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**Fluoroscopy
of the Diaphragm
During
Trumpet Playing**
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Recently, it was my privilege to thoroughly evaluate a number of professional trumpet players in our laboratories. Maximal cardiovascular stress-testing was accomplished as well as complete pulmonary function testing, flexibility studies, percent body fat evaluation, and quantitative evaluations of the chest wall and musculature involved in trumpet-playing. Because my curiosity had been tweaked by conversations with various pulmonary physicians and professional musicians, a study was outlined to help determine the function of the diaphragm in regards to effective trumpet playing. Throughout the trumpet and medical literature, there are numerous references to "diaphragmatic breathing", and many paragraphs urging "development and strengthening of the diaphragm". Since at post-mortem examination and surgical examination, the diaphragm is a very thin layer of tissue, it has always seemed to me to be a bit of a misconception to expect so much contribution to trumpet-playing from this organ.

Arrangements were made to study the movements of the diaphragm under fluoroscopy. Because this is done daily in hospitals throughout the nation, the techniques of this study provided no particular difficulties beyond that of convincing administrative personnel that studying the diaphragms of trumpet players had long-range merit and could contribute to the fund of knowledge significantly. Once this had been accomplished, two of the trumpet players in our study were selected and represented seventy-some years of playing professionally. The fluoroscopy screen was situated so that it could be visualized during trumpet performance and was placed in such a position so that the observers could also carefully evaluate the movements of the performer's chest and abdominal walls. Observers were chosen for their medical expertise and understanding of trumpet playing and included a radiologist, a sports medicine specialist, and a professional trumpet player and teacher.

The performers were first asked to sustain a crescendoed "G" in the staff for as long as possible and to continue the crescendo until no air could further be expelled. The diaphragm was observed to flatten with the inhalation of breath prior to the initiation of sound. As the note was struck, no movement of the diaphragm was noted though the chest wall and abdominal musculature were noted to squeeze invisibly. As the crescendo continued, the diaphragm was noted to tense visably, and shortly thereafter, the diaphragm was noted to move upward. During this time, the musculature of the chest wall and abdomen were noted to continue their squeezing-type action, but no abrupt changes in the musculature were noted. The diaphragm was maintained in the upward position as long as this squeezing action of the abdomen and chest wall musculature was continued. As soon as the flattening of the diaphragm and the musculature relaxed, the diaphragm dropped immediately.

Next, the participants were asked to play an arpeggio of half-note "high-C", above the staff, and then to continue to play four measures of "C" for a duration. Diaphragmatic movement and chest wall and abdominal movement were again carefully observed simultaneously. Upon initiation of the sound, the diaphragm again flattened and maintained this position throughout the first "C". The chest wall and the abdominal musculature were noted to continue their squeezing action, but no diaphragmatic movement was noted. As the second note of the arpeggio ("E" in the staff). As the first "G" was initiated, the diaphragm was noted to move upward and the diaphragm maintained this same position throughout the duration of the musculature of the abdominal wall.

With cessation of the expiration, the diaphragm was noted to move downward. Next, the performers were asked to play a half-note "C" for a duration. Diaphragmatic movement and chest wall and abdominal movement were again carefully observed simultaneously. Upon initiation of the sound, the diaphragm again flattened and maintained this position throughout the first "C". The chest wall and the abdominal musculature were noted to continue their squeezing action, but no diaphragmatic movement was noted. As the second note of the arpeggio ("E" in the staff). As the first "G" was initiated, the diaphragm was noted to move upward and the diaphragm maintained this same position throughout the duration of the musculature of the abdominal wall.

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you could see it on a fluoroscope, the speed of movement would be amazing. Its shapes and movements are unending. No one can explain exactly the position of the tongue, only the manner of its movements because no two mouths are shaped alike. The manner of movements, however, is the same. It is one of the natural forces of the universe.

The baby practices and practices, hundreds and thousands of repetitions until it can form the sound that it hears. Without a tongue it would never be able to talk or to form syllables such as "Aww" and "Eee".

So it is with the brass player. He must do hundreds and thousands of repetitions until the tongue finds its position for each note on the scale in every conceivable model, until it works correctly by *HABIT (NOT BY THEORY)*.

As Herbert L. Clarke said, "The tongue rising in the the mouth to make the inside of the mouth shallow, is the 'Knack' of producing high tones."

And Alessandro Liberati said, "The very tip of the tongue will naturally take a position back of the lower teeth. Never allow it to strike back of the upper teeth."

The great books that will never die are Saint-Jacome, Arban, Clarke and Gatti. All those of a later date that are based upon the principles contained in these great books, were written keeping the basics we are discussing in mind. All flexibility books are basically tongue-level books. The student must study these books to get the sense of what the author was writing about. Then, by diligence and perseverance, the student must stay with the principles until the tongue works correctly, *by habit*.

Training the Tongue

To start your practice to develop the tongue, take the book *Tongue Level Exercises*, Gordon, published by Carl Fischer (Treble Clef instruments O5089 and Bass Clef instruments O5090), and study thoroughly pages 2 and 3 until you get the sense of what is said.

Turn then to page 8, Part 1, Exercise 1 and practice with the tongue in the manner prescribed on pages 2-3. *Repeat each measure many times.* (Watch the tongue; never rigid). Practice this exercise many times every day until you get the knack or feel of the tongue in this manner. This may seem strange or difficult to some at first. Stay with it and you will be well rewarded. Think "Tee" as you go up. Keep the tip of the tongue resting *lightly* behind the lower teeth. The tongue will adjust to different registers, so DO NOT HOLD IT RIGID OR ANCHORED.

Remember, this is an exercise and should be practiced like any model. Do not try to use it immediately when playing. Just practice it as an exercise every day. It will tell *you* when to use it.

Some players start to tongue this way from the very start without knowing it. Others must develop the knack or feel.

Developing the Tongue for Strength and Agility

In order for the tongue to function easily, it must be very strong, agile and fast. This takes time and practice. It will probably take many months to develop up to the goals that you want.

To start, using the tongue as explained, take my book, *Tongue Level Exercises*, and turn to Exercise 1 on page 8. Repeat each measure *many* times at a metronome setting that you can stay with. This could be any setting such as ♩ = 52 or ♩ = 92—possibly faster. In the