The Trumpet Mouthpiece:

A study of its history, function and development

Kent Foss

May 6, 2004

MUS 491 – Independent Studies

Mouthpiece History

In order to understand past developments in trumpet mouthpieces it is important to recognize that the trumpet has evolved greatly over the course of time, perhaps more than any other instrument. The earliest of trumpets - often made from large seashells, animal bones and horns, or wood - served as an amplification device for the human voice. Mouthpieces for these instruments were unnecessary as the player did not actually buzz his lips.

Instruments resembling the modern day trumpet began to show up in Egyptian drawings dating back to 1500 BC. The Egyptian trumpets, made of silver or bronze, included a mouthpiece, long tube, and bell. Mouthpieces of these early trumpets were merely an extension of the main pipe of the instrument, not the removable mouthpieces we know today. Other ancient cultures, such as the Israelites and the Greeks, developed similar trumpets built using both animal materials and metals. The Etruscans, a mysterious culture eventually conquered by the Romans, are believed to have developed the earliest removable-mouthpiece, bronze trumpets.

Due to their primary role as signaling instruments, ancient trumpets were not designed with tone quality in mind. In fact, trumpets were specifically designed to produce a very alarming tone quality. As a result, mouthpiece construction remained rather primitive as timbre and physical comfort were rather low priorities for musicians and instrument makers. The lur, an instrument developed by the Teutonic tribes from present day Scandinavia, served as one of the important vehicles for mouthpiece development. Advancements in metallurgy, coupled with a desire to enhance the playing

characteristics of the instrument (it is believed that the lur was used mainly for religious purposes), created the proper situation for mouthpiece improvement. The mouthpieces of the early lur were similar to other ancient trumpets, serving merely as an extension of the tube of the instrument. Eventually the lur included a removable, bowl-shaped mouthpiece, comparable to modern trombone mouthpieces.

From the fall of Rome in A.D. 476 through most of the Middle Ages, the trumpet functioned primarily as a signaling instrument for martial, religious, and athletic events. Although new instruments in the trumpet family came into existence during this period of time, little advancement in instrument or mouthpiece design took place. The gradual evolution of the trumpet as a practical signaling device to a musical instrument began to take place during the late Middle Ages, from the 12th through the 14th centuries. On a regular basis trumpeters could be heard in the courts of royalty, announcing the beginning of tournaments, and serving as municipal trumpeters in the towers of wealthy trading cities of the time. The most advanced mouthpieces of this time were usually constructed from several pieces made of sheet metal. The most advanced of these included a cast cup attached to a rolled tubular shank. Some mouthpieces of this time included up to seven individual parts (Tarr, *The Trumpet*, p. 50-51).

The Renaissance of the 15th and 16th centuries brought about important changes in mouthpiece construction techniques. Whereas trumpeters of the 13th and 14th centuries generally played only in the middle and lower registers, trumpet players now were called upon to play from the 8th to the 20th harmonics of the instrument and even higher, a range known as the *clarino* register. With these changes in the role of the trumpet, changes in equipment soon followed. Casting techniques, formerly used in the manufacture of the

actual tube of the trumpet, began to be used for the construction of mouthpieces. Initially, mouthpiece shanks were still made of rolled sheet metal with cast cups attached with solder. Eventually entire mouthpieces were cast. Early mouthpieces of sheet metal construction had shanks with little or not taper at all. Shanks with standard taper rates began to appear with the advent of one-piece cast mouthpieces.

By the beginning of the Baroque Period (1600 to 1750) the role of the trumpet as a musical instrument had become well established. A more delicate way of trumpet playing began to emerge along with more advanced techniques. Mouthpieces of this period, generally made of brass castings, were further refined with the use of lathes and reaming tools. In addition to this, standard characteristics among mouthpieces began to emerge. Typically, Baroque mouthpieces are much larger in diameter than modern trumpet mouthpieces and have very flat rims, which aid in producing crisp articulations. Also, the shoulder of the Baroque mouthpiece (where the cup meets the throat) is generally very sharp and the backbore is larger than that of modern mouthpieces (see Figure 1).

