The Proper Selection of Cup Mouthpieces

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PART ONE:
ACOUSTICAL ASPECTS OF CUP MOUTHPIECES

One of the most important decisions a wind instrument performer must make is the selection of a mouthpiece. Yet he always has had to make that decision with very little information, guidance, or concrete evidence. The usual process of selection has been a combination of trial and error, chasing down rumors of the "perfect" mouthpiece, and listening to the advice and experiences of other musicians. The latter activity has led to many an argument, for the relative merits of various mouthpieces are sometimes hotly debated.

In order to provide a logical, scientific guide for the selection of a mouthpiece it is necessary first to determine the areas of agreement and disagreement among musicians. Then, using objective, experimental evidence, it is necessary to determine the reasons for such agreement or disagreement.

AREAS OF AGREEMENT

It is agreed by nearly 100% of all musicians who play cup mouthpiece instruments that a "large" mouthpiece requires "more air to fill", more "breath support" and greater embouchure development, especially for playing the high register or for extended periods of time. It is also relatively well agreed that a "large" mouthpiece produces a "darker" or "more full", "rounder", or more "Teutonic", type of sound. The "large" mouthpiece also tends to flatten the entire instrument.

On the other hand, it is generally agreed that a "small" mouthpiece requires less air, less embouchure development, has an easier high register, a "brighter" sound, "smaller" or at least "more centered" sound, and sharpens the instrument. (Note: the items which add up to our "large" and "small" mouthpieces will be discussed later.) Almost the only basic disagreement with the above statements is by those players who do not separate embouchure development from the characteristics of the mouthpiece itself. For instance, a player can develop the embouchure to the point that he can play sharp with a "large" mouthpiece, or can play a "larger" mouthpiece with more ease than a "small" one. Any other disagreement usually is the result of confusion as to what constitutes a "large" or "small" mouthpiece.

The difference in response and intonation between a "large" mouthpiece and a "small" mouthpiece is shown clearly in Figure 1.

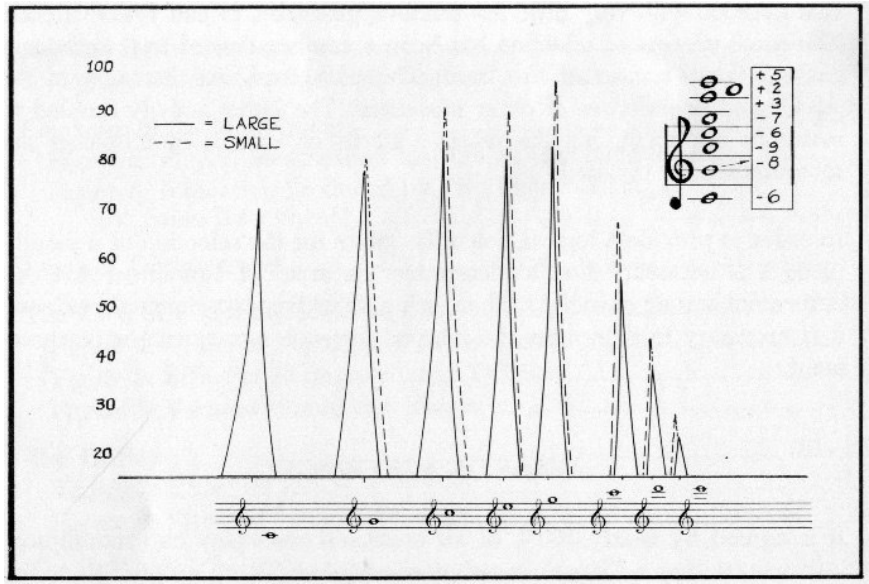

FIGURE 1: LARGE VS. SMALL MOUTHPIECE
Intonation shown as number of cents that large mouthpiece is different from small one.

These resonance curves are measurements of the reaction of a trumpet to an electronically-produced sound, with no player. Note that with the smaller mouthpiece, the complete instrument reacts with more resonance on the higher notes. (The higher the peak, the more the resonance). Thus, with the smaller mouthpiece, the instrument provides more assistance to the player in the high register. Because of the contrast in amount of resonance (more adjustment required on part of the player) the low register may be more difficult for the player even though the resonance on low "C" is unchanged. Also, with the "larger" mouthpiece, the instrument tends to be flatter, though the extreme high register in this case is a trifle sharper. (The reason for this high register sharpness will be shown later). Intonation is shown in the table as the number of cents that the larger mouthpiece is flatter or sharper than the small one.

It is easy to see why players generally agree as to "large" and "small" since the difference between a "1arge" and "small" mouthpiece can be measured so clearly with electronic means.

In spite of the seeming basic agreement among musicians where extremes from "small" to "1arge" are involved, there is much disagreement as to degree, manner, and causes of differences. In order to understand why these disagreements exist it is necessary to understand the functions of the mouthpiece.

FUNCTIONS OF THE MOUTHPIECE

The mouthpiece is primarily a coupling device between the instrument and the player, as seen in Figure 2.

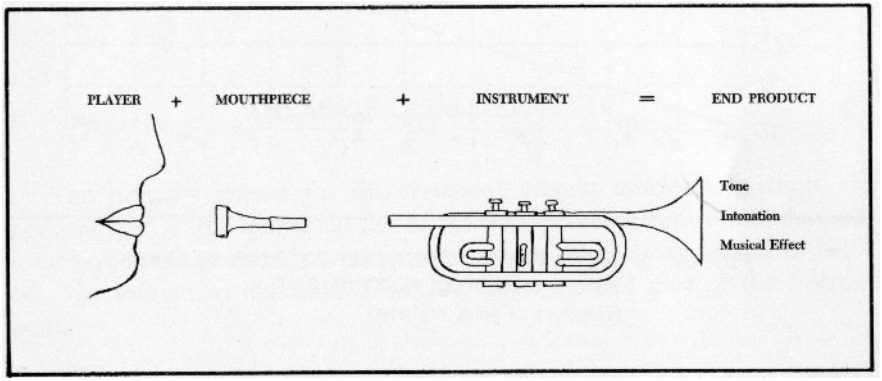

FIGURE 2

When individual musicians play the same instrument and mouthpiece, each individual produces a different timbre. This personal factor is the result of a combination of such things as the embouchure (including the manner in which the lips are held, the size and texture of the lips, etc.), the size and shape of the oral cavity, the manner of breathing, the manner in which the instrument is held (including pressure on the lips, amount of mouthpiece on each lip, etc.), and the concept of each musician.

