

LARYNX - DOUBLE-SOUND GENERATOR

Boris Chernov
Dozent
Conservatoire
Novosibirsk, USSR 630099

Valentin Maslov
Phoniatic
Policlinic No 1
Novosibirsk, USSR 630099

ABSTRACT

Only aural transmission from man to man of the oldest form of creative activity brought to us the method of phonation of the genetic period of an inarticulated speech. Millions of years have passed till the entrance to larynx was excluded from the process of phonation. The beginning tone of vocal folds got the possibility to be formed into vowel and consonant sounds of speech. From whistle to voice-whistle and articulate speech - that's the way of evolution.

INTRODUCTION

Nowadays on vast territories of the Centre and the South of Asia among Turkish and Mongolian peoples there remained the most ancient forms of the organisation of sound formation in normal larynx that demonstrate an active participation of vestibular folds at the expense of sharp contraction of the larynx entrance, such as larynx whistle and phonation simultaneously through the two barriers of vocal and vestibular folds.

Larynx shows the capacity of a double-sound generator and clearly demonstrates the mechanism through which the formation of an articulated speech is impossible. The peoples of Mongolia, Touva, Bashkiria managed to preserve the ways of phonation peculiar for the genetic period of an

inarticulated speech in the form of traditional singing folklore that have passed through centuries thanks to living transmission.

The most stable are the methods of double-voice singing in four styles: Syghyt, Ezingeler, Kargyraa and Barbbannadyr of the Touvinians.

The first notes of the Bashkirian style Usllau date to 1897. Folklorist Rybakov S.G. has characterized it as Forest Willdeness. The forms of Touvinian double-voice singing were studied by musicologists and folklorists beginning with 1900. The analysis of Touvinian guttural singing was made by the Soviet composer A.N. Aksionov during the 60-th. The acoustic analysis of Triple-voice singing of Tibet lamas was made by English scientists H. Smith, K. Stevens, R. Tomlinson in 1967. In 1973 at the VIII all-union acoustic conference of AS of the USSR A.A. Banin and V.N. Lozhkin reported the results of acoustic analysis of Touvinian larynx singing made with Sona-Grav-7029 A apparatus in diapason of 40 - 4000 Hz. They found the characteristics of low tone from 60 to 220 Hz and high pitch from 2000 to 3000 Hz. But it appeared to be impossible to explain the physiological mechanism of larynx with the help of acoustic analysis.

Special research group of the authors of this report was made at the initiative of Ministry of Culture of Touvinian ASSR and rectorate of the Novosibirsk Conservatoire.

The first examination of vocal apparatus of Touvinian singers showed that they have no abnormal deviations of anatomophysiological character. When the singer began double-voice regime of phonation the before seen vocal folds entirely disappeared off the investigator's sight. The source of the second sound appeared to be a round whistle hole of $D=1,5-2$ mm formed by (false) vestibular folds. In 1975 - 76 unique photographs of the sources of the high-frequency whistle of 2000 - 4000 Hz were made (Fig. 1). The following methods were used: filming of singers; indirect laryngoscopy; film-

ing of the functioning of the larynx in indirect laryngoscopy; tomography of the larynx; tele-X-ray cinematography; video-magnetic recording from TV screen; recording of various styles of double-voice singing.

In the Syghyt style, a singer begins the first phrase of the song with words in an ordinary manner with his face relaxed and his articulation and breath having no visible signs of effort. After finishing the phrase sung naturally the singer takes a new breath and begins double-voice singing which excludes the possibility of using words. So the vocal organs start working like a peculiar double-voice musical instrument (fig. 1). To the ear double-voice singing presents itself as two melodies the lower of which is of ostinato character and keeps the pitch

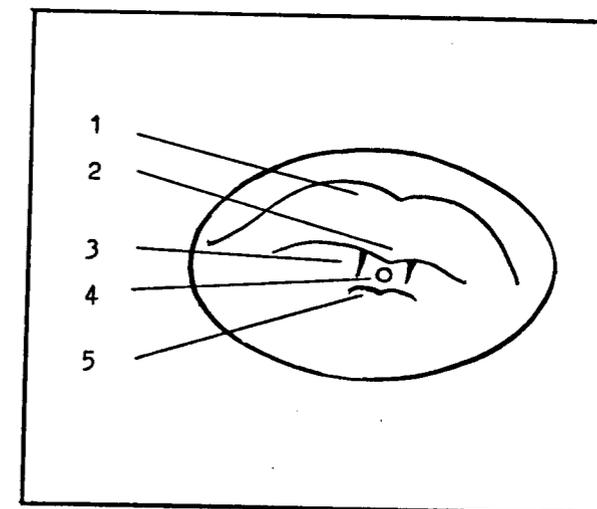


Fig. 1. Opening to the larynx in Touvinian double-voice singing (in laryngoscopy). One can see a tuberculum epiglotticum the tops of the arytenoid cartilages and the margins of false vocal folds in action in forming a narrow opening to the larynx like a small passage or nozzle. 1 - Lead of epiglottis; 2 - tuberculum epiglotticum; 3 - margin of ventricular vocal fold; 4 - opening of 'nozzle' surrounded by foaming mucus; 5 - top of arytenoid cartilage.

of the octave. The second melody is heard as a kind of whistle complicated by flowery decoration and lies in the sphere of the third and fourth octave.

