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Embouchure

Embouchure - what a puzzle, what a mystery. In a hundred years of brass literature it is difficult to find one clear-cut, indisputable answer. Teachers disagree, players disagree, top level players disagree. Some credit a particular horn, others a mouthpiece. Many say it's their own secret, a special combination that works for them but isn't likely to work for anyone else. You would think there would be some basic uniformity in method and approach, but little evidence of this will be found, and the obvious pattern of trying to improve one's embouchure is a certain patchwork of information and coaching, consisting largely of tips and slogans, together with plenty of rather pointless encouragement. The result, all too often, is little real progress. In spite of all this, there are some remarkable players from an embouchure standpoint. In the wider spectrum though, these players are a minority and the lesser player considers them especially endowed and lets it go at that.

Most players do not have an embouchure on a par with their mechanical ability. But this need not be the case. I play with confidence because the ability to do what the mind conceives is not hindered or compromised by a limited embouchure. This same confidence can manifest itself in your playing personality if you know how and what to do. Who knows how many players, with great potential, remain in obscurity due to a faulty embouchure apparatus or a misconception of the facts and their relationship to sound? A brass player should not subject himself to many years of hard work, pain, confusion and frustration, only to discover he is limited in executing his will to play.

In dealing with problems of the embouchure on a clinical level, my experience shows that players vary in their problems based not on any physical attributes, but on their understanding and training. Those players, with and without physical defects, who, presumably, have no problems regarding the embouchure, are upholding the principles of physical law governing sound production on brass instruments although they may not be consciously aware of these principles.

A brass instrument is incomplete in and-of itself. Preparation and development of the embouchure must come first, thereby completing the instrument. Any person should be able to produce sound covering the full range of the instrument, before applying the mechanics. In cases where physical deficiencies exist, they must be overcome or eliminated. It has been my experience that many so called deficiencies proved advantageous, when used to uphold the physical law and its application.

Many teachers warn the player not to strain his embouchure. It is their contention that playing on a graduated scale will gradually build the embouchure muscles. This is commonly called the “evolutionary” approach and is correct in part, for if no attempt to develop the muscles is made, any attempt to play high notes will, of course, lead to trouble. However, it is my contention that, by developing the musculature to receive air prior to placing the instrument on the lip, and, by upholding all the principles and physical laws involved, the player prepares himself, in terms of muscle strength, for instrument or mouthpiece placement. He has developed a pattern or habit of muscle behavior that will give him a starting point in the production of sound. Since sound on a brass-wind instrument is created by air going past and vibrating lip tissue, what better way is there to develop muscles than by fighting air? Developing, in the muscles, a familiarity resisting air gives the player a mental image prior to playing. The player develops muscle memory and learns muscle behavior, jaw position, lip position and teeth aperture. He also identifies
which specific muscles to use, and which muscles not to use. The proper place for evolutionary development is after the embouchure has been established, completing the instrument. If there is trouble, weakness, deficiencies, irregularities in teeth formation, jaw position and so on, at least a sensible evaluation of the player's potential has been made early and he knows better what road to take.

The question that these teachers fail to consider is, "Can that particular embouchure apparatus permit the acquisition of unlimited range?" This question must be asked. If their method or theory, if their answer to the student's problem, contains an inherent ceiling, that is, if at some point sound production becomes impossible not by virtue of human limitation, but because of a violation of physical law, their theory or the principle upon which they predicate the production of sound has no merit. If the principles of physical law are not incorporated into the production of sound in all registers, the player will experience a ceiling, a limited range. My theory and procedures allow the physical laws to be upheld over the entire range possible on the instrument. Players and teachers must learn to accept principles that are logical and effective in practice and reject those that are not. A concept based on physical law will then begin to emerge which can become the basis for a playing image.

Some of these same authorities contend I have harmed more players than I have helped. To this all I can say is that they have not heard my beginners play a four octave scale. Nor have they spoken to the many, highly regarded professionals from the commercial, jazz and legitimate fields who come to my clinic aware that they are limited in embouchure development, if today's playing demands are any barometer. These players are the products of their formal training with habits developed over many years of playing, and they themselves recognize their own inadequacy.

In regard to embouchure development, known facts and "evolutionary" experience are incompatible. Requisites for sound production exist and are constant and predetermined. It is the understanding and application of these requisites that are revolutionary when developing the embouchure of a beginner or dealing with the embouchure problems of a player, I have no doubt that there will be many who will disagree with what I say. In reply, I can only state: "Negate me. Show me a better way." The playing capacity of my current embouchure consists of low F# to a consistent triple C and sometimes a quadruple C depending on the shape I'm in. All tones, low, middle and high are relative to each other.

I am in business as a result of the "evolutionary" approach to teaching, not vice versa. As long as private and formal institutions of learning continue to deal with embouchure development and embouchure problems as they have in the past, my position is secure. I articulate and transfer to the pupil principles and laws that cannot be negated by adverse reasoning, argument or logic. The physical laws are constant whether one recognizes them or not. They exist whether one knows of them or not.

The playing habits of the world are not going to be changed by me. The players themselves will determine that. If they are content to play within the framework of their present skills, they need not seek additional range and endurance. In this context they can limit the writing of arrangers and composers. Unfortunately (from this point of view), there are players arrangers and composers that perform and write on a level demanding higher range and endurance. However, these players are specialists and are limited in number. They cannot possibly perform or record all the works written by arrangers and composers. As a consequence the exposure given such works is also limited. There inevitably must be
a leveling off of standards between player and composer from which both move on with the ability to do or not to do. In my view, the composer has outdistanced the player. Especially today, the playing standard of the majority of brass players leaves much to be desired if they hope to be part of the top level playing scene. Please bear in mind I am speaking from an embouchure standpoint. I admire and respect the very talented performing players, and in no way are my remarks intended to offend anyone who has gained the respect of his fellow artist.

Literature comprising musical content is not the solution to overall problems concerning the embouchure of the brass player. Criticisms of such a book and its author are fully justified, since the answers to problems do not lie in playing exercises. Problems must be resolved first in order to benefit from playing exercises. The books released by my predecessor and myself have been subject to such criticism, but they were not meant to be a cure-all. Rather, they were intended to point out basic principles and logical steps in the development of the embouchure. The intent of the literature was highly misinterpreted and misquoted.

Short-lived application of the principles I advocate will not work. Years of playing habits and reflex action are not changed overnight. Yet, in many cases in the past, if it didn't work immediately (and it won't) the whole concept was abandoned. The player must be aware of his inability to correctly apply this new information. If the mind is not open to truth based on facts, one is constantly in the dark. If a better way emerges, an old concept must be discarded.

All branches of knowledge are based on some truth and fact. In playing brass instruments, the senses have to be trained to react indirectly to evidence and reality, since the senses cannot perceive them directly.

Basing expectations on sense impressions can have justification only if there is a mental connection between "the real world" - natural physical law - and the sense impressions. The resulting sense experiences will not emerge as arbitrary, free mental creations. Physics relates directly to sense experiences and to the "understanding" of their connection with reality. In contrast, psychological impressions and experiences emerge as arbitrary mental creations. However, a bad or good physical experience can act as a catalyst for psychological fear, apprehension or lack of confidence. In order to avoid mental creations out of proportion to the real experience, understanding must exist. For example: - The concept of the "real external world" of everyday thinking rests solely on sense impressions. The psychological effects - mental image, feelings, sense experiences, etc. - are a result, not an arbitrary starting point. The mind of man is not made; it is in the making. Every day something is added to the conscious mind that was not there before. The investigation of things leads to the increment of knowledge. When you know, to know that you know, and when you do not know, to know that you do not know is the essence of self-improvement. It is foolish and in vain to study without thought. Do what I tell you to do, but before you do - think about the knowledge you already have; then retain what is valid after comparing and digesting the new information. It is in this framework of thought that the physical laws regarding brass playing will crystallize. Retain an open mind and let the facts sink in. Incorrect or limited knowledge can, if not checked, act as a barrier of preoccupation, restricting the ability of the mind to absorb new information that may alter former concepts and create new starting points. Elements of correctness exist in the production of any brass sound. The big problem is to retain and translate those elements and that sound into a logical sequence with no limitations. We
are all subject to the law of limitations as human beings, but there is nothing to prevent us from upholding laws and principles that are limitless. This requires knowledge and understanding of muscular behavior, muscle memory and physical law. I hope to answer the unanswered questions that have arisen from the problems surrounding the various ways of playing.

I don't know of anyone in the world who has been exposed to as many lip problems as I have, numbering literally in the thousands. I no longer conduct my clinic with appointments. The problem cases are there waiting in groups when I arrive in the morning. Almost each problem case sits through the analysis of the others. I prefer that they stay in order to get a better perspective of all the issues involved, which is to their advantage. During the analysis process, elements and factors may come to light in regard to one pupil that the observer, with different problems, never gave a thought to. He was looking elsewhere for resolution or, not knowing what to look for, not knowing what to do specifically, was in a quandary.

Now the question is "What do you look for and what do you do?" The following steps will describe the procedure so that you can identify your physical structure. This is concerned with your present way of playing. No matter what your embouchure setup is, certain rules and laws must be introduced and upheld while playing. This is not a change of embouchure but a correction. Some portions of your playing image will be affected, but it will be for the better, not the worse. If you give your subconscious mind a good starting point, you'll be surprise how quickly your automatic reflexes respond relatively, at the same time enlightening the conscious mind. But the original starting point should be established by the conscious mind. The following steps are procedural and should be observed in order to get the most effective benefit to yourself and/or those you teach.

STEP I: Read the book.

STEP II: As you read try to visualize the meaning of the various expressions, since many of them may be new to you.

STEP III: Study your playing habits in front of a mirror. This will help you retain that which is desirable and negate that which is undesirable.

STEP IV: Study your facial structure. Examine your teeth for any high spots or irregularities in the formation. Notice if your top lip is normally shorter and above the center of the top teeth edges. When playing, the top lip must be kept below the top teeth edges.

STEP V: Identify the true position of the corners of your lips. Open the teeth about ½ inch for this. The lips should be relaxed and should retain their natural thickness. If the corners naturally line up between the open teeth edges they can act as fixed points to help line up the two lips within the teeth aperture.

STEP VI: Relax all facial and neck muscles. Move the jaw forward, then recede the jaw. Keep the jaw loose and repeat the action several times. See if the bottom teeth edges can line up parallel to or slightly beyond the top teeth edges without pain. If there is pain, exercise will soon condition the masseter muscle to distend itself.

STEP VII: Play some slurs or scales in your regular setup. Notice the increase of your arm pressure or mouthpiece contact weight as you climb from tone to tone. Keep climbing till
you reach your ceiling. Repeat the same notes again using more arm pressure than is normal for you. Notice if there is much difference between so called normal and excessive arm pressure. Pay attention to how many tones were knocked off your normal ceiling.

**STEP VIII:** While still working in front of a mirror, notice if your jaw shifts from left to right or right to left while ascending and descending. The jaw should move in its own arc, down and up only. (The whole range of the horn, including all dynamic levels, is obtained with a maximum jaw motion of 1/8th inch or less, starting from a fixed teeth aperture that permits two lips to be equally spaced between both rows of teeth. The motion is down and up in the predetermined area of the jaw. For the sake of clarity, let's take a hypothetical teeth opening of ¼ inch, with each lip occupying one half that space. The bottom teeth edges controlling the lip aperture should not go up more than 1/16th inch beyond the starting point nor should they go down more than 1/16 th inch from the starting point. This jaw and teeth articulation combined with varying degrees of air compression, mouthpiece-arm pressure and matching resistance of the embouchure muscles, comprise the main elements of playing, exclusive, of course, of physical defects.)

**STEP IX:** Try to get a profile look in the mirror while playing. See if the jaw recedes radically while ascending; see if it comes forward to the starting point while descending. Try to determine also if the jaw is closing a little with each higher tone.

**STEP X:** If the above behavior prevails in your normal playing, try playing the same tones with a little more weight on the bottom lip. Delay the receding and/or closing of the jaw for as long as possible and substitute increased compression or air flow and matching muscular resistance. Think of the letter M as your lip formation image and resist the increased air column by contracting the two lips in the direction of each other.

Remember these are steps to help you recognize your playing habits as a conscious act. There will be times when you may feel there are too many things to remember and coordinate. I can only tell you that others have overcome obstacles as severe as lip damage, partial paralysis and a severed bottom lip held on by the corners. There is no need for me to go into the details of these cases. Suffice it to say they are true. If you truly love the sound of your instrument, you can never get bored or exasperated to the point of quitting. A challenge makes it worth while.

GOOD LUCK!
Sound and Sound Chambers

Sound
Vibrations are sound and sound is vibrations. Vibrations reaching our ear are identified as sound. Our hearing apparatus, receiving these vibrations or undulations, permits us to identify many different types of sound; impact, friction of matter, air against matter, and so on, all characteristic of the material causing the vibrations and related elements. Tubular structure permits more than one pitch or tone. How many depends on the length of tube. This is possible because of the existence, at various places within the tube, of nodes, or points that are relatively vibration free. The vibrating segments between two successive nodes are called ventral segments.

To produce sound there must be a resonator and an amplifier. In brass playing the top lip is the resonator and the instrument is the primary amplifier. The top lip vibrates at a certain rate of speed causing the air column to vibrate at a similar rate frequency. Amplified vibrations emanate and radiate in all directions as sound waves. The vibrating air column, consisting of nodes and ventral segments, stays constant or stationary in the horn. That is, it vibrates longitudinally while amplified sound waves move on, radiating at a speed of about 1100 feet per second. Prior to playing, the horn is already full of air that is being displaced as more air is introduced past the -lips into the instrument. Once the air has served its purpose, that of vibrating the upper lip, air displacing itself leaving the horn has no significant value other than blending in with the atmosphere. Since sound does not travel on airwaves, its purpose has been served. The sound is long gone before the air comes out of the horn.

