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On the Roentgenography of the Speech Organs

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Roentgenography of the speech organs has a relatively long tradition. We shall attempt to demonstrate its advantages for phonetics.

Roentgenography enables investigation of the articulatory formation of the speech organs not available to direct observation. As opposed to previous X-ray techniques using the usual variety of contrast materials – most frequently barium – native X-ray shots have gradually taken over the field – i.e. roentgenography without the use of any contrast material¹. This excludes the disturbing effect of extraneous material on mechanics and the psyche when present in the supraglottal cavities, interfering with the normal function of the speech organs. In connexion with the method of complex registration, i.e. synchronous sound and oscillographic recordings during exposure of the X-ray picture, results in research on the articulatory function of the speech organs are available which enable one to reproduce the sound simultaneously like on the original realisation².

In research on the mutual correlation between physiologic articulatory processes and their acoustic sequelae it is necessary to use methods which record the motion of speech organs and sound synchronously and continuously in the natural formation. On analysis of the roentgenograms it is then possible to compare corresponding segments from the point of view of articulation and the acoustic resultant and the auditive action from these motor acts. To this end one can use at least in part for phonetic purposes rapid roentgen

¹ A natural contrast medium is the air present in the supraglottal cavities. For details see Ondráčková, J. and Poch, R. (8).

² The method of complex recording is described in the work of Ondráčková, J. and Poch, R. (7).

seriography with native and complex recording methods. Serio-grams enable the observation not even of continuous course of motion of the speech organs but the separate phases of these motions, which, at a speed of 4 pictures/sec., give a satisfactory view of the motion of their soft parts during continuous speech.

Application of this method has enabled us to investigate which acoustic effects are associated with transitional articulatory phenomena³ on roentgenographic (seriographic) records, and on the other hand the corresponding motor phase of the speech organs corresponds to some sort of transitional acoustic phenomenon, determined, for example, by the *Janota* segmentor⁴. In this way it can be determined which of the articulatory phenomena, acoustically manifest, are relevant for the identification of the given sound from the point of view of the hearer. The determination of these relationships is important because articulation and acoustics form an entity from the point of view of both speaker and hearer.

A further contribution to phonetic research of the action of the speech organs, quite widespread today, is sound X-ray cinematography⁵. With adequate technique native X-ray films of the natural motions of the soft parts of the speech organs and their transitional phases between sounds can be used at various filming speeds⁶.

Analysis of single shots from the X-ray sound film is carried out by means of loops projected by a special adaptor for sound projection⁷. They have contributed considerably to more complete understanding of the interplay of the soft parts of the speech organs in the supraglottal cavities.

From analysis of X-ray cinematographic sound records it would appear that it is not of advantage to use the term "position"

³ Transitional phenomena from the point of view of acoustics, see for example: Speech Communication Seminar (11); Carnochan, J. and Skaličková, A. (1); Romportl, M. (12).

Phenomena previously labelled as transitional could be investigated only after use of adequate registration methods for acoustic and articulatory phenomena.

⁴ Janota, P. and Romportl, M. (2).

⁵ Films are usually presented at sittings of the Association internationale du cinéma scientifique and are listed in their catalogue.

⁶ For example, Shelton, R. L. et al. (9); Ondráčková, J. (5).

⁷ Ondráčková, J. (6).

Loops enable random uninterrupted repetition of the same phenomenon, so that characteristic signs of motion of speech organs can be identified (method of comparative analysis).

or "maximum articulation position" of the speech organs, since the soft parts are practically in continuous motion even when phonation does not occur. Not even the so-called maximum articulation phase, previously understood as the "maximum articulation position", need always be relevant for identification of the sound⁸. It is therefore of greater advantage to observe the whole syllable than the separate sounds⁹. It is important to solve the problem of the boundary between separate sounds from the point of view of articulation and acoustics, and the problem of how the various articulatory and acoustic relevant features change in time. With reference to this one must concentrate on content when using the term "transitional phenomenon".

X-ray films can be evaluated by observation on various types of trans-illuminators. For studying roentgenograms positive copies should be used¹⁰. Native roentgenograms can be objectively analysed, using a photoresistance adapted for reading off from the films¹¹.

The promising results in phonetic research enables the application of new X-ray technique, e.g. high-voltage roentgenography¹² and rotational cinefluorography¹³. Tomography has also contributed to the solution of some special phonetic problems.

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⁸ Romportl, M., p. 75 (12).

⁹ Skaličková, A., p. 79 (10).

¹⁰ In the complex method the original roentgenogram is a necessary part of the material.

¹¹ Ondráčková, J. (4).

¹² McDonnell, G. et al. (3).

¹³ Winter, F. S. and Lehman, J. S. (13).

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