experimental phonetics is, strictly speaking, not phonetics at all".

P. Hestermann in *Jahresbericht der Oesterr. Ges. für exp. Phon.*, 1915, 38: „Ich habe auf dem Hamburger Kongress mich mit einer gewissen Reserve, wie mir scheint, ausgedrückt wenn ich sagte, dass wir in den nächsten 10 bis 15 Jahren nichts Wesentliches für die Linguistik, bitte, ich betone, für die Linguistik, zu erwarten haben. Ich könnte Ihnen Zeugnisse dafür anführen, die mir scharf widersprochen haben, mehr als notwendig war, so scharf, aber ich kann nicht behaupten, dass ein Linguist unter diesen war. Aber ich könnte Ihnen ach Zeugnisse beibringen, dass man mir recht gebe und dass wir in 100 Jahren oder auch nie etwas würden erwarten dürfen, ich sage es noch einmal, für die Linguistik von der Experimentalphonetik. Ich bin so ehrlich und offen, Ihnen hier zu gestehen, dass unter den letztgenannten ebensowenig ein Linguist war, aber es waren namhafte Physiker. Und die Autorität eines Marbe und Zwaardemaker wird doch wohl niemand gegenüber Panconcelli selbst nach den Kinoapparaten von Hegener-Colzier bezweifeln wollen."

To Jespersen the principal or the exclusive value of Instrumental Phonetics for Linguistics lies in the possibility of obtaining objective criteria of speech-Sounds (*Phonetische Grundfragen*, 1904, p. 139—140): „Man muss sich doch wenigstens dazu bequemen können, die Arbeiten der anderen Seite zu kennen (i. e. the work of instrumental phoneticians) und auch, wo sie es verdienen, anzuerkennen, oder, wo sie es nicht verdienen, sachliche Kritik zu üben." ... "... haben wohl alle Phonetiker nicht selten das Gefühl gehabt, dass die früheren Untersuchungsmethoden nicht immer genügend waren; Forscher verschiedener Nationalität, ja auch bisweilen solche innerhalb derselben Sprachgemeinde verstanden sich nicht immer, wenn sie von einem *o* oder *a* sprachen ..." „Diesem

Gefühl der Unsicherheit, diesem berechtigten Drang nach objectiven Kennzeichen sucht die Instrumentalmethode entgegenzukommen[1]: und wenn sie auch nicht alle Rätsel lösen kann, und vielleicht mehreren Rätseln in aller Zukunft ratlos gegenüberstehen wird, so ist das Bestreben doch in hohem Grade anzuerkennen ebenso wie der auf Ausfindung von Instrumenten usw. angewandte Scharfsinn."

To W. Schmidt (Was erwartet die allgemeine Sprachwissenschaft von der Experimentalphonetik ? *Anthropos*, II, 1907) the „allgemeine Sprachwissenschaft" is „eine wesentlich vergleichende Wissenschaft, (die) in hervorragender Weise sich mit nichteuropäischen Sprachen beschäftigt." (Diese Umstände) „lassen die allgemeine Sprachwissenschaft einer Unterstützung durch die Experimentalphonetik mit besonderen Erwartungen entgegensehen." What can be expected ? The investigation of Sounds, the systematization of Sounds, the comparison of Sounds. But nothing can be expected „für jenen Teil, wo die Sprache anfängt Werkzeug des Geistes zu sein und die im innern des Geistes immanent sich vollziehenden Vorgänge nach aussen zu offenbaren. Aber indirekt kann die Experimentalphonetik selbst auch in diesen Teil noch fördernd hinüberwirken, etc."

Heinitz in *Vox*, XXX, 1920, 74 : „Viele einschlägige Arbeiten sind überwiegend phonetisch orientiert, d.h. sie suchen in ihren Ergebnissen nicht den ursächlichen Zusammenhang mit psychischen Phänomenen. Andere möchten die aus wenigen Versuchspersonen gewonnenen Ergebnisse sofort verallgemeinern. Die optimistische Verallgemeinerung weniger experimenteller Resultate und gar der Versuch ihrer Anwendung auf praktische Fragen hat aber ohne Zweifel sehr oft dazu beigetragen, das Experiment in Miskredit zu bringen".

These quotations may recall to our memory some phases in the history of an antagonism, which has existed more or

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[1]) A gramophone-record would suffice (note of the present author).

less up to the present day: it deals with the problem of the value of instrumental phonetics for the study of language. Before dealing with the value of Instrumental Phonetics for linguists, a few words may be said about '*Experimental* Phonetics'.

The *term* „experimental phonetics" is an expression, altogether inadequate, for a conglomerate of various methods used in the investigation of speech-sounds and of speech-movements. These methods may be thus classified.

Classification, (1) instrumental methods (using instruments or other concrete expedients, such as gum, flames, meal)

a. registering only.

b. registering and reproducing (gramophones etc.)

(2) non-instrumental methods, e. g. the estimation of the loudness and sonority of distinct sounds in the open air by Rousselot; the estimation by a great number of persons of the variations in stress during a verse recitation, according to a certain scale.

Characterization. The rôle of the really experimental element in these methods, i. e. of the arranging of causes and circumstances in order to see which effect corresponds to which cause, varies with each case; it remains in the background e. g. in studying gramophone-records put upon the market by trading companies, but it is never absolutely lacking. The experiment in phonetics, however, is not confined to „experimental phonetics"; every one who pronounces alternatively *god good god good* etc. in order to establish the difference between *o* and *oo*, or who simply pronounces an *a*, in order to establish its characteristics, is experimenting, as well as he who tries to establish the pitch of different whispered vowels by pronouncing them.

As to what characterizes and typifies this conglomerate of methods, opinions greatly differ. The methods either aim at voluntarily reproducing of speech-sounds, or at getting visual reproductions of physical or physiological phenomena, or at

getting rather exact quantitative estimations of qualities. What they have in common seems only to be that they enable us to make more exact statements.

The term „maschinale Phonetik" (Forchhamer, *Die Grundlage der Phonetik*, 1924, 3) is rather an invective; not even all instruments are machines. The opinion of Gutzmann (Rede für den 1. intern. Kongress für Exp.-phon.) that its characteristic is the experiment, is incorrect, as has been shown above. The characterization by Roudet (*Eléments de phonétique générale*, 1910, 8) that the characteristic of experimental phonetics should lie „in the objective and quantitative character of the experiment instead of the subjective and merely qualitative one" is not quite satisfactory, as the methods of experimental phonetics are not always absolutely objective, nor are the other methods merely qualitative. Calzia says (*Experimentelle Phonetik*, Sammlung Göschen, 1921, 7), „die experimentelle Phonetik ist die Wissenschaft von der Phonation, d. h. von der Stimme und von den Lauten mit den ihnen eigentümlichen Komponenten: Farbe, Höhe, Stärke, und Dauer". Obviously Phonetics and Experimental Phonetics are mixed up here, i. e. the domain of science is mixed up with a group of its methods. He goes on saying, „Die Aufgabe der exp. Phonetik besteht darin, sich in der Gegenwart vollziehende, vom Orte unabhängige Phonationsvorgänge im normalen Organismus festzustellen, zu zergliedern, zu ordnen und die Bedingungen ihrer Veränderungen zu erforschen." By „vom Orte unabhängig" he seems to imply that phonetics should study speech-Sounds without taking into account their relation to the phonetic system of any definite language; if this is true, phonetics is arbitrarily confined to what is only of remote interest to the linguist: it is, indeed, in this way that his words are interpreted by Wilczewski (see below under „Sounds").

In order to avoid misunderstandings we shall use the term „Experimental Phonetics" to indicate the methods summarized above, so that it indicates a conglomerate of various methods

of investigating speech-sounds and speech-movements for obtaining more exact statements.

Experimental Phonetics, thus defined, is, as far as it is of interest to the Linguist, the counterpart of Experimental Psychology of Language; together they constitute Experimental Linguistics. As everyone who pronounces a sound in order to establish its characteristics, experiments, there can be no reasonable doubt as to the value of the really *experimental* element in Experimental Phonetics. The well-known question of the 'Value of Experimental Phonetics' obviously refers to the use of instruments, therefore to *Instrumental Phonetics.*

I shall try to prove that Instrumental Phonetics is of real value to Linguists, but that its present development is not quite so as to supply their wants. In order to make this clear, it is necessary to put the question: *what does the Linguist want to know about speech-sounds and speech-movements?*

Linguistics is the science of speech-form, speech-function, and of the semantic relations between speech-form and speech-function. Consequently, the linguist is interested in speech-form (movements and sounds), speech-function ('meaning' of words, 'meaning' of intonation, etc.), and the semantic relations between form and function. He wants to know the elements of speech-form, the elements of speech-function, and which elements of speech-form convey which elements of speech function.

A direct *element of speech-function* is a semantic-functional element directly expressed by a definite quality or a by definite combination of qualities of a sequence or a fraction of a sequence of movements and sounds. To give an example: the concept and the associations of hatred indirectly suggested by reading a great part of a whole poem is not a direct element of speech-function; the same concept and associations directly suggested by the word h a t e, in the sentence I h a t e y o u, or by the intonation of the sentence S c o u n d r e l! is

a direct element of speech-function. A direct element of speech-function is a distinct and direct rôle or task in the play of speech, i.e. in the general and more indirect psychological, sociological and biological function of speech.

A *quality of speech-form* is an impression (given by the perception of sounds or movements) that is analysable only in so far as it may vary during the perception of successive movements or (and) sounds, in the same way as the direct impression of a perfectly plain colour orange, or green, or brown, is unanalysable. The qualities of speech-form are:

(1) impression received from the energy of movements;

(2) impression received from the tempo and duration of movements;

(3) impression received from the direction of movements; these are the impressions received by the speaker as such;

(4) loudness of sounds, i.e. impression received from the amplitude of the air-vibrations;

(5) impression received from the tempo and duration of sounds;

(6) pitch, i.e. impression received from the tempo of air-vibrations;

(7) timbre, i.e impression received probably from the tempo of complex air-vibrations and from psychical factors, such as motory images; see further on under „Sounds". These are the impressions received by the hearer as such, and by the speaker in so far as he is hearer. A direct *element oj speech-form* is a quality of speech-form, or a combination of successive or (and) simultaneous qualities of speech-form that has a definite speech-function, i.e. that conveys one or more definite elements of speech-function. To give an example of the distinctions made here:

A direct element of speech-form is a quality or a combination of qualities either of a shorter fraction of a sequence of movements and sounds, or of a longer fraction. It is either the timbre of vowels and consonants; or the timbre, syllabifi-

cation, accent, of a word; or the timbre, division, accents, intonation, of a sentence; etc.

Speech-melody (pitch) is a quality of speech-form; the *air-vibrations* of pitch are qualities of the physical medium between speaker and hearer; *intonation* (comprising generally variations in pitch as well as in stress, duration, etc.) is an element of speech-form (conveying different elements of speech-function). Speech-melody is only exceptionally an element of speech-form, as it functions almost exclusively in combination with variations in stress, duration, etc. (see further on, pp. 55—59). It is important not to mix up these notions; speech-melody, however, is often mixed up with intonation, the tempo of the air-vibrations is often mixed up with pitch. The investigation of the qualities of speech-form (pitch, etc.) is a psychological investigation, it is the study of psychical impressions. The study of the functions of speech or language independent of speech-form does not belong to linguistics; it is the domain either of psychology or of sociology. Nor does the study of the form of speech or language independent of its function belong to linguistics: it is the domain of psychology. The study of air-vibrations or of articulative movements independent of their speech-function is the domain either of physiology or of physics, just as that of the movements of the heart, stomach, intestines.

Consequently; in studying movements or sounds the linguist wants to study the elements of linguistic form; in order to determine what are the elements of linguistic form, he must necessarily know which elements of form convey a definite linguistic function, and which do not. Only the former are elements of linguistic form, and they alone are of interest to him.

