

THE WRITING ON THE WALL FOR PHONETICIANS

by Hendrik Mol

Movement is all.

The relation between Phonetics and Phonemics is a bone of contention between linguists and phoneticians, two types of researchers not always broadcasting on the same wavelength.

In my opinion the concept of the phoneme is an abstraction leaning heavily on alphabetic writing. To me, phonemes are poorly disguised alphabetic letters or combinations of letters. It is revealing to discover how phonemes are being arrived at in most textbooks on phonology.

First of all an alphabetically written list of key words 'covering all possible vowels and consonants' more or less appears out of the blue. A cleaning-up action in which the letters of the poverty-stricken alphabet are replaced with the letters of the so-called phonetic alphabet comes next. In order to avoid confusion the new letters and even complete words are placed between square brackets. In the phonetic notation of Dutch, combinations of letters are replaced with only one phonetic symbol. Also, different letters (or combinations of letters) having the same 'phonetic value' are replaced with only one phonetic symbol, etc. In short, the cleaning-up action removes the ill effects of the fact that the number of letters available for writing most Western languages is too small for depicting all

phonetic values tradition deems necessary.

The crucial next step is to replace the square brackets [] by obliques / / and to label the resultant symbol as 'phoneme' from that moment on. The following example in Dutch illustrates this procedure. Alphabetically written key word schoen, meaning shoe in English, is phonetically transcribed as [s X u n], the sequence of the phonetic [s], [X], [u] and [n]. The subsequent phonological transcription yields / s X u n /, being the sequence of the phonemes /s/, /X/, /u/ and /n/.

Though, in Dutch, about 90% of the introduced phonetic letters are without much ado changed into phonemes by changing the square brackets [] into obliques / /, in the remaining 10% there are the classical complications with the 'narrowness' of the transcription. For instance, in the case of the symbols [i:] and [i], depicting an in Dutch not phonemically functioning difference in vowel length, two phonetic symbols are swept together under one phonemic heading /i/. Likewise, the phoneme /r/ covers the various (accepted) variants of that much debated liquid molly-coddle of Dutch speech therapists. In this connection we must remark with regret that in the Netherlands many professional speakers for radio and television display pathological variants of [r], calling for, not to say crying for speech therapy. At first sight, and especially to phonologists, this rather blunt description of the traditional way of introducing phonemic symbols between obliques may seem to be an oversimplification. Unfortunately, however, it reflects the truth. Even the more sophisticated looking methods of persuading the reader to 'believe' in the phoneme, found in some textbooks, are unthinkable without the prior knowledge of the alphabetic notation and its subsequent canonization. Phonology only arose in languages that were, and indeed could be, written the alphabetic way.

From the way they are being postulated it becomes clear that the phonemes are hand in glove with the letters of the alphabet. They share their poor credibility as 'natural' units with the alphabetic signs.

The phonetician should be well aware of what is really expected from him when he is urged by phonologists to 'measure' the distinctive features of their phonemes. Also, when engaged in the construction of voice operated machines he must realize that the phonemes of the phonologists are of little use to him because these units are too abstract to be handled by machines.

There are two main ways of referring the concept of the phoneme to its proper level of abstraction.

The usual and well-trodden way is to disprove by experiment the claims of phonology. The following claim, presented at a Phonetic Congress, leaves no doubt about a school of thought that still prevails in linguistics.

'Discrete elements (phonemes) are, in turn, transformed (via nerve impulses) into continuous muscular activity, then into a continuous sound-wave. The sound-wave reaches the hearing apparatus of the receiver where it is decoded as a sequence of discrete elements again' (Oliverius, 1967, p. 702).