The displacement of air in the horn does not affect the nodes and ventral segments, which remain stationary. (Similar to aiming a flashlight at a fixed object in a hundred mile an hour wind, the beam of light is constant.) It is interesting to note that the production of sound does not require a displacement of air. If the top lip could be made to vibrate without air going past it, one would still be able to play the instrument. However, as humans, we have no other means to activate the mucous membrane of the top lip to vibrate or flutter against the bottom lip, which acts as a base or facing. So we must resort to air and our ability to manufacture compression at many various levels of intensity. At the same time, we must recognize that the ability to resist the air column from the musculature standpoint is the most vital factor in the production of sound.

Embouchure muscles

In trying to evaluate the many problems that beset the brass player and teacher, it is most difficult for me not to enter into the already existing wide range of controversy involving how and what to do. For in many instances, I find myself completely isolated from the theories put forth by others. By placing intent and objectives above and beyond accepted performance and behavior, I have been compelled to examine the player's natural equipment and determine, from that standpoint, if it is possible to have an unlimited range, together with relative sound, flexibility and endurance. What can living tissue do and how can it adjust to metal tubing within the framework of the fixed mathematical laws governing brass instruments?
The result is a departure from the large majority. In researching literature regarding embouchure, I found many graphs, x-rays, medical charts of the breathing mechanism, throat and head, pictures of players hitting and playing high notes, arm pressure gadgets, air pressure gadgets with mouthpiece and rubber tubing attached, horns with the mouthpiece hanging on a string, horns on table tops with the mouthpiece sticking out beyond the edge, common agreement on the arched tongue position for high notes (EEE), statistical readings of students and professionals performing the same tests, statements that black skinned players have different lip tissue, statements that thick lipped players should not play brass instruments, and so on into the night. Not one explored the embouchure possibilities, because the accepted premise was that the playing capacity of the embouchure is limited. My position is that the embouchure and its related muscles can be developed and trained to uphold physical laws that are unlimited in principle, thereby increasing the playing capacity to its maximum, within the mathematics of the metal tubing and the law of limitation as applied to humans. Variations in limitation depend on varying degrees of understanding, application of the principles, coordination and upholding of the physical laws involved.

From any given note, there is nothing to prevent the player from increasing the speed of the vibration by using a fixed teeth aperture as a starting point, (with lips equally spaced between teeth edges) and training the embouchure muscles to resist and contract against the increased gradation of compression in a relative manner under the proper playing weight of the mouthpiece. And the faster the vibration, the higher the pitch, provided the stroke of the top lip against the bottom lip facing does not become longer. If done diligently, the lips will develop a smooth muscular contraction relative to any increased air column. If the tones stick and the lips feel frozen or immobilized, the mouthpiece weight at that particular point is excessive on the lips. With conscientious practice of the palm exercise (outlined in Part II), the lips will overcome the mouthpiece weight. The player will now be substituting air pressure and muscular resistance for mouthpiece - arm pressure in order to increase the speed of the vibrations. (So as not to choke off the air column on a high fast narrow vibration there is a point at which the arm pressure or mouthpiece weight must cease to increase, while air and muscular tension must continue to increase to keep ascending. Alignment of both lips must be maintained; teeth must not close.)

The two lips cannot defend themselves against heavy arm or mouthpiece weight unless they are trained to resist air. This necessitates exposure to air. The more a group of muscles works in sympathy resisting air, the more these same muscles protect themselves against abusive arm or mouthpiece pressure and damage from any teeth irregularities.

The muscles used for playing vary in size and strength, but everyone has the same muscular structure and the same relative strength. The texture and fiber is the same in everyone and is subject to the same abuse. Embouchure weakness is not indicative of inherent muscle weakness, but, rather, of the incorrect use of muscle combinations, together with excessive mouthpiece contact weight, poor breathing, bad lip alignment.
Scheme of musculature of embouchure, side view.

Fig. 1.—M, modiolus. 1, orbicularis oris (upper lip portion). 2, levator labii sup. alaeque nasi. 3, levator labii superioris. 4, levator anguli oris. 5, zygomaticus minor. 6, zygomaticus major. 7, buccinator. 8a, risorius (masseteric strand). 8b, risorius (platysma strand). 9, depressor anguli oris. 10, depressor labii inferioris. 11, mentalis. 12, orbicularis oris (lower lip portion).
and little understanding of what does and doesn’t play. These factors prevent the embouchure structure from developing and are the reasons for functional variations among different player, student and professional alike. There are no notes, written anywhere that can resolve an embouchure problem. The embouchure problems must be resolved first by understanding and upholding the laws of brass playing. Then and only then should notes be used to develop the embouchure behavior imposed on it by the player’s intent and needs.

The reader should study the muscular structure of the embouchure (Figure 1) as shown and memorize the directional layout of each muscle. A muscle may contract or act independently causing other related muscles to relinquish their position. Several muscles acting in sympathy form a directional pull.

For practical purposes the muscles will be referred to by numbers, rather than by their respective names.

Muscles 2, 3, 4, 5 and 6 are not to be used as functional muscles, since the contracting direction would be upward and backward, taking muscle 1, the lip that vibrates, above the top teeth edges, thus contributing to lip separation from the lower lip and to lip thinning in both lips, thereby causing extreme weakness.

Because the bottom lip has thicker and stronger muscles inserted from the corners down, it is better equipped (from a physical standpoint) to receive the bulk of the overall mouthpiece contact weight. The natural structure of the bottom lip makes it relatively insensitive to vibrations.

Muscles responsible for the production of sound, control, range and endurance are muscle 1 (or 1 and 12), a circular muscle consisting of the upper and lower lip, and the corners, called the modiolus (M). The mucous membrane of the top lip confined in the inner circumference of the mouthpiece rim constitutes the reed. The built in elasticity of this naturally formed cherry acts in a recoil manner slapping against the bottom lip, which acts as a facing. This action causes vibrations which stimulate the air column to pulsate within the tubing. These pulsations then become amplified by the tubing, resulting in tone.

The radiating muscles 7, 8A and 8B, attached to and emanating from the modiolus, or corners, act as the lateral walls of the oral cavity. Muscles 9, one attached to each corner, gently lock the corners between the teeth aperture, at the same time bringing the lips, 1 and 12, together against the teeth. These muscles are able to do this by means of a strand of muscle fiber, which extends through the top lip and attaches to a muscle 9 at each corner. This strand also enables the muscles 9, when producing equal resistance, to exercise control over lip tensions. Muscles 7, 8A and 8B act in sympathy with muscle 9 to retain the natural width of both corners. The outer red mucous membrane sections of both lips, closest to the outer skin, face each other. The inner red mucous membrane sections of both lips face the teeth and gums. Muscles 10 and 11, attached to the bottom lip, act as supporting girders creating a buffer zone for the bottom half of the mouthpiece contact weight. Muscles 1 and 12 constitute a lip aperture evenly spaced, gently touching, within the teeth aperture of about 1/4th inch. If the jaw is naturally receded, it must be brought forward till the bottom teeth edges are parallel to, or slightly forward of, the top teeth edges. This constitutes a playing formation. The mouthpiece may now be placed against a firm background enabling the player to take advantage of the well-bolstered bottom lip. The release of air and its force, channeled by the lateral walls of the oral cavity, be it fast or slow, against the lips will determine the playing tension. (WARNING) Any lip thinning,
sneering, stretching, pulling of corners back and upward, or pancaking of bottom lip flat against the chin, which takes place, will weaken and destroy the embouchure musculature forcing the player to revert to extreme mouthpiece-arm pressure. The player will have lost his ability to exercise control over those muscle tensions, which have a direct bearing on the surface lip tension of the vibrating area in the cup or chamber of the mouthpiece.

Muscles 1 and 12 must constantly be exposed to air between the teeth edges. If both lips are exposed to air they will remain buffed while resisting the air, permitting muscles 7, 8A, 8B and 9, which are attached to the corners of the two lips, to equally match the air in the oral cavity. Any increased compression with matching muscular resistance of the lateral walls (7, 8A, 8B and 9) will proportionately change the tensions in the two lips, muscles 1 and 12.

The varying tensions of these muscles will be governed by the player's intent. This intent will determine both the air speed, which will in turn determine the speed and length of the vibrations, and lower jaw movement up and down in its predetermined area.

If the mouthpiece weight is excessive on the top lip, the muscles affecting the surface tension of the vibrating area will be immobilized. Mouthpiece distribution of weight should be 40-45% top, 60-55% bottom. Left to right 50-50.

The jaw must be constant and consistent in its role as a foundation for the bottom lip. The bottom teeth edges must be parallel too or a fraction beyond, the top teeth edges and open (not closed, blocking air to lips). If the jaw recedes into its underbite, the weight of the mouthpiece will shift to the top lip. The tendency to recede the jaw and raise or close it at the same time is inherent in all players due to various reasons, the most prevalent being fatigue in the masseter muscle, causing an involuntary, subconscious, state of rest position.

The dreaded Tu-ee action pulls the corners back and up, raises the sides of the bottom lip (between the corners and the outer edges of the mouthpiece) up above the top teeth edges, and forces the muscles inserted into the bottom lip to disengage their grip and relinquish the vital function of keeping the center of the bottom lip buffed and above the bottom teeth edges. This action can be identified by the use of a mirror. The purpose of fixed corners is to keep the bottom lip up and the top lip down evenly spaced between the teeth aperture. Any muscular pull taking lips out of alignment or thinning destroys the ability of the lips to contract in the direction of each other. Muscular change affecting the surface tension of the vibrating area in the top lip will then become solely dependent on mouthpiece-arm pressure.

The natural function of facial muscles and their subconscious behavior, if applied to brass playing is incorrect, since utilizing the natural function of all the muscles contradicts our intent and is hostile to our objectives. However, the natural function and behavior of the facial muscles must be understood, in order to make specific muscles that work in sympathy with other muscles serve the brass player's intent and purpose. Muscles working in sympathy with each other creating contradictions that are harmonious to our objectives require conscious understanding, in order to properly train the subconscious mind to react automatically when playing. All things function under the laws of contradiction and relativity
Facts about muscles and their behavior

**Masseter:** A large muscle, which raises the lower jaw and assists in mastication. It arises from the zygomatic arch and the zygomatic process of the temporal bone and is inserted into the angle and ramus of the lower jaw. (Ramus designates the entire right or left half of the lower jaw.)

**Zygomatic muscle:** A slender band of muscle on either side of the face, rising from the zygomatic bone and inserted into the orbicularis oris and skin at the corner of the mouth.

**Contraction:** Continuous contraction, gradually and temporarily deprives muscles of their ability to contract, this condition being characterized as muscular fatigue. Normally, however, healthy muscles can relax and, after a short time, recover from the effects of repeated, continuous contractions.

**Leverage:** Skeletal muscles work on the principle of a lever moving on a fulcrum, or fixed point. The fixed point may be somewhere between the force applied and the resistance offered (Class I lever); or it may be somewhere to one side of the resistance and the force, in that order (Class II lever); Or it may be somewhere to one side of the force and the resistance, in that order (Class III lever). The most important fact to remember about muscular behavior is that the factor of leverage permits muscles to increase the speed of movement while decreasing the power; to increase the power while decreasing the speed; and to turn a movement into a new direction.

**Attachments:** Each skeletal muscle is attached to bone at two points. One point, the origin, remains fixed, while the other, the insertion, is movable. As a skeletal muscle contracts the part attached to the bone at the origin moves very little or not at all, whereas the part attached to the bone at the insertion draws nearer to the origin. In this way, for example, the temporalis muscle, with a fixed origin, contracts to close the jaw. With certain muscles, either end can serve as the origin or as the insertion, depending on the type of movement,

**Cramps:** Painful, sustained muscular contractions, possibly due to insufficient oxygen for the local blood stream.

**Sprain:** The result of an excessive stretching of the ligaments, tendons, or muscles. Muscle fibres or whole muscles may be ruptured by violent contractions. If such injuries are extensive, surgical repair may be required. In some cases healing may become a prolonged process.

**Stimulus in regard to Contraction:** When an effective stimulus, such as a nerve impulse (produced by an internal or external force - electrical, chemical or thermal) affects a skeletal muscle, one or more fibres contract. As the strength of the stimulus increases, more fibres are activated. (In our case, the established playing formation is affected by the air column. Intent is the stimulus.)

Thus in brass playing we have:

**First:** Resistance without force. That is, the playing, formation prior to release of air.
Second: Intent to play releasing the internal force (air). Muscular resistance (playing formation) enters into a marriage of equal status with force, to be governed by intent. The stimulus, which will increase, decrease or sustain tensions in equal ratio to the resistance controls the mouthpiece weight on the lips, directs and controls jaw behavior, holds the lips in alignment, exercises control over all embouchure muscles, lip aperture, teeth aperture, mouth cavity, soft palate and, in fact, affects and controls all moving parts relative to the production of sound at all levels. Being aware of what does and does not play will make it possible to exercise control over the intent to play.

The chart of the embouchure musculature should be studied and committed to memory.

The jaw

I have stated to my students many times that the jaw is a rudder and resonator and that it is the key to resolving many of the embouchure problems that beset the brass player. Brass instruments demand a free flowing air column to the lips. A loose, floating, uncontrolled jaw can, by coming up and back, into a state of rest position, inhibit the airflow to the lips. This action violates all the rules of brass playing. Excessive jaw movement from the original starting point, whether receding, raising or dropping the jaw, or protruding the bottom teeth edges to the point where the bottom lip (facing) does not make contact with the top lip vibrating area, will create problems that may appear to be insurmountable. The player's only recourse under these conditions is instinctive extreme arm-mouthpiece pressure to overcome the deficiencies in the lip aperture which are the results of a faulty teeth aperture.