These facts may illustrate what I said before on the tendency of confining phonetics to the study of sounds independent of speech function. So, in order to establish the elements of linguistic form which the linguist is interested

to know, we must necessarily begin to establish the functions of speech. There exists in reality a certain hierarchy of functions. It is not at all easy to classify them in a thoroughly satisfactory way. The following provisional scheme may suffice for our present purpose.

Functions of speech. The *indirect function of speech* is that it furthers the development of personality and of society by promoting nearly all elements of personal and of social life.

The *direct functions of speech* are

a. with regard to the speaker: discharging; making logical thought possible;

b. with regard to speaker and hearer: bringing into action and causing emotions of all kinds without „communication"; e.g. by scaring or by rhythmical singing; communication, either of one's own feelings and thoughts, or of something belonging to the outer world; both including the very important function of social differentiation, in the same way as may function all kinds of social behaviour, such as dressing, eating, walking, etc.

The *function of the major elements of speech-sound-sequences* is to express. This can be done

a. in a habitual and conventional way (1) more or less intellectually: notions, concepts, relations between concepts, etc. (by means of vocabulary, sémantèmes; or of morphèmes, for grammatical function; etc.);

(2) more or less emotionally (by means of intonation; etc.).

b. in an habitual but not conventional way: involuntary expression of emotions, etc. (influence of different states of minds and moods on tempo of speech, pitch of voice, etc.)

c. occasionally (according to the important investigations and terminology of Grammont), i.e. when the attention of the hearer is unvoluntarily drawn to the resemblance between associations of form on the one hand, and of function (meaning of the word, context, etc.) on the other; the attention of the hearer may e.g. be drawn to the length of Fr. *prestidigitation*

in connection with the meaning of the word. Each element of sound or of movement, and each combination of elements may occasionally function in this way.

The *functions of the minor elements of speech-sound-sequences* are

a. to *distinguish*; this is the function of speech-Sounds in technical-linguistic sense (phonèmes, as opposed to „sons"); in order to avoid confusion we shall write the word in this meaning with a capital S: speech-Sounds, or simply Sounds;

b. to *group*, i.e. to give the hearer the impression of unities, or groups, which will be defined further on (p. 21);

c. to *correspond*, i.e. to draw the attention of the hearer to the likeness of successive sounds or sound-sequences;

d. to *express in an occasional way*, as has been indicated above.

The phonetician is interested only in the elements of speech-sounds and of speech-movements. In investigating them he can proceed by means of two methods [1]:

1. either he starts from the distinguishing, grouping, corresponding, and other functions, in order to ask: which are the elements conveying these functions? (Sounds, verses, feet, etc.)

2. or he starts from the distinct qualities of shorter or longer fractions of the sequences (variations in muscular energy, loudness, duration, pitch, etc.) in order to ask: which are the functions conveyed wholly or partially by each of these qualities? (expressing, grouping, correspondence, etc.).

In studying sounds or movements independent of their function, he leaves the realm and the aim of linguistics.

I. The phonetician starting from the linguistic functions of speech:

A. the distinguishing function (Sounds); B. the grouping function (rhythmic groups and musical groups); C. the corre-

[1]) There is no other possible method; the phonetician applies either the one, or the other, generally without realizing it.

sponding function (corresponding words, Sounds, verses, feet, etc.).

A. *the distinguishing function*: conveyed by the linguistic element of form called Sound.

It will be my purpose to demonstrate, firstly, that in studying speech-Sounds the methods of instrumental phonetics are of real importance to linguistics; secondly, that the effective development of instrumental phonetics in subservience of and of use to linguistics, i.e. of Instrumental Linguistic Phonetics, is encumbered by misconceptions held partly by the phonetician who experiments, partly by linguists or by not instrumental phoneticians; these misconceptions may be neutralized by mutual cooperation.

For that purpose I may be allowed to state what the linguist desires to know about speech-Sounds, in what way his wishes may be met, and what is the rôle of instruments in finding out that which the linguist wants to know. It may be, therefore, briefly stated what a speech-Sound is, and what are its functions.

It is a characteristic of a Sound that it does not express anything, as does a word for instance, but that it can distinguish one word from another; that it is not a group, but can contribute to the forming of groups; that it belongs to a definite language, and that it is one of its limited number of Sounds; and that it is the smallest fraction of the sound-sequences of that language that can serve as a distinguishing fraction between two words. To give an example: *i* and *e* in Engl. *big* and *beg* belong to a definite language (English) and can distinguish *big* from *beg*.

So a Sound may (provisionally) be defined as follows. A Sound is one of a limited number of combinations of sounds, simultaneous (e.g. produced by vocal chords and by tongue or lips) and successive, belonging to a definite language. Of these combinations all words of the language to which the

Sound belongs are built up; each of these combinations may fluctuate between two extremes round an average without losing its linguistic function. Sounds are *the shortest fractions of speech-sound-sequences of a definite language that can function in that language as a distinguishing means between words*, without being means of expressing.

There can be little doubt that the current text-books of phonetics scarcely trouble about giving a definition or a characterization of a speech-Sound that might offer a starting point for experimental researches. In fact, I did not find an adequate definition in any of them [1]). In Sievers and Rousselot we find hardly any definition. Jespersen (*Phonetische Grundfragen*, 104) speaks of a Mitteilungsmittel: it applies to a word or to a sentence: „Ein Sprachlaut ist ein Erzeugnis der menschlichen Sprachorgane, die eine solche Bewegung in der Luft hervorbringen, dass man imstande ist, sie mittels des Ohres mit einer Bestimmtheit wahrzunehmen und wiederzuerkennen, die hinreicht, um den ganzen Prozess als Mitteilungsmittel von dem einen Menschen zum andern benutzen zu können". Roudet says, „Un phonème est un son du langage caractérisé par un timbre déterminé". (*Eléments de phonétique générale*, 1910, 65). To this definition we may object that it involves a vicious circle, as the definition of timbre is dependent upon that of Sound. Further that in many languages other qualities (duration in Greek and Latin, pitch in Chinese) belong to the essence of a Sound.

To these facts it is due that the instrumental phonetician is at a loss how to experiment in matter of Sounds. Leaving out of account the distinguishing function of Sounds, he either starts from the notion of timbre with its innumerable possible variations, or from his registering curves, which, of course,

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[1]) The distinguishing function has been pointed out by H. Delacroix, *Le langage et la pensée*, 1924, pp. 138—139, and by De Saussure, *Cours de linguistique générale* [2], 1922, pp. 163—167.

show no abrupt limits between Sounds at all. The first is the case with Lote (*Etudes sur le vers français*, I, 43), who admits an exceedingly great number of Sounds, without sharply distinguishing between differences in timbre that may serve as a distinguishing quality, and those that are not. The second is the case with Scripture (*Die Neueren Sprachen*, VI, Beiheft, 86): „Im gesprochenen Vers gibt es ... keine Einzellaute", and with Von Ettmayer (*Jahresbericht der Oesterr. Gesellschaft f. exp. Phonetik*, IV. Vereinsjahr, 1917, 26): „Der Sprachlaut als Element der Rede ist ein Vorurteil." He adds that the investigation of Sounds is not the task of Phonetics: „Aufgabe der Phonetik ist Untersuchung physiologischer und psychischer Momente, wie Uebung, Ermüdung, Redetempo etc. auf das menschliche Sprechen". So he confines Phonetics to the study of the elements classified by us above sub b as „expressing something in a habitual but not conventional way" (which belong to speech, but not to language), and physiological phenomena which hardly interest the linguist from a linguistic point of view. Practically the same view is held by Wilczewski (*Vox*, XXXII, 1922, 71, cited by Luick, *Germ. Rom. Monatschr.*, XI, 1923, 259): „Die experimentelle Phonetik als solche sieht es nicht darauf ab die Stimm- und Lautfunktionen in einer bestimmten Sprache festzustellen, vielmehr die allgemein menschlichen, d. h. allem Sprechen zugrunde liegenden, vom Affekt befreiten mechanisch-physiologischen Tatbestände kennen zu lernen". If all phoneticians were of the same opinion, Instrumental Phonetics would be doomed never to be of any use to linguistics. Fortunately this is not the case.

The errors cited above can be traced to two sources: (1) misunderstanding of the nature of linguistic elements, more especially of elements of linguistic form (neglect of the function, identification of psychical and physical or physiological phenomena), and (2) ignorance of the wants of the linguist.

The functions of as Sound may provisionally be summarized

as follows: distinction, grouping, occasional expression, social differenciation (e.g. by affected pronunciation, by imitating the language of the superior classes, etc.). The first and the second function may occasionally be taken over by the context.

It is now possible to formulate *the wants of the linguist.* What does he desire to know, how can it be ascertained?

1. *What are the Sounds of a given language?* This can only be ascertained by introspection combined with observation, by establishing the distinguishing function. The fixation of Sounds and of Sound-sequences from dialects by means of gramophone records is, of course, highly important both for pure and for applied linguistics (teaching of modern languages). It is hardly necessary to be reminded of the fine work that has been done in this respect. It may even occasionally contribute to the explanation of Sound-changes, as e.g. in the case of the gramophone records of Heinitz from the Hamburg dialect in which simultaneously existing intermediate forms between *d* and *r* represent chronological stages.

What air-movements produce the Sounds? Averages and extremes can be calculated by means of instrumental researches. They are likely to vary from person to person. It is a matter of course that the previous choice of the material can only be made by the ear. The determination of such averages can be of importance both for the geography and for the history of languages. I venture to remind the reader of the comparative investigations by Clara Metz on consonants in Italian dialects, and of those into the explosive *p, t, k* in German and in other languages, which may have contributed to settle the problem of Grimm's law. It cannot be denied, however, that many of the differences ascertained in this way have no distinguishing function, and that some of them could have been ascertained, be it somewhat less exactly, by the trained ear.

2. *What is the relative frequency of the different Sounds in a definite language?* This can be ascertained by means of statistics.

3. *What is the subjective distinguishing criterion between Sound and Sound?* I.e. by means of what elements of the subjective impression conveyed by the Sounds the hearer succeeds in distinguishing one Sound from another? As has been rightly remarked by Heinitz (*Vox*, XXI, 1921, 165) the criterion lies in the last resort in the subjective impression. As a matter of course this criterion can only be found out by direct introspection; usually it will be a question of timbre. Timbre is analysable only to a certain degree, and it seems to be a consciously almost unanalysable, but complex element of perception. The analysis of the physical phenomena that are perceived, is, of course, quite another thing.

The question has been put whether the subjective criterion in the last resort consists of acoustic or of motory images, i.e. whether the timbre, taken as a purely acoustic element, or the images of the (real or illusory) movements used in the production of the Sound are the decisive factor. It is the well-known problem of „Akustisch oder Genetisch" (Jespersen, *Grundfragen*, Kapitel IV). The investigation into this determining factor during the perception of the Sounds is a psychological one. Whether or not Instrumental Phonetics can be of use here in future, cannot be predicted; but if so, certainly only by applying psychological methods.

4. *How, i.e. by the perception of what air-movements does the subjective criterion arise?*

It is certainly superfluous to remind the reader here of the fine instrumental work that has been done under the name of Vokalanalyse by Scripture, Poirot, Stumpf, Boeke, and others. Three possible errors, however, may be signalized here.

a. The study of the air-vibrations should not be neglected

by fixing one's attention mainly upon the sounds (perception) and the articulative movements (production of the sounds). I venture to see a tendency in this direction in the definition of Sweet (*Primer of Phonetics*, 2nd ed. 1902, p. 1):

"We see then that the word „sound" has two meanings. When we talk of the sound *s* we mean (1) the shape of the throat and the position of the tongue by which it is produced, and (2) the hiss which is the result of sending the breath through the passage thus formed."