In an important paper Lüdtkke (1969) presents an impressive list of authors who fight the above claim by means of experiments in the domain of physics, articulation, acoustics and perception. They fail to find evidence for the existence of a universal, 'natural' segmentation on the phonemic level, underlying the nature of speech production and perception. However, the main theme of his paper is an alternative approach to the problem of how to discover the true nature of the phoneme. Lüdtkke shows, by tracing back the historical origins of the alphabetic notation, that never during the

development of this economic system of symbols refuge had been taken to 'natural' segments as well as the phoneme. It was just the other way round: the letters of the alphabet were later on interpreted as natural units called speech sounds. As the phonemes are nothing but alphabetic letters they have no leg to stand on in their supposed role of being 'natural' units.

For many years at a stretch I have been warning phoneticians against the glittering enticements of the alphabet (Mol, 1963, 1964, 1972) but, I must confess, mostly in vain. Lüdtkke's method, however, put me on a new track in my campaign against blindly following the alphabetic tradition. It dawned on me that even in my own institute the alphabet exerted its laming influence on the researchers of speech and hearing. This is nothing to be ashamed of: it appears to be extremely difficult for linguists and phoneticians not to think in alphabetic categories. In fact this is difficult for anybody who has learned to read and write the alphabetic way. In my opinion the researcher has to unlearn his education in order to discover the real nature of the mechanism of speech and hearing. I am tempted to say that the illiterate is the best phonetician.

The historical approach is very attractive for teaching purposes because it kills two birds with one stone. The student learns how the alphabet, that corner stone of our culture, came into being. On top of that, because he now knows the real background of the alphabetic notation, he will recognize the fundamental inadequacy of the alphabetic letters to act as 'natural' pillars on which the 'phonemes' are supposed to sit like pillar saints.

In order to prepare the ground for an analphabetic approach to phonetics I returned to the study of Gelb's classic book on writing (Gelb, 1952). In an attempt to reach better under-

standing of the early problems of the pioneers of writing, I tried to 'de-alphabetize' myself.

Now what is the most realistic, non-committal way of defining a more advanced form of writing? In my opinion we may put it as follows:

Writing is a system of visible signs by means of which the writer invites the reader to pronounce the words the writer wants him to utter. Writing induces the reader to make familiar movements with his organs of articulation.

Note that this down-to-earth specification does not involve any pre-conceived idea on the nature of speech production or speech perception. It embraces primitive as well as more sophisticated systems of writing, including the Western forms of alphabetic writing; it may even be regarded as a design-objective for anyone who wishes to invent a system of writing.

The perfection of the art of writing has been accelerated by the increasing need for verbatim records. In the case of words that name objects, pictures of the objects in question will do the job. Personal names, abstract notions etc. require other techniques. The best (and only?) solution proved (and proves) to be the so-called phonographic method*) referring to acoustic aspects of speech, more in particular speech production. History shows that syllabic writings originated from many cultures independently which strongly

*) Strictly speaking the terminology 'phonographic' is a misnomer because writing is the result of an abstraction. The truly phonographic registration is the groove of a phonographic record (= gramophone record); it reproduces the real voice of the speaker, betraying his sex, his intonation, his mood, his possible speech defects, his dialect etc., etc.

suggests that syllables must be regarded as 'natural' segments into which the 'stream' of articulatory movements can be chopped. (Without having to learn it children, when shouting, automatically divide their speech into syllables.)

Why is a syllable a natural segment and what is a syllable? I like to put it jestingly as follows: Speaking closely resembles eating audibly with an empty mouth. Taking it strictly, speaking comes down to alternatively opening and closing the mouth, at the same time rendering these movements audible by means of the breath stream that acts on the larynx and several parts of the vocal tract. There are various ways of opening and closing the mouth; each language has its own repertory.

A *conditio sine qua non* for the possibility of syllabic writing is the ability of a reader to perform elementary articulatory actions (like opening or closing the mouth in a certain way) upon seeing an arbitrary, conventional sign. A syllabic sign merely indicates, refers to an articulatory action (a set of coordinated movements) already familiar to and mastered by the reader who speaks the same language as the writer does. The syllabic sign is a conventional command given by the writer to the reader. In a way it acts as one of the controls of a human talking machine.

