Part 3: Pedagogy, Conclusion

Use of scientific research to improve saxophone pedagogy has been a matter of debate. On one hand there are those that see no value, professing the science to be overly detailed, stale and detrimental to artistic thought and emotion, and impractical to place into application. On the other, there are those who feel that research is essential and could revolutionize saxophone pedagogy. Ray Wheeler expresses this sentiment, “The fact that x-ray motion pictures show which tongue positions are required for specific tones enables teachers to discard incorrect ideologies and to develop more efficient teaching approaches to assist students in overcoming difficulties which relate to acoustical phenomena of instruments.”65 This writer agrees that developing techniques based on fact is better than fiction and that scientific research is necessary to establish what those facts might be. Ray Smith commented:

Two extreme pedagogical approaches can be observed in some applied teaching studios across the country: the scientific approach at

one end of a continuum and the sound-imitation approach at the opposite end of the continuum. The scientific teacher is dominantly concerned with imparting knowledge to his students about what they are doing physiologically, acoustically, etc. This teacher is usually very analytical and has a scientific explanation for any problem that arises. On the other hand, some teachers don’t offer technical explanations at all, not caring if a student knows how he is accomplishing a given result as long as it happens. This teacher expresses the attitude, ‘I don’t care how you do it; just get this sound.’

Of course, many other teachers use a combination approach, falling somewhere in the mid range of the continuum. This type of teacher realizes there is a limit to how far the scientific approach can advance musicianship. He believes the student does need to have some idea of the principles, factors, and conditions involved in learning a technique, but understands there is always an amount of trial and error and adaptation to be made based on an aural example or goal. This teacher offers explanations and teaches concepts; but at the same time, he holds out an aural model worthy of emulation.66

Consider that if a teacher understands how things are accomplished, he may be able to create teaching techniques specific to a student. But herein lies the difficulty. As Eugene Rousseau puts forth, “Even in recent studies using the technique of fluoroscopy, the consideration of tongue position, throat opening, etc.—while they may ostensibly be observed and estimated—must, in the final analysis, be translated into language that will produce a meaningful result.”67

The remainder of this document will be devoted to the practical application of the information expounded up to this point. Attempts have been made by this writer for many years to do so. Some of the successes can be placed in the following categories:

1. Aural Emulation
2. Visual Emulation
3. Relation to Familiar Activity
   a. Vowels
   b. Larynx
   c. Soft Palette
   d. Embouchure
   e. Air Pressure
4. Basic Scientific Information
5. Reference Points
6. Exercise
7. Consolidation

66Smith, 82.
These categories are not necessarily in order of priority; in fact, they are often used in conjunction with each other. The complexity of information given to a student is offered in stages of comprehension and adjusted to fit the unique elements of the individual. The underlying pedagogical philosophy is cause and effect. It is intended to help students understand what physical situation might stimulate a desired aural outcome, to help them know how to manipulate the mechanisms of the vocal tract in order to achieve that outcome.

**Aural Emulation**

Most teachers would probably agree that listening to good aural examples helps a student to learn and is one of, if not the, most important factor in learning to play music on the saxophone. It is the manner in which we learn language. Often a student can develop and refine a technique by hearing a proper rendition and then telling the brain, “this is what I want.” The brain responds, “Okay,” and, through trial and error, subtle, scientifically un-teachable or inexplicable adjustments are made. Aural examples are critical for learning the details referred to by this writer as *micromovements* or “finding your way from the border of New York City to Carnegie Hall.” Many facts of “scientific minuiiae” cannot or need not be taught in any other way than aural example by the teacher and recordings.

**Visual Emulation**

Similar to emulating what is heard, copying what is seen is a major principle in learning. This too is a method used by most music teachers. Observation of the teacher’s embouchure, hand positions, posture, etc. and reproducing the “look” by using a mirror can be very successful if individual physical characteristics are kept in mind. The use of sketched, photo, video, and other visual media methods is not what is meant in this category and will be discussed later.