The player may well ask, "what is too much?" The answer to this lies in the rules and guidelines concerning apertures that must be learned and understood. Jaw motion must be in direct ratio to increased and decreased compression and vibrations must be faster and slower, shorter and longer. The whole concept of unlimited range lies in the above sentence. Any motion that is excessive brings on a point of departure for a vibration can be just so long or short and remain audible.

Fixed aperture and the jaw as rudder and resonator

The health of a tone depends on many factors, but for the present I want to discuss the jaw as a rudder and resonator. I will try to point out the advantages and disadvantages of jaw motion or the lack of motion. To function properly, the jaw should be brought forward until the bottom teeth edges are parallel to, or slightly forward of the top teeth edges and open approximately 1/4 th inch. This position acts as a basic starting point. The outer red sections of the lips should face each other in playing formation, occupying equal space within the teeth aperture. It is from this position that I will endeavor to explain the maximum and minimum jaw motion that will embrace the full spectrum of sound possible on any brass instrument. These are the elements necessary to attain our objectives.

1. Embouchure muscles must be developed and strong prior to any attempt at playing. (Preparatory exercises 24 take care of the playing muscles.)

2. Mouthpiece must grip the outer skin on both lips (not on the red or dividing line or red and outer skin). Mouthpiece weight should be moderate.
3. Breath support must be controlled and governed by the contracting abdominal wall and rib cage. The abdominal wall, upper and lower, contracts in the direction of your back. It should be firm, steady and smooth whether increasing tension or decreasing tension.

4. Placement of mouthpiece should be made on a gently closed lip formation with teeth edges open. The mouthpiece should be placed a little more than half (55 or 60%) on the bottom lip using the lip: aperture as the dividing line. The lip alignment is gently locked in place by muscle 9 (See Fig. 1), using the natural relaxed position of the corners as the fixed point or fulcrum. Mouthpiece playing weight must be firm, yet light enough to permit air displacement.

5. Lower jaw motion, minimum and maximum, in its role as a rudder controlling the lip aperture against a top lip constantly exposed to air, will at the same time control the minimum and maximum length of the vibrations. All dynamic levels in all registers are subject to control by the lower jaw and bottom teeth edges. (The inner circumference of the mouthpiece rim should be between the bottom teeth edges and the gum line, allowing for jaw motion... up and down, in the natural area of the predetermined jaw position. The bottom lip bears the burden of 55 or 60% of the overall mouthpiece playing weight. This will result in absolute control over all tones). Maximum and minimum jaw motion and its direct relationship to the lip aperture and air column are derived from one law, with variables based on the musical demand and intent of the player. I've given much thought to the explanation of this law and I hope the reader will give equal effort in trying to understand it. Experience has shown me that technical explanations never really suffice. I will, nevertheless attempt to explain the law and its variables and how the player must use and apply these variables to satisfy his intent.

The fixed aperture law states that from a moderate volume starting point increased air and relative muscular resistance into a fixed aperture will result in no ceiling in sound. In ascending, tones will increase in intensity and vibrations will increase in speed. The law demands a predetermined teeth aperture with lips, aligned equally between the teeth edges, occupying one hundred per cent of the space between the top and bottom teeth edges, specifically in the area of the mouthpiece placement. I make mention of this very important point, due to the fact that many players play off center and quite a few play on the side. (Center placement, however, is desirable). If the physical structure forbids a center placement due to extreme irregularities in teeth formation, the player should examine his teeth to discover the two most forward points in the bottom teeth formation, even though one point or tooth may extend beyond the other. The distribution of the mouthpiece weight should be equal (left to right) on these two points. This will establish the angle and direction of the mouthpiece stem and lead pipe relative to the lower jaw position. The most receded point or tooth on the bottom should be parallel to, or slightly forward of, its direct opposite on the top. By acting as a background formation or platform for the mouthpiece playing weight, this will help overcome some of the extreme difficulties encountered when playing with a crossbite. If this is not done, mouthpiece weight will distort the alignment of bottom lip facing and top lip reed by settling into the recession thus causing one part of the facing to be behind the reed and another part to be in front of the reed. The lower jaw position is of paramount importance since it determines the proper alignment of the two lips.
With a fixed teeth and lip aperture (no jaw movement) the main factors are, increased force behind the air column, matching muscular resistance, and contraction in the two lips in the direction of each other (an isometric concept – they "ace tension in the vibrating go nowhere), affecting the surf area of the top lip.

The jaw as rudder

The above stated fixed aperture law will give all tones possible. To control these tones dynamically, aperture control in the form of jaw motion is required. In a predetermined teeth aperture of about 1/4th inch (if lips are thin, a fraction less than 1/4th inch can act as the starting point), with both lips occupying equal space (50-50) a moderate volume tone will emerge. To sustain the tone and decrease the volume to its softest level, the jaw should come up in its natural arc, from the original starting point, one fourth or 25% of the Original opening, and the force behind the air column should be reduced in direct ratio to the jaw closing in going from a moderate to loud tone the jaw should go down one fourth or 25% of the original teeth aperture while the player increases the force behind the air column and, at the same time incorporates increased muscular tension and resistance in the two lips and all the related muscles in the bottom half of the embouchure musculature. (If the sound quit the teeth were opened too fast or too much. Opening of the and muscular resistance must be in direct ratio to each other. Experiment and you will discover this ratio.) The bottom half of the mouthpiece weight should favor the bottom lip.

Jaw motion, whether up or down, should not exceed one fourth or 25% of the original fixed teeth aperture. Total motion is 50% of the original fixed teeth aperture. But never should the jaw move up 50% from the original fixed aperture. Allowable motion is 25% up from the fixed teeth. aperture and 25% down from the fixed teeth aperture, giving the total motion of 50% of the original fixed teeth aperture or starting point.

The bottom lip should hug the bottom teeth edges. The bottom teeth edges should never slide past the bottom lip to a parallel or even alignment. If this happens, sound will cut out. One lip will occupy the space between the teeth. Your bottom teeth edges must control the lip aperture. To do this effectively there must be bottom lip exposed to air. But neither should the bottom lip slide over the teeth and curl into the mouth for this will force the top lip out of alignment. The one-fourth-motion rule allows for the alignment of both lips, keeping them properly exposed to air.

Now if, from a fixed aperture, you Increase air and bring lower jaw up one fourth or 25% of the original starting point in direct ratio, tones will ascend relatively louder. Thus, the teeth aperture for soft middle tones is correct for loud high tones.

The jaw as resonator

The jaw is a resonator, a conductor of sound, picking up the top lip vibrations against the firmer bottom lip facing. These lip vibrations are amplified in the mouth and nasal cavity as they are simultaneously amplified in the instrument. The sound in the mouth, heard by the inner ear, is drowned out by the outer amplification of the instrument. When the mouth chamber decreases as a result of excessive receding of the jaw and raising of the base of the tongue in ascending (intentional or otherwise), the soft palate drops thereby increasing the nasal cavity thus altering the sound relatively. We become
part of the instrument we play by providing the air column, the living tissue as reed and
facing and the nasal cavity, mouth cavity, upper and lower jaw embodied in bone, as
sound chambers. It is common sense that to produce a relative scale we should try to
develop a playing concept consistent with that of instruments with fixed chambers. To do
this requires a minimum jaw motion and tongue articulation from the silent intake - of air
position. (Ah - intake of air, Hah - emission of air.) For example, think of the mouth as a
violin sound chamber. Then imagine a very high tone played on a three-quarter sized
violin and the same tone played on a full sized violin. When playing in the middle area on
a full sized violin and tones start to ascend; it would be foolish to shrink the size of the
chamber by 25%. If the intent is to have a richer sounding upper register, we should, if
anything, try to switch the chamber from a full sized violin to a viola. Of course the violin
chamber is constant. Fixed chambers in all instruments act as the acoustical base for all
moving tones permitting a relative scale. So it must be with us.

When the jaw as a resonator conducting sound or vibrations to the mouth cavity
recedes to its normal underbite position, it radically reduces the chamber and additionally
transfers the mouthpiece weight to the top lip and teeth, thus putting the onus on the
upper jaw, which is directly related to the nasal cavity. The balance of mouth cavity and
nasal cavity has been altered adversely. As the base of the tongue level rises, the soft
palate drops, and the nasal cavity type sound begins to materialize. Mouth chamber
decreases, top lip vibrations are inhibited and sound inhibited, teeth edges eventually
block air column to the lips and the air column begin to back up at the throat. Compression
decreases with the tongue level raised for the upper register, contrary to the belief that the
opposite is true, for the player subconsciously computes the air relative to the resistance
created up front at the mouthpiece placement. The air column, leaving the throat and
encountering a raised tongue, is hissed to the soft palate and the beginning of the hard
palate. This hissing is amplified by the instrument and manifests itself in a fuzzy sound.

To reverse the effects of a loose floating jaw, the player should try to establish a
parallel or slightly forward position of the bottom teeth edges and work with controlled jaw
motion. The benefits of this position are many:
(1) Throat is open.
(2) Base of the tongue is permitted to stay low and articulate from that position.
(3) When the base of the tongue is low, the soft palate raises, increasing the mouth
chamber in both directions.
(4) When the tongue level is low, the air column is free to expand equally in all directions,
which in turn strengthens the embouchure muscles in the cheeks, emanating from the
corners of the two lips, working in sympathy with each other while exercising control
over the lips. (Providing the two lips are exposed to air, corner to corner as fixed
points.)
(5) The two lips have a firm platform to receive the mouthpiece.
(6) A consistent vibrating area is established for all tones.
(7) Nose leakage of air is eliminated when the EEE action of the tongue is avoided.
(8) Relativity of sound is possible in all registers.
(9) Overall increase in range and embouchure strength is noticeable almost immediately.
(10) The contour drape of the embouchure musculature hugging the predetermined jaw
position puts the leverage principles of muscular behavior in our favor, increasing
range and endurance.
(11) Extreme lip flexibility and a healthier sound materialize as the result of a freed top
lip. (Mouthpiece weight a little more than half on the bottom lip.)
By being constant with the mouthpiece weight on the bottom, the facing will always be firmer, within the inner circumference of the mouthpiece rim, than the top lip vibrating area, thereby allowing for air displacement and top lip recoil action.

Lips are permitted to close from the corners to the outer edges of the mouthpiece rim with no overlap of the sides, establishing a playing formation with minimum tension and allowing for air displacement at the weakest point of the two lips (center or slightly off center). The release of air establishes the playing tension and activates the recoil action of the vibrating area of the top lip.

When playing high - think low, so that the proper tongue level and jaw position is maintained. Varying air pressure, varying muscle tensions and varying mouthpiece weight, when combined to affect surface tension in the vibrating area are the main factors in the production of sound. The parallel or beyond teeth position puts these factors into sharp focus.

Advantages inherent in the forward jaw position

The jaw must support the embouchure muscles, which also must receive breath support. The lower jaw and its teeth edges must control the lip aperture and its alignment. In order to do this effectively the jaw must work from at least the parallel position and should not recede. If the lips have not been thinned by pulling the corners back and the natural thickness of the lips has been maintained in setting up the playing formation, the bottom lip will tolerate bottom teeth edges that are a fraction beyond the top teeth edges. This latter position (or the parallel position) will compliment the contour drape of the playing muscles and greatly increase flexibility and playing strength. This jaw position puts all the leverage principles in our favor by aiding in aiming the air up. The principle of aiming the air up conditions and disciplines the proper use of the correct muscles, and eliminates muscles that contribute to lip thinning and separation.

The concept of aiming the air up for all notes or tones must be upheld. It is this formation of the embouchure musculature that will prevent slack or collapse of the surface tension in both lips. Anchor muscle 9 (See Fig. 1), attached to the jaw below the corners and inserted into the corners, will then exercise control over both lips by increasing and decreasing its contracting strength and working in sympathy with muscles 7, 8A and 8B, also inserted into both corners. (Note here that the lips consist of one circular muscle.)

If jaw control is to be maintained, the muscular image of aiming the air up must be constant, even though a moderate volume low note requires a greater displacement of air and a wider or longer vibration at a slower speed. If the same note is to be played louder the recoil action of the top lip vibrating surface must be antagonized or activated into lengthening the vibration by proportionately increasing the air speed, and using the bottom teeth edges to open the lip aperture, thus permitting the extension of the vibration. Tension must increase relative to the displacement of air, in order to avoid lip separation. The increased air or energy force will increase the speed of the vibration, but the more open aperture will make the stroke longer, and it will, consequently, make the same amount of trips as for the soft or softer note.

In playing from loud to soft, the mouthpiece weight must back off relatively. The same rule applies in reverse, from soft to loud. When playing from a soft or moderate volume to a loud volume or high tone, the muscular resistance to the air column increases,
thereby equipping the lips to receive the ever-increasing mouthpiece weight. (This is very much in our favor.) For a soft or moderate volume tone to maximum loud use increased air and a slightly more open lip aperture, (as determined by the bottom teeth edges - Warning: bottom teeth should not slide down past the bottom lip permitting it to overlap into the mouth). For a moderate or soft volume tone to higher and louder use a fixed aperture, increased air and increased muscular resistance with both lips contracting in the direction of each other, relative only to the force (air) increasing the speed of the vibration.

In slurring or tonguing up to high tones the player must try to avoid bringing in the mouthpiece weight or arm pressure too soon or too radically, as this will shorten the stroke of the vibration, even though the speed increases, and the timbre will get thin and anemic. Relativity is based on the vibration traveling the same distance as of the starting point, only going faster and faster and faster. (In spite of ourselves, the stroke or vibration will get shorter, but delay this action as long as you can by not closing the teeth faster than the air increase.)