Suppose two musicians had an identical concept of tone and were trying to produce an identical end product, but one musician's sound was "more brilliant" than the others. Those two players could produce matched tones by using different mouthpieces, each suitable to their individual requirements.

It has been proven that musicians differ in their intonation patterns when playing the same instrument and mouthpiece, see Figure 3.

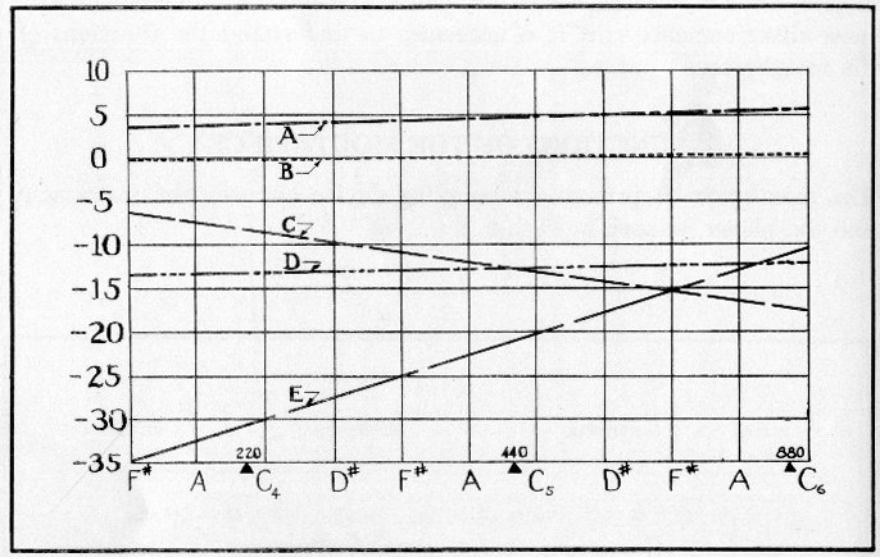

FIGURE 3: INTONATION PRODUCED BY FIVE PLAYERS USING THE SAME INSTRUMENT.
(Courtesy of John Webster)

With mouthpieces individually tailored to each person's needs, it would be much easier for the players represented in Figure 3 to play in tune with each other.

These individual differences in tone quality and intonation are basic and inherent. It is true that a fine player will be more likely to match his sound and intonation to the musical demands than will an inexperienced musician. However, a mouthpiece which properly couples the musician to the instrument will aid that matching process by decreasing the amount of necessary adjustment.

The lips vibrate in a very complex manner during cup mouthpiece performance. High speed motion pictures show that they vibrate much more like the larynx than like a violin string. However, just as a violin string needs definite ends, or termination points, in order to establish a precise vibration, so do the lips. One function of the mouthpiece is to provide a rim on which the lips must rest comfortably, with a definite termination point for the lip vibration at the inner edge of the rim. However, the mouthpiece inner rim must also provide a shape which facilitates changing of the frequency of the vibration of the lips, and it must also provide room for the excursion of the lips into the mouthpiece during vibration. The demands on this shape will vary according to the individual.

In summary:

The mouthpiece is an individual coupling device which matches the personal characteristics of the player with the characteristics of the instrument, encourages lip vibration in all registers, and facilitates the production of a timbre, intonation, and musical effect within the concept of the performer.

AREAS OF DISAGREEMENT

1. The primary reason for disagreement among musicians' ratings of mouthpieces is the personal factor. Each player rates a mouthpiece according to his personal requirements, which differ from person to person. The individual musician is actually an acoustical part of the instrument.

2 It has been pointed out that agreement is rather common as to the effect of "large" or "small". However, a mouthpiece is not just "large" or "small", but is a combination of several factors. The degree and manner in which each of those factors contribute to our "coupling device" leads to misunderstanding. In order to analyze the effect of mouthpiece factors individually and in combination, it is necessary to determine a common vocabulary.

THE PARTS OF A MOUTHPIECE

Figure 4 shows a cross section of a trumpet mouthpiece with the various parts of the mouthpiece identified.

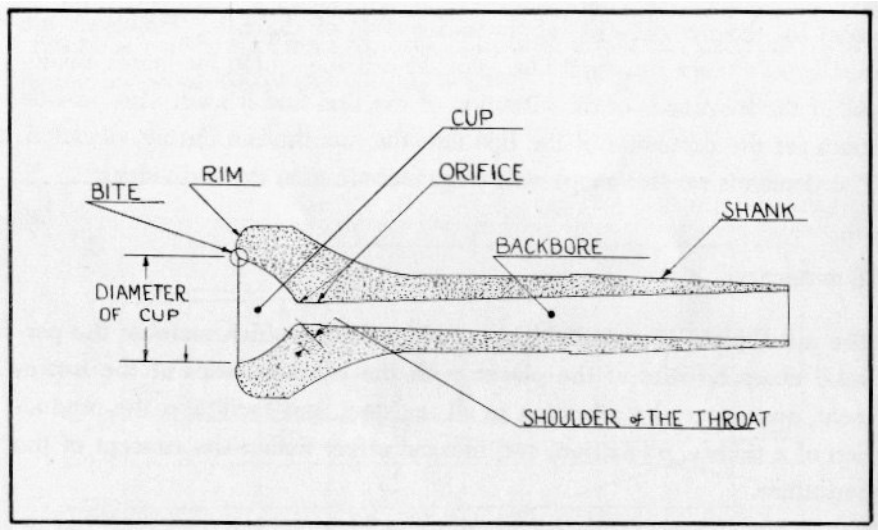

FIGURE 4: TRUMPET MOUTHIECE CROSS SECTION

Note that the term "throat" has been avoided. Some performers refer to the "orifice" as the "throat" of the mouthpiece. There are others who consider the bottom of the cup, or "shoulder of the throat" as the throat. Since this conflict exists, the term "orifice" is used herein for the narrowest portion of the mouthpiece which is the cylindrical portion between the backbore and the shoulder of the throat. The entire cup, including the "shoulder of the throat", will be discussed as a unit.

