substance of the temporo-sphenoidal lobe, and greenish fœtid pus mixed with small shreds of solid matter (quantity six to eight drachms) trickled out. The cavity was washed out with warm boracic lotion. A few days after the operation drainage was found somewhat imperfect. It was also noticed that *some kind of communication existed between the abscess cavity and the cavity of the tympanum.* The patient was put under chloroform again, the abscess cavity reopened, and a No. 12 gum elastic catheter placed *in situ*. The patient made an excellent recovery.

In the second case the symptoms pointed to the presence of a cerebellar abscess. On exploration no pus, however, was found. The author thinks it probable that a subdural abscess with meningitis existed, which discharged through the tympanic cavity.

The patient, a man aged twenty-eight, had had left-sided middle-ear disease for from sixteen to seventeen years. On September 28th he was found to have left facial paralysis with acute pain over the mastoid process. An operation was undertaken (with probable injury to the lateral sinus), which gave temporary relief. On November 6th the headache returned. During the next few days vomiting and cold shivering attacks were frequent. On admission to hospital patient complained of great headache, had a staggering gait, but no giddiness. There was no mastoid œdema, and no optic neuritis. The tympanic cavity was first cleared out, and then the mastoid antrum was opened, but was found to contain no pus. The headache now disappeared for two days and then returned. The temperature, pulse, and respirations were subnormal. Commencing optic neuritis was also found. It was decided to explore the cerebellum. This was accordingly done, but no pus was found. Two days after this second operation a copious discharge of pus from the meatus took place. After this the patient gradually recovered and left the hospital in apparently perfect health.

[The author appends in a tabular form the leading symptoms met with in intra-cranial lesions following ear disease. Those interested in this subject would do well to refer to the original paper.]

W. Milligan.

ASSOCIATION MEETING.

PARISIAN SOCIETY OF LARYNGOLOGY, RHINOLOGY, ETC.

Phonetic Rôle of the Trachea or "Porte Vent." By Dr. MOURA.

§ I. LENGTH.

AFTER quoting other authors (Galien, Dodart, Muller, P. Koch) Dr. Moura goes on to remark that the vibrations of the glottis and of the wall of the tracheo-bronchial tree are not of the same order, the one being direct, and others indirect, or, so to speak, second-hand. The tracheo-bronchial tree being during life in a state of tension (the isolated trachea after death removed from the body shortening ten, fifteen, twenty millimetres) permits respiration to fulfil in part the conditions of rigid tubes of musical instruments, *e.g.*, the hautboy and flute, and gives it a resistance

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sufficient to vibrate. This fact is of great importance, and explains the movement of the aerial tree in efforts of speech or singing. The vibratory influence of the length of the tracheal tube on the formation of glottic sounds is founded on :

1. Its tension and resistance diminish when it is shortened, whilst its calibre increases by descent of the larynx.

2. The tension of its walls increases when it lengthens, and its calibre diminishes as the larynx rises.

This double movement is associated with the lengthening and shortening of the pharyngeal tube or "porte voix" (voice carrier), the movements of the "porte voix" (voice carrier) and "porte vent" (wind carrier) occurring simultaneously and inversely.

The ascent of the larynx may reach twenty-five millimètres during phonation, and thirty to thirty-five millimètres during deglutition. The tracheal tube thus submits to a shortening or lengthening of twenty to twenty-five millimètres. The length of this tube, being of an average of eight to ten centimètres, can therefore experience a diminution or augmentation of one-fifth or even one-fourth of its length, corresponding to nearly three and a half tones of the musical scale.

Lengthening of the trachea and diminution of its calibre take place simultaneously, and either one or the other increase the acuity of sounds making the aerial undulations of the "porte vent" smaller and the vibratory nodes of the tracheal wave more numerous.

Their effects are superadded, doubling or tripling the small influence which the length may have on the formation of vocal sounds.

Shortening of the trachea and increase of calibre will inversely influence not acuity, but depth of sounds.

§ II. Diameters. Defects.

The calibre of the trachea is in man eighteen millimètres, and in woman fourteen millimètres, on the average, but the tracheal tube is not as regular as the tube of a wind instrument.

The antero-posterior and transverse diameters are unequal once out of twice in the female sex, and twice out of three times in the male. It is more frequent in the latter, because the tracheal diameter, varying from ten to twenty-six millimètres, allows of sixteen variations, while in the female the diameter is from seven to twenty-one millimètres, or allowing of fourteen variations.

In a trachea of seven millimètres the aerial vibrations will produce a sound in which the sonorous vibrations correspond to the double upper octave of the twenty-one millimètre trachea, and in the male the vibrations of air in a trachea ten millimètres diameter will be much above those of a trachea of twenty-six millimètres diameter.

When ordinary reeds are united with tubes, the sound produced is not that of the reed, but one of the sounds of the tube nearest related to its reed. The glottic sound is therefore modified by the sound of the tracheal wave, and is highest when the undulations of the latter are smaller than the glottic vibrations, and lower if they are greater.