Using a fixed aperture as a starting point, from any moderate volume middle or low register tone you will be able to ascend to above a triple C, if you don't change the starting setup by any excessive action of the jaw or any muscular contraction contradicting the lip alignment and natural width of the corners (as a Tu-ee action resulting in lip thinning and weakness).

Jaw motion other than up and down

Jaw motion left to right or right to left while playing may introduce high spots and/or emphasize irregularities in teeth formation that may not have been too extreme in the original formation. This motion may occur while playing (especially while changing registers) or may manifest itself as a slight shift of the jaw just prior to release of air. Rasp and fuzz in the sound may be the result. Try, therefore to be aware of and to avoid any such movement.

Tonguing and its relationship to the jaw

I am very much opposed to any strict rule of tonguing to the top or bottom. My attitude is the same regarding the K attack. For a rule to exist there must be a consistency in the elements upon which the rule was built. The tonguing rule must be as consistent (or inconsistent) as the moving part, in this instance the lower jaw. To effectively block the air column to the lips so that the retrogressive action of the tongue leaves the striking point as close to the point of response as is possible, the player should tongue to the most forward point. A receded jaw player should and must tongue to the top teeth) top gum line, or even higher, to the beginning of the hard palate. (However, almost all receded jaw players bring the jaw down and forward for the low tones, yet most of them continue to tongue to the top. This can only result in leaky, split, indistinct attacks. The striking point of the tongue must drop as the jaw lowers and comes forward. If the bottom teeth edges finally protrude beyond the top teeth edges, the striking point of the tip of the tongue must be to the bottom teeth edges.) In double and triple tonguing, the K striking point to the roof of the mouth will adjust relative to the speed of the tongue and the forward striking point.

Players who articulate from a position of parallel open teeth edges and play all registers by bringing the jaw up and down in the predetermined jaw position can tongue
and play all registers with the same striking point of the tongue. The tongue can strike the top teeth edges and slightly touch the bottom teeth edges or strike bottom teeth edges and slightly touch the top teeth edges.

Those who play with the jaw slightly forward must tongue to the bottom teeth edges. (I, in fact, prefer the bottom teeth edges since I play with my bottom teeth edges a fraction beyond the open, parallel teeth edges concept. I find the leverage principles of muscular behavior more to my advantage. It also helps overcome physical deficiencies due to irregularities in my bottom teeth formation.)

At no time should the top of the tongue go through the lips and cause unnecessary lip separation, because arm and mouthpiece pressure will then have to increase radically to offset the beveling apart of the two lips. The rule: Tongue to the most forward point and as close to the point 0." response (vibrating area) as possible. The tongue should not be sluggish. The tongue should move the same rate of speed (striking force) whether the air column is slow or fast or whether playing slow or fast.

Use the syllable DEH for rapid single tonguing, and DET crisp closing off of sound irrespective of the value of the tone. For example, crisp staccato - DET - longer notes D - Eh - T. The above syllable establishes definitely the end of a tone, which then becomes the beginning of the next. It also permits the concept of playing with full value.

Think of tonguing in the following terms:

TONGUE STOP: Most forward teeth edges receive the forward thrust of the tip of the tongue. This seals the teeth aperture and acts as a brake interrupting the air column to the lips.

TONGUE START (The end is the beginning): A retrogressive action or withdrawal of the tongue that releases air to the lips already aligned in playing formation. Thus by tongue-stopping one tone, we are in the correct position to tongue start the next.

The force behind the air column should not be diminished at each tongue stop but should remain constant, as if playing slurred. Thus, the embouchure setup, which is resisting the air column, will not break down or collapse after each note. Motion by the jaw and embouchure muscles, when tonguing, should be the same as when slurring; the absolute minimum.

Further observations on the jaw

I do not advocate a loose and flexible jaw, but rather a firmly established jaw position, with the bottom teeth edges parallel to or slightly beyond the top teeth edges, thereby establishing a firm background for the receipt of the mouthpiece. It is from this position that the jaw moves up and down in its own arc to satisfy the player's needs by controlling the lip aperture.

I do not advocate any pivot action as a basic playing concept.

I do not advocate any pucker, pout, and smile combination, but rather that the corners remain in their natural position retaining the lips normal thickness and that a rolling in of the red of both lips take place before the setting or placement of the mouthpiece.
I do not advocate a minimum to maximum pressure on the top lip, but rather a minimum to maximum on the bottom lip. The jaw should not recede radically at some given point thereby transferring the weight to the top lip.

I am vehemently opposed to the "common ground argument". Of the (EEE) action of the tongue for the upper register combined with the relative jaw action because:

**A:** Raising the tongue to the EEE position raises the floor of the oral cavity and thus cuts the oral cavity approximately in half.

RESULT 1: Vibration is inhibited and muffled in the smaller chamber, leaving a smaller, basic sound to be amplified by the instrument.

RESULT 2: EEE position of tongue prevents cheek muscles from fighting or resisting air column in the mouth cavity because the air column doesn't reach the cheek muscles. Lip tensions therefore become strained.

RESULT 3: EEE position of tongue causes air leakage through nasal passage, reducing needed compression at the lips. (I would say that 100% of the players that articulate EEE leak air through the nose at the peak of their range. Sound waves travel through space. The jaw is a resonator and, as such, amplifies the vibration of the lip in the mouth cavity; but part of the sound is traveling through the nose and cannot take advantage of this function of the jaw. This leakage is usually not discernable to the player or the listener. Cheek it out; see if I'm wrong. Play your highest note and while sustaining it have someone Pinch your nostrils, or do it yourself with your free hand, and notice how the sound changes.)

RESULT 4: Front line resistance to the air column is now in the throat causing a compromise in the abdominal contraction and inducing chest or costal contraction, which is capable of fast breathing, but is not capable of the powerful breath support required by the embouchure. Dizziness and palpitations eventually must materialize.

**Choked Lip Aperture, Incorrect Breathing, Excessive mouthpiece or arm pressure** (equals)  **Dizziness, Heart and Temple palpitations, Blackout**

(If you are breathing correctly, dizziness may occur while inhaling because the body is being oxidized. However, this is not serious for the body will quickly adjust.)

**B:** Setting up to play with a receded jaw, receding the jaw back and up while playing and ascending, tends to partially close the throat. It also acts in sympathy with the arched tongue base. Receded jaw players usually have beautiful fat low tones. The fact is, for low notes they bring the jaw forward, opening the throat, freeing the air column, and increasing or enlarging the mouth cavity. (This action helps them identify a lip alignment and is probably the reason for long low tone warm-ups. Unfortunately, they don't know how to maintain this lip alignment for the entire keyboard of the instrument.)

RESULT 1: Same as before. The sound is affected depending on the starting area.
RESULT 2: In articulating from low - middle, to high, the bottom teeth edges will eventually slide past the bottom lip blocking the air column to the lips bottom lip will touch the top teeth edges, weight of the mouthpiece on the top lip will be way out of proportion to the lip's ability to absorb punishment, surface tension of the vibrating area in the cup will be solely dependent on mouthpiece-arm pressure, and swelling of the lips will occur at the pressure points due to edema, a fugitive condition of short duration. Vascular structures and tissues exchange fluids under normal conditions but this exchange is impeded when outside pressures is extreme. Water or tissue fluid is then excessive-at the focal area.. Result swollen top lip due to an accumulation of fluid. The top lip does not lose its resiliency or ability to vibrate as most authorities contend, but the progressive slipping away of the outside grip of the mouthpiece and the player's relative weakness will result in lip separation and closing of the air column. This, plus his inability to maintain his playing formation and his closed teeth formation blocking air to the lips, will bring on a fuzzy, airy, leaking at the sides, type of sound.

RESULT 3: Swelling of the lips due to distended capillaries. Faulty breathing will markedly increase the body blood pressure and relatively increase blood circulation. Excessive outside mouthpiece pressure impedes circulation causing a back up, (somewhat like the back up of the air column) which may result in miniature ruptures or hemorrhages. Result: more accumulation of fluids.

**Tiring of the embouchure apparatus**

Some years ago, while preoccupied with several problems relating to pupils, I found myself with my jaw in a very closed, clamp-like position. This not only bothered me but also aroused my curiosity. Why should the jaw, apparently instinctively, assume this position? Research revealed that there is, for various parts of the body, a natural state of rest position. Since I was making no conscious effort to keep my mouth open, the jaw assumed this position and closed. The masseter or chewing muscle, which controls the jaw, is probably the strongest muscle in the body, but its strength lies in its ability to contract. Furthermore, we exercise this muscle daily, by chewing, thereby maintaining peak power. This muscle is weakest when distended, that is, when the jaw drops and the mouth is open and we don't, in any normal function, train this muscle for such action. If a brass player, especially a receded jaw player, puts mouthpiece-arm pressure on this untrained muscle, the muscle, no matter how strong, will gradually seek its normal state of rest position. In other words, the jaw, if not trained to stay open, will, over a period of several hours playing, close, and the air column will be blocked by the teeth and will not reach the

Subsequent examinations of problem players, especially those with extremely receded jaws tends to substantiate this conclusion, for they complain that they were strong for only the first hour or two and that then fatigue quickly set in. My conclusion is that these players, when fresh, are able to keep the jaw open but that as fatigue gradually sets in the jaw assumes a more receded, closed position.

This will cause several problems, possibly including pain. When pain occurs in the lips it requires more effort to maintain a fixed grip between the lips, and therefore tiring comes sooner. Pain is nature's demand for either rest or corrective measures.

But, before we look at the problems let us first, very briefly, examine the player's setup when he is fresh. At this puncture the jaw is distended in such manner as to
produce a teeth aperture, which will allow both lips to receive air. Further these lips are touching. To be more specific the bottom is touching the top lip and, at this point, the top lip is vibrating. The position of the bottom lip determines which part of the top lip vibrates for it will vibrate wherever the bottom lip creates a facing or base.

As fatigue develops in the masseter muscle the jaw will probably become more receded (depending on the initial position) and certainly more closed. When the jaw recedes several changes take place. First the bottom lip goes back with the jaw, that is it changes position and therefore causes a different section of the upper lip to vibrate (this constant variation of vibrating area will, of course, greatly affect your accuracy); second, the mouthpiece-arm pressure will shift more to the top lip, which, because it is the vibrator, is less able to absorb such punishment; and third, a lip separation will take place necessitating the use of even greater arm pressure. When the jaw closes the player will be forced to thin the lips by sneering, smiling, "tu-eeing" or otherwise pulling the top lip out, in order to properly align the lips within the insufficient teeth aperture. There will be a tendency also to lose mouthpiece grip on the bottom lip to aid this fine alignment. Then at some point the jaw will close enough to prevent the air from reaching the lips and the player will experience total cheek collapse and a complete back up of the air column. So, these two actions (jaw receding and jaw closing), together result ultimately in very excessive arm pressure on thin, weak lips and finally in extreme fatigue. Please note that merely lessening the arm pressure will do no good because under this faulty setup great arm pressure is required to keep the lips touching.

Let us now see what can be done to avoid these problems. First you must be certain that your Initial setup is correct. The teeth should be open (approximately 1/4th inch) so that air can reach the lips, which are aligned within the teeth aperture, are inverted, and are touching, gently but firmly. The sides of the lips, that is the lips outside the mouthpiece rim, should be closed gently but firmly.

Second, when you make the mouthpiece placement be certain that there is a slight or minimum tension in the lips. (Actually this means putting tension in the circular muscle of the lips. Since this is one muscle, it is impossible to put tension in one lip without tension materializing in the other. Since the muscles inserted into the bottom lip are thicker and stronger than any comparable muscles in the top lip, they create a better cushion and form a much stronger area for overall mouthpiece pressure. So put 55-60% of mouthpiece weight on the bottom lip. Placement should be made on the outer skin of both lips. Do not pin the lips with the mouthpiece while the lips are collapsed for this will immobilize the centers of the two lips and prevent them from coming together in response to air and they will have to be crushed together to play. In addition, mouthpiece pressure on soft, collapsed lips, even if placement is on the outer skin, will tend to cause the player to incorporate the radiating muscles emanating from the fixed corners and the lips, consequently, will be unable to acquire a proper playing formation. If the lips are soft or collapsed when the placement is made the player will, out of necessity, be forced to excessively open his teeth, so that air may flow. To offset this separation, the player will instinctively use more arm pressure. The lips, if properly exposed to air and allowed to resist the column of air within the framework of a decent teeth opening, will develop a buffer zone. Not a pucker, not a pushing forward of the center of the lips, but a drape-like position hugging the front teeth.

Third, don't weaken the lips by pulling the corners back or thinning them but leave them in the natural, normal width of the mouth. Do not use all of the facial muscles to pull or contract in every direction. This action contradicts the intent of the player, that of
keeping the lips in a closed playing formation while allowing for displacement of air. I must constantly stress the value of not contradicting our objectives or intent by using muscles that pull the lips apart or raise the corners taking the lips out of their fixed corner alignment position. (If, for example, you were to chew an ear of corn or bite an apple without separating your lips, you would rip them to shreds. This sounds foolish, yet countless brass players, just as foolishly, before the placement of the mouthpiece, sneer, thus creating a deficiency of the top lip or of both lips, forcing a lip aperture that is too wide and which must be offset by excessive arm pressure. This excessive arm pressure will cause a choking condition in which the player will be unable to get air past his lips.) The use of contradictory muscles is one of the most prevalent fundamental problems that I have found among brass players.

Thus, with minimum tension and the sides closed you will play with a fixed formation, the player must now consciously and constantly keep a grip between the lips and the mouthpiece.

Fourth, in playing a wind instrument, what I call the two-aperture concept must be upheld. That is, the teeth aperture must be rather large (approximately 1/4t b inch), while the lip aperture is paper-thin. Therefore it is necessary to keep the teeth edges apart and jaw open. This must become a conscious act since the muscles, which are trying to keep the mouth open, are weaker than those involuntarily trying to close it. We have the former fighting a losing battle and the result is fatigue - more and more fatigue. You may call this normal tiring of the embouchure, but I have found that by training these weaker muscles to bear forward in order to resist both the playing weight of the instrument and the basic necessary arm pressure a player can survive round-the-clock playing from the embouchure standpoint. His only problems are body fatigue, and a diminishing mental alertness requiring sleep.