**Relation to Familiar Activity**

Progressing from the familiar to the unfamiliar is a valid educational concept. Thus, relating techniques to things that the student might already know or be able to do can be effective. Vowels, for example, can be useful because they are formations already within the student’s ability to create even though their shapes are not visible. The position of the larynx is useful because its height is visible, even though it requires practice to control. Other examples explained below involve the soft palate, embouchure, and air pressure.
Vowels. Saxophone instructors have been using vowels to manipulate tone for a long time albeit with varied amounts of success. Understanding the shapes that vowels create and the standard formations of the saxophonist’s vocal tract renders a high percentage of success when teaching on a fundamental level. Mooney’s findings for clarinet correlate closely to those of this writer’s saxophone observations:

The results of this comparison indicate that for the low register the vowel sound /u/, as in boot, is the correct vowel to use. For the transition to the high register the lower center and lower front vowels, /ã/, as in under, and /a/, as in father, are indicated as the best ones to use.

Although the /i/, as in eat, vowel sound does pull the cheek muscles up in a tight position, this vowel has the effect of putting the tongue very high in the front of the mouth which almost closes the air passage between the tongue and the hard palate completely. In actual playing the results imply that for the high register, a better teaching combination would be to suggest pulling the facial muscles up as taut as can be with the /i/ vowel position, and then place the tongue in a /a/ vowel position. This would match more closely the high register conditions as shown in this study. 68

In order to use vowels for teaching tone, one must learn the general tongue configurations of a few vowels and their relation to actual vocal tract shapes for saxophone playing. It should also be realized that there are no absolutes, no exact matches, and that vowel shapes vary with language and accent. Even the English language vowels used herein, like most other techniques for teaching tone, are only close or approximate. That being said, there are three groupings of vowels: posterior (back), center, and anterior (front). Each grouping raises and lowers that portion of the tongue. (See Figures 5, 6, and 7.) Not all vowels have equal use as applied to saxophone tone production.

Of the posterior vowels /u/, as in “boot”; /õ/, as in “book”; and /o/, as in “obey” (see Figure 8 for symbol pronunciations) work for the low register as their formations are similar but with varying heights. This should be considered in relation to student vocal tract and tongue size, which can sometimes be related to general physical size, but not always. The solution also varies from saxophone type to type (soprano, alto, tenor, baritone). /õ/, for example, often works better in the low register of the baritone saxophone instead of /u/, which is usually good for classical tenor. /u/ can have success at the top of the first octave, around c². It is not the general contour that varies, just the degree to which it is applied.

The anterior vowels /e/, as in “chaotic,” and /ɛ/, as in “bet,” work for the mid- to-upper registers, but need to be modified. Other vowels, some that have had traditional use, such as /i/, as in “beet,” and /a/, as in a bright “ah,” produce

68 Mooney, 76-77.
unsatisfactory results. /i/ raises the tongue too high and moves it too far forward while
/a/ flattens the tongue too far and closes a portion of the pharynx.

Vowel modification is a useful device and explains why many teachers and
players have had success with a single vowel such as /a/. The center vowel /a/, as in
“up,” and the low posterior vowel /ə/, as in “authors,” tend to work well as modifiers.
The concept comes from vocal pedagogy and practice and has been explained in many
ways:

The neutral vowel serves as a device for essential vowel modification
in some circumstances in singing. 69

Let us take some examples: the three lowest formant frequencies for
the sung vowel /i/ are more similar to those of the spoken /y/ than to
those of the spoken /i/. Some singing teachers would even
recommend that their students “color” the sung /i/ toward the /y/ in
order to obtain the effect. Similarly, the sung /a/ is colored toward the
spoken /o/, and the sung /e/ and /æ/ toward the spoken /ə/. 70

The principle of vowel modification is that the initial vowel
undergoes some migration as the scale ascends, by modifying toward
a near neighbor. The laryngeal configuration changes for each vowel,
and there should be a corresponding change in the shape of the
resonator tract. When the filtering aspects of the vocal tract are in
tune with laryngeal configurations, the vowel is properly “tracked.”
Vowel modification in the ascending scale permits vowel tracking and
balancing of the formants (areas of acoustic strength), thereby
avoiding either “open” or heavily “covered” singing. 71