The parts of the mouthpiece are interacting, and bear a relationship to each other in that any one part can not be changed too much without necessitating a change in the other parts. These interrelationships actually can be shown mathematically by an acoustician. For instance, the ratio of the volume of the cup to the size of the orifice and the size of the backbore is important. This ratio was not the same in the two mouthpieces shown in Figure 1. The change in ratio caused the slight sharpening of the extreme high register. If the ratio had been the same, the entire instrument would have been flattened by the larger mouthpiece.

If a mouthpiece is constructed with a proper balance between the various components, then it generally will be rated as a "good" mouthpiece. Some player will like it, even though it might not exactly match the individual requirements of most players. On the other hand, if the interrelationship between parts is not carefully designed, then every player will immediately condemn the mouthpiece. It is easy for any musician to determine this for himself. Simply drill a 5/16" hole through the orifice of an expendable trumpet or cornet mouthpiece. No one will rate the result as a "good" mouthpiece on any instrument because the interrelationship of the component parts has been destroyed. Note that this completely changes the electrical response pattern. (Figure 5) (Note: In this and all following response graphs, the higher each peak, the more resonance on that particular note, with intonation change shown in cents sharp (+) or flat (-).)

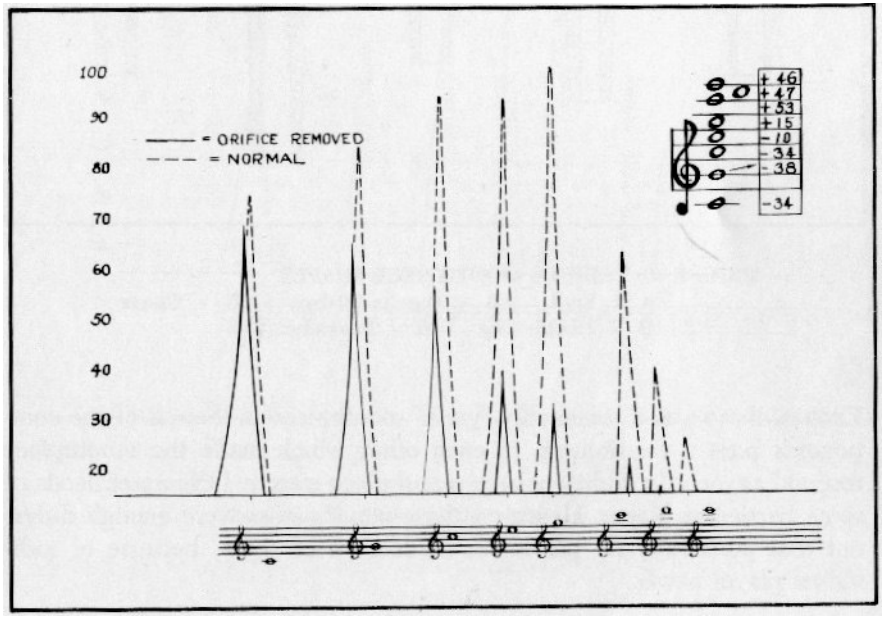

FIGURE 5: EFFECT OF EXTREMELY LARGE ORIFICE
Intonation is shown as the change in cents caused by large orifice.

The intonation of the instrument has been seriously affected, with the lower tones flattened and the upper register sharpened.

The shapes of several mouthpieces are shown in Figure 6.

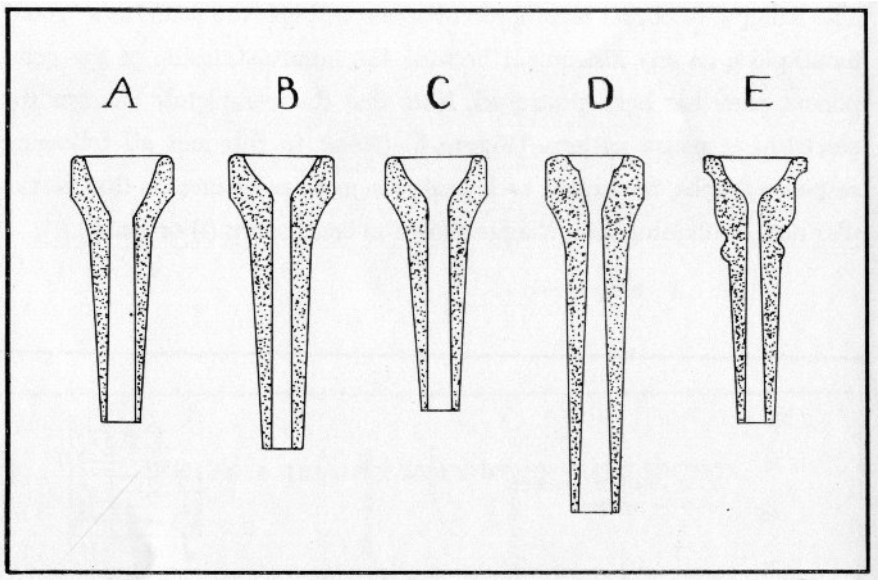

FIGURE 6: VARIOUS MOUTHPIECE SHAPES
A – Kryll B – Popular Modern C – Glantz
D – Double Cup E – Llewellyn

Each of these was a reasonably "good" mouthpiece in that all of the components bore a relationship to each other which made the mouthpiece respond as such. In addition, each mouthpiece matched the exact needs of some particular player. However, these mouthpieces were enough different that practically no player would like all of them, because of individual player needs.