We strengthen the masseter muscles by doing exercises predetermining the forward jaw Position with the teeth open at least a quarter of an inch and the lips aligned using the fixed corners as the basis for the alignment. Then, by placing the lip aperture between the teeth aperture and blowing from the abdominal cavity as hard as possible, we train the muscular apparatus to resist and drape around the scaffolding or the bone structure of the face; The jaw is now the agent for controlling the range and flexibility and receives the brunt of the playing weight.

Problems of the embouchure in the receded jaw player

In dealing with the problems of the embouchure, I find that they are many and varied. It has been my experience that they differ from player to player and from time to time with the same player. I attribute the latter to the player’s inability to identify his problem. The player does not uphold the physical laws involved a situation that may be caused by physical deficiencies that he is not aware of and that contribute to his problem. I find that most problems are traceable to physical defects in the embouchure apparatus and that sometimes these problems manifest themselves in varying degrees of mental stress, making it more difficult to concentrate and to pinpoint the source of the trouble. If the player understands how to overcome a physical deficiency or how to take advantage of a physical deficiency, this mental stress and anxiety need not exist. Certain principles, if upheld, work whether there’s a deficiency or not, but they have to be understood. Physical handicaps cannot be overcome solely by practice. The handicap must be overcome by adjusting the natural formation to conform to the required formation that has been
established in physical law as the basis for playing the full range of the instrument. Physical handicaps can and are being overcome every day in my studio. This requires discipline and perseverance.

I can sympathize with players who have such physical handicaps, but how about players who have none? What is their excuse? For they have similar problems. If you have embouchure troubles with no physical defects, what can a player with a deficiency hope for? The point is a common starting place must be established. Our starting place is a scientific principle based in physical law. The various elements of the embouchure apparatus must be made to conform to this principle in order to bring about the desired results. At the same time, management of this apparatus must be adapted to counteract marked abnormality or deficiency in the muscular apparatus of the embouchure. In human beings there is a law of limitation but, in principle, the results are unlimited. World records are broken every day in all walks of life. Why shouldn't the same apply to brass playing?

It is not my intention to try to convert every player into a forward jaw position player, for it is only from the practical point of view that the forward jaw position is recommended. Since the jaw is the only moving part of the face, it is, therefore, a much more controllable background setting upon which the mouthpiece may be placed. Also the bottom lip is a better recipient of arm pressure because of its muscular structure, and because it is not the vibrating surface. In addition, the forward jaw causes the air to be blown in an upward direction, which I consider preferable. There are those, however, who, because of their physical structure cannot bring the jaw forward. My purpose here is to try to help the player who has deficiency in his setup realizes where his difficulty in functioning under the receded jaw concept lies.

Therefore, I would like to direct my remarks to those receded jaw players who may not have the desire to change their present way of playing, or those players who have the inability to bring the jaw forward due to some physical deficiency. By this I mean the inability to make the bottom teeth bypass the top teeth, or at least, come to a position parallel to, or even with the -natural overshoot of the top teeth. Certain principles work, irrespective of the jaw position, but it is most important that the receded jaw player recognize and uphold the physical laws even though the jaw be receded. The player shouldn't feel that he must change his playing image and mouthpiece placement, but knowing what to do for specific problems will in effect act as a transition from old to new regardless of your present setup.

The physical law may be stated this way. To produce a continuum of sound encompassing the entire range of a brass instrument: (1) the lips must at all times be in a position to permit vibration; (2) the lips must at no time be prevented from changing tension. This means: (1) the lips at all must be exposed to air, that, at all times the top lip must be below the top teeth edges and the bottom lip above the bottom teeth edges and that at no time may the teeth be closed; (2) that lips must be touching at all times but excessive arm pressure may not close the lips tightly to the point of air backup; (3) that mouthpiece pressure must not be brought to bear on collapsed lip muscles thereby preventing these muscles from contracting. The adjustments sound simple and, indeed, are simple. But please remember that you are correcting habits that have been developed, consciously or unconsciously, over a period of years. Patience and awareness are primary requirements.

You must uphold the following:
Do not make mouthpiece placement while the lips are collapsed or open, but instead have the two lips touching, gently but firmly, from corner to corner with a minimum tension. Mouthpiece placement may now be made. Open your teeth at least a quarter of an inch to permit a lip alignment. You can now establish your fixed corners between the teeth edges. Keep your grip between the lips and the mouthpiece. Upon the release of the air column you will go from playing formation to playing tension. Arm pressure should be at a minimum at this point. The mouthpiece acts as a washer preventing the air from escaping. At the same time, the distribution of weight should be favoring the bottom lip, that is the distribution of mouthpiece weight 55% or 60% on the bottom and about 40% or 45% on the top. Try to slur, from any given note, as high as possible In the harmonic series. Do not close your teeth as you climb but add air, increase the compression, and match the compression with the muscular resistance that is so vital. Continue contracting muscularly as you increase the compression. Under no circumstances should you close your teeth at the early part of the slur or climb. If the sound cuts out during the climb, the teeth were opened too much causing a separation of the vibrating surface from the facing as the lips contracted. Reset the teeth aperture to a slightly less open position. You should still feel both lips between the teeth edges by checking with the tip of the tongue. Then make another attempt to slur. Again do not close the teeth but make a relative muscular lip contraction by resisting the air proportionately as you gradate the air column. If you now find difficulty in slurring, check the jaw position again. You may be receding the jaw further and going into your normal underbite. As a result, the bottom lip, traveling with the jaw, may be separating from the top lip, which does the vibrating. You must become acutely aware of both the jaw position and the teeth aperture. Again, the teeth should not close a fraction for each interval you slur but, rather, should retain a fixed opening. Increase the air, resist it and force a muscular contraction, thus eliminating the necessity of closing the teeth on a graduated scale. If you retain the lip margin in the bottom lip, you will have complete control of your climb and will be able to play with no ceiling even though receded. One of the main faults of the receded jaw player is permitting the bottom teeth to go back and up into their normal receded bite prematurely, forcing the bottom lip to touch the top teeth. (At the same time the mouthpiece may be riding up pushing the top lip up above the top teeth, thus causing a positive lip separation.) The player with the receded jaw must know that if the teeth close, the bottom lip will touch the top teeth and sound will not materialize.

Recognition and correction of certain embouchure Deficiencies
(Especially regarding receded jaw players)

(1) If you feel a back up of air together with the inability to resist the air with your cheeks, check the following: first determine either if arm pressure is excessive, or if the teeth are closed, thus blocking the air column to the lips. Closed teeth may also cause the bottom lip to touch the top teeth. Closed teeth plus excessive arm pressure will result in no air going past the lips, therefore a back up and a total cheek collapse. You must be aware enough to realize no air is going past your lips. The most common fundamental error in this regard, is that the playing formation is not simulated prior to the release of air and therefore arm-mouth-piece pressure is being applied on soft collapsed lips, closing the aperture to the point of back up. However, if you merely open your teeth more or recede your jaw more, to permit a displacement of air, lips will still be too soft, arm pressure will become the gauge for the changing of lip tension and notes will only play up to a certain point, after which the lips, which are contracting and thinning, will separate. Remember, the principle is the same whether blowing air up (upstream) or down (downstream) for the lip alignment and the teeth position determine the correctness of the principle.
If air is going past the lips, but no sound materializes, either the lips have been pinned too far apart at the mouthpiece placement or you have receded the jaw to the point where the bottom lip no longer has contact with the top lip, which is the vibrating surface. The top lip will not play if it is separated from the bottom lip by even the thinness of a hair or a piece of paper. Any separation, even so slight, must be compensated for with arm pressure, but this is only effective in the lower register where the lips are soft. For as you proportionately tighten the cheek muscles and corners, to which the cheek muscles are attached, you will be thinning the lips in the mouthpiece cup, thereby causing a separation. A “tu-ee” action, a raising of the corners (as a smile) or any other thinning will also cause separation. In any event, the player must discover the cause. The recommended corrective procedure is this. Bring the jaw slightly forward to allow the bottom lip to make contact with the top. There must be a conscious awareness of this contact. If this doesn't help, then you must check your outer grip. Reset your playing formation by having the lips touching gently all across the board from corner to corner only placing a little more outer skin from the top lip and a little more from the bottom lip in the mouthpiece. (Your lips may be slightly more curved in now than previously.) Work with a minimum arm pressure on the lips and proceed to blow air gently past the lips. Resist the air and response should be immediate. Try to climb. If you don't contradict or violate the physical law, the sounds, could continue until you can no longer contract which would take you extremely high with a feeling of strength and control. Muscular resistance to air becomes identified as a feeling of control.

To develop flexibility, the receded jaw player must experiment with and develop the fixed teeth aperture concept. Don't close the teeth, but keep the grip between the lips, resist the air, change the air radically and resist just as radically. The lip behavior will be relative to the air increase demonstrating the possibility of tremendous lip flexibility which, when controlled, can be incorporated in your playing needs. It is recommended that you practice resisting air without your instrument. Simulate your playing formation, expose your lips to air, emit the air abdominally and resist the most powerful compression you are capable of producing. This will prove invaluable when incorporating these same muscles in your playing. When playing, the feeling of resisting air will be familiar, thereby helping enable you to continue the muscular contraction as you increase the compression without closing off the teeth or receding to the point where the lips separate.

In observing many receded jaw players, I have found that most descend from the middle and upper register to the low register in a similar manner. As they descend, they erupt the bottom lip outward introducing the inner membrane. This is necessary because as the jaw drops and recedes the lip separates and this lip separation must be offset. So, as the teeth go down and back, the player introduces more lip upward. Since arm pressure is noticeably reduced in the middle and lower area, the top lip reverts back to its natural thickness and the player will protrude the upper center of his top lip. Therefore the bottom lip inner membrane acts as a facing against the upper lip inner membrane, which is the vibrating surface. Since the inner membrane is extremely sensitive, the note sounds good, and the player is deceived into thinking this is correct. However, he finds he cannot invert his lips or bring them back into his original playing formation in his attempt to climb. He cannot play from low to high on this embouchure or retain the playing formation he originally started with. I intend, therefore, to establish the proper procedure for the player with the receded jaw and point out that there are but two correct ways to descend. The player will find that he is able to produce those variations in shading, volume and timbre required of him by using either one or both of these ways.
If the player is playing in the middle register and intends to descend and the requirement is that the notes be relatively soft, the practical and logical way to descend would be to proportionately reduce the arm pressure while not receding the jaw thus permitting sensitivity to materialize in the top lip. (This backing off process is very, very subtle. The player should not back off violently to the point of practically disengaging the mouthpiece grip from the lips. This would cause the lips to chase the air column in the mouthpiece or would allow leakage of air or if overdone sufficiently would cause lip separation.) The player must retain his playing formation and permit sensitivity to materialize in the playing surface of the top lip, the vibrating area, by slightly reducing the arm pressure. If the player then wants to play at a greater volume in this same area, he should increase the air column and in relationship to the increased air column, increase the tension inward below the corners of his lips and relatively open the teeth aperture in its natural arc. The player should not radically open the teeth as this will definitely separate the lips and cause sound to cut out. With practice the player can master this technique in a comparatively short time.

If the requirements are that he produce a consecutively louder sounding series of notes, in descending, the player must add air, increase the tension below the corners of the lips and proportionately open the aperture. This increased tension will prevent the lips from either separating and/or chasing the air column. The very fact that the aperture is being opened relative to the increased air will cause the lip, out of necessity, to vibrate wider. This is descending, to the low notes with value. Remember, it is incumbent upon you, the player, to keep the lips touching. The greater the displacement of air, the less the muscles are inclined to work. (It's like blowing air through a wide open door.) The lip must make a consistent effort to keep touching and at the same time permit a greater displacement of air.

By upholding the principles I have mentioned, the receded jaw player can build his range, endurance and flexibility, and improve the timbre and brilliance of his sound enormously.
Mouthpiece placement and weight distribution

In the small mouthpiece brass instrument family (trumpet, cornet, French horn, etc.), the placement should be a little more than half (about 60 - 65%) below a gently closed lip aperture. This permits the bottom lip facing to extend, left to right, beyond the top lip vibrating area and insures a complete seal of facing and reed. In the larger mouthpiece family, (trombone, tube, etc.), the placement of the mouthpiece should be closer to 50 or 55% on the bottom. The larger mouthpiece encompasses more outer skin area, thus introducing a larger vibrating area. At no time, under any conditions, should the bottom lip (facing) be shorter in length than the top lip (reed) within the confines of the mouthpiece cup or chamber. To correctly identify the mouthpiece placement and distribution, the jaw and lips must simulate a playing formation. The closed lip aperture will act as a fixed reference point to help determine the proper placement of the mouthpiece.

The player can then concentrate on the contact pressure of the mouthpiece or overall arm pressure, which is the playing weight. The weight should be light yet firm. The bottom lip should receive approximately 60% of the mouthpiece weight. This will enable the player to use the edge of the bottom teeth to exert pressure upon the inner red mucous membrane facing, the teeth and gums and thus become the controlling agent for the lip aperture. This is achieved by bringing the jaw forward to an even (parallel) or slightly forward bite of the lower teeth while maintaining an aperture of approximately 1/4th inch. Lips can now be gently inverted so that the red of both lips face and touch each other from corner to corner, evenly spaced between the teeth edges. Mouthpiece should be placed on outer skin at all times. If lips are thick they should be rolled inward to permit placement. The red mucous membrane, closest to the outer skin, of the top lip should face the same membrane section of the lower lip.

