CINERADIOGRAPHIC OBSERVATIONS OF VELAR AND GLOTTAL MOVEMENTS

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The new equipment for X-ray cinematography that gets into use in many medical research centres has tempting possibilities for phonetic investigation. However, it puts us before the task of interpreting an enormous amount of new information that is poured out over us.

We will report in this discussion on our recent analyses of filmstrips taken with a 9 inch image intensifier with a speed of about 50 frames/second.[1]

We have been primarily interested in the movements of the glottis and those of the soft palate. Their functions are mostly considered separately; this seems logical since one is the voice organ par excellence and the other a structure for articulation.

Voice and articulation are however intimately tied up. In some instances it is clear how the three valves of the vocal tract (the glottis, the tongue and the soft palate) are linked up to produce certain acoustical results. It is easier to picture the production of vowels than that of many consonants, because of their short duration.

The vocal tract should not be visualized as a stiff tube, but rather as a pulsating muscular tube, somewhat like the heartmuscle. It may exert pressure on its contents by contracting its walls; the rising pressure within may help to close the velopharyngeal valve. This pump-like mechanism is partly responsible for articulation-pressures; it modulates the air-pressure from the lungs during speaking.

We came across this glosso-pharyngeal pumping mechanism in the course of studies on oesophageal speech (1, 2). We think that with this pharyngeal air-trap in mind we may be able to explain some typical movements of the vocal folds as we see them on the filmscreen.

We see that the vocal folds remain approximated during the whole of a continuous spoken phrase. The vertical movements of the vocal cords are produced by changes of air-pressure above the glottis. This is in keeping with the well established fact that during connected speech air-pressure below the glottis remains fairly constant (3). This makes it probable that the rapidly changing air-pressure in the pharynx must be caused by the structures above the glottis.

The term "closed glottis" is not exact in its description; it may mean that the vocal cords are lightly adducted, as in phonation, but also that the cords (eventually also

[1] We gratefully acknowledge the cooperation of Dr. J. L. Chaillet of the Cardiology department (Prof. R. L. J. van Ruyven) and his technical assistant Mr. W. A. van Beek.

the ventricular folds) are pressed together over a great depth. The latter situation does not allow any passage of air, but the former (approximation of the vocal folds) is so balanced that a small subglottic pressure may open the valve and put it into vibration. An equally small (supraglottic) counterpressure (of short duration) suffices to momentarily stop the vibrations. This happens during the hold before the release of a plosive consonant; it is also clear from this that voiced plosives cannot be spoken with the same articulatory force as their voiceless analogues, without raising the voice too.

Because we were not equipped for a synchronous visible sound tract like for instance the magnificent set-up described by Björk (4), we have contented ourselves with analyses of very short speech samples that could easily be identified in the picture.

Lately we have recorded the air-pressure in the pharynx on the X-ray film itself. A Marey's capsule, specially designed for suitable sensitivity and damping, is connected with the pharynx by a tube through the nose. It is mounted on the X-ray screen, so that the metal tip of its light-weight pointer casts a shadow on the screen. As line of reference a piece of 0,5 mm copper wire is used. In this manner every frame of the film shows a synchronous pressure reading. Though quantitatively not accurate, the typical pressure-curve may very well serve to compare the lateral films of the soft palate with the antero-posterior films of the glottis.

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LITERATURE

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