THE ORIFICE

If the cup volume stays the same and the size of the orifice is changed, the "resistance" of the mouthpiece is also changed. The larger the orifice, the greater the demands on the physical development of the embouchure. If the orifice becomes very large it is difficult to play a pianissimo, especially in the high register, but an over-all bigger volume of tone is possible. Usually, a medium sized orifice, matched to the rest of the mouthpiece, is desirable for producing an even response in all registers and a good intonation, plus endurance. The change in resonance and intonation caused by a large orifice is shown in Figure 7.

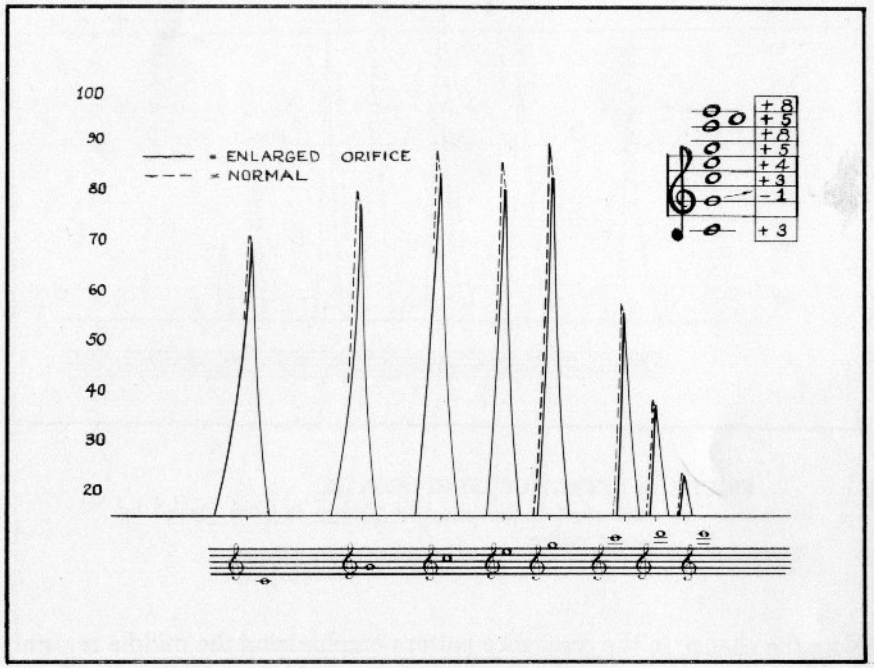

FIGURE 7: EFFECT OF ENLARGED ORIFICE
Intonation is shown as the change in cents caused by larger orifice.

Note that the resonance is decreased, particularly in the upper register, and that the upper register is sharpened by the enlarged orifice.

A longer orifice increases the "resistance" to the player. The change caused by lengthening a trumpet mouthpiece orifice to nearly one inch, without changing the diameter, is shown in Figure 8.

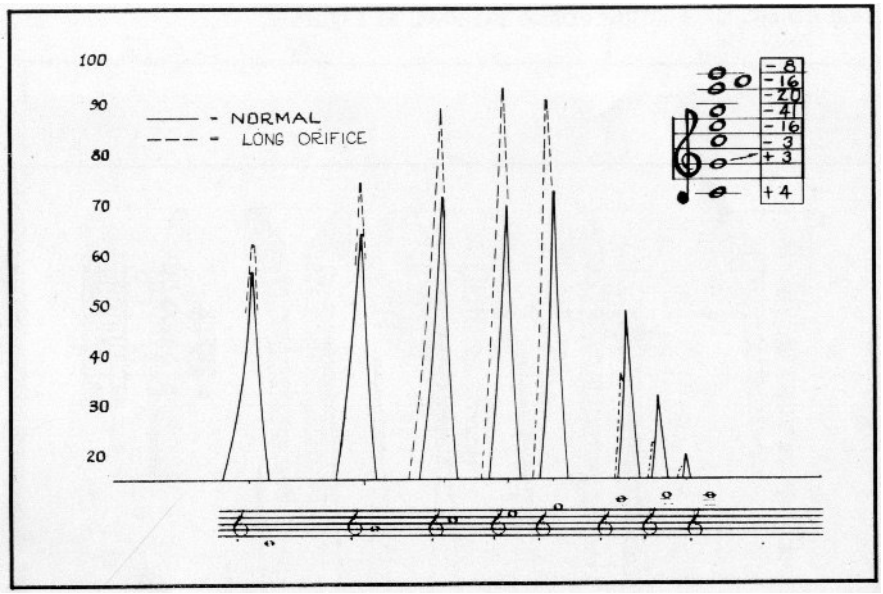

FIGURE 8: EFFECT OF LONG ORIFICE
Intonation is shown as the change in cents caused by longer orifice.

Note the change in the resonance pattern emphasizing the middle register, with a loss of resonance on the higher notes. Also, note that the lower notes are sharpened and the upper notes flattened by the increased orifice length.

Both the length and diameter of the orifice must be matched to the other components of the mouthpiece, in order to obtain optimum performance.

THE BACKBORE

The backbore of a mouthpiece has a definite effect on both tone quality and intonation. If the backbore of a mouthpiece is too small, the high register will be "stuffy" and usually flat. On the other hand, if the backbore of a mouthpiece is too large, the response may not have sufficient resistance and the instrument will perform in a "loose" manner. The octaves will be stretched somewhat, with the high tones slightly sharper.

Figure 9 shows the difference in resonance between a much smaller than normal backbore and a normal-sized one, with all other factors the same. Both the resonance and intonation patterns are changed so much that the instrument is virtually unplayable.