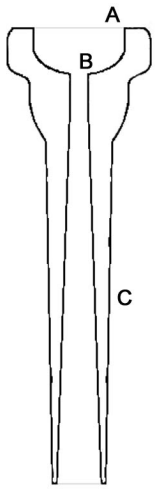

Figure 1
A. Flat rim and crisp bite
B. Sharp shoulder
C. Tapered Shank

Whereas the trumpet experienced great popularity from 1600 to 1750, its role in the orchestra drastically changed with the onset of the Classical Period. Trumpet players, now relegated to primarily tutti sections in the orchestra repertoire, did not have the same demands placed on them as in the Baroque Period. However, some very important developments in trumpet design came from this period of decline. With composers writing trumpet parts in a lower tessitura (usually below the 13th partial), the ability of trumpet players to play melodic passages had greatly diminished and second trumpet

parts often had wide awkward leaps due to the limitations of the harmonic series. Feeling confined by the harmonic series, composers and trumpet players alike wanted to create a trumpet that could play diatonic or chromatic passages in any register.

Attempts at creating a chromatic trumpet during the Classical Period included the stopped trumpet, keyed trumpet (cylindrical descendant of the trumpet), keyed bugle (conical descendant of the bugle), and slide trumpet. While the stopped trumpet, keyed trumpet, and slide trumpet generally included mouthpieces similar to those of natural trumpets, the keyed bugle mouthpiece was somewhat different. "They feature wide, slightly rounded rims, which are very comfortable to play. The cups of these mouthpieces are funnel-like and deep. The throat or hole entering into the backbore is wider than would be expected from an average modern trumpet mouthpiece" (Dudgeon, *The Keyed Bugle*, p. 185).

Several factors early in the 19th century Romantic Period lead to an increase in the popularity of the trumpet. As composers began to write for the newly invented chromatic versions of the trumpet, a new invention proved to significantly advance the trumpet, perhaps more than any other single development. The piston valve, invented around 1815, would eventually surpass all other trumpet developments of the classical period. The main benefits of the piston valve were an evenness of tone among different valve combinations (the stopped trumpet and keyed trumpet had rather heterogeneous tone from one note to another), and an increased ability to negotiate technical passages.

Although the invention of the valve trumpet did not directly influence mouthpiece design, this new technology certainly encouraged composers to utilize the trumpet in new ways. Much of the new, technically challenging repertoire influenced mouthpiece design

as players desired more variation in mouthpiece selection. Specifically, the angularity at which the cup of the mouthpiece entered the throat had become significantly diminished by this point. By rounding off the shoulder of the mouthpiece, the overall tone of the instrument became less sharp and pointed, and the slurring of notes over wide intervals became easier.

The cornet, invented around 1831 by adding the newly invented piston valves to a posthorn, posed somewhat of a threat to the trumpet. The differences between the keyed trumpet and the keyed bugle are similar to the differences between the trumpet and cornet. Whereas the cylindrical keyed trumpet included a shallow, bowl-shaped mouthpiece, the conical keyed bugle included a deep, funnel-shaped mouthpiece. The cornet, a conical instrument, included a funnel-shaped mouthpiece with a gradual entrance from the cup to the throat, producing a warm, mellow tone. The pleasing sound of the cornet along with its 'safer' upper register (the trumpet's brighter tone seemed to augment any mistakes in the upper register) prompted many musicians, conductors, and listeners to prefer the cornet over the trumpet.

Around the middle of the 19th century, the trumpet began to be built in the key of Bb. Perhaps the most important contribution of the cornet was that of Bb tuning, as cornets were built in Bb long before trumpets were, and it was from the cornet that the trumpet derived its Bb tuning. The Bb trumpet proved to be more accurate than older, longer trumpets, and its tone served to project better, which was especially important considering the growing size of the orchestra. By the 1920's the Bb and C trumpet had become the instrument of choice in the orchestral world.

