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LOOKING AT THE LARYNX DURING RUNNING SPEECH

FRANKLIN S. COOPER, Ph.D.  
ARTHUR S. ABRAMSON, Ph.D.

MASAYUKI SAWASHIMA, M.D.  
LEICH LISKER, Ph.D.

NEW HAVEN, CONN.



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# LOOKING AT THE LARYNX DURING RUNNING SPEECH

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In the course of research on speech perception, and in later work on articulatory dynamics, we were led to suppose that there is a close relationship between voicing distinctions, a prominent phonetic feature of the world's languages, and the relative timing of laryngeal and supralaryngeal articulatory events.<sup>4,5</sup> Thus, certain classes of sounds in English may be distinguished by whether or not the arytenoid cartilages move apart during the production of these sounds, and when (relative to other events) they resume a phonatory position. The voiceless fricatives of the words *see*, *she* and *fee* regularly show separation of the arytenoids, while the voiced stops of *bay*, *day* and *gay* do not; but some consonant classes show a degree of variability in this respect, in particular, the voiceless stops of *pea*, *tea* and *key* when unspirated, as they are before unstressed vowels. The initial data were from perceptual tests and measurements of sound spectrograms; further evidence has come from observations, indirect and direct, of the laryngeal gestures.

Various techniques have been developed during the past ten years or so for observing indirectly the changes in glottal aperture during running speech. These include transillumination,<sup>10</sup> measurement of electrical impedance across the glottis,<sup>2</sup> ultrasonic monitoring,<sup>1,7</sup> and x-ray motion pictures.<sup>3</sup> The transillumination technique was used in earlier work at Haskins Laboratories,<sup>6</sup> yielding valuable information on laryngeal maneuvers during speech. The data were

ambiguous, however, at some points and raised questions that could best be solved by direct visual examination of the glottis during ongoing speech. We have used a flexible fiberoptic bundle, employing a technique developed at the University of Tokyo,<sup>3</sup> to examine the glottis visually and photographically.<sup>9</sup>

Preliminary experiments only have been made in collecting transillumination and pictorial data at the same time but it is clear that transillumination will be a useful supplement to visual observation. The data from an early experiment are shown in Figure 1 for the sentence, "It's a police whistle." Sample frames from the pictorial record obtained with a fiberoptic endoscope are shown for the open glottis (extreme left) and for three selected sounds that are identified by the phonetic transcription at the bottom of the figure. Closure of the glottis is indicated by the trace at its lowest level; partial opening, allowing the passage of some light, is shown by the small upward peaks of the transillumination trace.

The arrangements for direct visual observation employ a fiberoptic endoscope that contains two groups of glass fibers, one to carry light to the glottis and the other to bring out the image. The composite fiber bundle and plastic sheath has an outside diameter of about 5 mm. It is inserted through the nose and positioned in the hypopharynx at the level of the tip of the epiglottis, following surface anesthesia (Xylocaine®)

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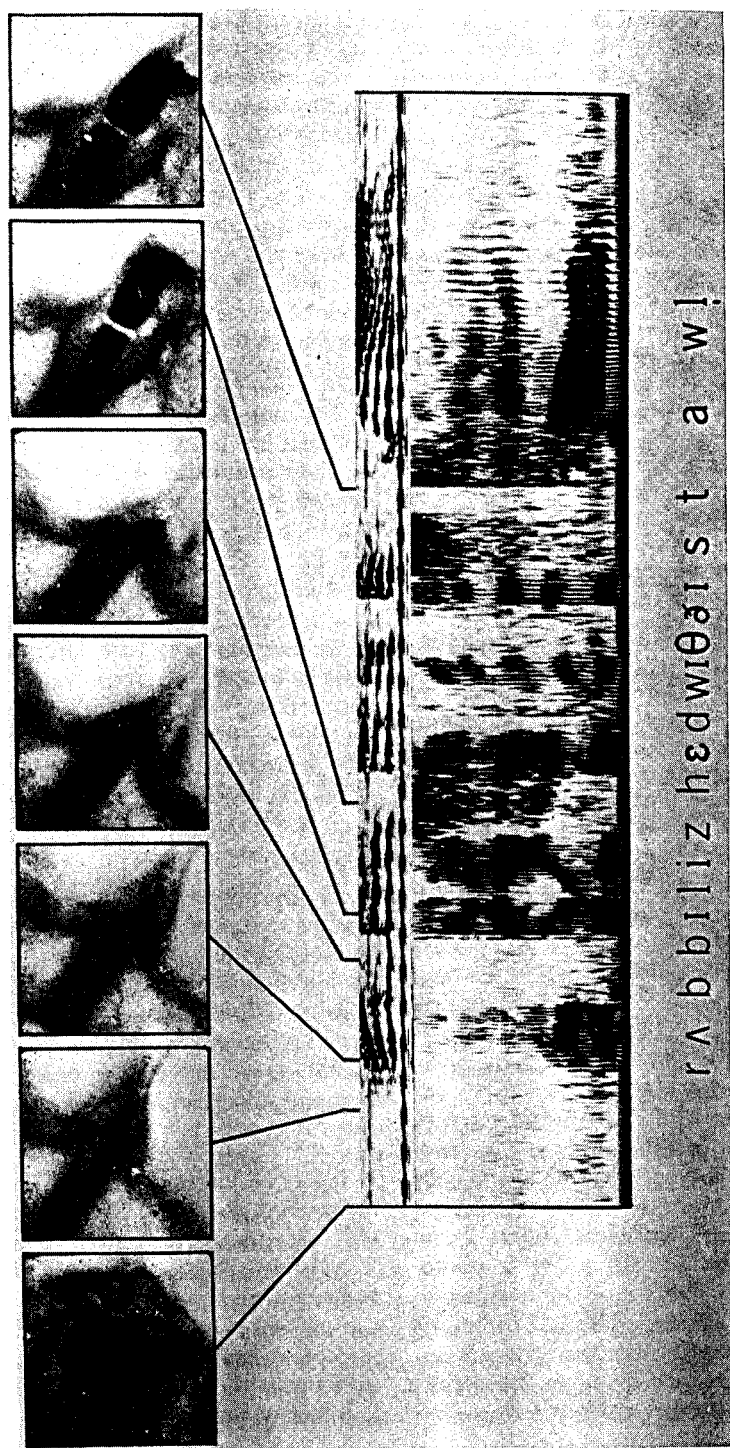


Fig. 2. Views of the glottis and corresponding moments along a sound spectrogram of the spoken sentence, "Rub Billy's head with this towel."

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