It is this combination of harmonics [1000, 2000, 3000 Hz] that can
be used pedagogically to induce the “ring” into subsequent sung
vowels. When vowels of the back series ... tend to lose “frontal
brilliance,” a better balance can be established by prefacing “low”
vowels with the pilot phoneme /æ/. 72

Basically, in application to saxophone, vowel modification is altering a vowel
by mixing it with another. If one were to form an /i/ vowel while playing in the high
register of the saxophone it would sound forced and “stuffy,” as if some of the
overtones were not being allowed to sound, their amplitude stifled, or their energy
constrained. If, however, one were to modify the /i/ with the center vowel /a/, the
configuration would be much closer to correct. The actual shape would neither be /i/

69 Miller, Structure of Singing, 70.
117-118.
71 Miller, Tenor Voice, 47.
72 Miller, Tenor Voice, 83.
nor /ʌ/ but a hybrid. This explains why some vowels not mentioned above might have been used successfully. It depends on the starting point. If a student, especially an intermediate to advanced student, is playing with the tongue too high, asking him or her to apply the /ʌ/ or /ɔ/ vowel will bring the tongue down. It probably will not form a perfect /ʌ/ or /ɔ/ shape as used in speech but it will have served its purpose. Students with an overly bright tone and having a tendency to honk in the low register may be told to apply the /u/ vowel with success. Unfortunately, if the teacher thinks the sound was caused by a closed throat and that the /u/ vowel opens the throat; the teacher may have problems with the next student.

Beginning students may not have as much success with the unintended vowel modifier because their starting point is much more pure. It is more likely that they will form a shape closer to the spoken vowel. Consequently, it is important for a good teacher to know the standard shapes associated with saxophone playing, the characteristics of vowel formations, the technique of vowel modification, and perhaps the idiosyncrasies of dialect within the teacher’s region in order to be successful in using vowels for teaching tone production. A method that often does work for young students is to have them form the shape for /ʌ/ or /ɔ/ and ask them to place the anterior, or tip of the tongue, close to the reed. This modifies the /ʌ/ and /ɔ/ vowels, sort of a reverse method as that described above.

In summary, the following vowels work well for initial instruction or modifiers:

1. /u/ for low notes
2. /u/ around e²
3. /e/ around f sharp²
4. /ɔ/ with the anterior tongue closer to the reed for high notes
5. /ʌ/ or /ɔ/ if the tone is stuffy (modifier)
6. /u/, /u̯/, or /ɔ/ if the tone is bright (modifier)

**Larynx Position.** Figure 9 shows the position of the larynx, by means of the hyoid bone mentioned earlier, as the performer plays four octaves of C. The larynx, or Adam’s apple, starts a bit higher than normal and moves progressively downward, especially from the second octave and up. One should also notice that the posterior tongue descends as the notes ascend. The height of the posterior tongue is usually related, connected to the height of the larynx.

Teaching a student to control the position of the larynx will help to focus notes through the registers of the instrument. Asking the student to place a finger on his Adam’s apple, then telling him to yawn, can do this. The Adam’s apple will descend. Ask the student to hold his Adam’s apple down and to blow a column of air, without the saxophone. Once he can do this, and it may take some practice, ask him to hold the Adam’s apple down and blow a d³ or other moderately high note. This then can be a tool for checking and adjusting pitches: Adam’s apple down for high notes and up for low notes. In the beginning, a student may place the Adam’s apple
too high or too low. Again, there are no absolutes. This practice is a good starting point, a macro-movement.

**Soft Palette.** Movement of the soft palate can be observed by viewing the dashed lines on Figure 9. Notice that it rises when notes ascend. One can learn to control this involuntary motion by associating the “feeling” in the vocal tract when blowing a column of air straight down. First, reach the student where the soft palate is by telling her to feel the hard palate with the tongue, then move the tongue back until the surface becomes soft; this is the soft palate. Next, ask the student to put a hand in front of her face, blowing a constant air stream while lowering the hand toward and touching the chest. Keeping the head level requires a change in embouchure in order to complete the task. Ask the student to “feel” added pressure on the soft palate as this downward air stream is blown. The added pressure signifies a raised soft palate. In time, the student can learn to apply this feeling to an open pharynx and the production of higher-register notes.