Tracheas not only vary in their diameters, but are often irregular in their course. They are, in some individuals, flattened antero-posteriorly

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or laterally, or at some particular point or portion of their length, sometimes retracted or S-shaped. Such defects help to alter and falsify the tone of the vibrations of the human reed, and explain why certain persons can neither sing nor speak clearly, why some have a low and veiled speech and others have a falsetto, shrill, acute voice persisting during life, although the larynx and voice-carriers may be conformed just like those of good speakers and singers.

§ III. Parallelism of Development. Anomalies.

The parallelism of anatomical development between the length of the ligamentary glottis and the diameter of the trachea and the diameter of the cricoid is very often defective.

Thus in two female subjects, whose vocal ligaments measured nine millimètres, the diameter of the trachea was in one eight millimètres, and in another fourteen millimètres. The voice of the first could not have the same tone as the latter. In one the voice must be heightened, in the other lowered.

The inverse of this is seen in a vocal ligament of two, three, and four millimètres longer than the calibre of the trachea; the influence of the tracheal wave is to raise the glottic tone.

This occurred in one female patient, whose vocal ligaments measured thirteen millimètres, the transverse diameter of the trachea being ten, and the antero-posterior nineteen millimètres. Numerous vibratory nodes are inevitable in such a case in the tracheal wave. Such defects of parallelism are more common in the male sex.

Laryngometry demonstrates that there are individuals of each sex in whom this apparatus is the same, the vocal ligaments of ten millimètres corresponding to a masculine trachea of eighteen to twenty millimètres diameter; others being eleven millimètres diameter have tracheas of fifteen to twenty millimètres; some with a number of thirteen millimètres have a trachea of twenty to twenty-one millimètres, etc.

Conversely, ligaments of twenty millimetres exist with tracheas of eighteen and twelve millimètres, seventeen and thirteen millimètres diameter.

The calibre or diameter of the cricoid is the most fixed and regular point of the respiratory channel, so that the value of the column of air respired, other things being equal, may be calculated according to the circumference of a circle having for radius the half of the inferior diameter of the cricoid.

Examples :—

Subject.	Lig. Voc.	Cricoid.	Trachea.
1.	15mm.	10mm.	21mm.
2.	10 „	18 „	18 „
3.	14 „	16 „	18 „
4.	15 „	19 „	20 „
5.	13 „	17 „	18 „
6.	15 „	13 „	18 „
7.	14 „	14 „	21 „
8.	20 „	14 „	18 „

etc.

Thus 1, 4, and 6 having vocal lips of the same length, 15 millimètres, the diameters of the trachea being 6, 5, and 3 millimètres more, the

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tracheal waves correspond to more ample vibrations than those of the edges of the glottis, and combining with them lower the glottic tone. But the cricoid has only ten to thirteen millimètres diameter in 1 and 6, *i.e.*, eleven to eight millimètres less than the calibre of the trachea. The tracheal vibrations can influence the glottic vibrations only to elevate their tone.

The eighth subject is the same.

The seventh subject, the diameters of whose cricoid ring and ligaments are the same, is in the most favourable acoustic conditions for unison between the glottic vibrations and cricoid waves.

Is it not evident that the low, cavernous, sepulchral voice of the ventriloquist is obtained from a trachea of large diameter? It cannot be performed by women.

§ IV. Acoustics of Reed Tubes.

The author is in entire agreement with the laws laid down by Muller (Tome II., p. 127), and which he quotes at length.

These laws explain the influence exercised by the tracheal or sub-glottic wave upon the vibrations of the edge of the glottis, and, again, upon the sonorous waves of the laryngo-pharyngeal resonator, *i.e.*, upon the voice.

§ V. Pectoriloquy, or Resonance of the Voice in the Chest.

Dr. Moura severely criticizes the statements of Fournié ("Phys. de la Voix et de la Parole"), who "has been endowed with an original and fertile imagination." The harmonic tables of Fournié and others are imaginary. That such should exist in the trachea it would be necessary for it to be not only rigid, but perfectly regular. Laryngometry shows the slight foundation for this invention.

The retention of the voice or of the glottic tone in the chest is in relation to the amplitude of the sub-glottic vibrations and inversely to their number. It is enfeebled as the sound rises, and ceases at a certain elevation, that of acute notes of both natural voices, ordinary and complementary (plain voice and head voice). If the centre of the tracheo-bronchial resonance mounts progressively from low to high, meeting the larynx, vibratory nodes are formed, probably more numerous in the column of air of the "porte vent." Retention decreases, becomes null or very feeble, the orifices of the glottis becoming rigid, small, and no longer vibratory; the expired air is broken on the edges more than it can cause to vibrate, and the sound takes the *timbre* and character of whistled (*sifflées*) or fluted notes.

Vibrations of the glottis are reinforced by the tracheal wave, provided that there is no irregularity of conformation too much malforming the tube's calibre. The sensations felt by singers in the chest are sensations of assistance to the voice.

Clinical observation and the laryngoscope prove that deep and full notes resonate in the tracheo-pulmonary channel ("porte vent").

These notes, to the number of about ten, form the so-called chest voice. They form the first two registers, the deep and the full of the first natural voice (or of "plain-chant").

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