Usually the total number of possible syllables is very high. It puts a burden on the reader who has to know them by heart. Improvements in writing have been inspired, among other things, by the trend to decrease the number of different signs necessary for writing as verbatim as possible.

The Phoenicians confined themselves to the use of signs for open syllables as reading (= spelling) commands. Probably this procedure fitted well in their language though it certainly was not problemless (see Gelb, 1952, p. 163).

On top of that they swept together the open syllables into groups the members of which only differed in the vocalic quality (=timbre). They allotted only one sign to each group which is a principle of economy. Suppose we label a group of, say, five open syllables, for instance [su], [si], [so], [sɛ] and [sa] with the syllabic sign S, also called the root S. On reading the syllabic sign S the reader is expected to decide himself which of the five possibilities offered by the root is meant by the writer. In the Semitic languages this choice is facilitated by the structure of the language because words containing the same roots form a semantic family (see, for instance, Lüdtke, 1969). The Semites only sporadically took refuge to extra means for indicating the timbre of a syllable, with the purpose of relieving the task of the reader. Note that we do and may not yet speak of the 'vowel' here. In Oriental forerunners of the alphabet so-called *matres lectionis* were used. A syllabic sign that needed further specification was followed by a special (also syllabic) sign that was not to be pronounced; it only had the function of conventionally indicating the vocalic value of the preceding syllable.

The Greek, who adapted the Phoenician system to their own needs, applied the timbre indication systematically instead of merely in cases of grave doubt.

Returning to our example of the syllabic sign S, if it were in need of further specification, say as the member [sa] of the group, the Semites would have added another syllabic sign, say A (not to be pronounced!), so that the sequence S A meant: pick the syllable [sa] from the group S. In their tendency to reduce the Greek reasoned that they might as well consider the signs S and A as separate 'speech sounds' (whatever that may be) calling S a consonant and A a vowel, thus paving the way for later phonemic theory that declared

these new 'units' to be natural things that could be transported from the speaker to her hearer, even via telephone circuits. However, the fatal misconception is clear: by giving the sign S another name we cannot change its real nature, it still is a command to the reader urging him to produce a complete, indivisible articulatory gesture. The true nature of A was not changed either by calling it a vowel. Though in the disguise of a syllable it was not even to be pronounced. It was and remained a conventional sign for further specification of the preceding syllabic command. Therefore I am tempted to say that our present alphabetic system still is a, perhaps slightly streamlined, syllabic system of writing with systematic timbre indication.

The practice of timbre indication shows that already the pioneers of writing had a strong inkling of the existence of a system of mutually contrasting timbres having a function in speech production and speech perception. This system is produced by a system of mutually contrasting configurations of the vocal tract (Mol, 1968) and is characteristic of the language in question. The members of the system are traditionally called the vowels of the language. Formant measurements in this institute (Koopmans-van Beinum, 1976) strongly suggest that the mutual contrasts are optimal in open syllables.

Measurements of the formants of children, women and men suggest that the muscular commands these three categories give to their organs of articulation are essentially the same. (Mol, 1968). It is the length of the vocal tract that causes the differences in the absolute positions of the formants. What unites all the speakers must be looked for in the realm

* The vowel signs resemble baggage tags distinguishing identical looking suit-cases one from another.

of articulation, namely, in the positions and movements of the articulatory organs.

When we put out our tongue at a baby chances are high that it will imitate this gesture, even when it is hardly one week old. This proves that the baby 'knows' as it were automatically how to control the appropriate muscles involved in the gesture.

In "Collins English Learner's Dictionary" (London and Glasgow) we find: to ape: do the same thing as anybody (as an ape copies the movements of human beings).