**Embouchure.** It was noted that the embouchure applied an equal amount of pressure from low B-flat to F⁵ for classical alto saxophone. Teaching a student to apply an equal pressure from the embouchure is a concept that the student can comprehend clearly. This does away with the axiom, “drop your jaw,” that is sometimes applied by band directors to “help” students to play in the low register. If the embouchure is too tight for the low notes, it is probably too tight for the rest of the normal range. Upon entering the altissimo, the pressure increased slightly. It was also noted that the jaw moved forward fractionally. Teaching a student to increase embouchure pressure and move the jaw forward for altissimo notes is a concept that the student can grasp.

Useful concepts of cause-and-effect teaching became apparent through application of scientific observations. As previously stated, classical performers tended to maintain jaw and lip placement for low notes (thin lip). This will be referred to as the standard embouchure. Jazz performers were seen frequently moving the jaw in and using more lip surface on the reed (thick lip). This will be referred to as subtone embouchure. It was seen that, in the low register, a high posterior tongue helped to maintain a more even timbre throughout the range of the saxophone and that a lowered posterior tongue raised the peak frequency and increased the strength of high overtones. These four mechanisms (standard embouchure, subtone embouchure, high posterior tongue, low posterior tongue) can be used in various combinations to alter response and timbre:

1. standard embouchure with high posterior tongue - even timbre, best matching other ranges
2. subtone embouchure with high posterior tongue - traditional, old-style subtone jazz sound
3. standard embouchure with low posterior tongue - bright, contemporary jazz tone
4. subtone embouchure with low posterior tongue - unique, non-classical timbre with increased response and dynamic control
The reader probably recognizes the fact that varying degrees of the above situations create more variances of tone response, quality, and dynamic capabilities.

Air Pressure. Years ago, this writer asked a great player how to play altissimo, as he was extremely adept at the technique. His answer was, “Just bite down and blow.” Notwithstanding this advice, in the midst of an energetic improvised solo, this writer’s altissimo would “cut-out,” so to speak, something that did not happen in practice sessions. What was the difference? The idea of blowing harder to achieve altissimo notes seems to be common whether pre-decided or not. Over time this writer learned to play altissimo lightly, even when sounding “intense.” The results to Projects #2 and 3 indicate that saxophonists of high caliber use less air pressure to play “palm-key” and altissimo notes. The teaching element is quite simple. When playing high, blow less hard.

Basic Scientific Information

The combination approach to teaching, as mentioned by Ray Smith above, uses aural example and emulation in addition to scientific principles, factors, and conditions involved in learning a technique. This writer likes to teach the macro-movements, that is, the principles contained in Figures 3, 5-7, 9, 11, 17-19, and 21. Other details such as sound waves, nodes and antinodes, pressure readings, etc. are usually only touched upon if asked. This can be done through sketches and diagrams, photographs, video, or whatever media the teacher feels best suits the student. Figure 9 shows some very useful information for teaching a student about the embouchure. Jaw alignment, mouthpiece angle, reed surface covered by the bottom lip, lip thickness, comparison of alto and tenor variances, etc. can be taught quite effectively with these sketches made from fluoroscope images. Understanding of these principles, factors, and conditions comes over time, line upon line, by layers, from the familiar to the unfamiliar. The amount of detail should also be kept in check.