If, in defining the Sounds, not only the sounds are taken into account, but also the movements necessary to produce them, it is rather strange to exclude the equally necessary air-vibrations, which are likewise worth studying. Even if it should be proved that in distinguishing one Sound from another the motory images play an important, even a decisive, part, it would remain interesting to know what vibrations by means of the perception can cause these images.

b. The differences between different sorts of vibrations should not be mixed up with the subjective criteria. The former are physical, the latter psychical facts. The former are easily analysable, the latter often almost unanalysable phenomena. The former need not always logically correspond to the latter, as the latter may be based upon an „illusion". It is probable that Sounds of different quality but of the same length regularly give the impression of different length: such may be the case with Enhlish and Dutch vowels. If this be true, it is not, or not exclusively, the difference in quality, but also the illusion of the difference in length that constitutes the criterion. This illusive quantity may even become „occasionally expressive"! Moreover, the perception of the sounds necessarily conveys motory images, which may make the criterion even more complicated. The ***difficulty of analysing them***, as well as the ***„illusions"***, and the ***complex***

character of the subjective criterion, are psychical facts, and these psychical facts are for the linguist of even more primary importance than the vibrations of the air.

To cite one example: it is highly interesting to learn from the instrumental researches of E. A. Meyer, that the generally assumed quantitative differences between English vowels do not exist to such a degree; but it should not be forgotten that in distinguishing the vowels the illusive quantitative differences may play a part.

c. The differences that may be proved to exist between the vibrations of different Sounds are not always identical with those that are really distinctive. It is hardly credible that all vibrative differences should be really, be it unconsciously, perceived: the linguist is not equally interested in all existing differences, but mainly in those that are effective. Now, sometimes it looks as if in the instrumental study of dialect Sounds phoneticians do not sufficiently distinguish between the „äusserlich bestimmte Quantität" (Jespersen, *Lehrbuch*[3], p. 182) and the „innerlich bestimmte Quantität". To cite two examples: Heinitz, in an interesting article in the *Vox*, XXI, 1921, 16, mentions three kinds of *t*'s: long, medium, short, in a group of German dialects; the reader, however, from his exposition, does not clearly see whether these quantitative differences are distinguishing factors, or not. In the former case there would be three Sounds, in the latter only one; it may also be that there are two. The same seems to be the case with the publication of Grass in *Vox*, XXX, 1920, 69—70.

Compare the valuable exposition of Sapir, in his work *Language*, pp. 56—58.

5. *How, and to what degree, do the Sounds contribute to grouping?* I shall refer to this question further on, in dealing with the syllable.

6. *What is the occasionally expressive value of Sounds?*

This question is a psychological one. Instrumental Phonetics may be of use here, provided that it uses psychological methods.

7. *What is the connection between the Sounds of a given language? How are they to be classified?*

The Sounds of a given language may be classified according to their articulative or acoustic likeness (Sweet, *Primer*, p. 1: „the acoustic study of speech-sounds classifies them according to their likeness to the ear, and explains how the acoustic effect of each sound is the necessary result of its organic formation"). Such classifications may have methodological and practical value; to the linguist, however, they are not of essential importance. What he needs is a classification that corresponds with the real psychic connection (between Sounds) existing in the mind of the speaker and hearer, i. e. with the „phonetic system" of a definite language (see Vendryes, *Le Langage*, pp. 40—61). This psychic connection is determined on the one hand by the *equilibrium* based upon differences between Sounds, differences necessary to and resulting from their distinctive function; on the other hand by *various associations* (arising from articulative likeness, acoustic likeness, psychical factors). The investigation of the phonetic system of a language belongs to the (instrumental or not instrumental) psychology of language; interchanges of vowels or consonants in slips of the tongue and in the history of languages are of interest here. Instrumental Phonetics may in future be of utility here, provided that it avails itself of psychological methods.

A classification of Sounds belonging to different languages, e.g. a classification of all Sounds of all languages with regard to a phonetic notation, cannot possibly correspond with any psychical connection such as described above, and must necessarily remain an arbitrary and more or less practical scheme. Such a scheme may, however, certainly have its use for practical purposes.

In regard to the „phonetic system" of a language the question „acoustic or genetic" reasserts itself. It might be proved that in distinguishing one Sound from an other the images of organic movements play an important part; one may compare the rôle of the motory (writing) and visual (reading) images in hearing a language with which the hearer is familiar only from reading. The investigation of these phenomena belongs to the experimental psychology of language. Even if the importance of those images should be proved, this would offer no excuse for a purely organic classification of Sounds for another than a purely practical purpose. But, of course, even a purely organic classification contributes to the knowledge of the equilibrium and of the associations between Sounds. Probably the question is not simply: acoustic or genetic? Perhaps in hearing and identifying the consonants of a definite language the images of movement, in hearing the vowels the acoustic images are predominant.

8. Finally, the linguist wants to know: *which are the relations between definite Sounds and definite elements of organic movement?* By means of which movements which Sounds are produced?

The importance of this question is not at all confined to applied linguistics, i. e. to the teaching of modern languages; on the contrary, it is of interest:

a. to understand the occasionally expressive function of Sounds, such as e. g. in:

Quadrupedumque putrem sonitu quatit ungula campum.

The occasional value of Sounds can arise from the attention drawn to the likeness of movements and context;

b. (in synchronic linguistics) to understand variations in stress, pitch, timbre, even within the duration of a syllable, resulting from variations in muscular movement and tension;

c. (in diachronic linguistics) to understand sound-changes by studying the influence of qualities of movement on qualities

of sound (E. A. Meyer; Abas on the influence of dynamic stress on the length of the consonant in *Recherches de phonétique*, Dissert. Amsterdam 1925; others on the influence of surrounding sounds); to reconstruct and to reproduce dead languages;

d. (with a practical purpose) to describe the timbre of Sounds in a roundabout way by indicating the organic movements necessary to produce them; a poor, but indispensable expedient in phonetic notation. It may be that with regard to this practical purpose the utility of purely registering instruments has sometimes been overestimated, as the most striking facts can be ascertained by the trained ear and by touch, and those that cannot are mostly of no practical value. Everyone knows what excellent work has been done here with the help of ear and touch by Sweet, Victor, Sievers, Jespersen and others.

For the teaching of modern languages the same is true.

Two groups of errors must be signalized here: identification of physiological with psychical phenomena (Fouché on the syllable, see further on), and use of instruments where instrumental research is unnecessary.

9. *Conclusion.* To summarize: I think we are allowed to state that Instrumental Phonetics has largely contributed to settling many linguistic problems concerning speech-Sounds, and that it will certainly continue to do so in future. But the phonetician has to reckon more strongly with the nature of the Sound as a linguistic element, and with the requirements of the linguist, by sharply distinguishing between physical or physiological phenomena on the one hand, and psychical ones on the other, between functioning and non-functioning qualities, and by taking into account the special problems of the linguist and by inviting the indispensable aid of psychological methods.

B. *The grouping function*, i.e. the formation of groups: conveyed by the elements of linguistic form called *sentence*,

word-group, syllable, phonetic word (?), verse, foot (?), etc.

It is my intention to prove with regard to groups, what I have stated in dealing with Sounds, that Instrumental Phonetics is of great importance to Linguistics, but that its development is encumbered by various inadequate ideas, which may be neutralized by cooperation between Experimental Phonetics, Linguistics and Experimental Psychology.

Definition. A group is the impression of unity given by a sequence of sounds, or of movements, or of simultaneous sounds and movements, a unity with its psychical centre in a special moment.

For the sake of simplicity the sequence that gives the impression of a group may be called a group; strictly speaking one is allowed to call a sequence a group only if it is perceived and perceived in a definite manner. In the same way a „melody" as a psychological fact in not a series of tones, but the peculiar impression made by them upon a musical and musically trained ear. When a sonata of Beethoven is reproduced by means of gramophone records and nobody can hear it, the special psychical facts that we call the melody of that sonata will be lacking. When it is heard by a perfectly unmusical person, the melody is lacking as well: to him the series of tones has no melody, or an other melody than that felt and meant by Beethoven. But, for the sake of simplicity, the series of tones may be called the „melody".

The existence of a group necessarily implies three kinds of phenomena:

a. physical or physiological phenomena (in language sounds and movements); *b.* the perception of them (by a hearer in the case of sounds, by the speaker himself in the case of movements); *c.* the impression of a unity as characterized above. For the sake of simplicity we shall use the word „group" to indicate these three factors.

The importance of the group as an element of speech can hardly be overestimated, in consequence of the fact that the

speaker tends to produce many sequences in such a way as to be groups to himself (in the case of movements and sounds), and to the hearer (in the case of sounds); this is the origin of numerous spontaneous pecularities of sounds and movements (tendency to form a centre, etc.), and even of numerous durable sound-changes. Further, the group is of importance as a source of many illusions. The importance of groups as aesthetic facts has been brought to the fore especially by Th. Lipps *(Grundzüge der Aesthetik)*; their rôle in language has been pointed out by Van Ginneken *(Principes de linguistique psychologique)*. The development of psychology, aesthetics and linguistics enables us to characterize the phenomena in question in a clearer and more complete way, perhaps even more correctly, than could be done twenty years ago.

What is the *linguistic function of a group as such?* il. habitually: to make speech easy, agreeable, beautiful [1]), ntelligible, clear, effective, perhaps even possible; further, to express, by the falling or rising „character" of the group (place of the centre), etc.

2. occasionally: by the fact that the attention of the perceiver is drawn to the likeness of certain associative images of the group on the one hand, and certain associative images of the context on the other, i.e. to the likeness of form and function; e.g. the falling character of verse feet may derive occasional expressive value from the melancholy contents of that verse.

What is it the linguist wants to know about groups? in what way can what he desires to know be ascertained? 1. what are the groups of speech? 2. by what factors groups are effected?

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[1]) The impression of beauty arises from perceiving the unity in the diversity.

1. *what are the groups of speech?* how can their existence be proved?

The only conclusive proof is by the direct way of introspection; by this method separately spoken sentences, syllables verses, prove to be groups. In other cases introspection is insufficient, viz. when the groups are hardly conscious or even subconscious. When introspection fails to give a conclusive proof, we can try to settle the question by ascertaining: does the speaker tend to form the sequence so as to give the impression of a unity? this tendency would necessarily imply the preexistence of the image of a group in his mind, and would make probable that the sequence is perceived as a group by him, as well as by the hearer. In order to apply this indirect method the use of instruments is of invaluable utility; it has enabled us, as will be seen further on, to prove, by calculating the average variations in stress, duration of the syllables, pitch, that the verse is a quantitative-energetic, as well as a tonic group.

2. *by what factors are groups effected?* In this respect one must clearly distinguish the impression of unity (connected with variations of attention, which possibly form the essence of a group), and the physical or physiological phenomena (the perception of which, together with psychic factors, cause the impression of unity). The physical and physiological phenomena generally result in variations in stress (rise, fall, pause), duration, pitch, timbre, of the sounds, and in variations in movements. The psychical factors seem to be mainly the expectation to perceive a series like that which has been perceived just before (sensorial setting, German „Einstellung"), and the tendency to perceive a group, which tendency frequently causes acoustic and other illusions as to the variations meant above.

The investigation of the physical and physiological factors causing linguistic groups has hitherto been rather exclusively

the work of psychologists; I shall try to show that it should be taken over by Experimental Phonetics, provided that the phonetician calls in the aid of psychological methods.

In order to determine the rôle of these physical and physiological factors the phonetician may begin by ascertaining how far the general rules of grouping that can be formulated on the fairly good authority of facts, apply to linguistic groups. These rules may be thus summarized.

I. There are two distinct kinds of groups: those in which energy and duration as grouping factors are predominant, (motory or auditory groups) and those in which pitch as a grouping factor is predominant (auditory groups). Two groups of different kind may be simultaneous without necessarily coinciding (comp. the bars of music, and the simultaneous phrase groups of music).

II. There is a direct correlation between energy (muscular energy, acoustic loudness; for the term 'loudness' see further on pp. 33—34) and duration, between energy and pitch, between pitch and timbre; there is a negative correlation between duration and pitch. A correlation between two qualities a and b means here that the speaker in producing the quality a tends also to produce the quality b, and conversely, and that the hearer in perceiving the quality a tends to perceive also the quality b, and conversely. Energy and length tend to coincide in Dutch and in many other languages. Energy may give the impression of higher pitch; pitch may strongly draw the attention to the energetic top [1]). The correlation between pitch and timbre needs no commentary. It is known from psychological experiments that pitch as a rule draws the attention of the observer away from duration.

