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A SYSTEMATIC APPROACH TO THE
MAKING AND ADJUSTING OF SINGLE REEDS

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Shelley J. Hanson

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A SYSTEMATIC APPROACH TO THE MAKING AND ADJUSTING OF SINGLE REEDS

By

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ABSTRACT

A SYSTEMATIC APPROACH TO THE
MAKING AND ADJUSTING OF SINGLE REEDS

By

Shelley J. Hanson

Tone quality and response of reed instruments may vary greatly depending on the reed used. Clarinet and saxophone reeds with consistent tone quality and response may be obtained by using a non-traditional reedmaking method based on 1) a system of profiling cane to basic reed shape, and 2) a conceptual model of the reed's motion and resultant necessary shape.

In traditional methods of reedmaking, a reed blank is cut to the approximate reed shape, then filed, scraped, or sanded to the finished shape. Although general guidelines may be followed, the inaccuracy possible with this method allows much variation from correct shape.

For consistent correct results, the basic shape may be approximated by a series of sanding operations to yield a straight line from the shoulder to a point at least one millimeter from the tip. The tip of the top side of the blank is held at a forty-five-degree angle to a sheet of #220 carborundum paper on a flat surface, and is rubbed alternately away and toward the reedmaker to form a straight line between the extreme tip and a point on the vamp.

The angle of the reed with the paper then is lessened progressively so that areas farther from the tip receive the force of the sanding; the straight line with the tip gradually moves back to the shoulder.

Areas of the blank untouched by the paper are thinned with a reed

knife or sandpaper. The reed is inverted and sanded on #400 paper; the tip bends away from the paper and is not sanded. When a straight line has been formed from the shoulder to a point behind the tip, the cane remaining at the sides is removed so that the reed tapers from center to sides and shoulder to tip. The basic reed shape is now present in the blank.

The conceptual model is based on a simplified view of the action of the reed. All parts of the reed should move toward and away from the mouthpiece at the same rate. Resistance must decrease gradually from shoulder to tip and center to sides, because areas nearer the tip must move greater distances, and greater force of embouchure and airstream is present in the center.

Vibration rates must be equalized between parts of the reed. If one part of the reed vibrates faster than the rest, excessive high overtones are produced.

The vibration of one part of the reed affects the vibration of all other parts. Parts of correct thickness may vibrate too fast if an adjacent area is too thin, or is so much thicker that motion is effectively stopped; a reed which seems "thin" to the player may be too thick at one or more points. An area only somewhat too thick may vibrate more slowly than surrounding areas, making the reed seem resistant.

The rigidity of the reed as a whole determines the ease with which it may be set into motion. Although the area toward the shoulder does not move, its resistance affects the freedom of movement of the entire reed.

Other topics discussed include methods of determining needed adjustments, adjustments based only on parameters of shape, effects of blank width and taper, and the breaking-in process. General guidelines are given for solving four basic adjustment problems: 1) too much resistance; 2) too little resistance; 3) too many high overtones; 4) lack of clarity.

Appendices deal with correct knife technique, making blanks from tube cane with hand or frame-mounted planes, common problems in commercial reed adjustment, sources of reedmaking supplies, and measurements of sample reeds.

ACKNOWLEDGMENTS

This thesis in its present form would not have been possible without the assistance of many people. In particular, I appreciate the contributions of Charles Bay, Richard Klausli, Elsa Ludewig-Verdehr, John McCaw, and Keith Stein. Double reed players John Heard, John Scott, Virginia Stitt, and Daniel Stolper were very helpful in developing my knife technique. Study of the Alexander Technique with Joan and Alexander Murray helped clarify ideas for the conceptual model of reed motion. Cathy Chambers and Sandra Moats cheerfully suffered through the editing of rough drafts.

I appreciate my parents' support and interest in my graduate studies, and the assistance of my sister, Maureen Hanson, in the preparation of the final draft of this thesis. Finally, I wish to thank my husband, Paul Little, for his intellectual and moral support throughout my graduate career.

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INTRODUCTION

One of the most important skills a reed player can acquire is the ability to adjust reeds to play well on his instrument. While players of other instruments may be able to detect some minor changes in their instruments' responses depending on the weather, the reed instruments are by far the most radically affected by day-to-day changes, and exhibit the greatest possibilities for variance of response and tone. An attempt to maintain consistency of instrumental response and tone at all times through consistent use of reeds with similar capabilities is thus a necessity for the serious player.

Most advanced double reed players are capable of providing themselves with an adequate supply of reeds whose response and tone is similar, through the use of a more or less systematic approach to reedmaking. While most double reed players start their reedmaking with a piece of cane which requires relatively little scraping to produce a sound, as in the case of the oboe reed, or a piece of cane which has been profiled to a configuration rather close to that of the final reed, as in the case of the bassoon reed, the single reed player must start from a "blank" -- a strip of cane whose only correct dimensions are length and width.

Traditional methods of making single reeds involve cutting the surface of the vamp (curved side) to approximately the correct shape, and then scraping, filing, or sanding the surface to the exact proper shape. The difficulties of learning this method of reedmaking are reflected in Kalmen Opperman's statement in the major reference on single reed making, that "it will be possible to make a playable reed within the first three dozen attempts."[1]

Beginners often make a major uncorrectable mistake in the first stage of reedmaking, that of the rough cutting of the blank, because of the large amount of cane which must be removed with only very general guidelines. An additional difficulty with the traditional method of making and adjusting reeds is that no truly systematic method has been presented; the major references do not give specific reasons for making an adjustment, but instead give a list of possible defects in the reed's response or tone, accompanied by a list of possible remedies for those defects. However, because the same unwanted quality in a reed may be caused by any one of several wildly different improper dimensions or a combination of improper dimensions, attempts to correct reed shape based on the symptoms of unsatisfactory qualities will often result in no improvement in the reed.

In attempting to systematize single reed making, the process may be divided into two major steps: 1) "profiling the cane", creating the basic reed shape, not by the use of inexact rough cutting, but by inverting the reed blank and sanding on rather coarse wet-or-dry carborundum paper to form a straight line from the shoulder to a point one or more millimeters from the tip of the reed, and 2) "final adjusting", correcting the reed's shape by using a conceptual model of the reed's function as a vibrating spring as well as by using parameters of shape

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1 Opperman, Kalmen, <u>Handbook for Making and Adjusting Single Reeds</u>, New York: Chappell and Co., 1956, p.1.

and flexibility.

The method described below has been used to teach reedmaking to approximately thirty single reed players at Michigan State University and California State University, Fresno. Almost all students made playable reeds within their first two or three attempts; all students made playable reeds within the course of the term. While several of these players are now dependent exclusively on reeds which they have made, for most players the principal value in learning to make reeds is the acquisition of the ability to adjust commercially available reeds to proper playing condition with great accuracy.

CHAPTER 1

APPROXIMATING THE REED SHAPE

Materials needed:

Flat glass, preferably plate glass, about 8" x 10";
Plaque (clear plexiglass about 1" x 4" on which the reed is placed for alterations);
#220, #400, and #600 wet-or-dry carborundum paper;
Cutting knife, such as X-Acto #5 or #6 handle with #25 blade (see Appendix A: Knife Technique);
Scraping knife, preferably double-hollow-ground (see Appendix A: Knife Technique);
Reed clipper.

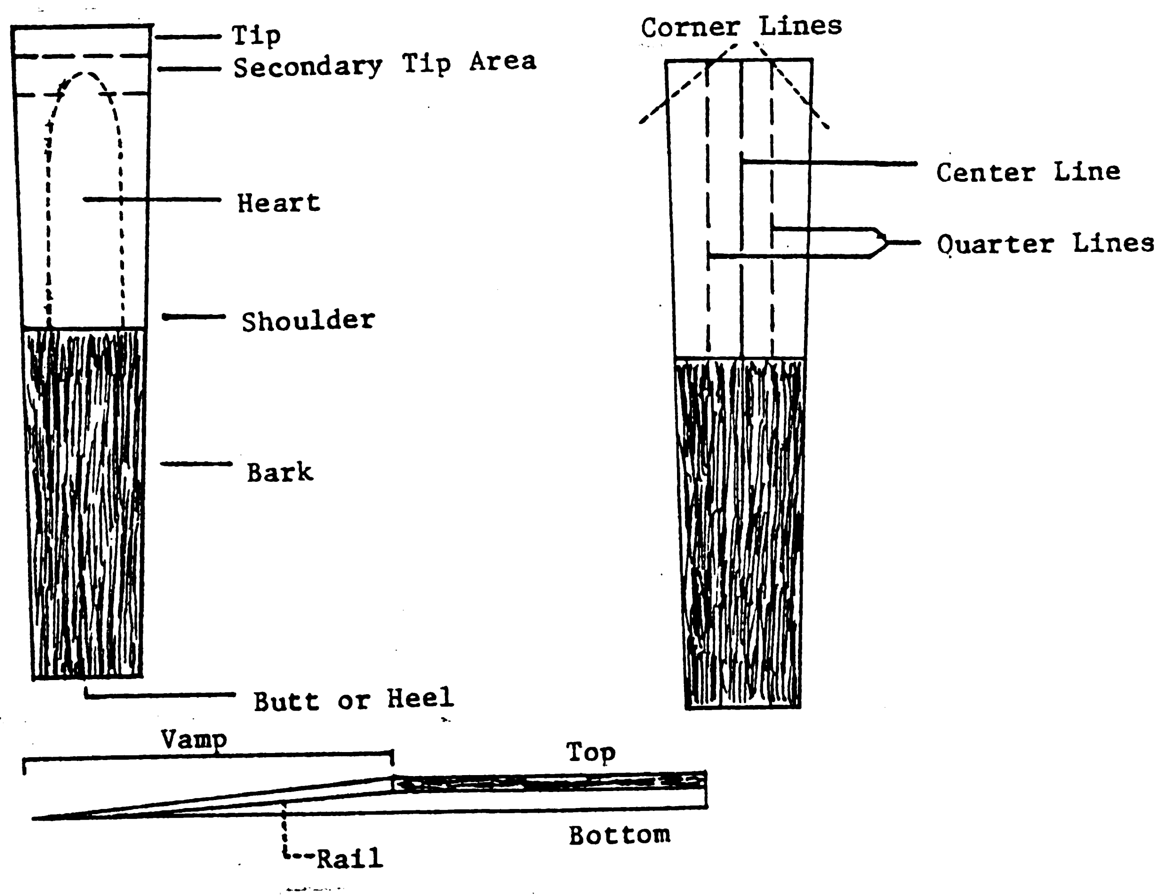

Figure 1. Terms for the parts of the reed.

For convenience, the Bb clarinet reed will be used as a model; this method of profiling and adjusting can be used to make reeds for other members of the clarinet and saxophone family with appropriate adjustments in scale.

Because of variations in the blank,[1] every reed will be slightly different even from other reeds made by the same person. However, a similarity of tone and response can be maintained by using the same basic profile, and thus similar proportions, for all reeds, and adjusting each reed to play as well as it can.

Reedmaking may be divided into two main stages: profiling the blank into the basic reed shape, and adjusting the reed into its final form. Before the actual work of making the reed can begin, however, the blank must be cured and flattened.

CURING THE BLANK

The reed must be completely flat on the bottom to vibrate most efficiently. If it is not flat, adjustments will have to be made later in the vamp of the reed to compensate for its lack of flatness. Additionally, a blank cured over the proper amount of time will produce a reed which will last longer and be less susceptible to changes in humidity.