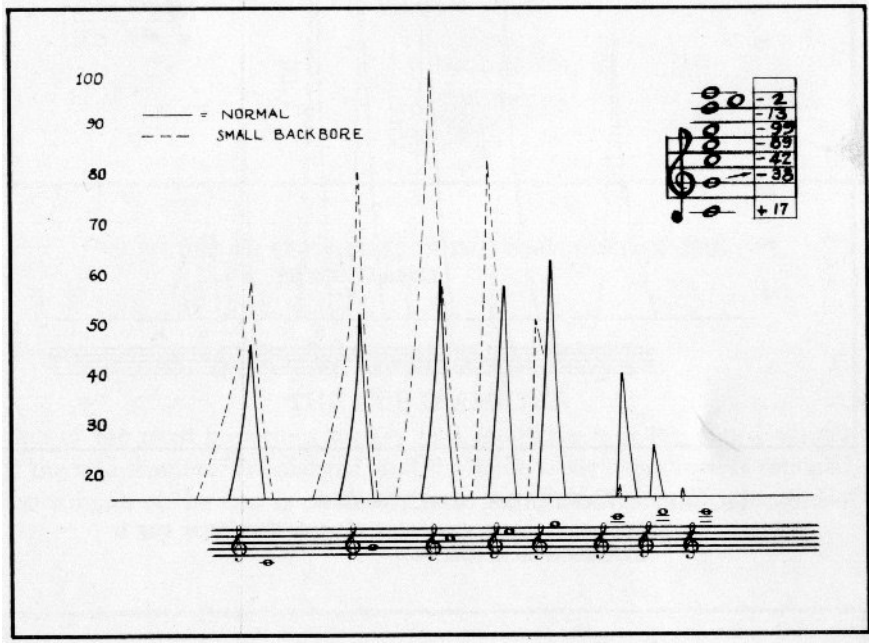

FIGURE 9: EFFECT OF SMALL BACKBORE
Intonation is shown as the change in cents caused by small backbore.

THE CUP VOLUME AND SHAPE

The volume of the cup is a primary determinant of tone quality, of pitch level, and of intonation. A cup with a larger volume aids in the production of a "darker", "rounder", "fuller" sound. However, the resonance pattern of the larger cup is such as to make the higher notes less responsive. In addition, the entire instrument is made flatter by the larger cup. See Figure 10.

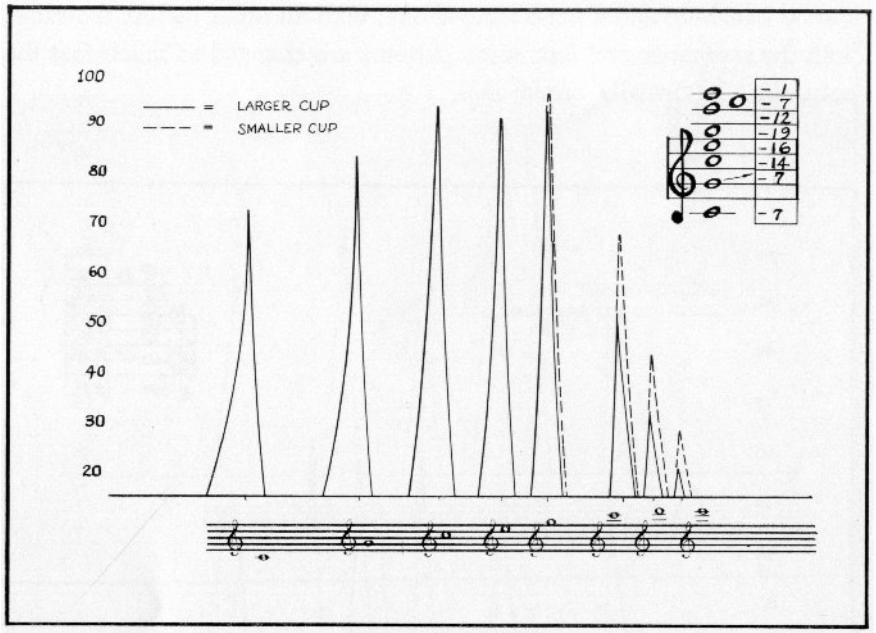

FIGURE 10: LARGER VS. SMALLER CUP
Intonation shown as number of cents that larger cup is different from smaller one

Experiments using mouthpieces with exactly the same volume, same orifice diameter, same rim, but with different cup shapes indicate that cup volume is more important than cup shape, especially in respect to intonation. However, there is much subjective evidence to indicate that the shape of the bottom of the cup, or "shoulder-of-the-throat" does affect tone quality, and to a lesser degree, the "resistance" of the instrument. The general "rule of thumb" is that a cup shaped as in "A", which blends smoothly into the orifice, will have less stridency of sound than will a cup with the abrupt change shown in "B" of Figure 11.

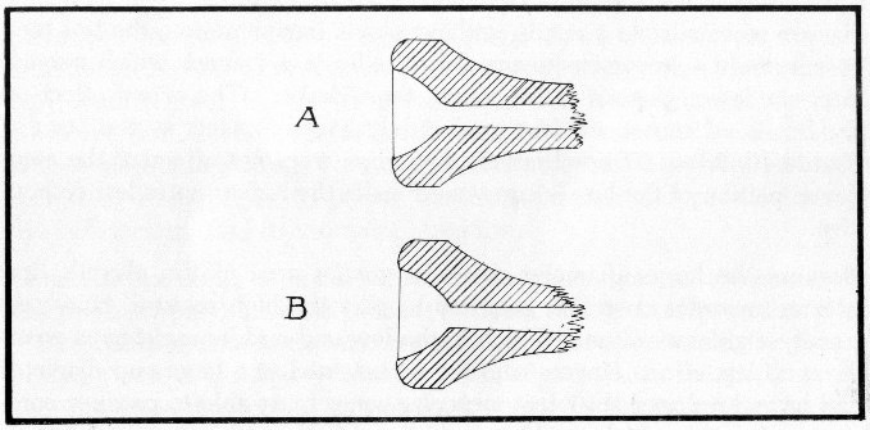

FIGURE 11: CUP SHAPES IN THE "SHOULDER-OF-THE-THROAT" AREA

THE CUP DIAMETER

One of the most important factors in a mouthpiece is the cup diameter. If the cup diameter is enlarged, and the same basic cup shape is retained, the volume of the cup is obviously enlarged (See Figure 12). Because of