III. *Quantitative-energetic groups.* Grouping is favoured or favourably influenced by:

[1]) We shall allways distinguish the *tops* of the physical or physiological groups from the *centres* of the psychical groups (culminating point of attention ?)

1. variations in stress (articulative energy, loudness) and duration, also in pitch and timbre. None of them, however, is indispensable to grouping: even the absolutely non-differentiated ticking of the clock regularly creates groups; even the non-differentiated sound of a steam-whistle may occasionally do so;

2. the tops lying either at the beginning or at the end of the group (as in music at the beginning of the bars); the influence of falling character may be stronger than that of rising character; this would account for the fact that our music only knows falling bars, while excluding the others.

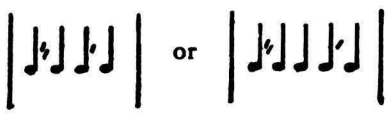
3. the group being bipartite or tripartite (feet are usually bi- or trisyllabic);

4. the group being repeated (often connected with correspondence; the „rhythm" of music; comp. G. E. Müller, *Zeitschrift für Psychologie*, Erg. Band V, p. 256);

5. the group having a certain duration, varying from individual to individual, and from case to case (comp. feet, bars, Sprechtakte); this duration may correspond with that of waves of attention, or with pulsations of the heart (see Pavlov in *Journ. de Psych.*, 1927), or with other physiological or psychical phenomena.

Grouping is often accompanied by:

1. "hierarchy" (e.g. in musical bars):



2. "variotomy" with other groups (in music the limits between bars and those between melody groups do not necessarily coincide).

IV. *Tonic groups.* Grouping is favoured by:

1. variations in pitch and timbre, perhaps in other qualities

2. the top lying in the midst of the group.

Grouping is often accompanied by:

1. "hierarchy" (e.g. in music; for speech comp. Grammont, *Traité pratique de prononciation française*, p. 159, on the melody of the French sentence);

2. "variotony" (harmony of simultaneous tones or melodies).

V. *The centres* are probably the maxima of attention; they are of two distinct kinds: those caused mainly by the perception of an energetic or quantitative top, and those caused mainly by the perception of a tonic top. The difference is illustrated by the existing differences in word-accent in different languages: Old Greek on the one hand, Modern English on the other. The positive or negative correlations between stress, etc., as described above, are strikingly illustrated by the investigations of Wallin (*Researches on the Rhythm of Speech*, Studies from the Yale Psychological Laboratory, Vol. IX, 1901, p. 17).

The investigation of the psychic factors contributing to grouping can conveniently start from what has been said above about them, in order to establish, how far the distinctions made there, apply to speech.

It is possible now to formulate more in detail what the linguist desires to know, and what should be the methods of investigation.

He then desires to know:

I. the existence of a group (to be shown by introspection or in the indirect manner indicated above); the exact place of the centre (maximum of attention?; to be established in the same way);

II. do the general rules of grouping apply to speech?

a. is the extant group an energetic (-quantitative) or a tonic one? Do these two kinds of groups exist in speech independently of each other?

b. do the details of the rules about the rôle of the *phy-*

siological and physical factors of grouping apply to speech?

1. are there variations in stress, etc. in the sequence of sounds and movements?
2. where are the tops?
3. what is the division of the group? is the group bipartite, tripartite?
4. is the group repeated? is there correspondence?
5. is there hierarchy?
6. is there variotomy or variotony?

c. do the details of the rules about the rôle of the *psychical factors* apply to speech?

1. is there effect of a sensorial disposition („Einstellung")?
2. is there effect of the unexpected?
3. is there effect of motory images?

What Instrumental Phonetics can do in these respects will be shown further on when we deal with the different kinds of groups; but it is perhaps already evident now that the appliance of psychological methods is indispensable.

We may state a few errors here that can be avoided in future by the cooperation of phoneticians, linguists, and psychologists.

The first error is that the physiological and physical *tops* are not always sharply distinguished from, or that they are even identified with the psychical *centres*. Sievers (*Phonetik*[4], par. 543) says: „Die Abstufung nach Stärke (Intensität) und Tonhöhe pflegt man unter dem Namen Accent oder Accentuierung zusammenzufassen, und diese Namen mögen auch hier verwendet werden..." Zwaardemaker (*Die experimentelle Phonetik vom medizinischen Standpunkte*, Monatsschrift für die gesamte Sprachheilkunde, XIX, 1909, pp. 355—356) says: „Man unterscheidet im allgemeinen drei Arten von Betonung: 1. der musikalische Akzent; 2. der dynamische Akzent; 3. der Zeitakzent. Unter der ersten Bezeichnung versteht man eine vorübergehende Erhöhung des Sprechtons". Etc." Abas (*Les sons dans la phrase*, Arch. néerl. de physiologie, XI, 1926,

307—350, pp. 26—27): „un son n'a pas besoin d'être accentue pour être frappé d'accent musical" and: „l'accent de la phrase hollandaise est plutôt descendant. L'accent est donc ici une *illusion* dont l'explication doit être cherché probablement dans des causes d'ordre psychologique". The psychic centre is never an illusion, but it may be caused by an illusive top. The centre, even if based upon an illusion, is to the hearer more real and of more real importance than a physical top that is not noticed at all.

Secondly, the exact place of the centre should not be identified with the exact place of the top. That the moment of the centre is not at all to be identified with the moment of the top clearly appears from the researches of Miss Van Geldorp (*Contrib. à la connaiss. de l'allure de l'accent expiratoire*, Arch. Néerl. de Physiol., XI, 1927, 545, 560), which show that the stress of the syllable which bears the word-accent in Dutch is often anticipated by the preceding syllable without this preceding syllable being felt as bearing the word-accent, as this is strictly confined to one syllable.

Thirdly, the factors effecting the centre (maximum of attention ?) should not be considered as being exclusively either of a physical (physiological), or of a psychical nature. The former seems to be the current opinion. The latter is obviously that of Froeschels (*Jahresbericht der Oesterreichischen Gesellschaft für experimentelle Phonetik*, II. Vereinsjahr 1915, p. 72): „Der Akzent beruht darauf, dass der Sprecher die Aufmerksamkeit des Hörers dadurch auf eine Silbe, ein Wort oder einen Satz zu lenken sucht, dass er diese in einer für den Hörer ungewohnten Art ausspricht".

The true conception is found in Lote, *Etudes sur le vers français*, I, 40, and in Scripture, *Elements of Experimental Phonetics*, 507. The rôle of the sensorial disposition is illustrated by musical execution when, either by the intention of the executer, or by the nature of the instrument (organ, etc.), the first tone of a bar is not stressed, without the bar

losing its aesthetic value. So the image of a group can arise without the perception of any variations in stress, and, occasionally, even without the illusion of it.

The error of identifying physical with psychical phenomena (viz. air movements with variations in attention or in other psychical phenomena) seems to result from the frequent use of instruments and of curves, indirectly perhaps from former materialistic conceptions; it is one of the errors that are most common to experimental phoneticians.

The complex character of the physical factors has been ingeniously drawn attention to by Scripture (theory of the „centroid"), Wallin, Krüger. The importance of Wallin's experimental researches (Studies from the Yale Psychological Laboratory IX 1901: *Researches on the Rhythm of Speech*) has been indicated above; while the researches of Pernot in *Les parlers de Chios*, are also of great importance. The question is, however, and requires further examination, whether one quality (e.g. stress) is at the base of the other qualities. In this case the others should be considered as substituted for the basic quality; the importance of the „substitution" has rightly been pointed out by Meumann (*Philosophische Studien Wundt*, IX, 306).

In investigating the complex quality of the *psychical* factors the question about the importance of the motory images is most urgent; it is not at all improbable that these will prove to be the most fundamental ones of all. It may be, indeed, that it is mainly the image of a maximum energy of muscular movement that determines the moment of the centre; consonants of little loudness or sonority often seem to be strongly „accentuated" even to the hearer, e.g. in the case of a person speaking while suppressing his anger.

I hope to have sufficiently illustrated the need of cooperation between experimental phonetics, linguistics, and experimental psychology in the investigation of speech groups.

The phonetic sentence.

I prefer to avoid here a definition of the phonetic sentence; it must, of course, necessarily contain that it is a group. Its function is obviously to express, to group, to correspond. The expressing function will be treated further on under „Intonation", the corresponding one under „Correspondence"; remains the „Grouping". In most cases the centre and the limits of the group can be easily determined in a more or less exact way by the ear. The subjective impression given by stress, duration of syllables and of word-groups, pitch, can only be ascertained by introspection; remarkable work has been done here by a great number of phoneticians. As to grouping, the curve given by Grammont of the melody of the French sentence is highly interesting; it seems that he has obtained it by introspection.

Among the physical and physiological elements, the perception of which contributes to grouping, the energy of sounds or of movements cannot as yet be registered with sufficient exactness. The length of syllables can be determined with great exactness so far as the limits between syllables are determinable. These limits can be determined only by means of introspection; from this introspection, rules can be deduced for the determining of the limiting points in the registering curves. The variations in pitch can be determined with great exactness; the variations in the air-vibrations do not, however, exactly correspond to the impression given by them to the average hearer. The variations in timbre cannot be studied by means of instruments, as timbre is a complex quality resulting in a rather unanalysable acoustic impression, as was pointed out before.

We are justified to infer from these facts that also in the investigation of the phonetic sentence linguistics needs the help of instrumental methods in permanent combination with introspection and other psychological methods.

31

The syllable.

Definition. By syllables we understand, in accordance with common parlance, the shortest parts of a sentence which make upon the hearer and upon the speaker the impression of unities with a centre; they are *the shortest groups of speech.*

Characterisation. Being a group, a syllable necessarily includes: producing movements (in case of the syllable physiological ones), air-vibrations, perception (in case of the syllable perception of movements by the speaker, of sounds by speaker and hearer); impression of a unity with a centre (of attention?) both on speaker and hearer (in case of the syllable). As it usually forms part of a series of groups, it tends to correspond with preceding and following groups. It is, if not exclusively, an energetic group. If we call for convenience sake the combination of simultaneous energetic grouping and correspondance „rhythm", the syllable" is *the shortest rhythmic group of speech.*

Function. Being a group, the syllable makes speech-movements easy to produce, and agreeable, beautiful (to the speaker); it makes speech-sounds easy to perceive, and agreeable, beautiful (to the hearer). As a corresponding element, its function is the same. It functions in this way in ordinary speech, in rhythmic prose, in poetry: it causes that one perceives easily the unity in the diversity of speech-movements and speech-sounds: therefore it is an eminently aesthetic element.

What does the linguist want to know about the syllable? What are the syllables of a given sentence, where are their limits, their centres, by what factors is grouping effected.

1. What the syllables are can be established in a direct way by introspection only.

2. Where are their limits, their centres? these are usually rather vague. Introspection shows that neither the limits nor

the centre are precisely definable moments in the series of sounds and movements; they also are rather vague.

Where the limits and the centre are, may be approximately determined by establishing where the speaker makes the tops of *muscular energy*, of *loudness*, of *pitch*. Here instrumental research will probably be of use in future, as it has been already.