Like most wood, cane tends to swell and warp when it gets wet. Curing the blank is a process which accustoms the fibers of the wood to

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1 Good blanks are available from several sources; see Appendix D. Many players prefer to make their own blanks from tube cane to make certain that the blank is shaped properly.

moisture. The cane is allowed to warp as much as it would under normal conditions; the bottom of the blank is flattened over a period of several days, and hopefully will not warp further.

To allow the blank to swell, it should be soaked in water for several minutes, then left to dry, flat side down, on glass. For all reed work, room temperature water is best -- very hot or cold water tends to encourage extreme warpage and weakening of cane fibers. The process of soaking the blank and allowing it to dry should be repeated on several successive days, so that the blank has been soaked and dried for at least three days prior to the first sanding.

All reed work, sanding as well as scraping, is done with the reed wet. Although many players sand the reed only while it is dry,[1] sanding while it is wet has several advantages: 1) a layer of water on wet-or-dry carborundum paper (hereafter termed "sandpaper") allows the cane to be sanded more efficiently, since the water washes away the cane dust instead of allowing it to clog the grit of the paper or to be ground into the bottom of the blank; 2) sanding the blank while it is wet makes certain that the bottom of the reed will be flat not just when dry, but when it is wet as it will be when played; 3) sanding the bottom of the reed results in a smooth as well as flat bottom for the reed.

To flatten the blank, #600 sandpaper normally should be used, although the coarser grit of #400 paper may be required if the blank is obviously quite warped. The paper is placed on flat glass so that the

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1 Sanding the reed while wet was a suggestion of John McCaw, Principal Clarinetist, New Philharmonia Orchestra, London, England.

sanding surface will be flat. A layer of water is put on the paper, and the blank, which has been soaked for a minute or two, is placed flat side down on the paper. With the hand held parallel to the surface of the paper, several fingertips are placed lightly on the bark along the center of the blank. Then, with as little pressure as possible, the blank is moved on the paper in a circular motion. Little or no downward pressure of the fingers should be necessary; the friction between fingertips and bark should be sufficient to allow the blank to be moved.

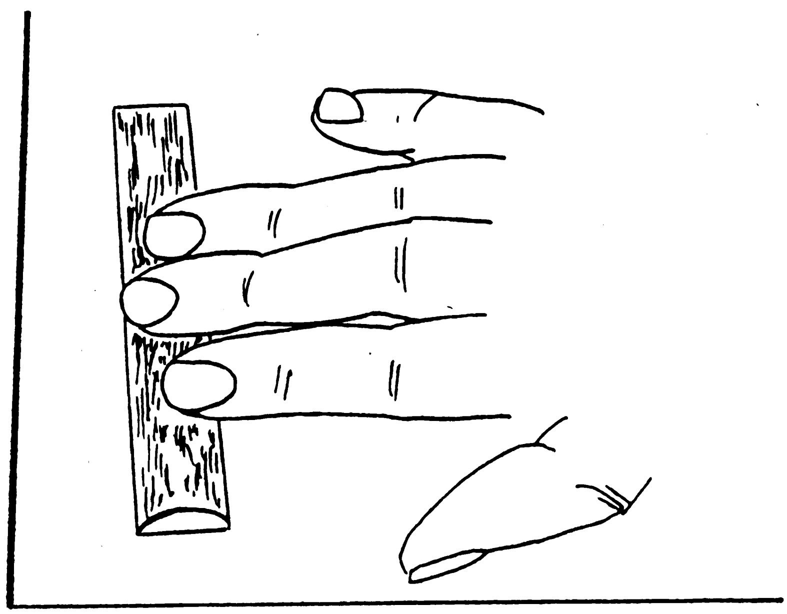

Figure 2. Sanding the bottom of the blank.

In general, whenever sanding, there must be plenty of water on the paper, or it will be very difficult to move the blank, and cane dust will be pressed into the blank. It may be helpful to reverse the direction of the blank or of the circular motion occasionally to be sure that sanding progresses evenly. When sanding at any stage, it is a good idea to rinse the blank often in fresh water, and occasionally to add more water to the paper to prevent clogging of the grit.

Most commercially available blanks are rather thin; the best blanks are just barely the desired thickness for clarinet blanks, 3 millimeters. In an attempt to leave the blank as thick as possible, and to continue to cure the cane, flattening of the blank is done gradually over a period of days, with only a small amount of sanding done on each of three or four days.

When the blank has been lightly sanded on several successive days, the blank should be rinsed and a fingertip rubbed along its bottom surface. If the entire bottom surface of the blank feels very smooth to the touch, all parts of the flat side have been at least in contact with the sandpaper. It then should be checked for flatness by placing it, wet, on a piece of flat glass. The blank should be pressed down firmly, and any excess water drawn off with a piece of paper towel aligned with one edge of the blank. When the glass is turned over, the entire bottom of the blank will be pressed against the glass if the blank is flat. If, however, it is still warped, an air space will be apparent between part of the blank and the glass. To be certain that the blank is flat, the bark may be pressed lightly near the tip, heel, and various points along the length of the blank; if pressure at one point forms an air pocket at another point, the blank needs further flattening.

The entire process of curing the blank should take about a week -- three or four days of soaking and drying the blank, and three or four days of light sanding. When sanding the bottom of the blank, it is better to take extra time to flatten the blank slowly than to take a chance on the blank warping later, since it will be virtually impossible to flatten the blank further once the making of the reed has begun. Especially in times of changing seasons, weather conditions may make a blank swell a great deal in one day, and sanding much at one time may leave a deep indentation in one area of the blank when the cane returns to normal.

PROFILING THE BLANK

The process of profiling is used to approximate the basic shape of the reed. An operation which makes the blank conform closely to the final shape of the reed, profiling nevertheless ensures that enough cane is left in the reed to allow for later adjustments. Because the process of profiling is less dependent than the traditional method on the judgement of the reedmaker, more consistent results are obtained, and later major adjustments in basic reed shape are minimized. By making the reed gradually over several days, the fibers of the blank continue to become accustomed to water; warpage of the finished reed is minimal, and the reed is partially broken in by the time it is first played.

Although the steps involved in profiling are described in some detail below, the process itself is neither complicated nor lengthy in practice. The stopping points indicated are for reedmaking in optimal conditions, when the player is not in urgent need of the reed; if necessary, reeds can be made in a much shorter period of time, with many or even all steps being done in the same day. However, reeds made in one day normally do not last as long as reeds made over a longer period of time.

The reedmaker is cautioned to be certain that the blank used is flat; once profiling has begun, any attempt to flatten the blank will create further warpage of the reed. At some stages of profiling, the blank may appear to have warped slightly; the reedmaker should not attempt to correct this, since it is usually just a temporary distortion caused by the shape of the reed vamp at that stage.

To approximate the shape of the reed, the basic profile of the reed may be thought of as a straight line from the shoulder to the tip.

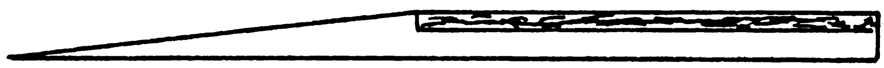

Figure 3. Basic profile.

To determine the length of the vamp desired, the length of the mouthpiece windway (opening on the flat side of the mouthpiece) is measured, and one or two millimeters added, depending on the length of the reed desired. Many clarinetists prefer to use a reed somewhat longer than the windways of their mouthpieces, feeling that a longer reed produces a darker sound. Even if this additional length is not wanted, it is wise to allow one-half to one millimeter of additional length to compensate for any loss of length while finishing the tip. An average length of profiled vamp is about 34 millimeters.

Removing the Bark

The reed blank should be lined up with the ruler in one hand or on a table. The wider end of the blank is the tip end. The blank should be pressed lightly at the desired length with the blade of an X-Acto knife or other sharp cutting knife. This light nick is just to mark the length, not to cut or make a deep impression in the bark. Taking the blank in one hand, the reedmaker may find the mark just made in the bark with the blade of the cutting knife. The knife should be rocked carefully once across the blank in a straight line to form an extremely shallow groove; this groove is really just a line (the "cut line") to indicate the length of the vamp.

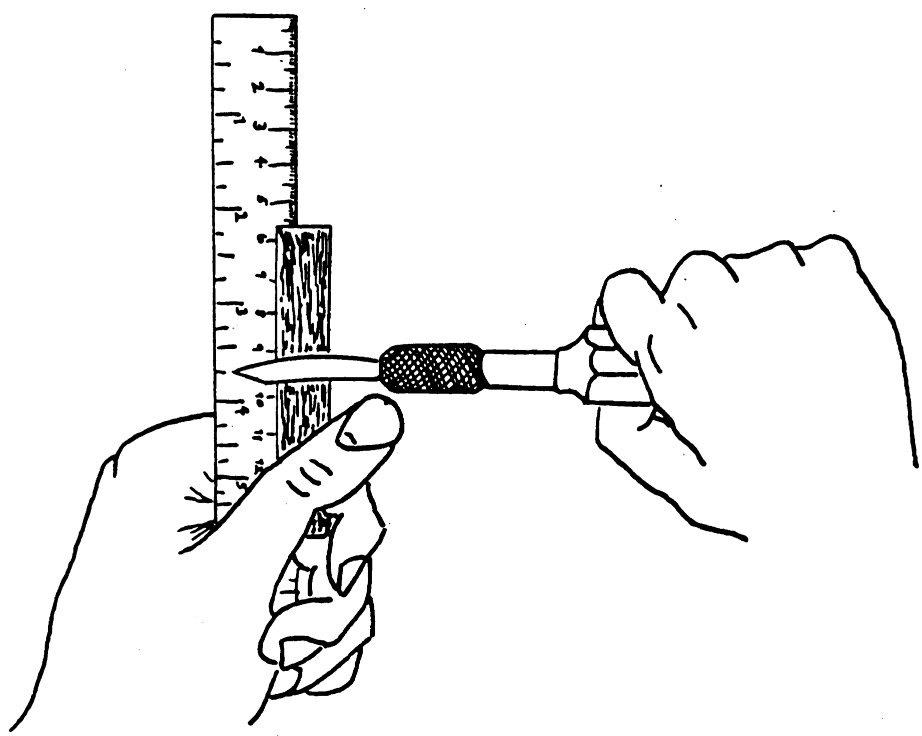

Figure 4. Marking the length.

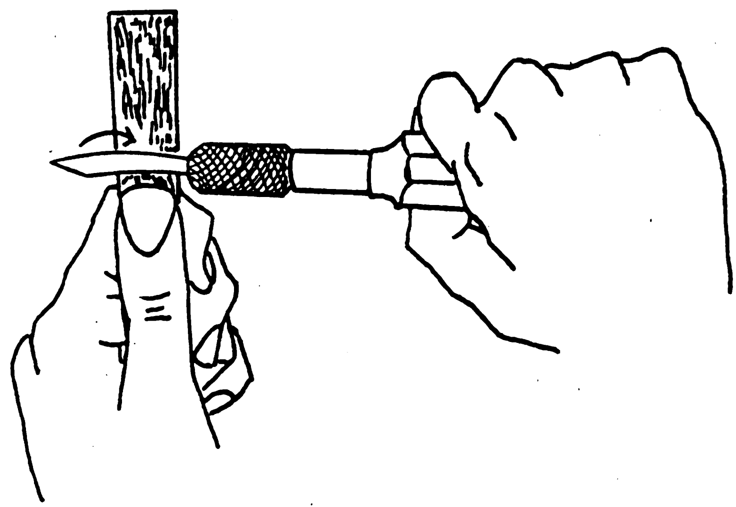

Figure 5. Rocking the knife.