The above mentioned baby certainly answers to this description when aping visible movements of the tongue. Later on in its life it is even able to ape audible movements of the tongue and other moving parts of the speech apparatus of people in its vicinity. We believe it accomplishes this feat on the basis of an inborn gift, acquired during evolution, that is most active during speech development. (We must not dismiss the possibility that the period of babbling might play a vital role in successfully applying this gift). The infant, when learning how to speak, does not and indeed cannot copy the acoustic parameters of mature speakers in its environment. The axial dimensions of its vocal tract are too small to produce formant positions in the mature region of the F_1F_2 plane. Also the repetition rate of the air puffs produced by its larynx is too high. Obviously, provided its articulatory organs have sufficiently developed, it can only copy the articulatory movements of the speakers (men, women and children) it accepts as models. The motor commands, once settled in youth, do not change when vocal tract and larynx mature. The opening and closing movements of the mouth and their muscular control remain the same.

Notwithstanding the unavoidable individual anatomical variations, all human beings have essentially the same organs of articulation. All have lips, a tongue, a soft palate, a mandible etc. moved by essentially the same muscles. People speaking the same language make the same movements though the absolute dimensions of the moving and stationary parts of the speech apparatus may be different.

In this institute we started to group unsatisfactorily explained phenomena around the hypothesis of the gift of aping (movements!) as a principle with which they are not at variance.

Koopmans-van Beinum and Van der Stelt* strongly recommend describing early infant sounds in terms of the movements of the articulatory organs already developed at that stage.

In short, the conviction that speakers of the same language make essentially the same fluent gestures with their organs of articulation led us to believe it is these movements the hearer derives from the sound signal produced by the speaker. From here it is a far cry to speculate that the recognition of these movements is in terms of the stimulation programs of the muscles involved in the motor commands necessary to reproduce them. Let us call these programs the secondary programs. It seems not too far-fetched to suppose that, when the speaker hears his own voice, the secondary programs evoked by his own voice, might (pathologically) interfere with the stream of motor commands the speaker uses to produce his own speech. This interference might cause phenomena of stuttering, a supposition supported (at least not contradicted) by the

* J.M. van der Stelt and F.J. Koopmans-van Beinum, (1978).
Note on Motor Analysis of Infant Sound.

known fact that stutterers cease to stutter when they are being prevented from hearing their own voices.

Back to our criticism on the traditional overestimation of the 'naturalness' of the alphabet: we present an alternative, namely that the speaker couples meaning to the articulatory movements. The hearer, after having detected the articulatory movements of the speaker, does the same.

Connecting meaning to (fluent) movements in stead of to (extremely atomized) phonemes comes down to abandoning the alphabetic tradition. In this light many hitherto employed methods will have to be frowned upon. For instance, the method of lifting small portions out of fluent speech and trying to identify them by ear is very alphabetic at heart. We should strongly distrust the measured data as to their relevance to understanding the real mechanism of speech and hearing. (Nevertheless we performed many experiments of this type hoping the results might be useful in some other respect.) No doubt the lifting of syllables is indicated, the syllables being tied to opening and closing movements of the vocal tract.

An interesting problem has yet to be solved: exactly how do the movements of the organs of articulation manifest themselves in a detectable way in the speech signal irrespective of the anatomical and other variations between the speakers? A question more easily put than answered. Or is it?

CONCLUSION

The future development of the phonetic sciences requires the exploration of new avenues of thought (or the reopening of existing unjustly blocked avenues) rather than getting trapped again and again in the dead alleys of alphabetically biased phonology.

POSTSCRIPT

In the Book of Daniel of the Holy Bible we read in Chapter V how during Belshazzar's impious feast there appeared a writing on the wall. Neither Belshazzar nor the wise men of Babylon were able to decipher the Aramaic syllabic signs that lacked vowel indication. Daniel, however, who could 'make interpretations and dissolve doubts' succeeded in reading the writing obviously by filling in the correct vowel values inspired by God.

Even a phonetician can cite Scripture for his purpose . . .