Firstly, it has often been maintained that the syllable is produced by one undulation of *muscular energy*; the experimental proof, however, is still lacking, as it is as yet impossible to measure the variations in energy of production. Nor is it known where the energetic tops lie: Van Ginneken holds that they lie in the consonants, others think in the vowels. Grammont and Fouché have made a most interesting effort to prove that the syllable is produced by one rise followed by one fall of muscular energy. This attempt, however, has to be considered as a failure. Fouché (*Etudes de phonétique générale*, 1927) assumes that the larynx is a totalisator of muscular energy, so that it rises and falls with it. This view is obviously wrong. The movements of the larynx do not, e. g., exactly reflect the movements of the lips; they are strongly influenced by the character of the vowel, as has been proved by L. P. H. Eykman (*Radiographie des Kehlkopfes*, in Fortschritte auf dem Gebiet der Röntgenstrahlen, VII, 1904): an *e* e. g. usually causes a rise, an *u* a fall of the larynx; the larynx tends to rise and to fall with pitch. [1]) It has not been proved that one syllable cannot be produced by two times an energetic rise-and-fall, analogous to the fact that some syllables have two sonority-tops, e. g. Germ. *Obst*, Engl. *stand*, and that others have two tops of pitch. Nor has it been proved that two

[1]) neither Grammont nor Fouché gives any indication as to the method used to obtain the curves of the larynx, whether with the instrument of Zwaardemaker, or not. From Fouché's figure 1 on p. 5 one might be inclined to infer that the syllable has two motory-energetic tops, if it was not for the tendency of the larynx to fall during an *u*.

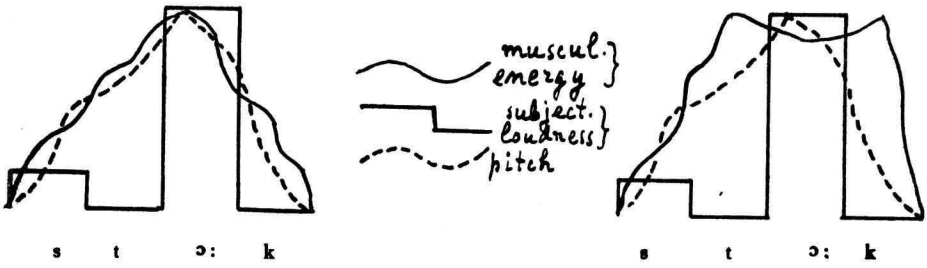
syllables can never be produced by one rise followed by one fall of muscular energy, as may sometimes be the case with Dutch *-bare*, in *hoorbare*, *tastbare* in a rapidly spoken sentence. Consequently, the instrumental methods in use to determine the top and the limits of an energetic rise-and-fall are still unreliable.

Secondly, a normally spoken syllable has always a top of *subjective loudness*. In order to avoid misunderstandings, I shall begin by defining my use of some words. I understand by *objective loudness* the amplitude of the air-vibrations, while by *subjective loudness* I understand the impression of loudness received bij the hearer. This impression does not always exactly correspond with the amplitude of the air-vibrations, no more than the subjective impression of pitch always exactly corresponds with the duration of the air-vibrations ; our faculty to estimate and to note slight variations, is even far more developed with regard to pitch than with regard to loudness. Subjective loudness is probably a resultant of objective loudness, of pitch, of the peculiarities of each definite Sound, and of other psychical factors. We shall call these peculiarities of a speech-Sound, in so far they influence its subjective loudness, its *sonority*. The sum of all acoustic peculiarities (as a whole) of a Sound (as an element of the phonetic system of a definite language), will be called its *timbre*. Consequently, sonority is the influence of timbre upon subjective loudness. It is often possible to determine the tops of objective loudness, and its lowest points. These may, or may not, coincide with the tops and the limits of undulations of subjective loudness.

Thirdly, a syllable has often a distinct top of *pitch*. This may be approximately determined by measuring the duration of the air-vibrations, i. e. by establishing the top of objective pitch. Miss Van Geldorp has shown in Amsterdam that the top of objective pitch in separately spoken Dutch *paa* lies at the beginning of the *aa*, in Dutch *aap* at the end of the *aa*. This may point to a tendency to put the pitch-top rather exactly

in the middle of the syllable; this might prove, in connection with the rules of pitch-grouping formulated above on p. 20, that the speaker tends to form the syllable as a pitch-group. There often occurs a secondary minor pitch-top in the same syllable. Instrumental research is undoubtedly of great importance here.

So the syllable shows simultaneous variations in muscular energy, subjective loudness, pitch, which may be illustrated by the following hypothetical schemes of English *stalk* (stɔ: k):



It should be borne in mind that the muscular movements are perceived by the speaker only: subjective loudness and pitch are perceived both by the speaker and the hearer.

I conclude that even here instrumental research may prove to be of use in future; if it could be established, e.g., that the tops of the three qualities in question tend to coincide, this might be an indication as to the place of the centre.

1. *By what factors is grouping effected?* i.e. by the perception of what physiological or physical phenomena? In other words: what kind of a group is the syllable? Is it a motory or an auditory, an energetic or a tonic group?

The speaker perceives movements and sounds; the hearer only sounds. So one might be inclined to conclude that the syllable is an acoustic group, as it is a group both to the speaker and to the hearer. But perception is a very complex process: it is a process of omitting and adding and it neces-

sarily involves numerous associations. Without any doubt the perception of speech-sounds evokes images of speech-movements. So it is not at all impossible that the unity of perception felt by the hearer is not caused directly by the perception of sounds, but by the associative images of movement. It is clear that the problem is analogous to that of the criterion of Sounds: acoustic or genetic, i. e. auditory or motory? One might even be inclined to consider all auditory groups as being in the last resort motory groups: this question, however, which is of a purely psychological nature, does not regard us here.

I am inclined to believe that for the hearer the syllable is mainly a motory group, i. e. a series of movements and sounds that is perceived as a unity mainly in consequence of the fact that the hearer imagines them to be produced by one single undulation of muscular energy; whether they are really produced in this way, or not, is irrelevant. But also here the problem is not simply: either motory, or auditory. The syllable is obviously also an auditory unity. More correctly perhaps, it seems to be not a motory unity with a simultaneous auditory unity: it seems to be rather one undivisable auditory-motory unity or group, with one single auditory-motory centre; in this centre, however, the motory images may be predominant and, so to say, primary.

The question remains: is it an energetic or a pitch group? In so far as it is a motory group, it is certainly an energetic group. Also in so far as it is an auditory group it is an energetic group, seeing its centre of subjective loudness. But the experiments of Miss Van Geldorp make us inclined to believe that it is also in many cases a pitch group.

Instrumental research may further our knowledge, more especially as to the question whether the motory or the auditory images are predominant, and whether the tendency to produce and to perceive it as a pitch group is a regular or only an occasional one. This may be done by analysing

the tendencies of the speaker. For it is a peculiarity of a "group" that the perceiver in so far as he is producer himself tends to produce the movements and sounds in such a way as to give the impression of a group. He usually tends, e. g., to make the energetic undulations rising or falling, and to make the pitch undulations rising-and-falling. If all energetic undulations prove to be either rising or falling (hierarchically arranged or not), and if all pitch undulations prove to be both rising and falling (hierarchically arranged or not), one is allowed to presume that there exists a tendency to produce as well as to perceive energetic and tonic groups. Instrumental research will certainly prove to be of use here in future.

In investigating the syllable various errors have been made. They may be traced back to four sources: identification of physical with psychical phenomena; identification of physiological with psychical phenomena; simplification of a complex process; underestimation of the importance of instrumental research.

1. Identification of physical with psychical phenomena. Panconcelli-Calzia and Scripture argue as follows. The syllable is a unity; it is not a physical unity; consequently it does not exist. Scripture, in his article in *Festgabe Luick*, infers from his curves of air-vibrations that the syllable does not exist, and Calzia says (*Die experimentelle Phonetik*[2], pp. 23 and 119). "Die Silbe existiert — phonetisch betrachtet — nicht, sondern ist eine Erdichtung, die im Laufe der Jahrhunderte in der Schule und in der Philologie eine solche suggestive Kraft ausgeübt hat, dass ihr fiktives Wesen in Vergessenheit geriet und sie sogar von manchem Phonetiker heute noch für eine Tatsache gehalten wird... Die Silbe phonetisch untersuchen und begründen zu wollen, ist also eine Utopie..." By these words the existence is denied of an element of speech which existence needed no proof. It is hardly necessary to remind the reader of the rôle of the syllable in versification,

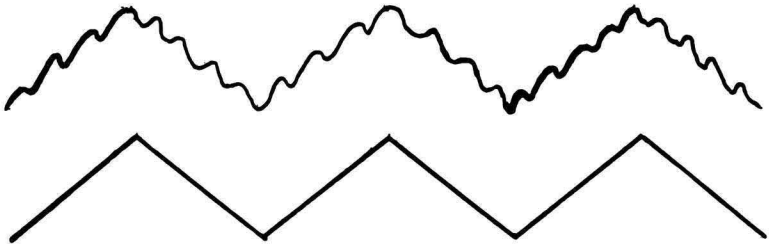
in the history of the alphabet, in certain mental diseases (see Vendryes, *Le langage*, pp. 62—65). To Calzia "phonetisch" and "physisch" are obviously synonymous. In this connection may be mentioned F. Krueger's opinion (see his remarkable article *Beziehungen der exp. Phonetik z. Psychologie* in Bericht... II Kongress f. exp. Psychologie, 1906) that the syllable is an abstraction, which is no more correct. With Grünbaum (Zeitschrift f. d. gesamte Neurologie und Psychiatrie XCVI, 1925, 518) I would sooner call it a "artikulo-motorische Gestalt". A Sound may be called an abstraction, a syllable certainly not.

2. Identification of physiological with psychical phenomena. Fouché (*Etudes de phonétique générale*, 1927) and may be Grammont (*L'Assimilation*, Bulletin de la Société de Linguistique 1925) argue as follows. The syllable is a unity; it is always produced by one rise of muscular energy followed by one fall; consequently it is a Sound or a series of Sounds produced by one rise-and-fall of muscular energy.

As a definition, this contention is impracticable, for it has not been proved that the syllable is always produced in this way: I am inclined to believe that it is not the case. As a characterisation it is inadequate, as it does not mention the essential quality of the syllable, *viz.* the impression as a unity. To illustrate its inadequateness: we may say that the horse is the species of quadrupeds which eats most oats of all species of quadrupeds. As a definition, this may be correct, i. e. in accordance with common parlance. As a characterisation it is inadequate, as it does not contain any of the essential characteristics of a horse. It says how a horse is fed, but it does not say what a horse is. Similarly the characterisation of Fouché says how the syllable is produced, but it does not say what it is.

It may be provisionally presumed that the syllable is produced by a number of slight undulations in muscular energy forming together one greater undulation with one or

two tops. Such slight variations may occur in nearly al Sounds, e.g. in vibrating or not vibrating long vowels, in an *r*, etc. So the first of the following schemes of the energetic variations in a three-syllabic word is more likely to be correct than the latter:



Supposing, however, that the latter scheme is correct, the definition of Fouché is, as a definition, incorrect, i. e. not in accordance with common parlance, or it is based upon a vicious circle. It runs as follows. „Par rapport à l' effort musculaire, la syllabe est constituée par un ou plusieurs phonèmes à tension croissante suivis d'un ou plusieurs phonèmes à tension décroissante." Consequently the syllable necessarily has at least two phonèmes. But what is a phonème? What are e. g. the phonèmes in three-syllabic *a-a-a*, or *r-r-r*, or Germ. *so-o-o*? What in bi-syllabic German Fe-ste? If the equation of Fouché shall hold good also here, we are obliged to define the phonème with the help of rising or falling energy, i. e. to get into a vicious circle.

Supposing that the latter scheme should be correct, the definition of a syllable: „a Sound or a series of Sounds produced by one single rise-and-fall of muscular energy" would be correct as a definition, but would offer no characterisation. Nobody could understand from it the importance of the syllable in conversation. As to its function in hearing a sentence, the question whether a Sound or a series of Sounds

is produced by one single rise-and-fall of muscular energy is of secondary or of no importance; whether it is felt as a unity, or is imagined as being produced by one single rise-and-fall, is of primary importance. The syllable differs from mere physiological contractions such as those of the heart, the stomach, the intestines, by producing sounds, and by being perceived both as movements and as sounds.