Procedure for evaluating mouthpiece placement

Do not trust your feel or image, use a mirror.

The first step in evaluating a mouthpiece placement, either your own or that of a pupil, is to determine whether it is possible to place the bottom teeth edges parallel to and touching the top teeth edges. It is from this position that teeth irregularities may be discovered: a missing tooth, a badly receded tooth, a tooth with an extreme high spot, a tooth pointing away from the other teeth and standing off by itself, rotated or sharp teeth or a crossbite. Now see if there is room to move the jaw beyond the top teeth edges so that there is a forward clearance of the top teeth by the most receded bottom tooth. Since the top teeth are in a fixed position, being one of the immovable parts of the face, the only practical step is to take the most flexible part of the face, the jaw, and adjust it, in order to overcome teeth deficiencies.

Teeth should now be opened approximately 1/4th inch, and lips should be lined up equally within this teeth aperture, touching gently from corner to corner. The soft inner mucous membrane inside the mouth or the second layer of red should be kept rolled in, not played on. The outer red, the first layer, should be the vibrating area and act as a wall of resistance to the second layer which may blow out or blow apart if the player does not properly maintain his playing formation grip. If the top lip, outer layer, red receives a full
compliment of the bottom lip facing, and thereby, vibrates rim to rim, the sound must and will be healthy, provided the teeth aperture does not block the air column to both lips. You can experiment with both lips this way without the instrument. Place the lips in their playing formation. See to it that they are properly lined up between the teeth edges and blow air hard and resist the air hard. Take your forefinger and slowly push the top lip up until it is parallel to the top edge of teeth. Notice the tremendous weakness that emerges. Notice the uselessness of working the cheek muscles and the corners and all the other muscles radiating from the lip. It’s like total collapse.

Educate the tongue to feel if both lips are exposed on both sides. They should be equally exposed to air. The teeth should be open approximately 1/4th inch with 1/8th inch of top lip and 1/8th inch of bottom lip exposed to air. (These figures are only approximations and are not to be adhered to dogmatically.) Place the tip of your tongue between the teeth edges and gently touch the two lips, thus identifying this position. Do not push the tongue through the two lips beveling them apart as this will set up a very wide margin lip separation, which will have to be offset by unnecessary arm pressure to bring in the very first note. If, with the instrument, the player maintains his playing formation prior to the release of air with both lips touching from corner to corner, and with the mouthpiece pressure at a minimum, (just enough to prevent leakage of air), then, upon the release of the air, sound should materialize immediately. Remember, the mouthpiece acts as a washer or sealer and the lip does not require great arm pressure to bring in the first sound under this set of conditions.

If the lips receive air from corner to corner they will be able to maintain the grip between themselves and an unbelievable strength will materialize. The lip will sense the ability to climb, resist, play a long tone, or receive radical changes in compression. The lip will behave and react relative to differences in air pressure.

Mouthpiece weight should favor the bottom slightly (about 10%) not excessively and should be brought against the two most forward points on the bottom. Experience shows that the lips can absorb an uneven layer of teeth provided the distribution of weight is balanced, but that you can’t exert mouthpiece pressure on any one high spot and have no support elsewhere. The lip, sustaining mouthpiece pressure at any given high spot, will eventually cut, bleed or rupture. But if a high spot in either layer of teeth is equalized with pressure on a lower spot in the same layer this problem will be overcome.

We have now created a situation where the inner rim of the mouthpiece has isolated the vibrating area in the cup from the rest of the top lip and has set up a firm base on the bottom lip, making a perfect seal within the rim of the mouthpiece. Air may now push its way past the lips while the top lip remains free to bear down as the bottom bears up. (Both lips go nowhere, however, as this is an isometric concept).

I would like to list the elements and factors that we now have in our favor for the production of sound: (1) we have definitely established a playing formation with a minimum tension; (2) we have established two apertures, one of the teeth, one of the lips between the teeth edges; (3) we have sealed the sides of the lip from the corners to the center; (4) we have a mouthpiece placement putting the bulk of the playing weight on the bottom lip, leaving the top lip free to vibrate, yet hold its playing formation; (5) the lip is in a position to receive air and establish a playing tension. The ratio now is close to being worked out. If sound doesn’t come, there is too much tension in the lips and not enough air pressure is being produced, or vice versa, too much air and not enough tension.
Only the air is the agent for determining the contraction. The contraction is not arbitrary on the part of the player. He must use air as the barometer for his muscular resistance. This will give us the equal ratio that we are seeking. In order to have healthy even sound, breath and lip tension must have an equal ratio and these two elements must be completely under the conscious control of the player. The ability to hold lip tension with matching air pressure must be found.

To find this ratio I prefer blowing easy, not going for volume or good notes. Use an easy steady air column and allow a muscular adjustment to take place. Simulate a playing formation and depend on the air to adjust the lip to its proper inverted position. Your first sound will be a clue. Then, from this sound try to slur progressively higher in the harmonic series in a relative manner, using air increase with matching muscular tension. A minimum of arm pressure or mouthpiece pressure on the two lips is all that is necessary. Remember, the mouthpiece serves two purposes; it isolates the vibrating area of the top lip from the rest of the lip, and it acts as a washer or a seal to prevent the escape of air.

Mouthpiece weight should never become the gauge for the change in lip tension. Therefore, even for the very first note air should be the determining factor in discovering proper lip tension and inversion. Once the mouthpiece is pressed through the lips it is physically impossible to adjust the grip of the lip. Once arm pressure has become the barometer for changing surface tension in the vibrating area of the top lip, arm pressure will remain the barometer for the rest of the climb. As a result of excessive arm pressure a ceiling in sound will materialize. If, on the other hand, the starting note is played with a minimum of arm pressure the air and muscular resistance will create the initial surface tension. Change in the lip tension through increase in air pressure and proportionate muscular contraction will cause the vibration to get narrower. The fixed aperture (fixed teeth aperture) law may now be upheld by filling the fixed aperture, gradually and evenly, with more and more air. We have the ability to climb with no ceiling. Experimentation must take place within the framework of these rules and procedures in order to discover your point of response. The more experimenting you do, the more lip knowledge you acquire.

**Mouthpieces**

A good mouthpiece should be an aid to the lips in maintaining their formation, yet should not cause the air column to choke or back up. Such aid comes in the form of a pocket of resistance to the air column. A balanced mouthpiece is one, which offers the proper resistance and allows proper air displacement.

A well-built mouthpiece should give you immediate results without the slightest injury to your embouchure. If you are playing correctly, a good mouthpiece will improve your playing. If you have a good instrument and are playing correctly, but still not getting satisfactory results, you should change your mouthpiece. Progress consists in discarding a good thing as soon as you have found a better one.

If your lips are not working properly mouthpiece evaluation is most difficult. Any lip thinning process, while playing, tends to weaken the lips thus making any mouthpiece ineffective. Be honest with yourself. Do not blame the mouthpiece when your embouchure is at fault.

The rim should seal off the vibrating area of the lip at a point close to the cup edge thereby requiring minimum arm-mouthpiece pressure to isolate the reed (top lip) and
facing (bottom lip) within the cup. The highest point on the rim, therefore, should be to the inside of the rim. A medium wide rim distributes the weight over a greater area thereby reducing the chances of damage to the lips.

Variations in the cup depth affect the tone and intonation more than variations in the rim, throat and backbore. For overall playing it is advisable to use a mouthpiece with a medium deep cup. In evaluating cup depth, keep in mind that if the lips touch the bottom of the mouthpiece cup, it does not necessarily follow that the cup is too shallow. The lips may not be inverted properly. If they fail to resist the air column properly by tucking in (that is, if they "chase" the air column), the sound is being kept alive by mouthpiece-arm pressure. If the cup is too small, your tone will be of nasal quality and your instrument will not respond evenly. Should the cup be too large, it will exhaust you physically and make it impossible for you to do your best work, even if you have a powerful lip.

If the throat is too large or too short, pitch and timbre will become difficult to maintain and endurance will be affected. If the throat is too small or too long, the air column will be choked and the timbre will sound choked.

The backbore must be relative to the rest of the mouthpiece, especially the cup. Thus a large cup mouthpiece cannot offer proper resistance if combined with a wide-open backbore.

The mouthpiece stem should fit the mouthpiece receiver firmly.
Breathing

The respiratory system - external and internal

External Respiration

All organisms exchange gases with their environment. Even the single celled amoebae contain oxygen as well as nutrients and discharges carbon dioxide through its cell membranes. To obtain oxygen and discharge waste products, higher organisms require a special respiratory apparatus. In humans this consists of the mouth and nasal chambers, the pharynx or upper throat, the larynx which contains the vocal cords and the trachea or windpipe which divides into the right and left bronchi and the lungs. The mouth or buccal cavity consists of a vestibule formed by the lips, cheeks, gums and teeth, and an oral cavity behind the gums and teeth. The hard and soft palates form the roof of this cavity, the tongue and its related muscles form the floor and the cheeks form the lateral walls. The hard palate is a bony structure forming a partition between the nasal and oral cavities. The soft palate is a fold of mucous membrane extending backward from the hard palate, its edge hanging downward into the pharynx and bearing a soft projection, the uvula. The soft palate moves upward to close the connection between the nasal and oral cavities during swallowing and speaking. The tongue consists of muscular tissue covered with mucous membrane. On its surface are thread-like elevations, some of which contain important taste buds. The root of the tongue is attached to the floor of the mouth at the mid-line of the under surface by means of a fold, the frenulum linguæ. (Tongue-tied speech may be caused by a frenulum linguæ that is too short.) Functions of the tongue are to move food around in the mouth, begin the swallowing action, aid in speech production and provide equipment for taste sensations. The lungs) primary organs of respiration, are cone shaped, spongy, elastic sacs, which fill a substantial portion of the chest cavity. The pleura, a double layered serous membrane, covers the lungs, chest wall and the diaphragm. A serum lubricates the two pleural layers so that the lungs move without friction during respiration.

The human body takes in oxygen and discharges carbon dioxide by means of breathing or external respiration, a process consisting of inspiration to take air into the lungs and expiration to expel air from the lungs. Inspired air passes through the respiratory apparatus and into the air sacs of the lungs, where, by diffusion, the red blood cells, crossing through the lungs, absorb oxygen from the air and discharge carbon dioxide into it. The expired carbon dioxide then returns via the same passageways to the outside.

However, air is not drawn into the lungs by the mere force of inspiration alone. In addition, a rather complex muscular mechanism causes the chest cavity or thorax to expand, thereby decreasing air pressure within the lungs. Specifically, the diaphragm, a great dome-shaped muscle separating the chest from the abdominal cavity, contracts; the intercostal muscles, which fill the spaces between the ribs, contract; simultaneously, the sternum, that is, the top part of the chest or breastbone, and the ribs are raised. These actions produce a sizeable enlargement of the chest cavity and air now flows to those areas (i.e., the lungs) where pressure is below atmospheric level.

In expiration, the diaphragm and the other muscles relax so that, as the chest wall returns to its original position, the pressure increases and the thorax expels the air. Thus as the diaphragm moves up, it pushes air out of the lungs and as it moves down it draws
air into the lungs, somewhat like a syringe. Expiration may be further aided by a number of muscles (i.e., neck, shoulder girdle, back and abdominal wall) which act to increase the pressure and magnify the effect. (It is interesting to note that since the passage of air over the vocal cords causes them to vibrate and thus produce sounds, for which the nasal cavities provide resonance chambers, the function of speech is closely associated with that of respiration.)

**Internal Respiration**

Oxygen cannot be stored in the body but must constantly be replenished through the mechanism of blood circulation. Within the body cells, the circulating blood gives off oxygen to the tissues and takes carbon dioxide from them. The oxygen in the tissue cells combines with other substances, which are repeatedly broken down into simpler oxygen-absorbing elements, until only carbon dioxide and water remain in the tissues. This chemical change, oxidation, releases energy to the tissues for use in bodily activities. The exchange of gases between the blood and body cells is called internal or cellular respiration. Some tissues, such as the muscles and glands, which use up a great deal of energy, especially in strenuous activities, discharge more carbon dioxide and require large quantities of oxygen.

I want to make known that the preceding statements do not reflect my personal opinion, but facts as made known by the medical profession, thoroughly verified and substantiated.

**Breathing for the brass player**

The natural recoil actions of the breathing muscles sustain our daily living while participating in various activities. They will function according to the body’s need for oxygen. The athlete participating in strenuous activities will burn the oxygen in the energy cells much faster than during normal or lesser activity. The breathing muscles will quicken or reduce their pace accordingly. This is known as normal breathing and is completely involuntary. Oxygen, being the main source of muscle energy in the animal world, is replaced as quickly as it is burned indicating how well equipped the body is in its breathing mechanism.

My purpose is to give the player a firm basic image of what parts of the body are concerned with good breathing, so that he will know what he is trying to put under the control of his will. There are two natural ways of breathing and man does a little of both under normal routine activity. The abdominal way is the strongest, capable of a great powerful compression.

In order to develop strength, flexibility and a sensitive control, the embouchure muscles must be supported by a constant controlled air column that is, at the same time, free flowing. In other words, air should flow freely through an open throat making the oral cavity a pressure chamber with one point of emission, the center of two lips. The cheeks, which act as the lateral walls of the oral cavity and contain the radiating muscles attached or inserted into the corners of the two lips, resist the pocket of air in the mouth and exercise control over the two lips. If the compression is increased the resistance is increased. The matching of air and tension is brought about by the player’s determination to keep the cheeks from bulging due to air pockets. If the front teeth
are open, the back teeth are open making the cheek muscles vulnerable to collapse. If the player permits the cheek muscles to blow out or collapse the two lips will lose their ability to resist the air column. Hence they will separate and start to chase or go with the air column. Since the lips must touch to play, necessity forces the player to overcome the separation by a radical increase of mouthpiece-arm pressure. This action aggravates an already bad situation by causing a back up or air at the point of emission (the two lips) resulting in total collapse of all the embouchure muscles. There isn't a player in the world that can resist his own capacity to produce abdominal compression at its maximum, if the teeth are closed, blocking air to lips already thinned, weakened, partially separated and choked up by excessive arm pressure.