Removal of the bark from the cut line to the tip is optional, but recommended for efficiency. To remove the bark, the blank is held in one hand, and the blade of the cutting knife placed along one part of the cut line. With the blade held as nearly parallel as possible to the plane of the blank, the thumb of the hand holding the blank is used to push and guide the knife blade out toward the tip of the reed. A thin and narrow strip of bark should be removed with this stroke.

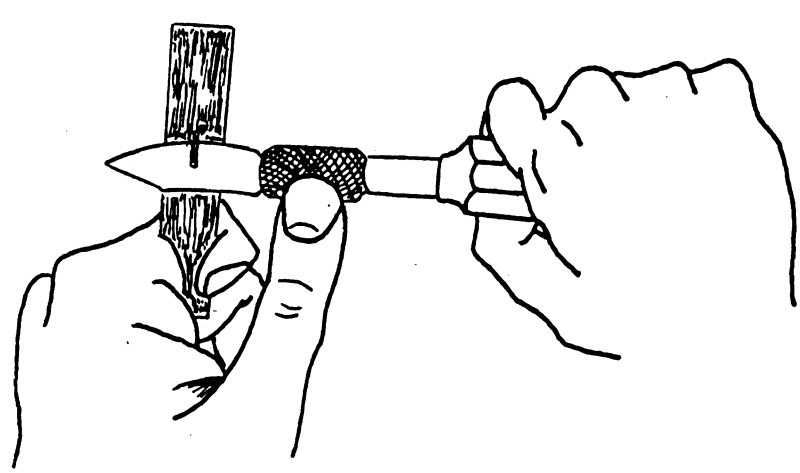

Figure 6. Removing the bark.

This process should be repeated at points along the cut line until all or almost all of the bark is removed. It is best to be very cautious when removing bark; any downward pressure of the knife may remove a layer of cane as well as of bark. An attempt to remove too wide a strip of bark at one time or to hurry at this stage may also give an unsatisfactory result.

If time allows, it is helpful, although not necessary, to soak the blank and allow it to dry overnight on flat glass before profiling it.

Profiling Operation I

The main profiling of the reed to achieve a straight line from shoulder to tip is done by inverting the blank and sanding the vamp side on #220 sandpaper. More experienced reedmakers may wish to remove the obvious excess cane by making a few shallow cuts along the length of the reed vamp with the cutting knife, with the first cut starting about three-quarters of the length of the vamp, and each successive cut beginning somewhat closer to the tip. These cuts must be very shallow to avoid removing cane needed in the basic profile. The inexperienced reedmaker is advised to make at least the first few reeds without making these cuts, both to learn the technique of sanding, and to be sure that cane needed in the reed is not inadvertently cut away.

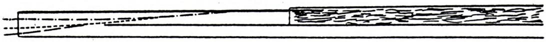

Figure 7. Shallow cuts in vamp.

To profile the blank, the reedmaker should put a layer of water on a sheet of #220 sandpaper placed on flat glass. The blank should be inverted so that it is held flat side up, with the tip area on the paper pointing away from the reedmaker. Held at about a 45-degree angle to the paper, the blank should be rubbed alternately away from and toward the reedmaker. The blank can be controlled most easily by holding it with thumb and middle fingers along the rails, and placing the index finger on the flat side.

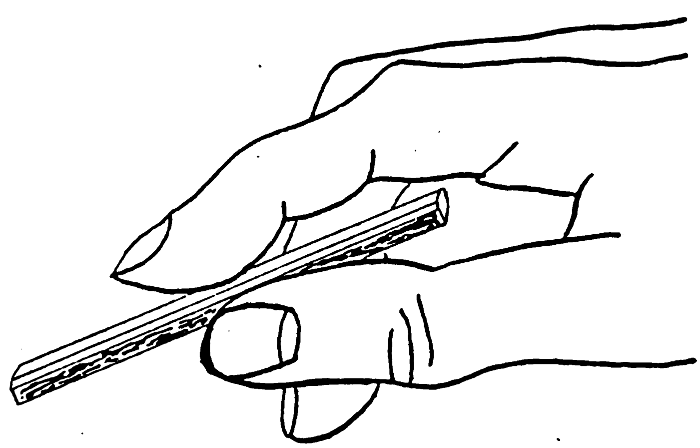

Figure 8. Holding the blank for sanding.

The index finger applies most of the downward pressure which causes the blank to be sanded. After the blank has been sanded for several strokes, it should be rinsed in fresh water. At this point, a straight line should have begun to form between the tip and some point of the vamp.

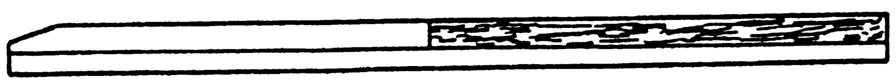

Figure 9. Straight line between tip and point on vamp.

The blank should be inverted, and sanding continued. At all times there must be a layer of water on the paper. As soon as the blank has been sanded so that the straight line is between the very tip of the blank and some point on the vamp, the index finger and other fingers if

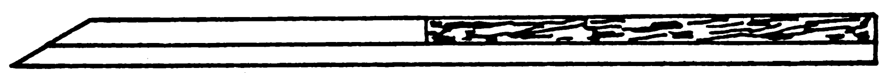

Figure 10. Straight line between very tip and point on vamp.

necessary should be moved back slightly farther along the blank, and the angle between blank and paper allowed to become smaller. The change of angle lifts the very tip slightly off the paper, and places the pressure applied by the index finger over the part of the blank which has not yet been sanded, rather than the part which has already been sanded.

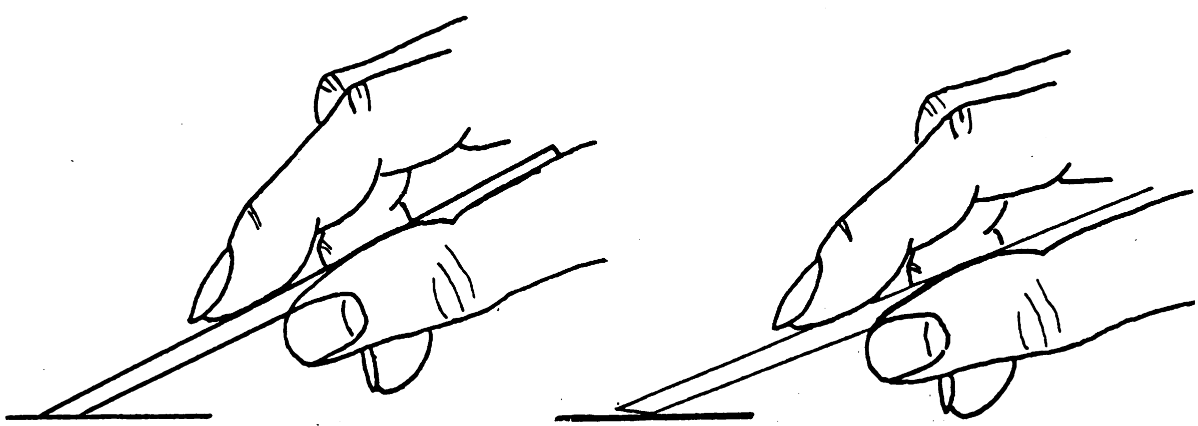

Figure 11. Change of angle and pressure point.

As profiling progresses, the pressure point of the index finger on the blank should be moved progressively further back, and the angle formed by the reed and the paper should become progressively smaller. If the pressure point is too close to the tip of the reed, or the blank is held at too steep an angle, the tip of the blank may be shredded or sanded away.

In the course of the profiling, the straight line moves between the tip and points progressively closer to the shoulder. When a straight line from the tip to a point about three-quarters of the length of the vamp from the tip has been formed, the blank should be rinsed well in fresh water, and allowed to dry on glass overnight.

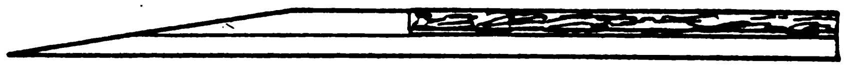

Figure 12. Blank after profiling operation I.

Profiling Operation II

The second day of profiling continues the process of inverting and sanding. The blank should be sanded until a straight line is formed between shoulder and tip, the basic profile of the reed. To be sure that sanding is stopped when the shoulder is reached, it may be helpful to pencil a line lightly along the flat side of the reed at the desired length to use as a guide; as long as the area behind the pencil line never moves over the edge of the sandpaper, it cannot be sanded accidentally. When the profile is completed, the blank should be rinsed and again left to dry.

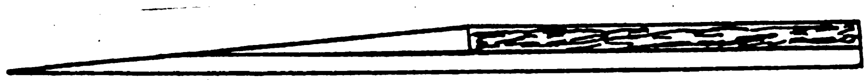

Figure 13. Blank after profiling operation II.

CORRECTING THE PROFILE

At this point, although there is a straight line from the shoulder to the tip down the center line of the reed, it will be apparent by looking at the blank that the rails are quite thick for the entire length of the reed; the areas not touched by the profiling are also evident because of the dark color of the layer of cane immediately under the bark.

Figure 14. Dark layer of cane in profiled blank.

Ideally, a reed should get consistently thinner from the shoulder to the tip, and from the center line to the sides.

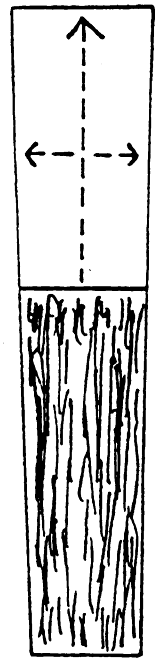

Figure 15. Directions of increasing thinness.

That situation is not present in the blank at this stage; much of the area of cane untouched by the profiling is as thick as the cane at the center of the blank, and, especially toward the tip, the blank is a consistent thickness across the width, instead of tapering from the center to the sides. To approximate more closely the true shape of a reed, this unwanted cane must be removed from the wet blank by using the scraping knife,[1] using #220 sandpaper, or even by inverting the blank again and sanding it diagonally or tilted to one side. This last method is somewhat treacherous even for experienced reedmakers, since large amounts of cane are removed rapidly, and even one misguided stroke may remove cane which is necessary for the shape of the reed.

To remove the excess cane, a combination of knifework and sanding

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1 A double-hollow-ground knife is recommended; see Appendix A: Knife Technique.

while the blank is on the plaque seems to work best for most people. If, while working with the knife, a gouge is accidentally formed, it is best to stop scraping immediately, and smooth out the gouged area with a small piece of sandpaper (used, as always, wet). Continued scraping in a gouged area often will result only in making the gouge deeper. The best direction to scrape is diagonally outward; since the cane should get thinner from shoulder to tip and center to sides, a diagonal scrape outward can take only the cane which should be removed, and, because the blade moves across the fibers instead of parallel to them, prevents most of the gouging and tearing caused by faulty knife technique.