It is significant for the indirectness of the importance of muscular movements that the hearer fairly well succeeds in determining the number of syllables in a sentence of a language that is unknown to him. He does not, as a rule, perceive the muscular contractions of the speaker: he tends to perceive mere sounds as groups, e. g. those of a steam-whistle or of a pendulum; in case of speech, he is disposed (Germ. eingestellt) to perceive groups such as he is accustomed to perceive.

(3) Simplification of a complex process. Jespersen argues as follows. The syllable is a unity; it has always a sonority-top which is felt as such; consequently the syllable is a sonority-top which is felt as such. He overlooks here that the syllable has also other tops. It is curious to note that Jespersen, who prefers the motory explanation of the Sound-criterion to the acoustic, prefers the acoustic definition of the syllable to the motory.

(4) Underestimation of instrumental research. Neither Sievers nor Jespersen have tried to elucidate the problem of the syllable in this way. The variations in pitch have already proved to be of interest. So the opinion of Jespersen has been falsified by facts: „Einen diametralen Gegensatz zu diesem Gebiete bildet die *Silbenbildung* mit den zahlreichen wichtigen Fragen, die damit zusammenhängen: ich wenigstens wüsste nicht, wie uns hier Instrumente behilflich sein könnten." (*Phonetische Grundfragen,* 1904, 134).

What we ought to know in the first place is: (1) are there cases where two successive contractions give to the hearer or even to the speaker the impression of one syllable (possibly

e. g. in Engl. *foot, food*, with strongly articulated final consonant, or in Engl. *ye-es*); (2) are there cases where one contraction gives to the hearer the impression of two syllables (possibly e. g. in long diphtongs). Therefore it is necessary to make a series of experiments by which the muscular movements, as well as the air-vibrations and the impression made upon the hearer as well as upon the speaker, are established. But it should not be forgotten that even if it might be proved that two contractions may be felt as one syllable, and one contraction as two syllables, the possibility remains that in judging about the number of syllables of a word the images of real or illusive muscular contractions to the speaker as well as to the hearer are always decisive.

Verse.

Metrics is one of the most important chapters of phonetics: it is the science of systematized grouping and correspondence in sounds and movements. It has not, however, as yet found sufficient treatment in textbooks or phonetics, as a result either of their practical aim, or of former intellectualistic conceptions of grammar and language, or of the difficulty of the subject. But already Jespersen alludes to the Sprechtakte as being probably of importance to the phonetician of to-morrow. If metrics is left out of account in a text-book of phonetics, the syllable has to be left out of account too.

I prefer to avoid a *definition* of a verse, just because it is questionable whether it is a group or not: if so, the definition ought indicate it. The *functions* of the verse as such are perhaps grouping, certainly corresponding with one or more preceding or sequent verses, and occasionally expressing: this last function will for convenience sake be left out of account here.

What does the linguist want to know? (1) is a verse a group, and if so, what kind of a group? (2) by what factors

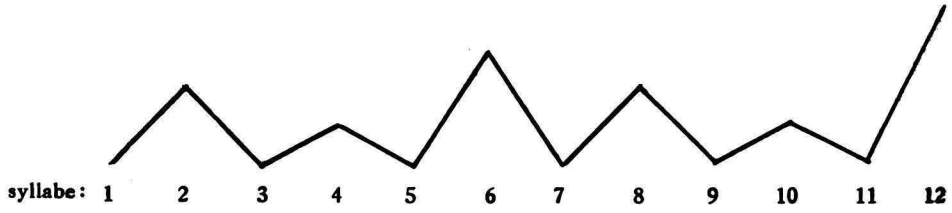
is grouping effected? (3) by what factors is correspondence effected? The last question will be treated in dealing with correspondence.

In many cases introspection shows that a verse is a group, e. g. when pronounced separately: a unity with a centre. If it is a group in modern languages, it is certainly an energetic group. Indeed, if we say we feel the metre of a verse, it means that we feel the verse as tending towards a unity, corresponding with one or more other unities (verses). Verrier, however, denies that a verse is a group, but consequently be is at a loss how to define it (*Métrique anglaise*, I, 173).

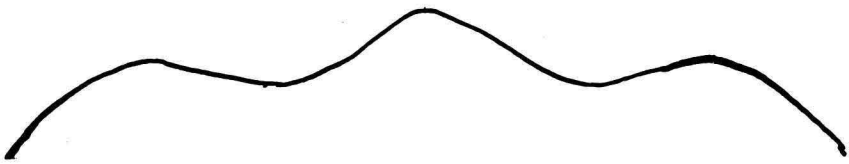
At any rate, introspection offers no conclusive proof that a verse is always a group, nor does it sufficiently show what are the grouping factors. The question requires, therefore, more exact treatment, and the true method seems to be (as already has been indicated) to analyse the tendencies of the speaker as revealed in the air-movements and perhaps in his muscular ones, in order to establish whether he tends to form the sound-sequences such as we know to make as a rule the impression of groups on the hearer. This method seems to be a rather complex one, as the actual variations in stress, duration of syllables, pitch, etc. do not only group (supposing they are really grouping), but also express the meaning of the words etc., and all that is conveyed by „intonation", and, finally, cause correspondence with other verses. The solution of the problem is even more complicated by the fact that, for the present at least, stress cannot be very well measured by means of instruments. Consequently, the curves for the said variations in the actual pronunciation of a verse nearly always show a rather perplexing variety. The question, therefore, is how to eliminate the expressing and corresponding factors in order to be able to deal separately with the result of possibly existing grouping tendencies.

I may be allowed to mention here that we probably have succeeded in enucleating the grouping factors by simply

calculating the average variations in stress, duration of syllables, and pitch, in a number of successive corresponding verses. The stress and duration curves of six-footed iambic verses of Dutch and German sonnets invariably fairly well approximate to the following schematic figure:



Those of pitch (investigated by Mr. Buiskool, also using the researches of Mr. Guittart) always yielded about this result („brace"):



Each separate verse of the sonnet deviated, of course considerably from these averages. The subject of one of the investigations was a recitation by a famous Dutch actor, Willem Royaards, to be got as Pathé Gramophone record (nr. 30036). The stress was estimated by a great number of observers; their estimations diverged widely, and it was astonishing how little the averages varied.

Now, as to stress we know that a sequence of sounds showing exactly the variations of the average verse tends to form a group, just as it is the characteristic form of a series of senseless syllables forming groups in memory experiments; compare G. E. Müller in *Zeitschr. f. Psychologie* Erg. Bd. V, p. 350—351); it is, moreover, the typical form of the „drone" of a Dutch poem.

As to pitch, the curves clearly show a tendency to form hierarchic tonic groups.

I have somewhat dwelled on this point in order to give an example of results that could neither have been obtained without the help of instruments (esp. as regards the exact determination of the length of syllables), nor could have been obtained without fully taking into account psychical factors.

In the first place we can infer from our curves that there exists in Dutch and German a strong correlation between stress and duration, probably in such a way as to permit partial substitution of the one for the other. Secondly we find that there is only a feeble correlation between stress and duration on the one hand, and pitch on the other. This is in accordance with the rules of grouping formulated above. Thirdly, the Dutch and German verse is probably both a quantitative-energetic and a tonic group.

If this is true, Dutch and German, probably also English, verse may provisionally be thus defined: a series ot words (occasionally beginning or ending between two syllables belonging to the same word) strongly corresponding with one or more preceding or sequent series of words, tending to be a more or less regularly and hierarchically constructed quantitative-energetic as well as a regular and hierarchical tonic group.

The recitation by W. Royaards does not give at all an impression of constraint, nor did the other recitations as far as could be judged from their reproduction by means of gramophone records. Therefore, we may conclude that Mr. Sievers was wrong in saying (*Phonetik*, Vorwort zur vierten Auflage): („bezweifle ich auf Grund langjähriger Erfahrung im phonetischen Unterricht), dass es ohne schwerste Selbstzucht jemandem gelinge, in einen Apparat dasjenige hervorzubringen was er sonst unter normalen Bedingungen spricht". Moreover, modern apparatus enable as to make records without the subject himself being aware of it.

C. *The corresponding function.* Correspondence is, provisionally defined, the impression of likeness yielded by successive movement or sound sequences: the attention of the perceiver (speaker, hearer) is drawn to the (real or illusive) more or less perfect conformity of successive sequences.

Habitually it functions to make speech easy, agreeable, pleasing, beautiful, clear, effective. The impression of beauty arises in the case of correspondence as well in the case of groups from attending to the unity in the diversity. Occasionally correspondence functions to express „logical correspondence" between the meaning of two or more successive words, word-groups, sentences, as e.g. in: *speech furthers the development of personality and of society:* or in Dutch: *het onderzoek van de mogelijkheid en van de wenschelijkheid*: this function is predominant e.g. in the parallelism of the Psalms.

The linguist wants to know where correspondence exists, and by what (physiological, physical, psychical) factors it is effected.

Where correspondence exists, can often be directly established by means of introspection, e. g. in the case of stanzas, verses, verse ictus, intervals between verse ictus, symmetrically balanced periods, bars in music, melodies, phrases, etc. In other cases, where the introspection of the perceiver is not conclusive, e.g. in the case of successive words belonging to one and the same sentence, the tendencies of the producer (the speaker) must be analysed. It has to be ascertained whether the producer tends to equalize successive sequences in stress, duration, pitch, timbre, number of syllables, (rising or falling) character of the group, and in other peculiarities. Instruments can be of use here, especially to determine the length of groups. In Amsterdam we have probably succeeded in establishing correspondence in the case of successive words belonging to the same sentence in Dutch. In the following example the figures indicate the average duration of a syllable in one hundredth of a second, calculated taking the average from a number of cases:

Jan Dam	*36*	*38*		
Jan van Dam	*38½*	*33½*	*33*	
Jan van den Dam	*39*	*24½*	*16½*	*32½*

The first word (*Jan*) tends to become longer according as the sequent group (*Dam*, or *van Dam*, or *van den Dam*) increases in number of syllables and in length.

Which factors play a part, can often be ascertained by introspection: this is perhaps the only applicable method to establish the rôle of timbre, (for the term see p. 27) e. g. in alliteration, assonance, rhyme. Instrumental methods are of importance here to determine the influence of stress, duration, pitch. It should be remembered, however, that the curves of loudness till now obtained by means of instruments are not reliable, and that the curves showing the actual variations in pitch are not an adequate expression of the impression made by them on the hearer. As regards the rôle of duration, especially of intervals and of groups, remarkable work has been done by Lote, Landry, Verrier, Wallin, Patterson, and others. A few fundamental misconceptions, however, are to be signalized here. They are based either upon the identification of physical and psychical phenomena, viz. of isochrony and correspondence, or on a false simplification of complex facts.

As regards the first point, it may be stated that the terminology of Verrier is misleading (*Métrique anglaise*, II, p. 4): „Suivant le degré d'exactitude qu'elle (i.e. l'égalité des intervalles entre deux accents rythmiques successifs) atteint, le rythme est plus ou moins perfait, plus ou moins imparfait". It is not necessarily true that the more perfect the isochrony, the more perfect is the correspondence. The more strongly and satisfactorily the attention of the perceiver is drawn to the likeness of successive sequences, the more perfect correspondence is. This likeness is, as a rule, the combined result of all physiological and physical qualities (stress, duration, direction of the articulative movements, pitch, etc.), together

with that of the psychical factors (disposition, motory images arising from the perception of mere sounds, various associations, logical or emotional agreement between the meaning or associations of words or the contents of word-groups, periods, etc.) An example of such a combinative result is offered by the words cited above: ... *of personality and of society.* The importance of the rôle of duration, or of isochrony, as an independent linguistic-aesthetic element has been highly overestimated, resulting from its importance in the correspondence between the feet of classical (Greek and Latin) verse, between the bars of contemporary music, and between extremely simplified groups in psychological experiments concerning time-estimation and fluctuation at attention. Hence the erroneous opinion held by Lote, that „rhythm" should be identical with physical or with physiological sequences („les tracés seuls enseignent s'il est isochrone ou s'il ne l'est pas," Préface XV), and that the French verse should have neither harmony nor regularity: „De nos observations il résulte que le rythme poetique n'est pas régulier ... Il n'y a nulle part symétrie ..." (II, p. 699).