It is important to promote an awareness of the sensations that students are feeling and to associate sensations with what is really happening, the formation. When students know what is happening in one playing situation they can, perhaps, apply it to another. Each new task will become easier or be accomplished more quickly because of previous tasks. Accumulatively and over time, one learns to manipulate the vocal tract at will, accurately creating shapes for various purposes. New directions of development will occur because of a knowledgeable foundation in tone production fundamentals. Students will have an artist’s palette of resources to build their own unique sound.
Reference Points

Once the student begins to associate vocal tract sensations with actual shape, or formation, further physical reference points can be established and the rate of learning increased. The larynx is the first reference point established. It is a visual association with posterior tongue position and the sensations of raising and lowering. Teaching the posterior vowel shapes and associating these sensations with performance increases the student’s ability to manipulate the posterior tongue position. Three other reference points can be established in time: 1) tongue contact with the upper back molars, 2) tongue contact with the hard palate/soft palate merge point, and 3) tongue contact with the tip of the mouthpiece. If the teacher or student feels or hears that the mid tongue is too high or too low, reference to the molars may help. The student can raise the tongue until the point is felt and then adjust its position accordingly. The principle is to become aware of what the tongue is doing and associate the sensation and sound with the placement, the formation. The same is true of the mouthpiece contact. If the formation sought requires the tip of the tongue to be closer to, or under, the reed as in high note tone production, the student can feel its proximity by touching the reed and backing off slightly. The same may be true for a low note where the tongue should be farther from the mouthpiece. Contact with the hard palate/soft palate merge point will be explained in the next section. Tongue stability for articulation can be observed by tonguing notes playable with left-hand fingerings and placing the right hand under the chin close to the throat. The student can feel tongue movement and learn control according to the needs of legato and staccato playing.

Exercise

This writer likes to refer to exercises as vocal tract calisthenics. These, and many of the other techniques described herein, help the student develop flexibility and stability within the vocal tract and a greater understanding of what is truly going on. The terms flexibility and stability are significant to tone studies as some studies develop the ability to adjust while others teach control mechanisms that must remain constant under certain situations. Some exercises are important prerequisites toward another goal. It is like the football player who works out on the bench press. He certainly does not bring the bench and weights out on the field during a game.

Application of information derived from this researcher’s and other studies can be used to gain awareness, to associate the sensation with the formation, to understand what should be flexible and what should be stable, to speed up the learning process, and to help those students who “just don’t get it.” There are many exercises for developing tone. Some, like the myriad of long tone studies, are especially valuable if they are associated mentally and visually with the proper vocal tract formation such as the high posterior, low anterior position for low notes or the low posterior position
for high notes. A few exercises and their requisite vocal tract positions are included in Figure 22.

Figure 22. Exercises.

a. mouthpiece pitches

\[ \text{soprano} \quad \text{alto} \quad \text{tenor} \quad \text{baritone} \]

suggested by the research herein traditional

b. mouthpiece pitch pivot exercise

c. palm-key pitch bending

note \quad \text{bent pitch (x)}

open (Adam's apple down)

up

don't

d. harmonics

note \quad \text{harmonic (x)}

fundamental

open (Adam's apple slightly down and forward)
Mouthpiece Pitch. Presently, this writer uses the following pitches: soprano, C; alto, A; tenor, F-sharp; and baritone, D (figure 22a). As stated previously by Ray Smith, students tend to play rather high. Consequently, the first step is to get the student at the right pitch before any additional calisthenics are attempted. Try these steps:

1. **Embouchure.** This seems to be the number one problem for a pitch that is too high. Try an exercise that this writer calls the "Mouthpiece Wedge." Form the embouchure without the mouthpiece and blow air. Insert the mouthpiece until a slight amount of pressure is felt (wedge); tone should begin. Pull the mouthpiece out suddenly; ensure that the embouchure does not collapse. It should be supportive unto itself without dependence on the mouthpiece.

2. **Lower the larynx.** Have the student place his or her finger on their Adam's apple and yawn, hold the larynx down, and blow air. Apply this while blowing the mouthpiece. The pitch may go down slightly but probably not enough; however, if one examines Figure 22, one will notice that the posterior tongue is down for mouthpiece pitch tone. This sets-up the vocal tract for the next step.

3. **Hiss.** The point where the raised tongue has effect is approximately where the hard a soft palettes meet (perhaps a little more forward). This is approximately where a hiss is produced. If the student is trying the above steps, then adding the tongue position of a hiss sometimes helps, especially when thinking of increased air pressure.