To sand the blank on the plaque, a small piece of sandpaper should be placed across the tip of the index finger, and held there by the thumb and middle finger. While the paper may be rubbed back and forth in the direction of the shoulder to the tip if large amounts of cane are to be removed, it should be rubbed only forward to the tip, and not backward, if only a small amount of cane is to be removed. The back-and-forth motion, while more efficient, tends to leave ridges in the cane. At no time should the sandpaper be moved back and forth across the width of the reed, since tearing of the fibers often results, and it is extremely difficult to control accurately. At all times in the course of the sanding, both blank and paper must be wet. For both scraping and sanding, cane is most easily and accurately removed when the side being worked on is aligned with the appropriate edge of the plaque.

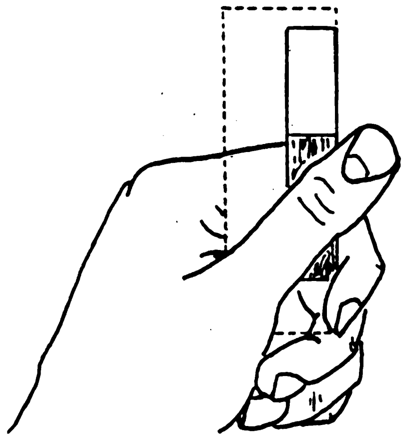

Figure 16. Right edge of blank and plaque aligned.

If the reedmaker is uncertain as to which areas of the cane should be removed, it will be helpful to draw a light pencil line on the boundary of the area which was sanded by the profiling, and a line down the quarter lines; all areas outside the boundary line or the quarter lines are likely to require thinning.

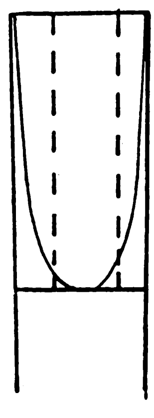

Figure 17. Areas requiring thinning.

It should be remembered at this stage that this is only the first approximation of the final reed shape; caution is necessary to avoid removing too much cane. Any mistake made in basic reed shape in the direction of too little cane removed will be easily correctable when the second approximation is made, but if too much cane is removed, it is impossible to correct the mistake other than by shortening the tip, making a new cut line, and completely re-profiling the reed.

When it appears that the scraping and sanding have formed the desired taper from the center of the reed outward, the areas which were scraped may be sanded very lightly with a small piece of #600 sandpaper to remove any small gouges, traces of knife-work, or burrs which may have formed. Again, the paper should be moved only forward along the length of the reed, not back and forth or side to side. The profile of the reed then should be inspected from each side to see if any obvious high spots have been left. It is advisable when looking at the profile to check it not only by holding it at eye level and looking at the profile straight down the center, but to tilt the reed slightly away or slightly toward the eye, so that any ridges in the areas between center line and rails may be seen.

To be sure that the blank does get thinner from shoulder to tip and center to sides, it is helpful to check the shadow of the reed. The blank is held tip downward in front of an ordinary gooseneck or desk lamp; the thicker the cane is at a given spot, the darker will appear the area. If the blank tapers properly in all directions, the shape of the shadow formed in the cane should be the well-known "U" shape, because areas near the sides of the reed will be the same thickness as an area in the center of the reed much closer to the tip.

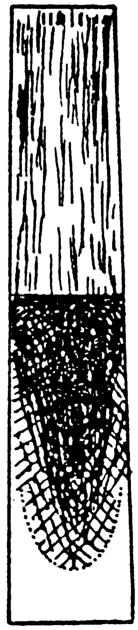

Figure 18. U-shaped shadow of reed.

A dark spot in an otherwise lighter area may indicate a spot in the blank which is thicker than the surrounding area. Although many players use high-intensity lamps to see the shadow, a comparison of the shadows given by the two types of lamps will show that the extremely bright light of the high-intensity lamp tends to minimize the important distinction between two areas of the reed which are nearly, but not quite, the same thickness.

The shadow of the reed should not be used alone to determine whether additional scraping is necessary, since some cane may have small streaks of discoloration which cast a dark shadow, even though the reed is in fact the proper thickness at that point. To be sure of a needed correction, the profile of the blank should be inspected, and the thickness of the vamp felt with a fingertip at the questionable spot, to determine whether there is in fact a high spot.

When the shape of the blank has been adjusted to approximately the proper one, it should be rinsed and allowed to dry on glass overnight. Storage in a reed case will minimize any possible warpage.

RE-PROFILING

The basic shape of a reed is now present in the blank -- a straight line from the shoulder to the tip, and progressively less cane at the sides and tip than in the center and at the shoulder. While this shape is a convenient approximation which puts the basic proportions of the reed in the blank, the shape of a reed more closely approximates a line from the shoulder to a point slightly behind the tip.

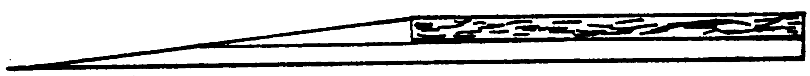

Figure 19. Straight line from shoulder to point behind tip.

To achieve this corrected shape, the reed is profiled a second time. Re-profiling is done as the profiling was before, with the blank inverted on sandpaper, but #400 or #600 sandpaper is used this time; only a small amount of cane is to be removed, and the finer grits of sandpaper will leave a smoother surface on the vamp of the reed than will #220 sandpaper.

When the vamp was profiled originally, the great amount of cane left at the sides made the blank extremely rigid and inflexible. With that excess cane removed to form the "U" shape, the tip can bend much more easily. When the blank is re-profiled on the #400 paper, the tip bends back away from the sandpaper, and the greatest amount of force is

exerted on the remainder of the blank; the area behind the tip up the center line is sanded away, rather than the actual tip itself.

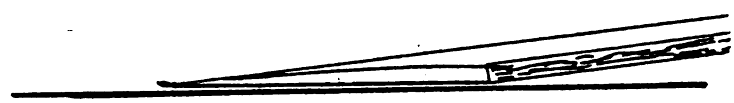

Figure 20. Re-profiling -- area behind tip sanded.

The profile after this additional sanding should be a straight line from the shoulder to a point a millimeter or so behind the tip, depending on the style of reed required by the individual player's mouthpiece.

SECOND CORRECTION OF PROFILE

As in the profiling operation, since cane has been taken from the part of the reed near the center line, cane must be removed from the sides to make the sides thinner than the center. If the surface of the blank is felt with a fingertip, a more or less distinct ridge is apparent, just as the darker area of the cane was evident after the original profiling. It is helpful to mark this ridge lightly with a pencil to give a guide to scraping.

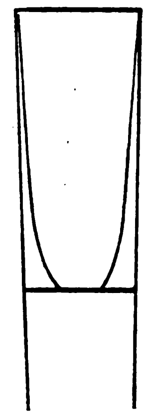

Figure 21. Ridge after re-profiling.

A combination of knife-work and light sanding with #600 sandpaper is used to smooth out the area from and including the ridge to the edges and tip of the reed. It may be necessary also to thin the reed at the quarter lines. The rails must taper evenly going toward the tip, and should be thinner than the blank is at the quarter lines. It is also a good idea after correcting this shape to remove any stray fibers or burrs left by faulty knife technique, by polishing the vamp of the reed; this is done by rubbing a small piece of #600 sandpaper very lightly a few times down the vamp only in the direction of the shoulder to the tip.

Often in the process of profiling and re-profiling, the cut line is accidentally sanded to become less than straight. The cut line may be re-defined by placing the blade of the scraping knife on the blank with a slight pressure at the point where the cut line is to be placed. The knife is rocked carefully across the blank to indicate the new cut line.

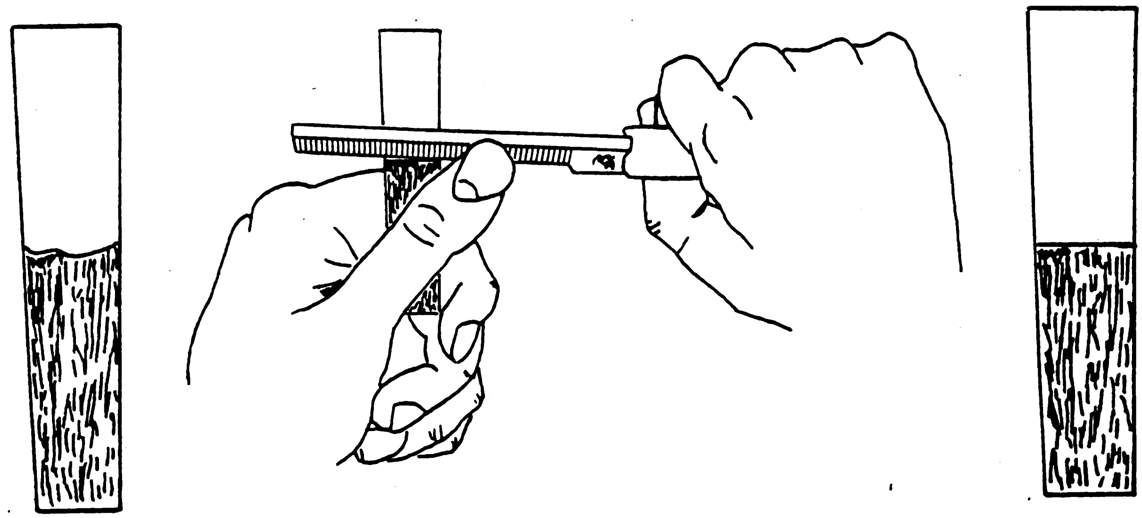

Figure 22. Indistinct cut line corrected.

Starting at the cut line which was just re-defined, the reedmaker should scrape very lightly from the line toward the tip for a millimeter or two to be sure that the beginning of the vamp is differentiated from the bark area. Blending of the bark into the vamp will cause improper vibration and response problems in the reed.

The blank should now have the basic shape of a reed; there is a straight line from the cut line to a point behind the tip, and it decreases in thickness from the center to the sides.

SUMMARY OF PROFILING STAGES

The process of approximating the basic reed shape in the blank may at first seem to be a complicated one. However, it is in fact a very simple process, and is outlined for convenience in the following figures.

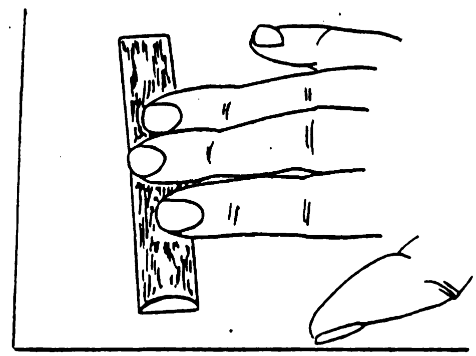

Figure 23. Blank flattened and cured over one week.

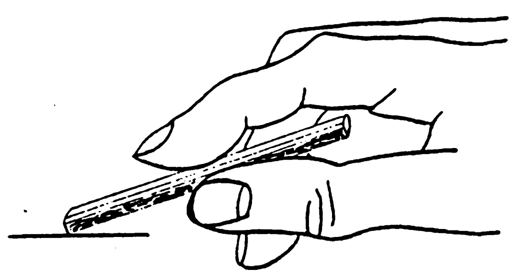

Figure 24. Blank inverted and sanded.

FIgure 25. Blank after first profiling.

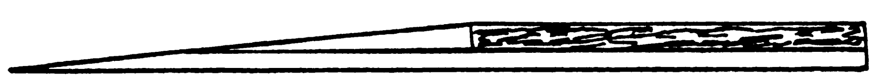

Figure 26, Blank after second profiling.

Figure 27. Shape corrected by scraping and sanding outside lines.