All players can develop, strengthen and train the embouchure muscles to resist, to their maximum capacity, a forced emission of air, providing the teeth edges are open and parallel, the lips are evenly spaced between teeth opening, the mouthpiece pressure is firm but on the light side, and the distribution of mouthpiece weight is a little more than half or 60% on the bottom and balanced equally, 50% left to right. As long as air is displaced as it is introduced, collapse of the embouchure muscles is impossible. The marriage of air and tension can now be made. The strength can only build relative to compression already existing in the oral cavity.

We take the position that the player doesn't take air in with the purpose of playing a phrase, but in order to replenish the body needs. If the body needs or requirements are not met first, the playing needs cannot be met. Remember, muscle tissue, burns up more oxygen, especially when under duress, by being highly activated and is therefore more subject to fatigue. By keeping the body properly supplied with oxygen, we offset some of this fatigue. I firmly believe in this one rule; the player should make breathing a conscious act and should take a breath whenever it is possible in the course of his playing. Don't wait until you run out of air.

The breath must be silent. Intake of air should be accomplished with an open throat. This greatly increases intake capacity and decreases time needed for breathing. Do not expand the chest cage, or the rib cage, but instead expand the abdominal wall outward while the chest cavity is being enlarged by the naturally contracting diaphragm muscle. The internal organs are going down and outward. Once the act of inspiration has been completed, the muscles of the abdomen should be braced or set. The degree of brace should be in proportion to the playing needs. We are now in a position to create internal compression with the use of the inner intercostal muscles. Since we are contracting all forces necessary to produce internal compression, the degree of compression will be determined by the actual tension we can institute in the abdominal wall.

In bringing the air upward, contract the abdominal wall in the direction of your back. The diaphragm muscle will slowly return to its normal state of rest position. Don't contract the abdominal wall too fast. It must be relative to the air output. Maintain your compression, but contract slowly. This creates the ability to play longer passages and still have the power to climb, if necessary. Don't push out- ward toward the belt buckle during exhalation. This is dangerous. Remember, you contract in the direction of your back and bring the air up in a direct column to the lips.

Be sure a bracing or hardening of the abdominal muscles takes place before contracting these muscles, thus creating the necessary inner compression needed to start playing and, also, avoiding the possibility of internal injury. Remember, prior to playing,
you are holding the air, which is below atmospheric pressure in the lungs with the breathing muscles. When you brace the abdominal wall as you maintain the internal pressure, you create the pressure necessary to exceed atmospheric pressure and, thereby, set the air column in motion. As you emit the air by contracting the abdominal wall inward and upward, the diaphragm muscle will gradually and slowly continue its upward movement and return to its dome-like position. This must be consistently maintained for even, smooth quality of timbre.

The tongue should rest low in the mouth at its base and should not be raised thus cutting the oral cavity in half. Keep the tongue low and away from the soft palate. This keeps the throat open and results in a silent emission of air.

For some reason after inhalation there seems to be a tendency in most players to shut off or control the breath at the throat. This action should never, and I mean never, take place. The control of the air column must be given to and kept by the powerful breathing muscles. This rule applies when air is at the peak of inhalation. Air is held in by the breathing muscles and emitted by a slow controlled contraction of the breathing muscles. The throat is not the valve that releases the air column.

**Procedure for breathing**

A. Front part of chest is up but not expanded.

B. Shoulders are down, relaxed and back.

C. When the chest is comfortably up, without expansion, the abdomen lengthens in a vertical direction and draws in, causing an upside down V shaped groove at the bottom of the breast bone and between the left and right lower ribs and causing a concave hollow to form.

D. This is the starting point for the inhalation. Expand the abdominal wall outward as you take in air and the hollow becomes a bulge. This bulge is a result of the diaphragm pushing down the liver, stomach, etc., deeper into the abdominal cavity below the diaphragm, leaving more room for the lungs to fill up in the chest cavity. The lower portion of the rib cage expands relatively. (WARNING - "Don't expand chest cage.")

E. At the peak of inhalation, gently close the lips and begin exhalation by means of the bracing action. Do not hold air in for any length of time. Inhalation and exhalation are one continuous action. "The end is the beginning."

F. The bulge becomes the focal point of the controlled emission of air, guided by the contracting strength of the muscles in the abdominal wall, braced, and working in sympathy with the intercostal muscles between the expanded rib cage.

Again, the principal source of muscular energy is oxygen, so watch your breathing.

**Posture**

In regard to posture, when seated or standing, it is my belief that sitting or standing rigidly erect detracts from the proper use of the costal and intercostal muscles, and that a
sympathy tension exists if the chest cage is held up in a semi-expanded or fully expanded position. When playing while seated it is my recommendation that the base of the spine should be two or three or even four inches away from the back of the seat. The player should lean back and relax. Shoulder blades should be relaxed. Chest cage should be relaxed. Rib cage should be relaxed. Muscles used for keeping chest expanded or holding body straight back or erect are now free to act in sympathy with muscles involved in the respiratory apparatus (abdominal muscles, internal and external muscles surrounding rib and chest cage, the diaphragm muscles and the nerves which are connected with them from the brain to the nerves which control and operate all muscles in the autonomous, involuntary nervous system). When playing while standing, the player should rest on his heels and the body and chest should be relaxed, resting on its own framework. This is best accomplished by arching the back slightly. He should stand flat-footed and not make any attempt to keep the chest cage up or the abdominal wall in, as this detracts from the ability of the abdominal wall by at least 50%. No player can produce the maximum compression required to play with the chest cage expanded whether sitting or standing. He should work the air column abdominally whether sitting or standing.

Exercises without instrument for controlling the air column

First Exercise.

1. Relax the base of the tongue below the soft palate.

2. Inhale a silent breath, slowly and steadily until the entire lower chest and ribs, from the back around to the sides are fully expanded and sore, and the hollow or depression between the ribs at the upper part of the abdomen hard and bulging (chest cage has not expanded). Hold the air in with the breathing muscles (not the throat).

3. Line the two lips up so that they are exposed to air between the teeth aperture (edges of teeth) and establish the embouchure playing formation with a minimum tension and the lips gently touching (the two reds closest to the outer skin are facing each other).

4. Start contracting the upper part of the abdomen and rib cage in the direction of your back (inwardly and slowly) and resist the air column by contracting the two lips equally in the direction of each other. (Muscles radiating from the corners must not give way, permitting air pockets. They must work harder as the compression increases. The lower portion of the abdominal wall is the real governing agent for the desired compression and power. Its contracting direction is inward and slightly up. All three areas - ribs, upper abdomen, lower abdominal wall, contract simultaneously and in sympathy with each other.)

5. Increase the force of emission to its maximum. Maintain the playing formation for all you're worth. Lips are still contracting in the direction of each other. Teeth are still open. (Do not pull corners back, as lips will then weaken and lose their contracting strength. Embouchure muscles cannot stretch or distend themselves. Any directional pull by one or more muscles contradicting the playing formation of the embouchure muscles will affect and neutralize those playing muscles related to the pulling muscle or muscles.)
**Second Exercise.**

1. Fill up as before, hold air in with breathing muscles for about five seconds.

2. Don't block air with the throat: Establish playing formation, release air in spurts, such as Hah – pause Hah - pause - Hah, for as many as you can until all air is out. Throw out abdominal wall without taking a breath and contract again for three or four short-Hahs.

**Third Exercise** (to identify the correct intake of air and its sensation).

1. Full abdominal wall in without taking air in.

2. Raise front part of chest. (Still no air.)

3. Close lips. Sniff air in through nose. Take short spasmodic sniffs, in, in, in, in, until there is a bulge of the upper and lower abdomen and rib cage.

4. Establish playing formation, still holding air in with breathing muscles. Brace lower portion of the abdominal wall and start contracting in toward the direction of your back. (Slowly and firmly.) Do this many times over. Breathing muscles will develop while the embouchure muscles resist the controlled powerful emission of air and vice versa.

When playing breathing in and out should be one continuous motion of the breathing muscles interrupted by the closing of the lips at the peak of inhalation, which becomes the starting point for the production of sound.
**Practice**

It has been established that we have two minds, the conscious and the subconscious. The conscious mind is the voluntary mind, the slow moving mind, with which we study, reason and think. The subconscious mind moves fast; it doesn't take time to think. It operates from habit and reflex action to control certain body functions. If you place your hand on a hot stove, thinking it is cold, the sensation of heat or pain will be transmitted to the subconscious mind, which, in a split second, by its reflex action, tells the hand to pull away - long before the slower moving conscious mind has realized that something is wrong. You react before you think.

These principles apply to playing a brass instrument. Your first duty to yourself is to have a conscious awareness of how and what you do. If you inflict pain in the top lip and are unaware of the cause, the subconscious mind will react to remedy the pain, and cause you either to stop playing or to relieve the pressure where the pain is. To try and continue playing under duress is stupid. Conscious awareness must take over, physical laws must be upheld, procedure must be identified so that you can coordinate and eventually perform certain actions automatically.

"Automatically" means that through study and practice as a conscious act, habits and reflexes are established in the subconscious mind, which then takes over, and allows you to play without thinking. However, you cannot be sure that your subconscious mind will function with total efficiency, since it is only as good as your conscious mind. So some conscious awareness must be present at all times while playing, even though you may be playing "automatically". Then should something go wrong while playing, the shock to your conscious mind, with its store of knowledge, will cause you to react and correct the error.

Slow, careful study of lip behavior, muscular behavior, breathing apparatus, compression, resistance, arm pressure, mouthpiece pressure, teeth high spots, teeth low spots, mouthpiece placement, mouthpiece distribution and playing weight and its equitable distribution, is the first step in solving embouchure problems, just as slow elementary control over the above variables must be mastered before speed, consistent production of sound, precise execution, range and endurance are achieved.

**Experimental Practice**

I have introduced the physical elements and factors necessary to the production of sound. It is your duty to apply and test these elements. To get the full fruits of knowledge, you must put it to practical use. You must find out for yourself what plays and what doesn't play. The conscious mind should train you to do things correctly, since this is to become the basis for the reactions of the subconscious. We depend on both minds. To find out what is correct we must set up an objective: "The Intent to produce sound." It is through practice, study and experimentation that we discover what is correct and what is not.

So, when practicing and a note gets fuzzy or quits, you should, clinically and analytically, attempt to discover the point of departure from correct procedure. On the other hand, if a good note is secured, it should be held a few seconds, then slowly and deliberately destroyed in order to ascertain how much margin for error you have. For example, increase the arm pressure or mouthpiece contact weight against the lips.
Move the mouthpiece up ever so slowly. Move the mouthpiece down slowly. (Note: It is possible that the note or sound may improve with these mouthpiece movements. The lip alignment may have been corrected, or put in a better position to receive air.) Tilt the head back. Tilt the head down. (Note: Notice if these last two actions is familiar. Most players do a little of each, unaware that either action takes the lips out of alignment.) Sneer. Observe this action in front of a mirror. (Chances are you do it subconsciously, especially while ascending.) Recede the jaw and notice the pitch drop. Keep receding till the sound quits. This will identify a point of departure. Close the teeth ever so slowly into the underbite position. Notice the bottom lip touching the top teeth edges. Pay attention to what happened to the sound. Pull the corners back such as in tu-ee, then bring the corners back to their natural width. Notice at what point the sound is healthiest. Flatten bottom lip against the chin. Notice the center of the bottom lip has gone below the teeth edges taking the facing away from the top lip reed and at the same time sides of the bottom lip are touching the top teeth edges. (The masseter muscle controlling the jaw usually acts in sympathy with this action and tends to recede the jaw to its state of rest position, unless conscious control over the jaw is exercised by the player.) Reset the mouthpiece placement pinning the lips a fraction further apart, then start the same note. Notice the greater effort to sustain the note. Notice the difficulty in maintaining a grip or playing formation between the lips and the mouthpiece. Slowly protrude the jaw taking the bottom lip facing past the top lip. Notice at what point the sound stops.

These are some of the experimental wrongs that the player must identify in order to retain the elements and factors that play, thereby upholding his intent to play. There is no absolute right or wrong, except determined by man's intent and objectives.

Practice Hints

1. In clinical practice you should reset your lip formation every few measures, when practicing musical content. This will help prevent a distorted lip and playing formation, which may arise due to carelessness or fatigue of the playing muscles. If the point of fatigue hasn't been reached, any directional pull of a muscle or muscles contradicting the playing formation will contribute greatly to fatigue. To continue playing on a distorted lip formation is not only a waste of time but detrimental to progress. You must consciously memorize which procedures successfully produce sound.

2. Consistent improvement can be attained by playing the simpler exercises on the correct formation and being absolutely certain that the formation is retained when proceeding to the more difficult.

3. You should maintain this high standard of playing for as long as possible. Any deterioration of the performance level should alert you to possible fatigue or the inability to hold playing formation.

4. Muscles and nerves are and must be rested in order to be rejuvenated. Lack of oxygen due to improper breathing is a major factor of fatigue. Pain contributes to fatigue. Where pain occurs in the lips it requires still more effort to maintain the correct playing formation.

5. When there is a sense of fatigue in the lips, even though there is no pain, the embouchure muscles working in sympathy with the two lips are waging a useless
struggle trying to exercise control over the two lips, which feel frozen and immobilized. You should be aware of the inability to contract those embouchure muscles that affect the surface tension in the vibrating area and be aware that you have become solely dependent on arm pressure, thus restricting the lip’s flexibility.