Objections should also be made against the procedure of Wallin, who investigates the isochrony of intervals between „centroids" or verse-accents, in prose and in poetry, without having previously established which intervals are really corresponding and which not, and without taking into account other physical factors except duration. Much more adequate is the remark of Verrier that the intervals must be „sensiblement égaux".

Thus we are already touching the second point, the complexity of the actual variations in duration. New, duration functions to express (mainly in connection with „intonation"), to distinguish (mainly between long and short vowels and consonants), to group (mainly by drawing the attention of the perceiver to the longest syllable of a word or of a foot, or to the longest word or word-group of a sentence. *Rhythm*

is grouping combined with correspondence between groups, centres, and intervals between centres. It requires neither absolute isochrony of groups or of intervals, nor, as has been pointed out by Meillet in his remarkable pages 29—30 of *Les origines indo-européennes des mètres grecs*, a tendency to isochrony. A series – ⏑ ⏑ – ⏑ may be even more „rhythmical" than a series – ⏑ – ⏑, without the former showing any actual isochrony between – ⏑ ⏑ and – ⏑, or a tendency to it. Why – ⏑ ⏑ – ⏑ is often aesthetically even more satisfactory than – ⏑ – ⏑, can be readily understood, and is, I think, of fundamental importance: because the former form, by its greater intrinsic variety, more strongly suggests a group. A tendency to grouping implies a tendency to anisochrony. Now, the tendency of our mind to perceive and to produce groups is so strong always and everywhere, that we are allowed to say: rhythm necessarily implies a tendency to anisochrony of successive corresponding groups and intervals. This tendency may, of course, be suppressed, e. g. in order to make the correspondence between the successive groups or intervals more complete. This suppression is shown by the bars of our music, by the pattern of stanza's, verses, feet, and by manyfold movements of labour and dance. The tendency to anisochrony of corresponding groups or intervals exists everywhere. It is found in the pattern of classical metres, e.g. in the Sapphaic verse:

– ⏑ ⏓ – ⏑ ⏑ – ⏑ – ⏓

in Gregorian religious music, within one and the same bar of our own music:

in „vers libre", in the variations in average duration of feet

in Dutch and German sonnets (see above under *verse*) in the variations in length of successive bars in ultra-modern music, in labour and in dance. The actual anisochrony of the groups of English verse, such as in:

The long light shakes across the lakes
12 13 27 45 7 34 9 55 (duration in hundredths of a second)

(Sonnenschein, *Rhythm*, 1925, p. 32) is not a symptom of imperfection, but of a tendency (both of the poet and of the recitator) to unify the verse by arranging and forming the groups of which it is constituted as follows:

shorter-longer shorter-longer shorter-longer shorter-longer (syllables)
shorter longer shorter longer (feet)
shorter *longer* (caesura-groups)

Variations of every kind (without necessarily implying any proportions of an arithmetical kind) as a rule tend to make groups. I am convinced that the actual anisochrony of intervals in French verse may prove to be: not a symptom of imperfect rhythm, or a symptom of lack of agreement between physical or physiological phenomena on the one hand, and the impression yielded by them on the other, or a result of some vague tendency to variation, but the result of a distinct tendency to constitute groups analogous to those existing in the English verse cited above. The quantity-curves of Dutch verse show a tendency to anisochrony of successive feet, obviously the result of a tendency to the formation of longer groups of a higher order, which we may call *caesura-groups*.

This complexity of factors influencing the actual variations in length requires a minute analysis of the underlying tendencies in each case; it is especially the tendency to anisochrony that is usually not taken into account, not even in the interesting investigations made by Wallin and by Patterson (*The Rhythm of Prose*[2]).

In investigating correspondence between groups full justice should be done to the correlations existing between stress,

duration, pitch, timbre (such as described above under the rules op grouping), and to the fundamental difference between quantitative-energetic groups on the one hand, and tonic groups on the other. Duration is usually an important factor of correspondence between energetic groups; the negative character, however, of the correlation between duration and pitch makes duration a factor of secondary or even less importance in the correspondence of pitch groups. The difference is clearly shown by our music, where bars tend to be isochronous, while melody-groups, or sections, do not.

I venture to conclude that Instrumental Phonetics is also of great value here, but that is urgently needs the help of psychological methods.

FEET.

Feet can be dealt with under Correspondence as well as under Grouping. A foot may be provisionally defined as the shortest series of syllables (in poetry or in prose) which forms an either falling or rising quantitative-energetic group, corresponding with preceding or followjng groups of syllables. It is obviously the product of a tendency to group successive syllables, and of a preference for either falling or rising quantitative-energetic groups (see above under the general rules of grouping). A foot may be called the smallest or shortest „occasional" group of syllables, as contrasted with habitual groups, such as words, or parts of words (e.g. *counterbalancing*). It obviously functions to group and to correspond, and may occasionally express feelings, etc., e.g. when the rising character of the feet goes together with cheerful contents.

The linguist wants to know: which are the feet of a verse (or of a prose-sentence): how is grouping effected?

Which are the feet of a definite verse, can often be readily ascertained by means of introspection, e.g. in:

The babes / did quake / for fear.

In other cases introspection does not suffice to decide whether there is really a foot, or only an illusion of traditional metrics, e.g. *-ty is* in:

A thing of beauty is a joy for ever.

Mostly, indead, the syllable *is* is not, or at any rate not perceptibly, stressed. It is customary nowadays to deny the existence of a foot *-ty is*, and to admit only either word-groups (Van Ginneken):

A thing of beauty // is a joy for ever //

or bars of speech (German „Sprechtakte"):

A thing // of beau // ty is a joy // for e // ver

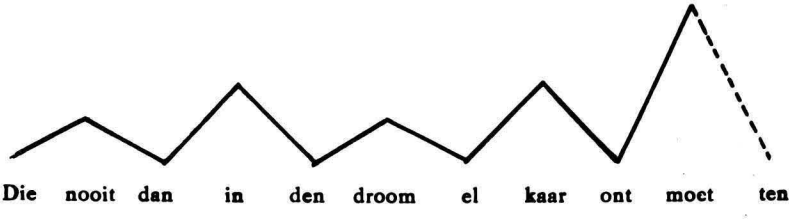
or:

A // thing of // beauty is a // joy for // ever.

Van Ginneken maintains (*Principes*, p. 314) that a Dutch verse does not consist of feet, but of word-groups, and Scripture holds (*Nature*, 11 Oct. 1924) that feet do not exist anywhere at all: „These investigations of verse show that it is purely a matter of rhythm: it has no metre. The usual scheme of prosody with feet, syllables, iambus, troches, etc., is a fantastic fabric of fancy without the faintest foundation in fact".

Instrumental Phonotics is destined to settle the question in an indirect way, viz. by analyzing the tendencies of the speaker, the recitator. This has partly been done, and is partly being done. Firstly, if it could be proved that the average variations in stress and duration of the verses of Keats' Endymion were as regularly built up as those of Dutch and German sonnets, the series *-ty is* in speaking could be accompanied by a sensorial and motory setting (Einstellung) to produce and to perceive permanently a short-feeble-syllable followed by a long-strong-syllable. This might be an indication that the speaking and hearing of these two syllables is always accompanied by the image of a group. A provisional investigation of analogous Dutch verses (Bou-

tens, Sonnet: Die nooit dan in den droom elkaar ontmoetten, etc.) has yielded a regularly built average of this form:



which may be called „undercurrent" of the verse.

Secondly, it may be proved that there exists a tendency to create a certain conformity between *-ty is* on the one hand, and *of beau-* or *a joy* on the other. At any rate this tendency would be very feeble, but it would be of interest to establish it: in Amsterdam we are just now occupied to make experiments of this kind.

The foot *-ty is* can be compared with a bar (in music) the first tone of which is not stressed. The same identification physical and psychical phenomena has led to the denial of the existence of Sounds (Von Ettmayer), syllables (Scripture, Calzia) feet (Scripture, Van Ginneken), caesura (others).

So, also here the actual variations in stress have been identified with grouping and correspondence: the latter may, however, be so feeble that they cannot possibly be established by introspection.

The phonetic word.

At present it is very usual to deny the phonetic existence of a word as a distinct part of the phonetic sentence: „Ein Wort hat keine Existenz, sondern findet sich immer nur als Satzglied." (Grimme, *Germ.-Rom. Monatsschrift*, XIII, 1925, 276). I will not dispute this view. I will only call the attention of the reader to the fact that it is based exclusively on passive observation, inexact experiment, and superficial interpretation of vibration-curves.

I shall try to summarize the problem, in order to show that more exact instrumental experiment can be of use here.

Introspection sufficiently shows that a word in modern languages, e.g. „Phonetics", separately pronounced in an unemotional way, is always a group; it may be a quantitative-energetic, as well as a tonic group. This means that its articulation is accompanied by a tendency to form a group, and that its perception by the speaker, but probably also that by the hearer, is accompanied by a tendency to perceive a group. This means that it is accompanied by a motory and auditory „setting" to get a group.

Now, in pronouncing „Phonetics" in a sentence, the variations in stress, duration of Sounds and syllables, pitch, timbre are modified; the question is: does the tendency to produce and to perceive it as an energetic and as a tonic group persist, and does it manifest itself in the physiological and physical phenomena, or does it vanish, in the sentence?

In formulating the pros and cons as follows, I am much indebted to the exposition given by Vendryes, *Le langage*, pp. 62—68.

Arguments against the phonetic existence of a word in the sentence. 1. The word may lose its word-accent, e. g. in old Greek, and in French (*chansón*, but *chanson de guérre*) 2. the limits between two words may lie in the middle of a syllable, i.e. in the midst of a rhythmic group (German *hat er es getan* can become in rapid pronounciation *ha te res getan)*; 3. by the vibration and breath curves a limit between words is only shown in case it coincides with the limit between sentences or between clearly distinguished parts of a sentence; 4. in hearing a spoken sentence of a language one does not understand, the number of syllables can often more or less exactly be made out, the number of words hardly ever.

Arguments in favour of the phonectic existence of a word in the sentence. 1. The word often retains its word-accent; the sentence-accents regularly coincide with one or more

word-accents; 2. the limits between two words often coincide with the limits between syllables, even in the sentence; 3. the vibration and breath curves are only physiological and physical, not psychological curves (this, however, comes very near the opinion of Scripture, *Festgabe Luick*); they reproduce neither the impression conveyed by the perception on speaker or hearer, nor grouping and correspondence; 4. the final consonant of a word in indo-european languages tends to weaken and to vanish (Gauthiot, *La fin de mot en indoeuropéen*, 1913); 5. the initial consonant is particularly resistant against sound-changes (scale of consonants of Grammont: comp. Juret, *Manuel de phonétique latine*, p. 53; a purely psychological interpretation of this law has been given by Kretschmer, *Einl. in die Altert. Wissensch.*, hrsg. von Gercke und Norden, I^3, p. 491: „Der Grund hierfür ist wohl ein rein psychischer: der Anlaut eines Wortes bildet gewissermassen dessen äussere Marke und drängt sich daher verhältnissmässig stärker vor in der Wortvorstellung als die übrigen Laute des Wortes"); precisely the rôle of the word as an element of linguistic form conveying a definite linguistic function may imply a tendency to grouping; 6. long words are usually spoken more rapidly than short ones, even in the sentence; 7. a word sometimes retains its pitch-top in the midst of the word, even when being part of a sentence; from the investigations of Abas (*Les sons dans la phrase*, cited above) it appears that the Dutch word *úitstekend* as well as *uitstékend* has often its culminating pitch-point on the second syllable, even in the sentence.