Figure 28. Blank re-profiled.

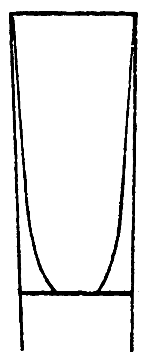

Figure 29. Ridge smoothed out by scraping and sanding.

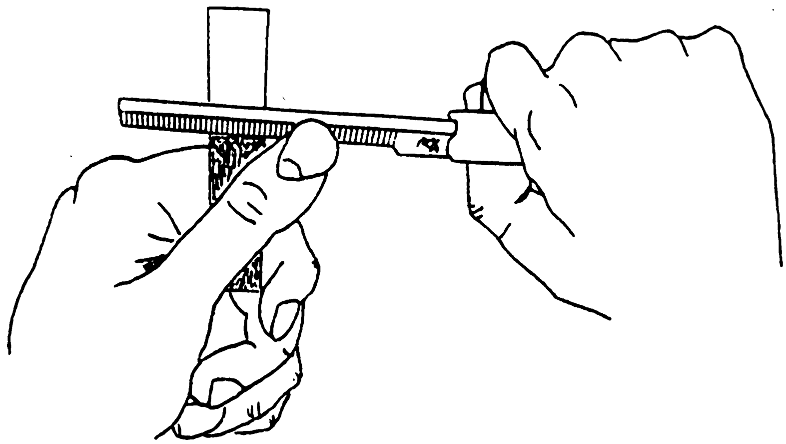

Figure 30. Bark and vamp differentiated.

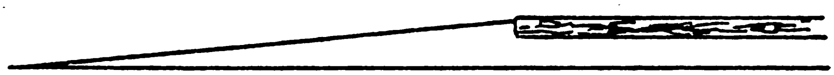

Figure 31. Basic profile of reed.

CHAPTER 2

PRINCIPLES OF REED ADJUSTMENT

The operations of curing and profiling the blank are purely mechanical ones which may be done easily even by a non-reed-player. At the conclusion of the profiling, the blank should have the basic shape of the single reed; the profile is a straight line from the shoulder to a point behind the tip, and the reed gets thinner from the center line to the edges and from the shoulder to the tip. Although profiling the blank to the basic reed shape approximates the proper proportions of the reed, and minimizes the amount of further reedwork which must be done, the fitting of the reed to the individual player's own mouthpiece and embouchure is a process which necessarily will vary considerably with each individual and each reed.

It is possible to catalogue defects in the reed's tone or response, and possible remedies for these problems, but, unfortunately, a specific problem is merely a symptom of an improper dimension in one or more areas of the reed; to attempt to correct one problem with disregard for the vibration of the reed as a whole may result in the improvement of one aspect of the reed's performance, while greater problems are caused by improper dimensioning of the reed. It is possible, with experience, to adjust reeds solely on the basis of their resemblance to an ideal reed shape, as described on p. 42. However, for greatest accuracy in reed adjustment, a conceptual model of the vibration of the reed may be used to provide a basis for determining what corrections are needed in the varying proportions of each reed to make it play the best it can. This model is necessarily a very much simplified view of the motion of the reed, but this simplification is necessary to create a manageable system.

CONCEPTUAL MODEL OF THE REED'S MOTION

Motion of the Reed on the Mouthpiece

The action of the single reed on the mouthpiece is that of a spring. The pressure of the embouchure forces the reed slightly toward the mouthpiece, and the player sends a stream of air toward the aperture between the reed and the mouthpiece. Although the volume of air in the player's mouth is rather large, the aperture between the reed and mouthpiece is comparatively small, and the interior of the mouthpiece also has a considerably much smaller diameter than that of the player's airstream. As a result, when air molecules are forced into the mouthpiece, they acquire a much faster velocity than the air molecules of the player's airstream, just as water sent from a wide hose into a narrow one must increase in speed (distance divided by time) when the driving force remains the same. Because the molecules in the mouthpiece are moving faster than those in the airstream of the player, they move farther apart in the same amount of time, creating a lessening of air pressure. This lessening of air pressure in the mouthpiece causes a partial vacuum to form, and the reed is drawn to the facing of the mouthpiece. When the reed completely covers the windway of the mouthpiece, the air pressure inside the mouthpiece becomes equal to that of the player's airstream, and the reed springs back to its original position. This cycle is repeated many times in the course of a second to cause the vibration of the air column which produces sound.

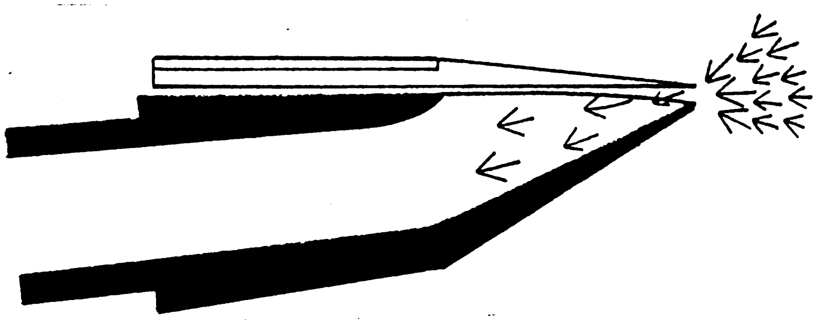

Figure 32. Speed of air molecules increases inside mouthpiece.

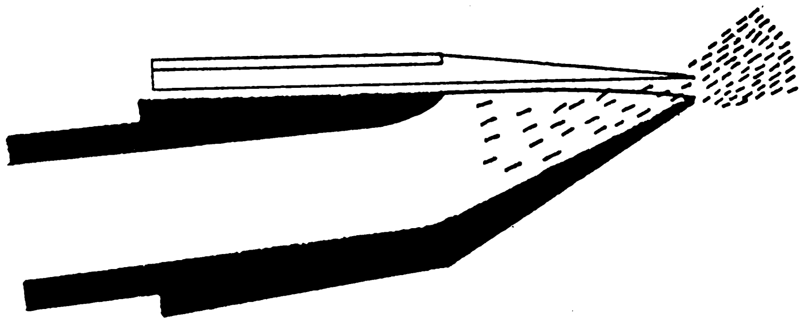

Figure 33. Air pressure less inside than outside mouthpiece.

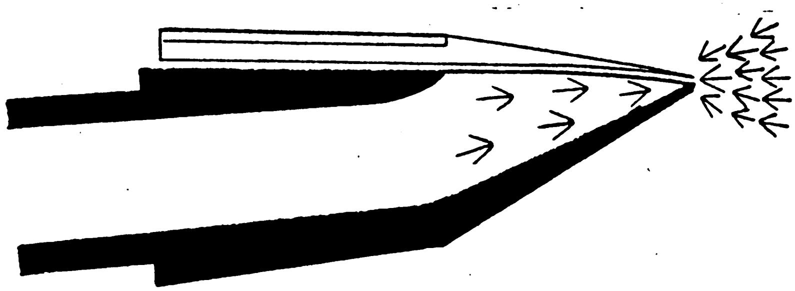

Figure 34. Partial vacuum draws reed to mouthpiece.

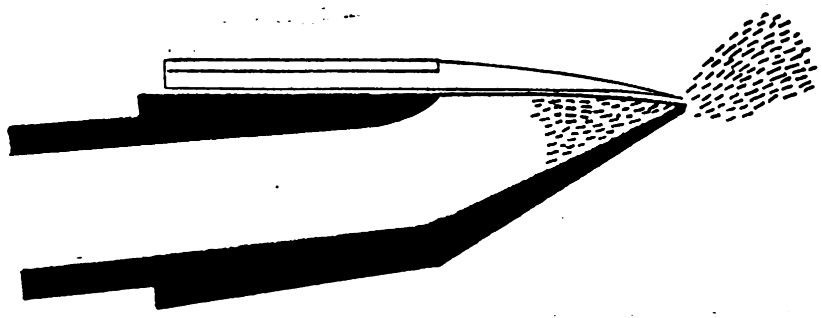

Figure 35. Pressure equalizes inside and outside mouthpiece.

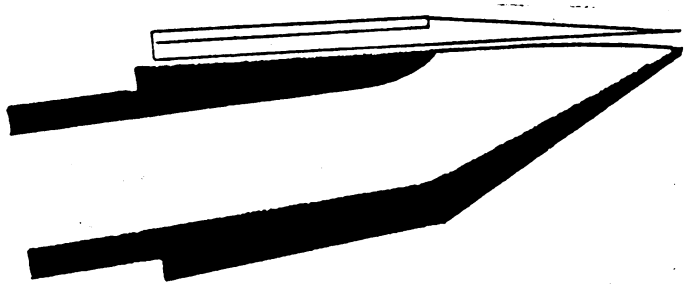

Figure 36. Reed returns to original position.

The point on the reed at which the mouthpiece begins to curve away from the flat back of the reed is commonly called the fulcrum of the reed. Moving forward from the fulcrum to the tip, each point farther away from the fulcrum must move a successively greater distance to close against the mouthpiece than did the area of the reed near the fulcrum.

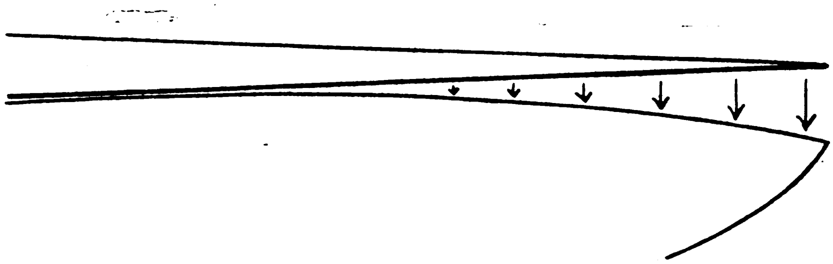

Figure 37. Points of successively increasing distance from fulcrum.

Equalization of Rates of Vibration

To create the type of vibration desired by many players, in which low overtones are produced in the greatest amounts possible, the reed should move in a simple pattern of motion, rather than a complex pattern; i.e., all parts of the reed should vibrate at the same rate. If some parts of the reed vibrate at a faster rate than that of the reed as a whole, they will tend to produce the higher overtones. To achieve the desired vibration, all parts of the reed should tend to move toward the mouthpiece at the same rate of speed, so that all parts of the reed touch the mouthpiece at the same instant, and continue through the cycle of vibration at the same rate.

Since the parts of the reed closer to the tip must move greater distances in the same amount of time as the parts of the reed which are more toward the fulcrum and thus much closer to the facing, the reed must get progressively thinner from the fulcrum forward to the tip to facilitate movement in the parts which must move the farthest. Additionally, the reed must get thinner moving from the center to the sides, because the force of the embouchure and air pressure is greatest at the center of the reed, and less at the sides.

A point on one side of the center line should have exactly the same flexibility and thickness as the equivalent point on the other side of the line to ensure that each side of the reed is moving at the same rate, just as all parts from tip to shoulder should touch the mouthpiece at the same time. If, however, the mouthpiece is warped or the embouchure is stronger on one side than on the other, adjustments

in the relative dimensions of the sides may have to be made to alter resistance accordingly.