The transition from usual single-voice phonation to double-voice singing is followed by abrupt changes in the functioning of the larynx. The larynx quickly pulls up and the loose margin of the epiglottis becomes visible deep in the mouth cavity, with the tongue not being stretched at all.

Indirect laryngoscopy shows that in this position the vocal folds become invisible as the upper opening of the larynx narrows to 1.5-2 mm because of all the formations arranged at this level. The tuberculum epiglotticum draws near the apex of the cartilagine arytenoideae. From the sides, muscles of the ventricular folds and fibres of the musculus aryepiglotticus par-

ticipate in narrowing.

The upper opening of the larynx begins to function according to the 'nozzle' principle producing a whistling tone resounding in the pharyngeal cavities.

This process of changing the larynx into a double sound generator was clearly observed in sagittal X-ray cinematography that shows the rise of the larynx as well as its narrowing and the sharp exact movements of the tongue which are synchronous with the changes of pitch of the whistling tones leading the ornamental melody.

The formation of two narrow passages in the larynx in accordance with the sounds produced by it in double-voice singing can also be observed in tomograms (fig. 2). In the frontal tomograms two narrow passages are seen: the first is due to the closure of the plicae vocales, and the second is formed by closing the

ventricular folds and musculature in general and other muscle elements of the upper opening of the larynx, with the ventricles of Morgagni being relaxed. The second passage works like a nozzle or a whistle. It creates high-frequency vibrations which then resound in the pharyngeal cavities, forming sounds of various pitch.

The larynx of a Touvinian singer who sings in the double-voice manner is a two-sound generator in which the pitch of the low tone is created by the vocal folds, while the pitch of the whistling tone is a result of the activities of the nar-

rowed entry to the larynx (nozzle) and of the resonator cavities of mouth and pharynx. These uses of the larynx and of the mouth and pharyngeal cavities demonstrate amazing functional possibilities of the vocal organs for creating sounds and exclusive abilities to govern their pitch and duration.

As a result of long and thorough examination of physiological mechanism of larynx singing of Touvinians, Khakassians and Bashkirs a new capacity of larynx unknown to science was opened - the capacity to form mechanism of aerodynamic whistle.

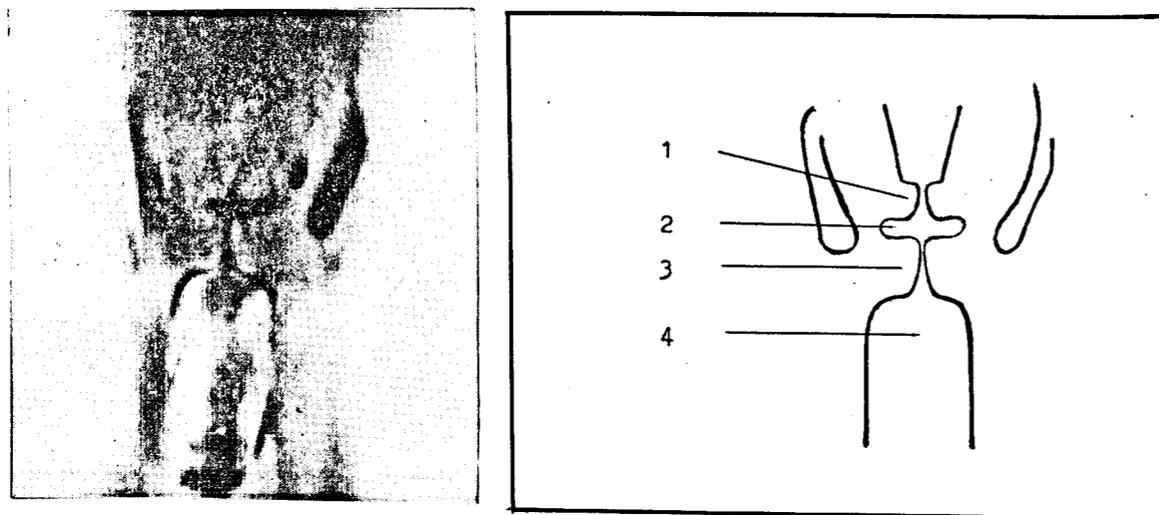


Fig. 2. Tomogram of the larynx in double-voice singing showing the presence of two narrow passages, one on the level of the true vocal folds and the other on that of the ventricular folds. Ventricles of Morgagni remain relaxed. 1 = Closed ventricular folds participating in the formation of a narrow opening to the larynx; 2 = ventricles of Morgagni relaxed; 3 = true vocal folds closed; 4 = aperture of trachea.

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