6. I do not advocate buzzing the mouthpiece prior to the warm-up, since the lip will be vibrating against, and become accustomed to resistance unequal to that in the lead pipe.

7. I do not advocate any type of low register warm-up, since the first playing image will be of a loose, flabby playing formation and will thus do more harm than good, in terms of relativity.

8. I advocate a considerable amount of work be done in lip slurring and flexibility exercises. It is the most effective way to develop control of the compressing force behind the air column against the resisting embouchure musculature.

9. I approach the development of tonal quality strictly from the physical standpoint. Good tonal quality is part of the technical equipment of the good brass musician. Good tonal quality is the result of healthy lip vibration and healthy lip vibration occurs when the facing or the bottom lip contacts the firm part of the top lip red vibrating area. This lip setup, together with the use of the jaw as the proper background support for the bottom lip and mouthpiece, will result in the desired tonal quality which can then be refined to suit the player’s demands.

10. I advocate the use of long tones only for stabilizing the embouchure apparatus, correcting pitch and developing breath control; in other words, for getting the maximum sound production with the minimum air displacement. But not for the development of embouchure strength. Long tones should be practiced at varying dynamic levels. The end should be as loud or as soft as the beginning, Long tones should be practiced in all registers. Note: In practicing upper register long tones, the player should first slur from an octave below to the intended tone and then sustain it. A better and more positive image of the elements necessary to sustain and play the tone will materialize.

11. I advocate practicing at all dynamic levels from very soft to very loud. Breath and muscular control are developed simultaneously and, at the same time, jaw behavior controlling the teeth and lip aperture are identified. It is very important that the outer grip of the mouthpiece on the lips used while playing soft be maintained while playing loud. Letting either lip slide or pull out of the mouthpiece bite will result in loss of range, extreme weakness and excessive arm pressure.

12. I advocate both standing and sitting while practicing. But whether standing or sitting, the player should not have his chest cage expanded and shoulder blades tight. Breathing should be abdominal. Abdominal muscles should be contracting in the direction of your back relative to the displacement of air.

13. To those who have trouble lip trilling, I recommend the following procedure. First, slur to the note you intend to trill, for example, G above the staff. Slur to G, push in the next harmonic (A-Bb) with air; maintain that air column; then open the teeth so as to open the lip aperture and allow the pitch to descend to the principle note (G); then close the teeth against the constant air that produced the artificial A or Bb. In
fact then, you are not trilling up from G by force, but down from A or Bb by opening
the aperture. The pulse or speed of the trill will be governed by the teeth edges of
the jaw, the bottom teeth edges.

Here is another experiment for the lip trill. Slur from middle C to high C, without
closing the teeth, that is with the fixed aperture; add enough air and resist forcing in
D; open the teeth to take you down to C., leave the teeth in the C position and add
still more air taking you back up to D; then start trilling using the teeth edges as
before. If
this procedure is done correctly you will develop an even seesaw of sound.

The procedures work whether the jaw is receded, parallel to the top teeth, or
slightly forward, however, here are several words of warning. Mouthpiece pressure
must favor the bottom lip, otherwise there will be no control of the lip aperture.
Remember, as you increase the air, the lips (principally the top lip) scissors in,
relative to the air, thus closing the lip aperture permitting the compression and the
tension to change the vibrations from fast to faster, and from wide to narrow, which
is higher sound. In addition, teeth edges must under no circumstances become
parallel to, or even with, the lip that is aligned with that particular row of teeth, since
It is the teeth edge that controls the lip, (in this case the bottom teeth edges and the
bottom lip.) Also, the top lip being against a fixed set of teeth must be constant in its
exposure to air. It must stay down. If you carelessly ride the mouthpiece up and
allow the top lip to become parallel to the top teeth edges, it will not vibrate. It must
receive air. The left side and the right side of the top lip (from the corners to the
outer rim of the mouthpiece) must also be exposed to air. The right bottom and the
left bottom (from the corner to the outer rim of the mouthpiece) must be exposed to
air and must be sealed with no leakage, no air escaping. Otherwise, sympathy
vibrations occur from the outer rim to the corner and a tremendous weakness will
be felt. (If all the above factors are being observed but the sound is strained and
there is leakage at the sides, then the starting tension is too great. Reduce the
tension and increase the arm pressure slightly. This results in a better seal of top lip
reed to bottom lip facing, while permitting air displacement.) The player must also
be aware of the mouthpiece distribution of weight left to right. Try as best you can to
get an even (50/50) distribution of weight while still favoring the bottom lip.

14. "Pain is nature's demand for rest or corrective measures " whatever the cause. If
there is pain, look for the high spots on the teeth and balance the distribution of the
mouthpiece weight evenly from the high spot to the nearest low spot. Create an
equitable horizontal balance on both lips and at the same time, put more
mouthpiece weight on the bottom lip

Warm-up

The warm-up serves as a stimulus, toning, limbering and activating the
embouchure muscles that have been dormant since the previous day's playing. It also
conditions the lips when they are swollen and stiff as a result of prior strenuous playing.

The player should be concerned with activating muscle memory, by simulating the
upper register playing formation. He should concentrate first on:
1. Lips, gently closed to receive the air column.

2. Minimum tension in both lips retaining the playing formation.

3. Teeth edges open to permit lip alignment.

4. Jaw position established and adhered to. This holds true for the receded, parallel, or slightly forward jaw player.

5. Mouthpiece placement on lips in closed playing formation (teeth open).

6. Very light mouthpiece pressure or contact weight on the lips. This is of prime importance for, if the mouthpiece weight is not light, it will immobilize the lips when attempting to resist the air column. Flexibility will be restricted. Weight should favor the bottom lip.

Now;

No attempt must be made to produce a fat lush sound.

Start, at a moderate volume, on any note in or above the staff and continue slurring up to anywhere you can take it, trying to maintain the same arm pressure or mouthpiece contact weight you started with. Repeat the process over and over. Sixty per cent of the mouthpiece weights constantly on the bottom lip - 40% on the top. The overall playing weight is light.

The warm-up should not contain loud middle register and/or low register long tones, for this result in too open a lip aperture. Do not articulate the slurs by raising the jaw thus closing the teeth effecting a blockage of air to the lips. All starting notes should be soft, resulting in a succession of relatively louder notes. The fixed teeth aperture should be maintained, making increased compression and matching muscular tension the only basis for the slur. The gradation in compression should be calculated, easy and smooth. If done without force or excessive arm pressure, the marriage between the air column and the resisting embouchure muscles will result in tones completely under the control of the player.

If the procedure previously outlined is followed you will find that:

1. The vapor in the air column moisturizes the vibrating area of the top lip making it sensitive and responsive.

2. The lips will contract in the direction of each other and will not be frozen or immobilized due to excessive mouthpiece contact, weight usually referred to as arm pressure.

3. Lip alignment will be consistent and constant, with increasing air pressure acting as the basis for determining the matching muscular change in tensions.

4. If the muscles in the cheeks, which act as the lateral walls of the oral cavity, act in sympathy with the two lips, which are contracting and resisting the air column, no damage or strain to the lips will materialize.
Points to think about during the Warm-up:

1. In the production of sound, air force and matching muscular resistance must be relative.

2. Be alert to any radical increase in arm pressure during the slurs. If the notes start to stick, stop playing and start the same series over with less arm pressure and a much softer starting note. The succession of tones in the harmonic series should get proportionately louder as you add air and resist.

3. Mouthpiece must not push both lips up, taking the top lip above the top teeth edges.

4. Teeth must not close; sliding past the bottom, lip, into a state of rest position.

5. Teeth aperture must never be less than 1/18th inch. Anything smaller than 1/8th inch cannot allow for a proper lip alignment. Thick or thin lips constitute their own natural thickness when the corners are in their normal position. The playing formation is based on the natural width of the corners, which in turn adjusts itself when air is released, resulting in a playing tension. Lips that are not thinned by stretching or pulling the corners back certainly cannot tolerate a smaller teeth opening than 1/8 th inch. With a good outer grip of the mouthpiece on unthinned, inverted lips they require a larger teeth opening than this. Experimenting will help determine the correct teeth opening for the individual player.

Experience will tell you when you are ready to play and how often to rest. The whole warm-up should take about fifteen to twenty minutes - including one and two minutes rests. Some may feel they require more time and some less.

Reference factors and reminders

1. Use a small mirror during experimental. Practice to help memorize playing formation. Pay special attention to facial muscles in the upper half, since they tend to destroy the lip alignment between the teeth aperture.

2. Place mouthpiece on lips already formed for the upper register to insure the outer grip, don't place mouthpiece on loose, flabby lips.

3. Keep lips parallel. Do not allow one lip to overlap the other (sides and front).

4. Bottom teeth edges should not block air to lips. Lips must be evenly spaced between the teeth edges. To check the teeth aperture do the following: While lips are still gently touching, separate the teeth edges. Use the tip of the tongue to gauge the teeth aperture. (Do not bite tongue thus making teeth aperture smaller.) Tip of tongue should feel both lips touching and should feel equally as much top lip as bottom lip. Bring the jaw forward till the bottom teeth edges are parallel or ever so slightly beyond top teeth edges giving the bottom lip a firm proper backing.

5. Fixed corners between teeth edges act as the basis for lip alignment and starting point. Do not pucker or pout. The natural width of the corners in the braced playing
formation is the position that prevents the lips from protruding into the mouthpiece cup. Any feeling of lips protruding into the cup should be relative to the decrease in tension. Reducing the chamber of the cup in the middle and low register is against all acoustical law if the intent is to have rich, resonant tones. You must try to be as consistent as possible with the cup chamber and mouth chamber. This means minimum movement of lips, tongue level and jaw, from a starting point of open throat, low base of tongue and high soft palate.

6. Corners must not pull back from their natural width while preparing to play or while playing. This action destroys the buffed contracting strength of both lips. The tu-ee action is wrong since it thins and weakens both lips. The ability of the two lips (as one muscle) contracting in the direction of each other is automatically negated. Mouthpiece weight must, once again become the gauge for changing lip tension.

7. Do not allow the mouthpiece to move the two lips up aperture. They or down out of alignment, between the teeth, will not play if out of alignment. Don't close the teeth edges leaving no room for the two lips to receive a healthy air column.

8. A gentle but definite grip must be felt between both lips and the corners before attempting to play (before releasing air).

9. Do not loop corners, during inhalation, pinning the center of the two lips with the mouthpiece. Lips will thin and pull out of the mouthpiece grip, Weakness will result. The proper way to intake air is: relax corners, back off mouthpiece weight, separate lips at aides slightly, inhale silent, (don't sneer) with throat open and base of tongue low. At- the peak of inhalation close sides gently. The release of air and its force will now determine both playing tension and its own displacement.

10. Air column must not be weak or feeble. Compression determines lip and facial playing tensions.

11. If, after placing mouthpiece on the upper register lip formation, you intend to play in the middle and low register the arm pressure or mouthpiece playing weight and tensions of the embouchure -muscules are proportionately reduced, permitting air displacement relative to the tones desired. When playing tones in the middle and low registers, do not permit a neutralized collapse of both lips. The lowest playable note on any brass instrument requires a lip formation and a tension relative to the playing area desired. For loud middle and low register tones, tensions below corners must increase and the bottom teeth edges (lower jaw) must open the lip aperture allowing for the greater displacement of air. Reminder: Mouthpiece weight must favor bottom lip by a little more than half of the overall playing weight - 40% top - 60% bottom).

12. Intervals on all brass instruments, to be effectively controlled, must be articulated with a minimum of jaw movement. This is in conjunction with air pressure, muscular tensions, and varying arm or mouthpiece contact weight. If movement is confined to a minimum there is less room for error. If the interval is wide, the movement may be more obvious. Nevertheless, movement should be held to a minimum in terms of relativity. Excessive motion is usually the cause of missed tones. It hampers coordination and contributes to mental insecurity. The lips can resist a graduated increase of arm pressure, if the lips and the facial muscles radiating from the lips are strengthened and trained to resist a proportionately increased air pressure.
13. Do not lift or tilt the head backward. Do not point your lead pipe or mouthpiece stem downward. Either of the above, or a combination of both, will result in an extremely receded jaw position.

14. When tonguing, don't push the tip of the tongue through both lips. This action causes consecutive lip separation, which must be overcome by excessive mouthpiece-arm pressure.

15. Avoid wearing tight or restricting clothing especially in the area of the neck, shoulders and abdomen.

16. Always kind time to practice the normal to frown and air to nose exercises, I'd suggest doing them before retiring. These are done without instrument.

Conscious awareness must be present at all times even when playing “automatically”. Listen carefully to your sound for its characteristics are the keys to solving your problems..

1. A choked, pinched, raspy, crackling sound is the result of a combination of factors. Excessive arm pressure against lips already touching and closed bottom tooth blocking air column to lips causing a back up of air in the oral cavity putting undue strain on the whole embouchure musculature.

2. If a tone is dull and funky, the top lip in receiving too much playing weight. Bring the jaw forward to absorb 60% of the weight. If the teeth edges are parallel then the angle of the lead pipe should be lowered. Usually a half inch will suffice, or until the sound improves

3. If the sound is strained and hard to maintain, the cause may-be a faulty lip formation at the time of mouthpiece placement. Most often lips are a little too unrolled thus preventing the two lips from contracting in the direction of each other.

4. If the tone is strained and hard to maintain, the cause may be the mouthpiece pinning the lips apart while taking a breath. Lips should be together before the release of air.

5. If you are struggling to hang onto a tone and can't ascend, the mouthpiece may have pinned one or both lips parallel to the-1hr related teeth edges, resulting in extreme arm and mouthpiece pressure. The physical law requires that the reed and facing touch in order for the top lip to vibrate.. yet, at the same time, the air column must be permitted to displace itself in equal ratio to the vibrations.