4. **Air pressure.** Sometimes the student still has a hard time accomplishing the task. The reed needs to be forced to vibrate slower than its tendency. Adding air pressure is required for this to happen. Explaining this concept, that of feeling pressure, often facilitates steps 2 and 3.

5. **Reminders.** Getting a good sound and pitch on the mouthpiece alone is best done at a forte level. Moving the embouchure is not the solution; it is the stable element. (This was observed through fluoroscope images of saxophonists performing the exercise explained in the next paragraph.) Establishing the proper vocal tract shape along with its accompanying air support/air pressure is the solution, the flexible element.

Once the student has achieved a good-sounding, correct pitch, several drills can be added to teach flexibility and stability. One is what this writer calls the mouthpiece pitch pivot exercises (figure 22b). If on alto, have the student play an A and bend the note down chromatically with an A between each pitch. The chromatic notes develop flexibility while the returns to A develop stability. Another exercise comprises simple melodies played with the mouthpiece alone. At this point, if the teacher has not shown the student what is happening within the vocal tract, he or she should do so as it helps the student to associate what is being felt with the actual shapes being formed, sensation with the formation.

Knowing where mouthpiece pitches change according to the range of the saxophone as shown in Figure 20 may also help the student. Achieving the higher
notes will help to refine the upper second octave and the palm keys. It is important, however, for the student to produce the b-flat and b (using alto as the example) without increasing the pressure from the embouchure. The raised pitches need to be produced from lowering the tongue within the vocal tract.

If an advanced student is already getting altissimo notes, the C mouthpiece pitch (1046.5 Hz) is helpful. When this researcher first observed the close relationship between this mouthpiece pitch and the altissimo register he wondered how it might be used for teaching. It proved unsuccessful as a device to first achieve the extreme range, but worked well as a refinement. For example, an alumnus dropped by this writer's office after having completed his master's degree at another university. He asked about his altissimo register, which he demonstrated. It was a bit out-of-tune and somewhat brighter than desired. We worked on a few things then tried applying the C mouthpiece pitch. The tone and intonation improved remarkably and quickly. Pleased with the success of this vocal tract refining tool, this writer has applied the technique many times since with positive results.

Palm-key Pitch Bending. This exercise applies the techniques learned from the mouthpiece pitch exercises to the instrument (figure 22c). Have the student play a d\(^3\) followed by a c#\(^3\). Return to d\(^3\) and bend the pitch back to C# with the vocal tract without changing fingerings or moving the embouchure. The C# played with the regular fingerings establishes the pitch to which the student will bend. Next, repeat the exercise but use a C natural instead of C#. Have the student work on the exercise until at least a pivot to a\(^2\) (on alto) can be achieved. Returning to D again develops stability, especially if one ensures that the intonation is correct by the use of a tuner and/or in-tune piano (or other pitch reference). Flexibility is improved, obviously, by having to bend the pitches. Again, the student should be informed of what is happening within the vocal tract in order to develop correct associations. At this more advanced level, explaining and diagramming the raised mid-tongue position, hard- to soft-palette contact point is useful. The above-mentioned biss technique and feeling of air pressure is also often useful. The larger the saxophone, the harder it is to bend pitches over larger intervals. A soprano saxophonist may be able to bend from d\(^3\) down to g\(^2\) or f-sharp\(^3\) whereas a baritone saxophonist might only achieve a b\(^2\) or b-flat\(^2\). Pivoting from other palm key notes besides D is also quite valuable.

Harmonics (overtones). Playing harmonics is a long established device, especially for learning the altissimo. Its value as a vocal tract calisthenic is high as it develops sensitivity and control. It is often very challenging for students to learn. For the uninitiated, playing harmonics means to finger a fundamental tone, such as low B-flat, and to produce the overtones as notes without changing the fingerings. It is the drawing out of a specific overtone in the series by weakening the fundamental and any lower overtones.