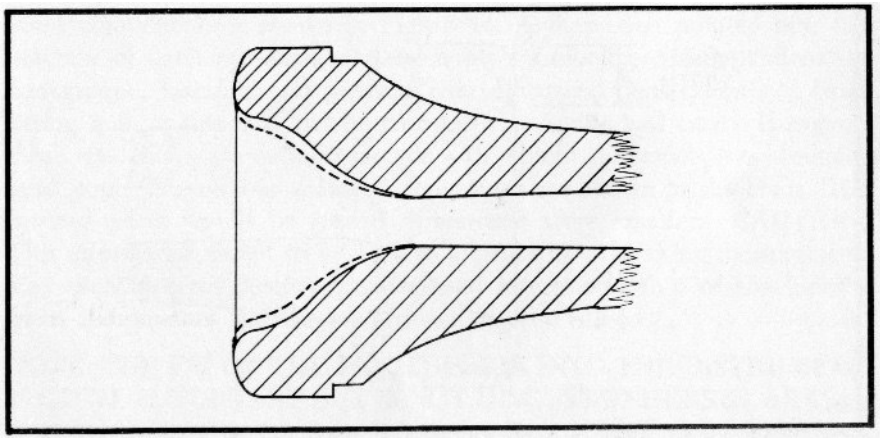

FIGURE 12: EFFECT OF CUP DIAMETER ON CUP VOLUME

the increased diameter both the length and the area of the lips inside the rim are increased. As a result, without player compensation, the lips tend to vibrate at a lower frequency and usually in a manner which emphasizes the lower partials of the sound, thus "darker". The actual effect on the lips is, of course, evident in electronic measurements as was seen in Figure 10. Even if the vibration of the lips were not affected, the resonance pattern of the larger cup would make the higher notes less responsive.

Because the larger diameter covers a greater area of the player's lips, greater muscular control is required to play the high register. However, usually a greater volume of tone in the low and middle registers is possible with less effort. Players who are accustomed to a large cup diameter and have developed sufficient muscular control, are able to produce compact and uniform high, middle, and low registers with great flexibility.

THE RIM

Figure 18 shows the three basic portions of a mouthpiece rim. Most mouthpieces have a fairly sharp radius on the inner edge combined with a medium wide rim with a somewhat rounded curvature. The latter provides a surface which distributes the pressure over a large portion of the lips.

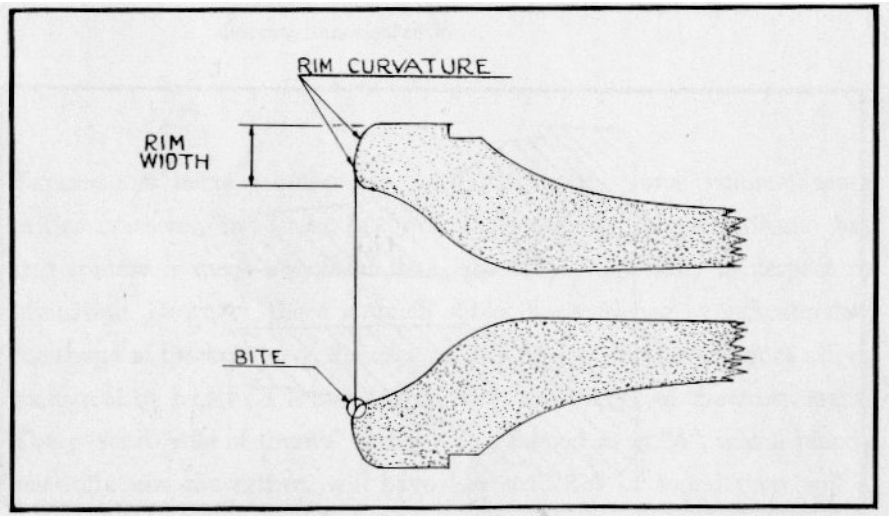

FIGURE 13: THE MOUTHPIECE RIM

The inner edge or "bite" is by far the most important part of the mouthpiece rim. Just as one must press the finger down tightly on a stringed instrument in order to produce a clear tone, so must one also have a definite contact point for the embouchure at the inner edge of the rim. However, during performance the embouchure is constantly changing its rate of vibration. For this reason, the exact effect of the "bite" will vary somewhat from player to player because of individual peculiarities of the embouchure and its muscular structure.

Generally speaking, a small radius on the inner portion of the rim (a sharper bite) provides more accurate attacks and greater precision. This is true because a more definite termination point is provided for the vibrating area of the lips. When the inner edge is more rounded, attacks and intonation may not be as precise, but greater flexibility may be provided. However, this varies according to the individual embouchure, and the rim which is most comfortable and efficient for one player may not suit another.

A mouthpiece with a sharper bite often responds like a slightly smaller diameter mouthpiece. Consequently the sharper bite will tend to provide a somewhat brighter sound, or a tone with a little more "edge", and perhaps even a very slightly higher pitch.

SUMMARY

Aside from the personal factor of varying individual needs, the most misunderstood aspect is the interrelationship of the various parts of a mouthpiece. At the risk of over-simplification, a quick guide to the effects of those components is shown in Figure 14. As has been pointed out, the reaction of each musician, and even his terminology, is dependent on background, training, and physical characteristics. Consequently, a brief listing such as this may not be true in every individual case. However, these tendencies are definite factors with which the mouthpiece designer must cope. The effects of larger dimension are shown in the chart. The reverse effect would be true if dimensions were smaller. CAUTION: This information is not to be used as a guide for reworking mouthpieces. Any such changes destroy the designed interrelationship of the mouthpiece components, and the mouthpiece may be ruined.

NOTE: THE FIT OF THE MOUTHPIECE INTO THE INSTRUMENT IS QUITE IMPORTANT BUT IS NOT DISCUSSED HEREIN. All Conn cup mouthpieces (except Bass Trombone) have a shank designed according to the music industry standard of .050" per inch taper with an outer diameter at the small end of .339" for the cornet and .385" for the trumpet.