Although mouthpiece rim and cup sizes did not undergo any significantly developments in the late 19th and early 20th century, some advancement did occur in terms of throat size and backbore shape. In general, throat sizes among mouthpieces of the 19th century and earlier were much larger than throat sizes seen in modern mouthpieces. Also, L.A. Schmidt of Cologne, Germany began to develop a standard backbore for mouthpieces, which although is larger than most backbores seen today, is sometimes used in modern mouthpieces. Stephen A. Morse, an American machinist, created the standard shank taper rates still used on mouthpiece shanks today. Vincent Bach, a Viennese born trumpet soloist who was also trained as a mechanical engineer, significantly standardized the American mouthpiece market. Bach began producing mouthpieces with a smaller throat size of #27, a size which is still the standard today. Bach felt that by producing mouthpieces with smaller throat sizes, players could customize the throat to a diameter that best suited them.

For most of the early 20th century orchestral trumpet players preferred mouthpieces with moderately-sized cup diameters and somewhat smaller throat and backbore sizes than seen with cornet-like mouthpieces of the late 1800's. However, a trend toward larger cup diameters developed in the late 1950's among orchestral trumpet players in the United States. One of the many factors that led to this trend involved Adolph "Bud" Herseth, principal trumpet of the Chicago Symphony from 1948 to 2001. In 1952, Bud Herseth was involved in an automobile accident and sustained severe damage to his lips and teeth. Due to severe scar tissue problems he was forced to switch from a Bach 7 rim (the mouthpiece which he began his CSO tenure with) to a much larger Bach 1 rim. As many trumpet players emulated Bud Herseth's orchestral trumpet

playing, orchestral players in Boston and New York soon began using significantly larger mouthpieces also.

Seemingly in parallel with the trend toward larger mouthpieces in the orchestral world during the 1950's, some jazz musicians began expanding the upper register of the trumpet beyond what was previously thought possible. In order to facilitate playing in this register, trumpet players preferred shallow mouthpieces with small cup diameters and narrow backbores. The parallel development of both large and small mouthpieces illustrates one of the most significant developments in 20th century mouthpiece manufacture: the wide range of mouthpiece sizes that could be obtained by the trumpet player.

Mouthpiece Function

The mouthpiece of any brass instrument serves as the most important connection between instrument and musician. In searching for the perfect mouthpiece, one usually finds that it does not exist. Finding the ideal mouthpiece is a give and take process. It is through knowledge of the different parts of a mouthpiece and the subtle nuances of those parts that one can make educated decisions when making equipment changes.

Rim

Perhaps one of the most noticeable features of the mouthpiece to the player, the rim influences the general feel of a mouthpiece more than any other part. The rim is the part of the mouthpiece that comes into contact with the embouchure. Numerically, the rim is one of the most difficult mouthpiece features to describe. Manufacturers commonly choose to describe the rim in terms of its width and its shape. Measurements of the rim usually include the outside rim diameter, inside rim diameter, and rim thickness (width). The inside rim diameter and the cup diameter are generally considered to be the same measurement as they are both measured where the cup meets the rim.

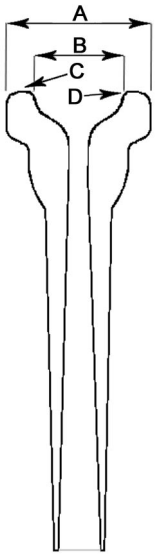

Figure 2
A. Outside rim diameter
B. Inside rim diameter
C. Bite
D. Rim thickness

General characteristics of mouthpiece rims fall into three categories: rim width, rim contour, and bite. Wide rims allow mouthpiece pressures to be distributed across the embouchure, aiding in comfort and endurance. Narrow rims provide more control as the embouchure is bound to less of the mouthpiece. Players often observe better flexibility and clearer attacks with narrow rims, but endurance can suffer. Rim contour is generally described in terms of flatness or roundness. Similarly with rim width, flat rims provide more comfort and endurance and round rims allow greater flexibility and control. The same principle used with wide and narrow rims is applied here; a flat rim allows more lip to contact the rim surface area whereas a round rim essentially has a smaller area of contact with the lip. In general, the peak of rounded rims lies nearer to the cup of the mouthpiece than to the edge. The bite

of a mouthpiece refers to the inner edge of the rim. A mouthpiece with a sharp bite will generally aid in clear attacks and well-defined pitch but can be uncomfortable and cause endurance problems, especially if too much mouthpiece pressure is used.