Configurations Yielding Complex Motion

If each part of the reed is the correct thickness for a given mouthpiece and embouchure, vibration of all parts of the reed at the same rate will occur. If one area of the reed is thinner than it should be for this efficient motion, and thus tends to move toward the mouthpiece faster than the remainder of the reed, it may complete more cycles of vibration in the same amount of time as the rest of the reed; this allows more high overtones to be produced. Conversely, a thick area may tend to vibrate more slowly, and present greater resistance to air pressure; this situation would necessitate more force to start and maintain vibration. Though causing different results, areas which are either too thick or too thin present the same immediate problem: that of a tendency for inconsistent rates of speed toward the mouthpiece between several areas of the reed.

The thickness of each area, however, does not totally determine its rate of speed toward the mouthpiece; the rate of vibration of every area of the reed is determined in part by the configuration of the remainder of the reed. The greatest strength and resiliency of a spring is produced when all parts of the spring move through the cycle of vibration together, and no energy is wasted in vibration of one part of the spring faster than the rest. If the spring is vibrating in segments, the vibration produced is not the same as that produced by the spring moving in one unified motion, but is the sum of the vibration of

each segment. While in the efficiently moving spring all parts of the spring must move together, in the segmented spring each part is free to move at its own rate.

The rate of vibration of an area is dependent on the thickness of other areas of the reed as well as on its own thickness. Not only the section of improper thickness, but the surrounding areas as well will vibrate at an improper rate of speed, even if the surrounding areas themselves are of the proper thickness. Just as a suspension bridge may collapse if only one section of the supporting cable is weak, a reed with an area of cane which is too thin may not have the strength necessary to resist the embouchure and air pressure to the degree required for unified vibration. Or, if a part of the reed is too thick to move with the reed as a whole, the surrounding areas are able to vibrate freely, as if they were not connected with the rest of the reed.

The effect of the surrounding areas on one part of a reed may be termed "support". If areas adjacent to a part of proper thickness are too thin, the area has too little support, and will vibrate too rapidly; if too much cane is present, there will be resistance to vibration, and too much support is present.

If rates of vibration are equalized in all segments, the reed will move as one entity, instead of as several small springs. Equalizing the rates changes the resistance to movement of the reed as a whole, since the formerly rapidly vibrating parts of the reed had less resistance to movement, and thick spots had more resistance; the equalization also simplifies the complex pattern of vibration set up by the formerly inconsistent reed.

Specifically, three possibilities for thickness of a reed at a given point may be seen. 1) If the area is the proper thickness, it will tend to move toward the mouthpiece at the same rate of speed as the surrounding cane.

2) If the area is too thin, it will tend to move too rapidly toward the mouthpiece; cane on either side of the thin spot will be free to move at its own rate, and the net result will be that the cane at the thin spot and forward from it to the tip may both move too rapidly, even though the cane from the thin spot to the tip may be the correct thickness.

3) The most complicated set of possibilities for improper vibration is presented by an area of the reed which is thicker than it should be. Several effects may be produced depending on the degree of thickness. If the area is only slightly too thick, that area of the reed may be slightly less flexible than the reed as a whole, and may merely cause the reed to feel rather resistant. If, however, it is quite a bit too thick, it may prevent the entire area behind the thick spot toward the shoulder from moving freely, and will greatly increase resistance of the reed. However, it is most likely that extreme thickness of an area will stop movement behind the spot almost completely, leaving the area in front of the thick spot with no support at all; since the area in front of the spot is effectively an independent short spring, it is left to vibrate very freely and rapidly, and may give the effect of the reed being too thin, even though the area from the thick spot to the tip is in fact the proper thickness.

Although the area of the reed behind the fulcrum does not actually move toward the mouthpiece, its thickness determines the amount of

support the reed has in front of the fulcrum, and thus its ease of vibration. Changes made to the reed in the area between the shoulder and the fulcrum are extremely important, since removing cane in this area changes the resistance of all cane in front of the affected area. Up to a point, removal of cane in this area allows the reed as a whole to vibrate more easily, especially at the fulcrum; removal of too much cane allows the reed to vibrate too easily, and in segments.

Basis for Determining Corrections

Determining whether each part of the reed is supporting the rest of the reed properly may most easily be done by making sure that all areas of the vamp blend smoothly into one another, and that flexibility decreases gradually going from the tip to the fulcrum. Any sudden changes in thickness or flexibility indicate an area which may be distorting the vibration of the entire reed.

Because of the effect that each part of the reed has on the vibration of the remainder of the reed, and because of the similar results which may accompany several different types of imbalances, the vibration of the reed as a whole must be considered when adjusting the reed; consideration only of the immediate problem spot often will result in creating a worse problem than the initial one. In particular, sometimes changes are made to the basic profile of the reed which create such large areas of thick and thin spots that the reed may most simply be termed "out of proportion". To correct such a situation, the original proportions must be restored by profiling the blank again; it also may be necessary to cut off the tip and move the cut line back to the

appropriate length.

It must be remembered that removing cane from the reed does not always result in "softening" (reducing resistance) of the reed. Specifically, where a thick spot causes the area in front of it to vibrate too freely, removing the excessive thickness of that spot results in a greater amoung of the reed being able to move, and thus more, not less, resistance being created.

One of the problems in defining principles of reed adjustment is the subjective nature of the judgements made by the player about a reed's quality. Tone quality and response are two interrelated aspects of a reed's performance; one cannot be altered without changing the other to some extent. The tone quality of the reed is determined by its type of vibration, unified or segmented, which produces varying ratios of overtones; the "response" of the reed is the player's measurement of the ease of setting the reed into motion, and must by its nature be judged subjectively, since a certain amount of resistance to vibration is necessary for control of dynamics and articulation. The type of vibration needed for "good" tone (unified motion emphasizing low overtones) and for "good" response (efficient motion with some amount of resistance to movement by the reed as a whole) are, up to a point, two compatible aspects of the same type of motion. As the response of the reed improves because of more efficient motion and consistency of vibration frequency between areas of the reed, the lower overtones should be present in the sound in greater proportion. However, depending on the mouthpiece, concept of tone, and, perhaps most important, the concept of embouchure of each player, as the reed approaches its optimum vibration, a small amount of efficiency may have

to be sacrificed to achieve the desired tone quality. The most efficient vibration of the reed may allow too many high overtones to be present in the tone for the player's taste; allowing the reed to be slightly resistant overall to reduce ease of vibration, and with it ease of production of higher overtones, may be necessary.

PARAMETERS OF REED SHAPE

The reedmaker's mental picture of the reed's shape ultimately determines the shape of his reeds. It is vital to reedmaking to have an accurate mental picture of the reed's shape as well as a conceptual model of the action of the reed to ensure consistently good results.

It is often a surprise to the novice reedmaker how little cane really is present in the vamp of a reed. Many people leave the reed far too thick, in the mistaken impression that a lot of cane, especially in the heart area, is necessary for the proper resistance to achieve a "dark" sound. According to this faulty concept of the reed's vibration, leaving a great deal of cane in the center of the vamp increases resistance of the reed as a whole, and thus decreases the high overtones present in the tone. In fact, this excessive thickness in the center of the reed, rather than increasing resistance of the reed as a whole, makes it difficult for the center of the reed to move, and allows the tip and sides to vibrate unsupported at a more rapid rate than the rest of the reed; the undesired high overtones are emphasized, not decreased. Many books and articles concerning the single reed instruments further promote the incorrect stereotype of the reed's shape in illustrations which show a reed exceedingly heavy down the center; the

illustrations below show a common incorrect mental picture of the shape of a reed, and an approximation of the actual shape of an average clarinet reed.

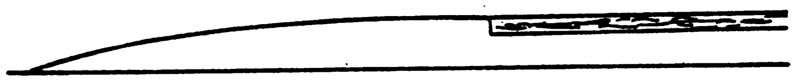

Figure 38. Incorrect picture of reed shape.

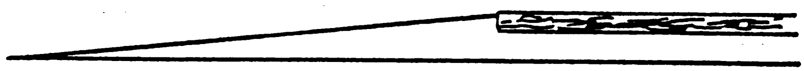

Figure 39. Correct picture of reed shape.

The mechanical operations of profiling ensure that a shape close to that of the finished reed is available to the reedmaker for final finishing to the desired shape. Additionally, although the straight line from the shoulder to a point behind the tip is an approximation of the shape of the reed down the center line, it may be used as a "measuring stick" -- as a basis for comparing the other parts of the reed to a standard.

It is very useful for the reedmaker to look carefully at old good reeds to establish his mental concept of the shape of reeds which work well on his mouthpiece and instrument. It may be helpful, when undecided about the corrections needed in the reed, to compare old reeds with the reed currently being made, as a reedmaker may, over a period of time, begin to make a consistent mistake in every reed due to a slightly faulty concept of reed shape. In particular, beginning reedmakers almost invariably tend to leave the rails too thick. Additionally, the reedmaker must be sure that the original profiling operation formed a

straight line from the shoulder to the very tip, since very often the tip is left far too thick at the profiling stage, with subsequent disruption of the correct reed profile.

Summary of Surface Shape

While individual reeds required vary with each player and each mouthpiece/ligature/instrument combination, certain general principles of reed shape may be stated. The principles of reed shape should be used in conjunction with the conceptual model of reed motion to obtain the best results, but adjustment of reeds may be accomplished very satisfactorily simply on the basis of reed shape. Reeds which are compatible with the mouthpiece/ligature/instrument combinations used by most players usually share the following characteristics:

1. The basic profile is a straight line from the cut line to a point behind the tip.
2. The reed gets thinner moving from the cut line to the tip and from the center line to the sides; as a result, a "U" shape is formed when the reed is inverted and the shadow is inspected.
3. The rails are thinner than any point between the rails and the center line, and taper, becoming extremely thin in the secondary tip area.
4. Unless an imbalance is present in the mouthpiece or the embouchure, a point at a certain distance from the center line is the same thickness as the equivalent spot on the other side of the center line.
5. Flexibility decreases gradually from the tip to the area near the fulcrum. Normally, no drastic changes in flexibility are present.

Shape of the Blank

An extremely important dimension of the reed is the shape of the blank (see Appendix B: The Reed Blank). While many reedmakers recommend a blank which is 13 millimeters wide at the tip tapering to 11 millimeters at the butt, on many mouthpieces it will be found that a generally narrower reed of greater front-to-back taper is more desirable. When a greater amount of taper is present in the blank shape, there is little significant difference in the shapes of the areas from the fulcrum to the tip, which are the areas that actually move; however, the area from the fulcrum to the cut line is significantly narrower. As a result, the amount of cane present in the area of the reed which does not actually more, serving instead a supporting function, is reduced, reducing resistance of the reed as a whole. By reducing resistance in this area, the area from the fulcrum to the tip is freer to move, but the danger of segmenting the vibration by removing too much cane in the surface of this area is avoided. As a result, the lower overtones are emphasized, resulting in a "darker" tone.

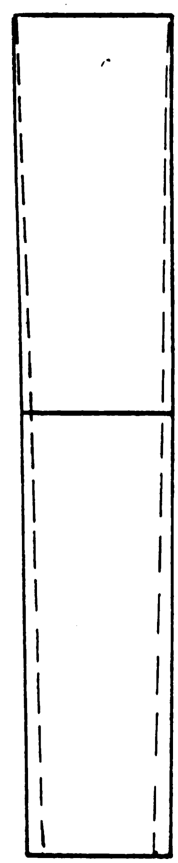

Figure 40. Increased taper in blank shape.