Components	Tone Quality	Response	Intonation
Orifice			
enlarged	"Bigger", "Fatter", "Rounder"	Less resonance, especially upper register "Harder to fill" upper register	Upper register sharper
lengthened	"More centered"	"More resonance middle & low registers" "More to blow against in upper register, but less resonance"	Upper register flatter
Backbore			
enlarged	"Bigger", "Fatter", "Rounder"	"More resonance upper register" "Less resonance middle register"	All registers sharper, except lowest
Cup			
volume enlarged	"Darker", "Rounder"	"Less resonance high register"	All registers flatter
shape changed	Slight change in sound		
diameter enlarged	"Darker", "Rounder"	"Less resonance high register"	All registers flatter
Rim			
"bite" rounder	Depends on individual; usually "darker"	Depends on individual, usually greater flexibility, less precision	Depends on individual

FIGURE 14: A CONDENSED GUIDE TO THE EFFECT OF THE VARIOUS MOUTHPIECE COMPONENTS

PART TWO: THE SELECTION OF A CUP MOUTHPIECE

It has been shown in the previous pages that a mouthpiece consists of the rim, cup, orifice, and backbore, and that a properly designed balance of these components is a mark of a fine mouthpiece, In addition, it has been shown that a cup mouthpiece is an individual coupling device which enables a player to produce the timbre, intonation, and musical effect that he desires on any given instrument. Of the various portions of the mouthpiece, the cup diameter, the "bite", and the cup volume provide the greatest possibility of "custom tailoring" for individual preferences of response and sound and for various embouchures. This "custom tailoring" is possible while still maintaining accurate and balanced over-all mouthpiece proportions throughout the mouthpiece for even response in all registers.

Conn has designed, for the first time in the music industry, a comprehensive offering of mouthpieces which provides a logical selection of cup diameter, rim "bite" and cup volume … the Conn Connstellation mouthpieces. Each mouthpiece has a cup size, cup shape orifice size and length and backbore carefully proportioned for greatest consistency of response, precise intonation, and tonal beauty in all registers. From this offering, a player can now select, with almost scientific precision, a mouthpiece which provides for him the exact type of sound and response that he desires and which aids flexibility of attack and agility in performance. In order to provide this selection, new exacting manufacturing tolerances have been necessary. The necessary accuracy and consistency is possible only because of a completely new tooling process developed by Conn.

In order to assist a player's selection, a logical numbering system is applied to the mouthpieces -again a Conn first. The cornet and trumpet mouthpieces now available are numbered 5, 7, and 9. The higher the number, the smaller the diameter of the cup, as measured at the bottom of the bite or inner portion of the rim. See Figure 15.