I venture to conclude that the problem has not yet been settled, and that its solution can only be expected from Instrumental Phonetics, combined with introspection and other psychological methods. I may be allowed to suggest two kinds of experiments, each of which starts, of course, from a definite linguistic problem.

a. a comparative study should be made of the tempo of long and of short words (i.e. of the duration of their syllables)

spoken both separately and in different sentences, in order to establish whether there exists in the sentence correspondence between successive words; for the results obtained by us for Dutch *Jan Dam*, etc., see above);

b. a comparative study should be made of the qualities of the syllable that usually bears the word-accent, as compared with the qualities of the other syllables of the word, spoken both separately and in sentences, in order to establish whether the characteristic qualities of the accentuated syllable disappear in the sentence, or not. E.g. in French *chanson, son champ*, as compared with *chanson de guerre, son champ de guerre,* etc.

The phonetic word as such (as far as it exists, e.g. spoken separately) is the result of the distinguishing function (by means of Sounds), the grouping function (by means of syllables, often hierarchically grouped), the corresponding function (by means of correspondence between successive syllables, or between successive groups of syllables, e.g. in *counter-balancing* or between successive phonetic words) of speech. These three functions account for all its characteristics.

II. The linguist starting from the elements of form.

Variations in stress, duration, pitch, timbre.

So far we have asked: the existence of a definite element of the minor functions of speech (distinguishing, grouping, corresponding) being admitted, by what elements of form (movements, sounds) is it conveyed.

We shall now ask: the existence of an element of form being admitted, what functions does it convey. It will be my purpose to show that also on this field of investigation the use of instrumental methods is of great importance, but that they need closer relations with Linguistics and with Psychology. We have to deal with the variations in force, duration, pitch, timbre, etc., but we shall mainly consider those in pitch. It

is here that the misunderstanding between experimenting phoneticians on the one hand and the other phoneticians and linguists on the other is most obvious and most striking. It can, indeed, hardly be maintained that the very minute investigations of Calzia and Scripture have appealed to linguists, or that the work of Sievers in speech melody has gained the confidence of those familiar with the appliance of more exact methods.

A few words on the variations in energy of articulation, acoustic force, duration, and timbre, may precede.

The instrumental methods to measure the energy of articulation are not reliable. The larynx is not a totalisator of phonetic energy (Fouché, *Etudes de phonétique générale*, 1927, p. 5), nor do the rising and falling movements of the larynx exactly reproduce the rise and the fall of muscular energy. We have even to reckon with the possibility of phonetic movements being repressed, e. g. in anger, with great energy, without this energy being reproduced by the movements of the larynx.

Nor can the instrumental methods of measuring acoustic energy be relied upon, as each medium between air-movements and lever-movements (or visual reproduction in general) is unequally responding to vibrations of the same force (or amplitude), but of different pitch.

The principles that should underlie the investigation of the actual variations in duration have sufficiently been laid down above under „Correspondence".

The variations in timbre or quality of vowels and consonants are not on a level with those treated above and with those in pitch. Timbre is, however, as well as pitch, or even more so, a complex quality, yielding definite impressions of a rather unanalyzable kind. For the present and for the near future its investigation will be mainly confined to introspection.

So we have now to deal with the *variations in pitch*, or with „speech-melody": what are its functions?

The actual melody of a spoken sentence is the result of a number of psychical tendencies, each of which makes for realizing a function of speech. The most important of these functions may be thus summarized.

1. distinction between Sounds, syllables, or words (e.g. in Chinese and Norwegian), comp. Selmer in *Vox*, XXXII, 1922, 124—131);

2. formation of tonic groups (hierarchical circumflex of Dutch verse, see above);

3. support of the energetic groups, by drawing the attention to the energetic centre;

4. expression 1) habitual expression a. in a more conventional way (as e.g. in interrogative sentences);

b. in a less conventional way (emotions, etc.; formation of individually varying melodies of speech, according to the hypothesis of Sievers? of a melody characteristic for a definite poem? see Heinitz in *Vox*, XXXII, 1922, 19);

2. occasional expression.

The final aim of phonetics as to speech-melody should be to be able to analyze the actual melody of a spoken sentence; it must be understood as the result of these tendencies. At first sight this may seem an unfeasible task. For melody, indeed, what has been said by Heinitz with regard to the variations in duration holds also (*Vox*, XXX, 1920, 102): „Allerdings ist eine detaillierte Analyse ebenso schwierig wie häufig unsicher, weil sie sich bald auf die Vergleichung der Mittelwerte, bald auf die der Einzelwerte stützen muss, die im einzelnen nicht kontrollierbaren Schwankungen unterliegen". Moreover, the value of instruments in this connection is considerably limited by the fact that the impression yielded by variations in pitch does not always logically correspond to the actual variations, in other words: melody is not always congruous to the vibrations of the air (Comp. Rousselot, *Principes*, pp. 1002—1003, 1098).

The problem is not, however, quite so hopeless as it may

seem; the influence of some of the tendencies can fairly well be established.

1. the rôle of pitch as a distinguishing factor in Chinese and Norwegian seems to be pretty well known both from introspection and from instrumental researches;

2. the rôle of pitch in forming tonic groups may be ascertained by calculating the average variations in isosyllabic corresponding verses or sentences, as has been shown above: attention may be called to the statement of Abas that the second syllable of Dutch *uitstekend* is (habitually or occasionally?) higher in pitch than the first, the accentuated one; this points to a tonic grouping within the limits of the phonetic word; the fact would require a closer investigation;

3. the rôle of pitch in supporting energetic groups has been greatly elucidated by Wallin, cited above;

4. the rôle of pitch as a medium of voluntary or unvoluntary expression has been investigated up to now nearly exclusively by unaided observation and introspection, and remarkable work has been done here by a series of scholars. Here, as well as in matter of Sounds, every language has its own system, and a tendency towards a certain equilibrium. Instrumental research on this field has not as yet yielded much that is really worth mentioning. It cannot, however, be liable to serious doubt that also here instrumental research is destined to further the solution of problems, provided that it is combined with purposeful experiment, the help of the trained ear, and of careful and trained introspection. This certainly holds good for the question put by Sievers, whether each author should have in all his works a melody of his own, etc.; as well as for those other hypotheses alluded to above, concerning melody of speech varying from poem to poem.

It may, however, be doubted whether instrumental researches in speech-melody (except those by means of gramophone records) will ever be of importance for applied linguistics, i. e. for the practical study and the teaching of modern languages.

Some erroneous conceptions may be pointed out here, both on the part of the instrumental and on that of the non-instrumental phonetician.

Those on the part of the instrumental phonetician can be traced back to two sources: misunderstanding of the nature of linguistic elements, and misunderstanding of the demands of Linguistics. From the former source originates the tendency to identify physical and psychical phenomena that can be seen from the following words of Scripture: „Obwohl die vorhergehende Untersuchung des Verses eine physikalische genannt werden darf, bezieht sich diese Behauptung hauptsächlich auf die Untersuchungsmethode. Die Resultate liefern eigentlich eine psychologische Analyse, da der Vers eigentlich eine psychische Ausdruckmethode ist. Die Energiekurve mit den vier Faktoren ist eigentlich eine psychische Kurve und das ganze Untersuchungsgebiet wäre ebensogut der experimentellen Psychologie wie der experimentellen Phonetik zuzuweisen". (*Festgabe Luick*, 1925, 86—87).

To the same kind belongs the neglect of the complex character of variations in pitch, as well as of intonation. The actual variations in pitch in a spoken sentence are the result of a number of tendencies. The „intonation" of a spoken sentence is not identical with the impression conveyed by the variations in pitch alone, but also by those in stress, duration of syllables, and other factors: the variations in pitch are a linguistic element (i.e. a factor conveying a definite function without the aid of other factors) possibly only so far as they form tonic groups. This neglect of the complexity of phenomena occurs even in judicious publications, as e.g. in that by Heinitz, *Vox*, XXX, 1920, 73—108: „Wie lassen sich experimental-phonetische Methoden auf die psychologische Zergliederung gesprochener Sätze anwenden?"

The requirements of the linguist are misunderstood in a great number of investigations which do not start from any linguistic problem. Calzia, after having determined with great

minuteness the variations in pitch in some spoken sentences, in absolutely at a loss how to interpret them (*Monatschrift für die gesamte Sprachheilkunde*, 1911, 175): „Am Anfang meiner Untersuchungen über die Höhe schwebten mir weder ein klar gezeichnetes Ziel noch die Lösung einer bestimmten Frage vor. Ich wollte nur „im Trüben fischen", wie Claude Bernard sagt". Further, more than once instruments that can only register are used to obtain results that could have been easily obtained by the trained ear with or without the help of gramophone records.

Also on the part of the not experimenting phonetician the complexity of the phenomena is often overlooked. Grimm says (*Neuhochdeutsche Sprachmelodik als Grundlage der Syntax*, in *Germanisch-Romanische Monatschrift*, XIII, 1925, 276): „Damit berühren wir dasjenige, was die eigentliche Bedeutung der Sprachmelodik ausmacht. Sie ist Trägerin von Redesinnwerten, und solches ausschliesslich". He adds on p. 280: „Wenn ich maschinelle Experimente nicht angewandt habe, so hoffe ich deshalb nicht den Vorwurf unexakter Forschung hören zu müssen". I would not for a moment wish to imply that his results are not as exact as possible in so far they are aiming at analysing the subjective impression yielded by variations in pitch, and I am fully aware of the importance of such subjective analyses. His results, however, should not be regarded as a reliable record of the variations in pitch as a physical phenomenon, the importance of which is not to be underrated, nor does he sufficiently take into account, as appears from his word cited above, the complexity of the psychical phenomena. The same is the case with the remarks of Sievers in his *Phonetik*[4], par. 631.

III. Conclusion.

In the preceding pages we had to state a lack of understanding between instrumental phoneticians on the one hand, and non-

instrumental phoneticians and other linguists on the other. This lack of understanding originates from the fact that the methods of instrumental phonetics are capable of improvement, and that its results are not so familiar to linguists as they ought to be.

On the part of the instrumental phoneticians the nature of speech-elements and the requirements of linguistics are not always sufficiently taken into account. As to the nature of speech-elements: we often meet with a tendency to identify physiological or physical with psychical phenomena; the fact that speech-elements have a (semantic) function, that functional elements of speech are not indentical with qualities of speech form (such as variations in stress, duration, pitch) and that their chief interest for the linguist who is not exclusively a teacher of modern languages lies in the fact that they are functioning elements, is often overlooked. The complex character of vibration and movement curves is not always sufficiently recognized as being the result of a number of tendencies, most of which aim at realizing a definite function of speech. As to the requirements of linguistics: the phonetician does not always start from a definite linguistic problem; he sometimes even confines the field of Experimental or Instrumental Phonetics to what is of no interest to the linguist at all; he frequently fails to draw from his results the conclusions which would be of interest to the linguist; his chief interest is often concentrated upon instruments and curves, instead of upon the elements and the functions of speech; more than once instruments are used where instrumental research is superfluous. The methods of Linguistic Phonetics are, of course, linguistic, i. e. semantic, i.e. in the first place psychological methods; the fact that the problems of Linguistic Phonetics are in the last resort not instrumental, or physiological, or physical problems, but semantic, i. e. psychological problems, is too often overlooked.

On the part of the linguist neither the nature of speech-

elements (Sound, Group, Element of Correspondence, Verse, Foot, Syllable), nor the requirements of linguistics (see e.g. W. Schmidt, *Was erwartet die allgemeine Sprachwissenschaft von der Experimentalphonetik*, cited above p. 3) are, as a rule, sufficiently formulated, so as to enable the instrumental phonetician to start from definite linguistic problems; the linguist does not always recognize the specific difficulties of instrumental investigation, nor the fact that Experimental Phonetics is still in its infancy; last not least, not all linguists sufficiently recognize the importance of instrumental researches, nor the fact that the solution of many linguistic problems is to be expected only from instrumental research.

The preceding pages are an attempt to prove that the methods of Instrumental Phoneticns are open to improvement, and that its methods and results are not so familiar to linguists as they should be. Phonetics has been up to now too „practical", too didactical, Instrumental Phonetics too physiological, too physical, too materialistic, Linguistics too much afraid of instruments.

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