Cup

The cup of the mouthpiece determines the overall tonal quality of the mouthpiece possibly more than any other single feature. Serving as a connection between the rim and the throat, the cup forms the main resonance chamber for the vibrations of the embouchure. The overall feel of the mouthpiece can be affected to some degree by the cup. Depending upon the amount of lip protrusion into the cup a player experiences, the embouchure may make some contact with the wall of the cup. Mouthpiece cups are generally described in terms of depth, width, and shape.

The cup, although easier to quantify than the rim, still poses some difficulties in terms of measurement. Cup diameter, as mentioned earlier, is measured at the point where the rim enters the cup. Cup depth measures the distance between the rim plane and the throat. Another measurement, the cup volume, takes into account both cup diameter and cup depth. However, cup volume alone does not describe the overall shape of the cup. Most manufacturers choose to use descriptive terms such as “bowl-shaped” or “V-shaped” when describing the cup as opposed to using actual measurements. In general, shallow cups tend to enhance the upper overtones in the sound strengthening the upper partials. Shallow mouthpieces often seem to “speak” more quickly than deeper mouthpieces since resonance takes place more quickly. An excessively shallow

mouthpiece can cause poor attacks, a thin sound, and bottoming out (the lip contacting the back of the cup, causing a disturbance in vibration) can occur. On the other hand, deeper cups and V-shaped cups tend to enhance the fundamental and lower partials of the sound. Overly large cup sizes can cause endurance and range problems, along with causing the overall sound to become dull.

Shoulder

The shoulder, located just below the cup, merges the bottom of the cup into the throat. In more shallow or bowled mouthpieces the shoulder tends to be more pronounced, creating what is called a second cup (also known as the small cup or double cup). In deeper, funnel-shaped cups the shoulder tends to blend smoothly into the throat, thus not creating a second cup. In cases where the second cup is pronounced, air flowing over the shoulder experiences significant turbulence. This can brighten the sound and serve to aid in upper register playing, but if the turbulence becomes excessive a loss of stability will occur and cracked notes will become more common.

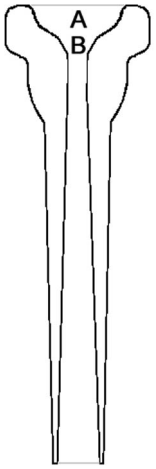

Figure 3
A. Main cup
B. Second cup

Throat

At the base of the cup before the backbore is a short cylindrical section of the mouthpiece called the throat, venture, bore, drill, or simply the hole. Since this is the narrowest part of the mouthpiece, the throat plays an important role in shaping the

vibrations produced in the cup by the embouchure. The throat is measured in terms of length, diameter, and sometimes shape. The vast majority of manufacturers exclusively make cylindrical throats, however some manufacturers have experimented with tapered throats. Throat length is simply the length of the cylindrical portion of the throat. Throat diameter is measured using drill sizes, with the #27 (0.144 inches) throat size considered the industry standard.

Wide throat diameters can enable players to use a greater volume of air, produce high volumes of sound without the tone becoming distorted or edgy, and produce a darker, warmer sound. Although one would think that a larger throat would not facilitate playing at softer volume levels, often times the opposite effect is observed; a large throat can enable players to use more air at softer volume levels, allowing players to play with more confidence at lower volume levels. While most players generally view the throat only in terms of its diameter, throat length has a great effect on the overall intonation of the mouthpiece. As the cylindrical throat of a mouthpiece is lengthened the upper register becomes flat and the lower register becomes sharp. Likewise, as the throat length is decreased the upper register becomes sharp and the lower register becomes flat. It is for this reason that it is not recommended to use a drill in order to change the throat diameter. When the diameter is increased with the use of a drill the overall length of the throat also increases.

Backbore

Serving as a transition from the throat of the mouthpiece to the leadpipe, the backbore of the mouthpiece is possibly the most difficult mouthpiece characteristic to observe. The fact that the backbore is difficult to see and cannot be easily measured causes many trumpet players to ignore this important part of the mouthpiece. Backbores are measured in terms the amount of taper that occurs from the beginning of the backbore (just past the throat) to the end of the backbore (at the end of the mouthpiece). However, this measurement does not completely describe the shape of the backbore. The amount of initial taper of a backbore describes at which point most of the taper occurs in the backbore. Mouthpieces with a high amount of initial taper expand closer to the throat than mouthpieces with a low amount of initial taper, which expand closer to the end of the mouthpiece. The overall amount of taper along with the amount of initial taper of a backbore are what determine whether a mouthpiece is considered to have a large backbore or a tight backbore.