When first trying the reed, it is usually helpful to place the reed on the mouthpiece slightly off center in each direction. Often, one position of the reed is drastically better than other placements, and may confirm the reedmaker's diagnosis of the problem. If narrowing of the reed is needed, the reedmaker can thus with certainty remove cane from the appropriate side.

METHODS OF MEASURING DIMENSIONS

General Methods

Judgements of corrections needed on the blank should be based on several ways of measuring the reed: looking at the profile, looking at the shadow, feeling the surface of the vamp with a fingertip to find high spots, flexing the reed, and, of course, in the final stages of adjustment, playing the reed. It is best to be sure that the hypothesized correction required by the reed is confirmed by at least two of the methods mentioned above. In particular, unconfirmed corrections made on the basis of the shadow are dangerous, because of the possibility of discoloration of the cane. Corrections made only on the basis of the way the reed plays are equally dangerous, since many different errors in shape may cause the same unwanted result in the reed's performance.

Profile

Examination of the reed's profile is probably the most useful and frequently performed measurement. While many players base adjustments mainly on the basis of the shadow of the reed, this method, while useful, does not present the player with a true view of the relative thicknesses of areas of the reed, since the intensity of the light source and the degree of wetness can greatly alter the shadow. Inspection of the profile is advantageous in that the entire proportion of the reed from shoulder to tip can be seen at a glance, and areas of greater than desired thickness can be seen easily as "high spots". The reedmaker is cautioned to be sure that he inspects the profile from both sides of the reed; often, a reedmaker may fall into the habit of checking the profile from only one side, with the result that high spots on the other side of the center line are left undetected. It is most useful, also, to look at the profile from angles other than exactly straight on; tilting the reed a few degrees away or toward the eye is often helpful in revealing inconsistencies of profile which lie at lines from the shoulder to the tip other than at the center line.

Flexibility

Checking the flexibility of the reed should be done with care, since over-enthusiastic bending may permanently damage the fibers. The reed is held in one hand, as the index finger of the other hand gently puts a small amount of pressure on the flat side of the reed at various points. On most mouthpieces, the amount of flexibility of the reed should decrease gradually from the tip to the area of the fulcrum. The fulcrum area of the mouthpiece may be determined for the player's reference by sliding a piece of cigarette paper or other thin paper between the mouthpiece and a reed; the paper obviously cannot go beyond the fulcrum.

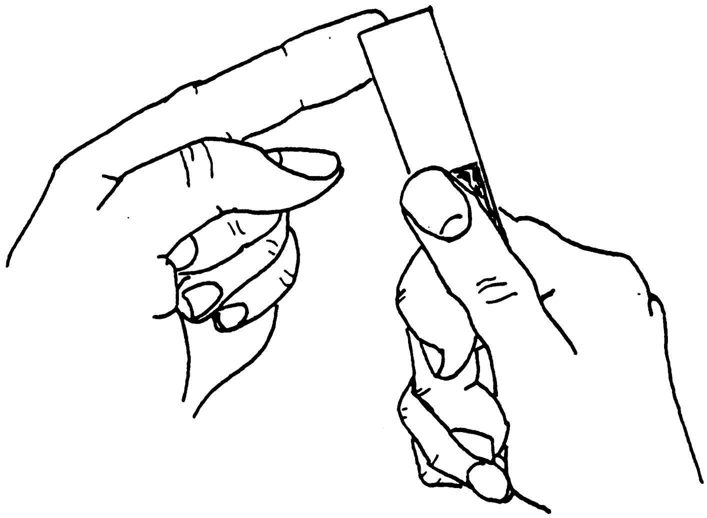

Figure 41. Checking the flexibility.

Thickness gauge

Although measurement of reeds using a thickness gauge is not necessary, some reedmakers find this method useful to compare their reeds with their old reeds, or to compare relative thickness in areas of the new reed. Caution is indicated when using a thickness gauge for comparison between reeds; for the comparison to be most meaningful, the reed used as a model must have had the same thickness of blank as the new reed, and the length of the vamp must be the same. Additionally, the cane must be very similar in resilience. Adjustment of reeds to the same measurements as those of an old reed does not guarantee good results, because the many possible variations in dimensions and especially in resilience make it very unlikely that any two pieces of cane will have exactly the same characteristics.

CHAPTER 3

REFINING THE REED SHAPE

After the profiling is completed, the blank may produce a sound easily when placed on the mouthpiece, and be ready for the final stages of adjustment. If, as often is the case, it does not produce a sound easily at this point, the proportions of the blank should be examined.

ALTERING THE REED FOR SOUND PRODUCTION

In general, if the basic profile of the reed is present, one further correction of the shape may be necessary to get the reed to produce a sound. The thin tip area is often not long enough, with the result that it is rather inflexible. If, however, the cane is soft, the blank is rather thin, or too much pressure was used in the re-profiling stage, the tip area may be extremely thin and/or long.

Normally, the tip area is thinned by alternating two types of knife strokes. The scraping knife may be held parallel to the direction of the cut line, and used to scrape the entire width of the tip in a stroke moving toward the tip to produce a consistent thickness all across the tip, and to scrape from the corner lines diagonally outward to blend the tip area with the rest of the reed. In scraping the corner line areas, it is best to scrape not just from the 45-degree angle of the corner line itself, but from several slightly differently angled lines across the corners to make sure that a smooth transition between areas is made.

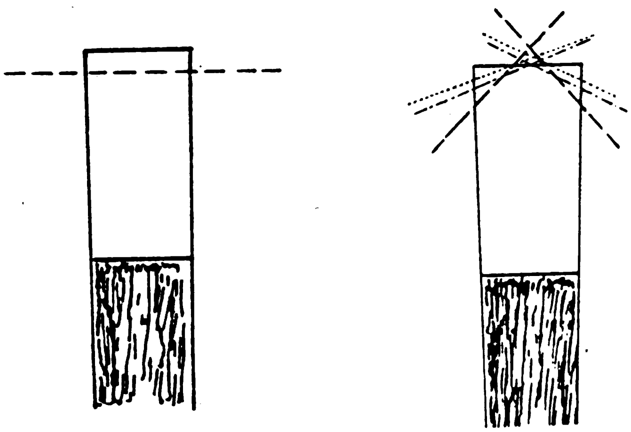

Figure 42. Angles for scraping tip area.

During and after this thinning, the profile of the reed should be inspected to make certain that the basic proportion of the reed is not disrupted. It should be remembered that a lack of flexibility of the tip area may be caused by thickness in any one or a combination of the areas of the tip, the rails, the sides, or the secondary tip area; thinning any one of these areas of the reed will affect the flexibility of the other parts. Although the technique of thinning each area is described individually, the reedmaker should alternate reedwork between each area which is too thick, frequently checking flexibility and profile, and making every effort to blend the sections together smoothly.

The thinning of the tip area itself was discussed above. The sides and the rails should be inspected, by both looking at and feeling the shape of the vamp of the reed with a fingertip. The rails must taper evenly from the shoulder to a point behind the tip, and must be slightly thinner than the immediately adjacent area of the vamp. Rails which are thicker or even just the same thickness as the vamp have the effect of making the entire side of the reed slightly too rigid, and hence rather resistant to vibration. Any thinning of the rails themselves normally should be done with #400 or #600 sandpaper to avoid gouging and removal of too much cane, unless the adjustment is so large as to require the use of the reed knife or #220 sandpaper.

When the first thinning of the tip area begins, the area immediately behind the tip may become, because of the lessened resistance of the tip, relatively much more resistant than the tip itself. The sudden decrease of flexibility in the secondary tip area is caused by the area from the quarter lines to the rails, and possibly the center itself, being relatively too thick. For greatest control, the knife should be used to remove cane from the appropriate area. When scraping any area, it will help to form a smooth transition if it is remembered that the purpose of the scraping is to smooth out the curve from the center to the edge, and free the vibration of the reed as a whole; concentration just on thinning one area of cane often results in rough transitions between areas.

When the tip area becomes more flexible, mistakes in reed shape may become more easily apparent. Sometimes the re-profiling step has been done too cautiously, and it is now evident that the center line is far too thick for the proper proportion of the reed. If this is the case, it can be corrected easily by repeating the re-profiling process, using #600 sandpaper, and again smoothing out any ridge left by the profiling.

A common discovery at this point is that the flexibility of the reed does not decrease gradually from the tip to the fulcrum area. The profile of the reed should be inspected to determine whether the reed is too thick at the center. If, by inspecting and by flexing the reed, it appears that the problem is not the thickness at the center line, inspection of the shadow should be used along with inspection of the profile from various angles and flexing of the reed to determine if the area between the quarter lines and the rails is too thick. The rails also should be checked to be sure that they are indeed thinner than the immediately adjacent area. Very often, for part or even the entire length of the reed, the area of the quarter lines to the sides requires thinning; this is best done with a combination of outward diagonal knife-strokes and, if necessary, some careful scraping straight down the length of the reed at the quarter lines.[1]

Any other obvious faults in shape should be corrected; however, if profiling has been done carefully, very few adjustments should be necessary, other than any initial thinning of the tip, sides, or secondary tip area required to get the reed to produce a sound.

FINAL ADJUSTMENTS

The process of adjusting the reed from one which produces a sound to one which plays as well as possible is by the nature of the task almost impossible to describe in any but nebulous terms at best. Not only does the process differ with each reed, because of the infinite number

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1 Scraping under normal circumstances is usually done diagonally when possible; see Appendix A: Knife Technique.

of combinations of adjustments possibly necessary, but also the terms used to describe unwanted qualities in the reeds mean very different things to different players.

The final subjective judgements of the reed's qualities must be made by playing the reed, but it should be remembered that the practiced eye can almost always spot an out-of-proportion area; an experienced reedmaker can take a reed to the point of being almost exactly as wanted without having to play it.

While not suggesting specific solutions for specific problems, the following summary of several principles of reed adjustment and the suggested procedures for determining adjustments should provide a basis for improvement of reed response and tone.

1. For efficient vibration, each part of the reed should move at the same rate, so that all parts move through the cycle of vibration together; to achieve this, the reed must taper from the shoulder to the tip and from the center to the sides. If one part of the reed, most noticeably the tip or an edge, is free to move faster than the rest of the reed, excessive high overtones are produced. For all parts of the reed to move together, a point on one side of the center line should be the same thickness as a point in the equivalent position on the other side of the line.

2. The vibration of one part of the reed affects the vibration of the other parts of the reed. A part of the reed which is too thin will allow other parts of the reed to vibrate too freely as well; a part which is too thick may affect the reed either by allowing an adjacent area to vibrate too freely, since it would effectively be independent, or by making the reed seem too resistant, depending on the degree of thickness.

3. Although for clarity the parts of the reed must be identified separately, the reed is an entity; except for the cut line between bark and vamp, there are no visible or measurable boundaries between the areas of the reed. The lack of distinct changes is reflected in the shape of the reed, which causes a gradual decrease in flexibility from tip to shoulder and sides to center.

4. The sections of the reed must be in the proper proportions to one another. This is achieved by profiling the blank and using the basic straight line from the shoulder to a point behind the tip as a "measuring stick".

5. The reed should be free to vibrate to increase the percentage of lower overtones, but not so free to vibrate that some parts of the reed may move through the cycle of vibration faster than other parts. The degree of rigidity of the reed as a whole determines its ease of being set into motion; adjustments made to decrease resistance must not allow segmented vibration. The area from the fulcrum to the shoulder affects the vibration of the reed as a whole; if it is in the proper proportion, it should allow the reed maximum freedom for unified vibration.