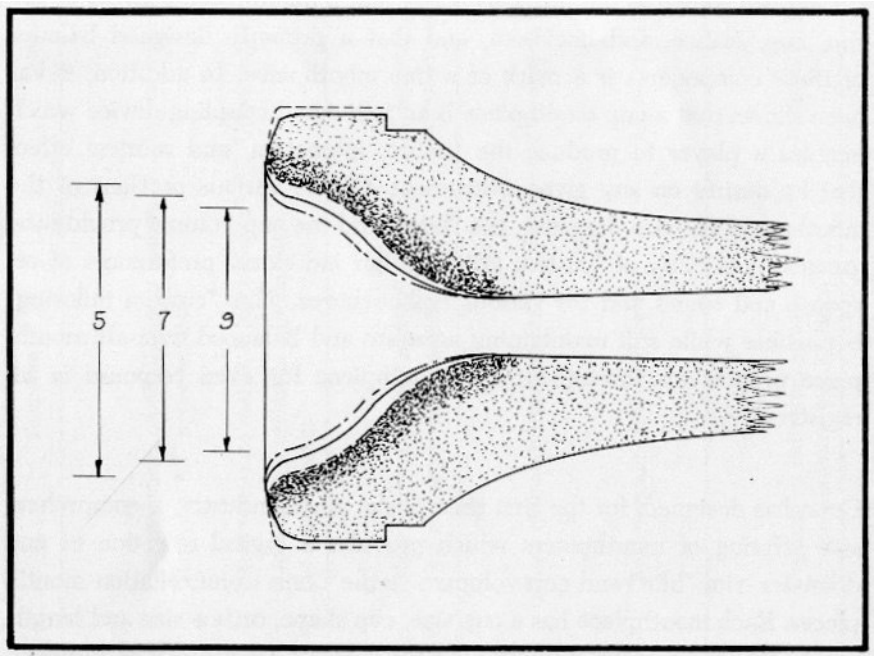

FIGURE 15: CONNSTELLATION MOUTHPIECE CUP DIAMETER OPTIONS

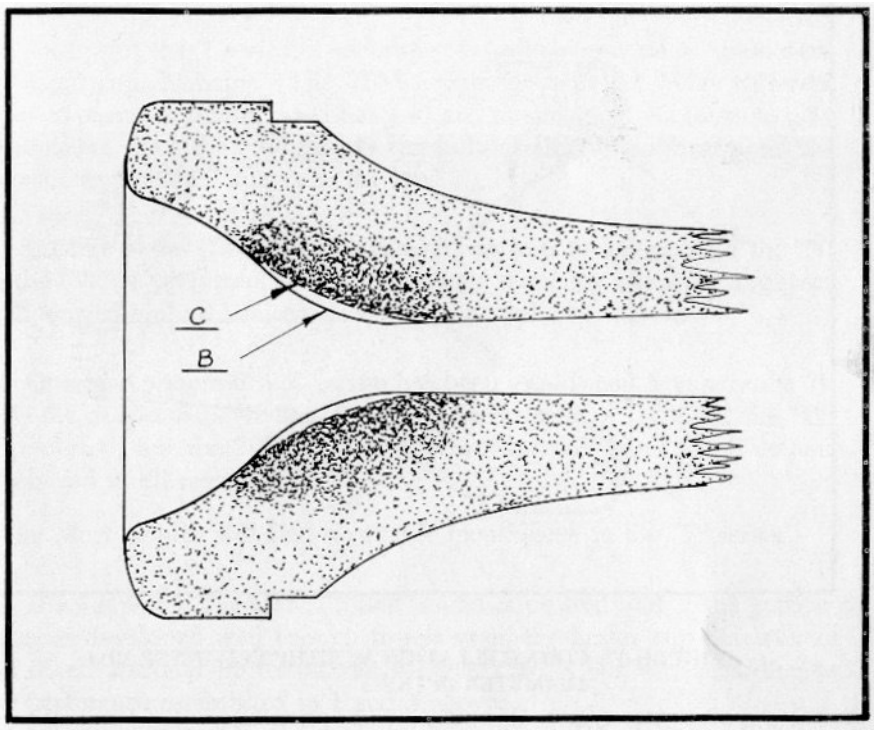

FIGURE 16: CONNSTELLATION MOUTHPIECE CUP VOLUME OPTIONS

In addition, a player can have a choice of a smaller cup volume, or a slightly larger cup volume. This is accomplished by enlarging the lower portion of the cup, in the area sometimes referred to as the "shoulder-of-the-throat". The Connstellation mouthpieces are designated "B" or ‘C" according to the volume of the cup. The "C" is identical to the "B" cup except that the lower portion of the cup has been enlarged. See Figure 16.

This operation has often been performed in a "do it yourself" manner by some instrumentalists, but now this feature is available in a stock mouthpiece, with correct proportions maintained throughout the critical "bottom of the cup" and orifice areas.

The most important advance embodied in the Connstellation line of mouthpieces is the choice of inner rim diameter, or "bite". The letter "N" designates a sharper inner rim diameter (smaller radius) and also a slightly narrower rim width. The letter "W" indicates a more rounded inner rim diameter or "bite". See Figure 17.

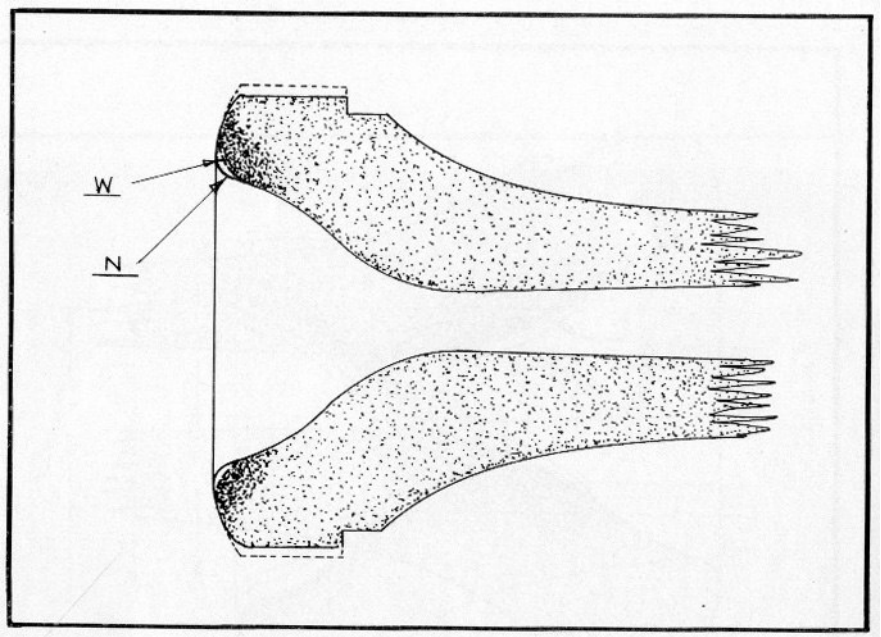

FIGURE 17: CONNSTELLATION MOUTHPIECE INNER RIM DIAMETER OPTIONS

As a result of this acoustically correct approach, a range of cornet and trumpet mouthpieces in logical steps is provided from the 5C (largest) to the 9B (smallest). Each of these mouthpieces is offered in N (sharp "bite") and W (more rounded "bite"). This approach removes the mystery from mouthpiece selection.

TIPS IN MOUTHPIECE SELECTION

From largest to smallest cup volume, the new cornet and trumpet mouthpieces are ranked as below. Since the rounder bite usually has the effect of a slight enlargement, the "W" model is listed as larger than the "N".

Larger Smaller

5CW 5CN 5BW 5BN

7CW 7CN 7BW 7BN

9CW 9CN 9BW 9BN

In order to select a mouthpiece, the following procedure is suggested.

1. Start with the 7 series of mouthpieces, which provide a "middle-of-the-road" cup diameter. The 7BW would be suitable. Play different types of passages, noting ease of attacks and of slurring, being sure to play all registers. Note the tone quality carefully at all volume levels, and the way the embouchure adapts to the rim.

2. Change to the "7BN". Repeat the playing tests to determine if the "N" or the "W" is preferred. Use test passages requiring changing registers, both slurred and articulated, with different styles of attack.

3. Once the preferred type of rim has been established, compare the 7B with the deeper cup. (If the "N" is preferred, test the "7CN", if the "W" is preferred, test the 7CW .) Carefully compare the sound at all volume levels and in all registers.

Note: Most players will find a suitable mouthpiece in the "7" series.

4. If a "darker", "rounder", "fuller" sound is desired and if the embouchure is developed enough to use such, the larger cup diameter of the 5 series should be tested, using either the "N" or "W", according to the preference established in 1 and 2 above.

5. If a "brighter" sound is desired and high register assistance is desired, test the "9" series using the preferred "N" or "W".

6. When a preference has been established among the "5", "7" or "9" series, retest the "bite" preference, "N" or "W". This preference sometimes can change with a change in cup diameter.

7. When both "bite" and "cup diameter" preferences are firmly established, carefully test the difference in sound and response between the "B" and "C" models. Very often a player will choose both mouthpieces, using the "C" for cornet, the "B" for trumpet.

Once this personal mouthpiece preference has been established, every player will be pleased to know that because of the exacting manufacturing tolerances which have been established, he can obtain, if ever needed, another mouthpiece like the first one selected, with a minimum of the variation which has plagued musicians in the past.