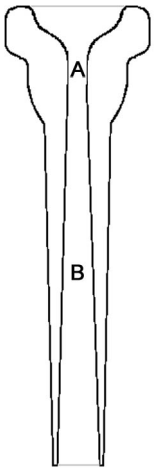

Figure 4
A. Throat
B. Backbore

Tighter backbores, in general, provide for more projection, more projection, and emphasized upper partials in the sound. An excessively tight backbore will cause the upper register to become flat and can become overly resistant. Larger backbores can decrease resistance, provide for a darker tone, and allows easier playing in the lower range. Backbores that are too large can cause problems with the sound becoming too "spread" or tubby and cause endurance problems.

External Mouthpiece Characteristics

Although the interior characteristics of a mouthpiece – the rim, cup, throat, and backbore – affect the overall playing characteristics more than any other part of the mouthpiece, some external characteristics should be considered as they do have some bearing on the overall quality and performance of the mouthpiece.

The shank of the mouthpiece is the tapered section which is inserted into the mouthpiece receiver on the leadpipe. The standard rate of taper, known as the Morse Taper No. 1, is .050 inch per inch. Although the shank does not directly affect any of the playing characteristics of the mouthpiece, it does determine how deeply the mouthpiece seats in the receiver. An improper fit between the shank of the mouthpiece and the receiver of the leadpipe can result in too much or too little gap between the mouthpiece and the leadpipe. Excessive mouthpiece gap will generally cause more resistance, but at the same time it can also cause better slotting. Not enough gap, or negative gap, will generally cause less resistance poor slotting. Damage can also occur to the leadpipe if the mouthpiece rests on the edge of the leadpipe.

The overall mass of the mouthpiece is believed to have some effect on the overall playing characteristics of the mouthpiece. Heavier mouthpieces have been observed to aid in the ability to slot notes, and some players may see an increase in projection. Additionally, heavier mouthpieces can serve to balance the weight of the horn. Some players feel that heavier mouthpieces cause a decrease in overtones, however

Most modern trumpet mouthpieces are made of solid brass plated with another metal, such as silver, nickel, or gold. Some experimentation with using other metals has been done, such as solid silver mouthpieces, but little change in sound has been observed with the use of these materials. However, the type of metal that the mouthpiece is plated with can have some effect on how the mouthpiece feels. Gold-plated mouthpieces generally feel more slippery than silver mouthpieces, which tend to grip the skin better. Also, many players experience sensitivity or allergic reactions to metals such as nickel, and to a lesser degree, silver. This sensitivity has been shown to be enhanced by pressure, friction, and moisture of sweat, breath condensation and saliva (Gambichler, *Contact dermatitis and other skin conditions in instrumental musicians*, p. 7). The use of gold-plated mouthpieces is generally the best remedy for this type of situation as allergies to pure gold are extremely rare.

Recent Developments in Trumpet Mouthpieces

Mouthpiece manufacturers have experimented with alternate designs and new configurations of trumpet mouthpieces for decades. In the early part of the 20th century, a number of European mouthpiece manufacturers experimented with altered cups, bowls, and even proposed adding a spring mechanism to the shank of the trumpet mouthpiece (Bate, *The Trumpet and Trombone*, 74). Interestingly enough, one of these experiments involved using an oval-shaped bowl in order to be "more adaptable to some lips." The

recent development of an asymmetric mouthpiece seems to be similar to what this inventor had conceived.

Certainly the most significant recent development in mouthpiece design and construction has been the use of computer-based design programs and computer-numeric controlled (CNC) lathe and milling systems. With the aid of design programs manufacturers have been able to mathematically describe every part of the trumpet mouthpiece. This has taken much of the guess work out of mouthpiece design, allowing the development of more efficient mouthpiece designs. In this age of the quantified mouthpiece, communication about trumpet mouthpiece specifications has become much more precise. Instead of using vague terms in describing mouthpiece characteristics we can now use exact values. In addition to this, the use of CNC equipment in the production of mouthpieces has dramatically improved the consistency of mouthpieces that are now being produced.