There are numerous exercises that can be done with overtones. One of the most valuable is to match an overtone with a regular pitch (figure 22d). Low B-flat on
most saxophones is sharp, placing the overtones based on this fundamental sharp as compared to the standard fingerings for matching pitches. Adjusting the harmonic to standard fingering is a good micromovement exercise. Moving from normal fingering to fundamental fingering is also a good way to begin learning to play overtones independently. Generally, the second overtone is easier to produce than the first. Playing an $f^2$, for example, then fingering a low B-flat while still blowing and maintaining the $f^2$ will sound the second overtone of the fundamental B-flat. For a first-time effort, leaving the octave key on is helpful. Next, have the student try the first overtone, b-flat$^1$. If it proves too difficult, have the student play a low B-flat and flick, briefly open, the D palm key (LSK 1), or lift the left hand third finger and slowly replace. Usually the first overtone comes out. To achieve the third overtone, again play the regular fingering first followed by the fundamental fingering. Sometimes this gets difficult. Again, try leaving the octave key down, flick the D palm key, or lift the left hand third finger. Proceed to higher overtones.

Illustration and explanation of the vocal tract movements can help but may take time to comprehend. Once understanding is achieved, that is, relating the sensation with the motion (formation), the whole process becomes much easier and more quickly learned. Examine the drawing in Figure 22d under the “Harmonics” heading. There are two motions that help produce overtones: 1) the pharynx gets larger by moving the base of the tongue forward and down, and 2) the center tongue moves up close to the hard palate/soft palate merge point. These are more easily described than done, however. Lowering the larynx like yawning helps the posterior tongue to find its place and the hiss sound, “g” as in “good” placement, or a little more forward, helps to find the mid tongue position. One other adjustment that some saxophonists incorporate to achieve the various overtones is movement of the jaw, as was mentioned previously. This slight outward motion can help students when they are first attempting to play overtones.

**Consolidation**

Often, teaching techniques from several areas come together to refine a single topic. For example, the following principles and exercises have been mentioned under various headings but can be consolidated to teach altissimo:

1. Overtone exercises
2. Posterior tongue down, open pharynx, lowered Adam’s apple
3. Anterior tongue forward, arch progressively lowered, /a/ or /i/ vowel as modifier
4. C mouthpiece pitch (without embouchure adjustment)
5. Increased embouchure pressure
6. Forward jaw movement (and flatter chin)
7. Less air pressure, blow less hard
8. Extreme altissimo: increase space in anterior vocal tract
Conclusion

Acceptance of the idea that the vocal tract is involved with tone production from the larynx to the embouchure is fairly universal in the woodwind world. Producing overtones, adjusting pitch, and changing tone quality are only a few examples of things the saxophonist can do without changing the embouchure or fingering, as stated by Johnston, et al.:

The woodwind and brass instrument pedagogical literature contains numerous references to the effect of the shape of the vocal tract of the player on the timbre and intonation of the sound emitted by the instrument. The position of the tongue is generally recognized as the main control variable, and instructions for developing this vocal tract technique are often expressed in terms of the formation of various vowel shapes, or by the adoption of terms used in singing training. Vocal tract manipulations are also thought to be important in the production of clarinet multiphonics, and in effecting the change of register.\(^{73}\)

How the vocal tract is involved and what is specifically happening or necessary are issues with many misconceptions. It is easy to associate a sensation with a formation and to believe it to be true, even if the formation that the performer assumes he or she is making is far from its true shape. One such assumption is that the vocal tract is open for the low register and closed for the high. Wheeler refutes this:

Many pedagogical concepts, based on sensations inside the mouth as perceived by performers, just were not satisfactory, especially since respected teachers and highly competent performers expressed different ideas about how the tongue and throat should be shaped to articulate and sustain various tones.