Another important innovation has been the development of interchangeable threaded mouthpiece parts. Two common configurations can be found: a two part configuration consisting of a rim and an underpart (consisting of the cup and backbore), or a three part configuration consisting of a rim, cup, and backbore. These mouthpieces allow the player to change certain parts of the mouthpiece for various musical requirements while keeping other parts of the mouthpiece the same.

The use of mouthpiece sleeves has allowed players to customize the amount of mouthpiece gap, a task that normally requires the use of lathes (to reduce gap) or shank reconstruction (to increase gap). Mouthpiece sleeves are designed to fit over a specially designed shank and the player can choose which sleeve will yield the proper mouthpiece

gap. The use of mouthpiece sleeves is not possible with particularly large backbores since a certain amount of metal must be removed in order for a shank to accept a mouthpiece sleeve.

The adjustable-cup mouthpiece allows the player to adjust the cup depth of the mouthpiece with great ease. The mouthpiece generally consists of a threaded cup which the player can adjust manually. Most adjustable-cup mouthpieces include some type of retention device to hold the mouthpiece at the selected cup depth. A click system is most commonly employed in these mouthpieces to ensure that the mouthpiece depth does not change while the mouthpiece is being played.

One of the most radical developments in trumpet mouthpieces is the asymmetrical mouthpiece, developed by John Lynch. This mouthpiece is characterized by a half-moon shaped cup with the upper half of the cup shaped like a traditional mouthpiece cup and the lower half of the cup serving as an extension of the throat. As previously mentioned, mouthpiece manufacturers had experimented with significantly different cup shapes, but these designs never were mass produced. The main principal behind this design is that the upper and lower lips of the embouchure function differently. Consequently, the makers of the asymmetrical mouthpiece feel the design should reflect this. One of the main benefits this mouthpiece can offer, according to the manufacturer, is increased high range. By causing the lower lip to protrude upward as opposed to into the cup, this mouthpiece is designed to assist in achieving a small embouchure aperture, which in turn aids in high-range playing.

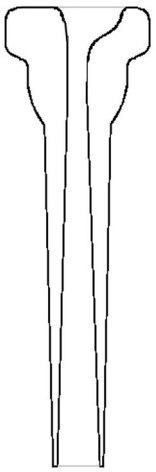

Figure 5
Asymmetrical mouthpiece developed by John Lynch

Works Cited

Bach, Vincent. *Embouchure and Mouthpiece Manual*. Elkhart, IN: Vincent Bach Corp., 1968.

Barclay, Robert. *The Art of the Trumpet-Maker*. New York, NY: Oxford University Press, 1992.

Bate, Philip. *The Trumpet and Trombone*. New York: W.W. Norton, 1978.

Chapman, Robert C. *Mouthpiece Cups, Throats and Calculations*. International Trumpet Guild Journal. January, 2002: 40-41.

Dudgeon, Ralph T. *The Keyed Bugle*. Metuchen, NJ: The Scarecrow Press, Inc., 1993.

Endsley, Gerald. *Comparative Mouthpiece Guide For Trumpet*. Denver, CO: Tromba Publications, 1980.

Frederiksen, Brian. *Arnold Jacobs: Song and Wind*. Ed. John Taylor. Gurnee IL: Windsong Press, 2000.

Gambichler, T., et al. *Contact dermatitis and other skin conditions in instrumental musicians.* London, UK: BioMed Central, 2004.

Laskey, Scott. Interview with James F. Donaldson. 2000. <www.dallasmusic.com/gearhead>

Lynch, John. *The Asymmetric Trumpet Mouthpiece*. International Trumpet Guild Journal. February, 1996: 52-55.

Maller, David. Personal Correspondence. 19 April, 2004.

Radtke, Gary. *GR Mouthpieces*. Dousman, WI: GR Technologies, 2004. <www.grmouthpieces.com>

Schilke, Renold O. *Schilke Mouthpieces for Brass*. Chicago, IL: Schilke Music Products, Inc., 1973.

Tarr, Edward. *The Trumpet.* Trans. S.E. Plank and Edward Tarr. Portland, OR: Amadeus Press, 1988.