The logic of one clarinet teaching concept was questionable, much more than others. In double tonguing technique, the ku syllable is shaped phonetically by closure of the air channel above and behind the tongue, near the soft palate. In other words, the tongue has to be in a high position to make the ku attack. If a clarinetist placed his tongue low in the mouth while playing low register tones he usually was instructed to do this by opening the throat as in singing awh or oh syllables—why was it that double tonguing produced acceptable tones in the lowest register (low tongue) rather than in higher registers (high tongue)? By all rules of logic, clarinetists should have been able to double tongue high notes, not low notes.\(^{74}\)

\(^{73}\)Johnston, et al., 67.
\(^{74}\)Wheeler, “Tongue Registration,” 5.
The research of Anfinson, Carr, Clinch, Compagno, Mooney, Pappone, Parode, Peters, Wheeler, and this writer account for thirty-three clarinetists and thirty-four saxophonists of high caliber that have participated in studies utilizing fluoroscopy and endoscopy. The tendency to place the low register with an arched posterior tongue moving to forward tongue position with the posterior down for high notes is supported by a significant amount of data.

Recognizing that there are many layers of understanding to sift through before truth is found, this writer realized that there could be more truth beyond “large chambers produce low notes and small chambers produce high notes.” Years of research revealed topics and concepts such as actuator, vibrator, and resonator principles; formant and Fourier frequencies and their relation to each other; vowel formants; the relationship of a formant to a fundamental; the influence of a strong vocal tract fundamental on instrument resonance; frequency adjustment based on the space around nodes and antinodes; the singer’s formant and possible “saxophonist’s formant” or a related concept; air pressure and reed vibration; vocal cord function; the relationship of sung pitches to played pitches; the relationship between the embouchure and the vocal tract; and new information concerning mouthpiece pitches.

What good is this kind of information if it cannot be applied to performance and teaching? One of the most valuable results of this research is the ability to relate the performer’s sensations of movement and shape (formation) within the vocal tract to reality. If a teacher desires the student to “open the throat” and tells the student to form an /u/ vowel (which, in reality, raises the posterior tongue), the student will be unsuccessful, even if forming the /u/ vowel perfectly. With this feeling of failure, the student may keep trying, changing the vocal tract shapes, until the note is played well. The student will associate whatever formation was required to achieve the right sounding note to the /u/ vowel and misinterpret it a sensation with a formation.

Truth will speed up learning. How many students do we have to hear honking in the low register before we teach them to say /u/ and raise the posterior tongue? How many times do we have to hear sharp, constrained palm-key notes before we teach them to lower their Adam’s apples and open up? In addition, if a teacher knows what is really happening and why, he or she becomes like the artist with a palette of more than just black and white. With all this information, with all these colors, the ability to create new ideas and methods for learning increases. The ability to customize to the unique needs of the individual improves. With the student, as he or she learns to relate one sensation to a formation or shape, it makes the next one easier. In time, the student can manipulate the vocal tract at will and play with a bright, dark, reedy, pure, rich, loud, honky, refined, or whatever quality tone is desired with great flexibility.

Science can be applied to art, to pedagogy. This does not mean that we have to take our students to laboratories. It does not mean that technical measuring devices need to be incorporated. It does not mean that a student be bored by monotonous lectures on acoustic theory and mathematical configurations. The application can be practical. It does mean that the pedagogy is based on accurate information and not hearsay and speculation. Art and imagination need not leave the music. A casual
comment to raise or lower the Adam's apple, reference to the appropriate vowel, knowing how a pitch is lowered, being able to give advice on difficult exercises based on what needs to be done in the vocal tract are all applications of science.

_Vocal tract theory exposes us to cause-and-effect pedagogy, a matter of choices that increase our ability to aurally depict the artistic aspects of music. Students can associate the sensation with the formation and improve their rate of learning. Understanding the flexibility and stability requirements of performance tasks cultivates control. The macro-movements of the saxophonist's vocal tract can be taught and represent the similarities, the general shapes that many of us share. The micro-movements require aural and visual example and exercise and represent the differences anatomically of the player and the traits of our varied equipment. Knowledge of the vocal tract positions themselves only helps; there is no magic pill. This writer has found the concepts contained in this paper to speed up the process; in fact, to speed it up markedly. But it must be emphasized that such things as listening and visual emulation of great players are critical. It must be realized that exercises are like calisthenics for the vocal tract. They prepare students to be able to do the detailed refinement unique to their physiology that will produce desired sounds out of the saxophone._