When the response or tone of the reed is not satisfactory, the shape of the reed should be checked by looking at the shadow and profile, as well as by flexing the area in front of the fulcrum and by feeling the vamp with a fingertip to check for high spots. The taper of the reed should be gradual; if there are any thick spots, it should be determined whether they could be causing the reed to vibrate in a manner which, according to the principles, is undesirable. Two or more areas may be out of proportion at the same time; corrections should be made on all areas gradually and alternately because of the effect that every part of the reed has on the other parts. If the reedmaker is uncertain about a correction, he should compare the reed to other good reeds, and then make the suspected correction only to a small extent; if the reed begins to improve, the correction should be continued.

SPECIFIC PROBLEMS OF REED ADJUSTMENT

When adjusting reeds, one problem is usually most apparent to the player; however, an apparent problem in either response or tone will naturally almost always really involve a problem with the other quality as well. Although problems of response and tone are discussed separately below, it must be remembered that they cannot in practice by corrected separately, and that any adjustment to the reed for one quality will affect the other also. Some common problems and solutions are described below; the player will have to use the model of reed action and the concept of reed shape to determine his own specific adjustments for each reed.

Response Problem: Too Much Resistance

If the reed is not set into motion easily enough, the flexibility of the area in front of the fulcrum should be checked for thick spots, and any needed changes made. If flexibility decreases consistently to the fulcrum, the resistance may be the result of thickness elsewhere in the reed. Inspection of the profile of the reed and of the shadow, with special attention paid to the area of the quarter lines and rails, should reveal any thick areas. The role of the rails in supporting the edges of the reed should be remembered. If the reed appears to be properly adjusted, but is still too resistant, the shape of the blank should be checked; if the blank is too wide, or does not taper much from tip to heel, the problem may be that the vibration is dampened by the excess weight of the unneeded cane of the wide sides. It is also possible that the area from the shoulder to the fulcrum is too thick to allow free vibration of the reed, or that the reed may simply be too heavy overall.

Response Problem: Too Little Resistance

If the reed is set into motion too easily, one section of the reed may vibrate too easily, either because it is too thin, or because an adjacent area is too thick or too thin; alternatively, the entire reed may be out of proportion. If only part of the reed is vibrating too easily, it may be possible to increase the resistance of the reed as a whole by thinning the appropriate areas adjacent to the thin area. The thinning provides more support to the thin area, because a greater amount of cane is free to move; the added weight to be moved provides more resistance. An adjustment to the length of the tip may be necessary if this adjustment is attempted. If the thin area is so extensive as to make the reed completely out of proportion, the length of the reed must be altered to allow re-profiling of the blank. Occasionally, if only the tip is too long, shortening the length of the tip and moving the cut line slightly back on the reed may restore the proper dimensions. In rare cases, if the reed is unresistant because the rails are too thin, narrowing the width of the reed[1] will allow thicker areas of the reed to become the rail area, and thus increase resistance down the edges of the reed.

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1 See Appendix B: The Reed Blank for a description of this process.

Tone Problem: Too Many High Overtones

If the tone quality seems to emphasize the high overtones rather than the lower ones, at least one area is probably vibrating more rapidly than the rest of the reed, or the reed as a whole may be vibrating in segments. If one area is vibrating more rapidly, this may be caused either by its own thinness, or by a section vibrating unsupported because of the excessive thickness of the adjacent section. Thinning of the adjacent area may provide more support, as described in the preceding section, ending the faster vibration and incidentally providing more resistance. High overtones are often present in great number if the reed is out of proportion, and most commonly if the tip is too long. The length of the out-of-proportion area must be adjusted by re-profiling and adjusting the length of the reed, if the affected area is not just the tip area. If, however, the entire reed is vibrating too freely and in segments, only re-profiling the reed offers hope of salvaging the piece of cane.

Tone Problem: Lack of Clarity

The opposite problem of too many high overtones in the sound usually manifests itself in what is clearly also a response problem; the common description of the unwanted sound is that the low notes are unresponsive, and the tone quality of the reed as a whole, but especially in the low register, is unclear ("buzzy"). In this case, the concept of "not enough reed vibrating" is useful; the reed is not vibrating freely as a whole. This characteristic is often present in a reed which is in good proportion and balance from the fulcrum forward, but whose area from the fulcrum to the shoulder is too thick to provide the necessary support for the rest of the reed. In effect, the length of such a reed is only from the tip to the fulcrum. Thinning of the area from fulcrum to shoulder provides more support for the reed, and effectively allows more reed to move; response and tone are thus improved. Again, in this case, the shape of the blank itself may be suspected for some of the problem; greater tapering of blank shape may remove unnecessary cane from the fulcrum to the shoulder which is causing dampening of vibration.

It should not be inferred from the preceding discussion of specific problems that the reedmaker in practice would isolate one specific problem and attempt to correct it by following the guidelines. Normally, the reedmaker determines which undesired qualities of both tone and response are present, and corrects both aspects simultaneously by inspecting the reed with all problems in mind. The reedmaker must really see the shape of the reed, and constantly compare it to his mental picture of the ideal reed and the model of the vibration of the reed. The actual playing of the reed is most useful simply to determine if a problem exists; additionally, it is possible to test the symmetry of the reed shape by moving the reed to either side to see if response or tone changes, and to be sure that the tip is too long or too short by moving it up or down on the mouthpiece before permanently altering it. However, if the steps of profiling and bringing the reed to the point of playing have been done carefully, few if any major adjustments in the reed's shape should be necessary to make a playable reed.

THE BREAKING-IN PROCESS

When the reed appears to have the basic desired qualities of tone and response, further adjustments should be done very gradually over several days. Many reeds which appear when they are first played to have slightly too much resistance or stuffiness of tone lose these qualities after they have been played for several days, because the fibers of the cane lose resistance from the repeated flexing caused by playing. The reedmaker should play a new reed for a few minutes on each of several days, and then determine if further adjustments will really be necessary. In general, the reedmaker should strive to leave the reeds very slightly too resistant in the finishing stage, so that there is leeway for fine adjustments to be made as the reed's initial resistance to vibration is overcome. The tip may be rounded by clipping at the player's convenience; it seems best to play the reed with the tip straight for several days before clipping.

Ideally, the reed should be played for five minutes or less on each of the first two or three days it is played, after which the length of playing time should be increased gradually. A gradual period of accustoming the reed to vibration often results in a reed which lasts far longer than if too much playing is done too soon. Before playing the reed each day, the reed after being soaked should be placed on the plaque and rubbed firmly with a fingertip in the direction of the shoulder to the tip. This process makes certain that the reed is flat when it is placed on the mouthpiece, and by aligning the top fibers helps to minimize any warpage of the vamp. When possible, the reed should be wet by soaking in water rather than saliva, since the enzymes present in saliva break down the fibers of the cane. It will be found that reeds will tend to last longer if they are rinsed off in water after playing, to remove any residual traces of enzymes left by playing.

CONCLUSION

By adjusting the reed with its vibrating action and basic shape in mind, the reedmaker should be able to make each reed play to its fullest potential. No reedmaker has complete success with all reeds; some pieces of cane, by virtue of the configuration or quality of their fibers, simply cannot be made into good reeds. Nevertheless, most players who make their own reeds will find that even though every reed made may not be a great one, the quality of reeds used on a day-to-day basis will be better than when dependent on commercial reeds.

APPENDICES

APPENDIX A

KNIFE TECHNIQUE

In the discussion of knife technique below all directions will be given in terms of a right-handed reedmaker; left-handed reedmakers should reverse the directions.

THE CUTTING KNIFE

Two types of knives and two distinct types of knife technique are needed for reedmaking. The first type of knife technique, the cutting technique, is used for rough work on the blank, and is relatively easy to learn, since it may be rather inexactly executed.

A satisfactory and inexpensive choice for the cutting knife is the X-Acto #5 or #6 handle (smaller handles are not satisfactory) with a #25 blade; much more expensive cutting knives are readily obtainable from virtually all reed supply houses, but are a worthwhile investment only for the accomplished reedmaker.

The cutting knife is used only to remove the bark from the shoulder to the tip and, if desired by the experienced reedmaker, to make a few basic profiling cuts (see pp. 13 and 61). For both operations, the knife is directed in the same manner: while the blank is held tip forward across the fingers of the left hand, the handle is held in the right hand, and the left thumb guides the knife blade outward by the use of pressure on the dull edge of the blade between the contact point with the blank and the right hand. Both the right hand and the left thumb exert the forward force.

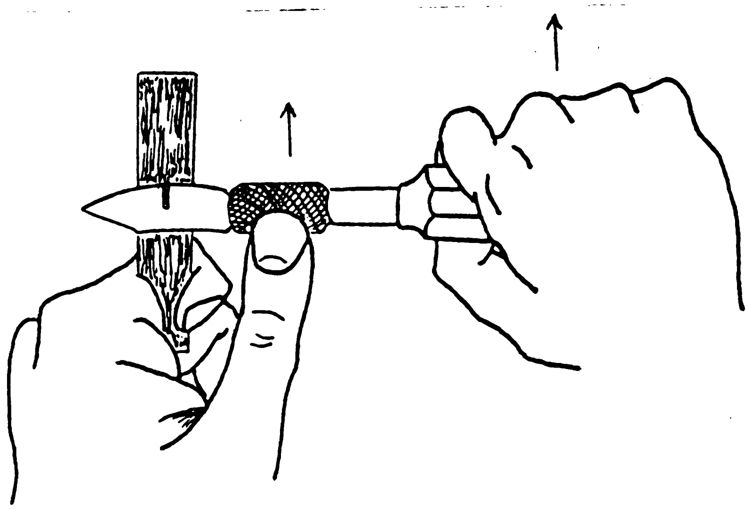

Figure 43. Using the cutting knife.

In the case of removing the bark from the blank, the reedmaker is cautioned to be sure that the knife blade is held as nearly parallel with the blank as possible, and that pressure of the knife is directed outward, to avoid gouging the blank and removing cane below the layer of the bark.

If the reedmaker wishes to save time in the profiling stage by making a few basic cuts in the profile of the reed, a few shallow cuts in the vamp may be made by allowing the blade to have a slight downward angle. No cut should start exactly at the cut line, or the basic profile of the reed will probably be disrupted. The first cut should start no further back than three-quarters of the length of the vamp, and the reedmaker should be careful not to remove cane which lies in the area under the straight line from the shoulder to the tip.

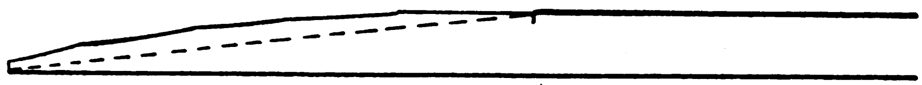

Figure 44. Profile of blank with rough cuts.

THE SCRAPING KNIFE

The art of using the scraping knife is usually somewhat more difficult to master. The scraping knife is used in combination with sandpaper to do all the fine work on the reed, and necessarily involves a much more refined technique than does the cutting knife.

While the technique of using the scraping knife may appear to be similar to that of the cutting knife, it is in fact much different. The handle of the scraping knife is held in the right hand, but the left thumb does not exert pressure; rather, it is used as a fulcrum. The reed, normally on a plaque, is held across the fingers of the left hand; the first joint of the left thumb rests on the reed, and the tip of the thumb curves upward. The right hand brings the flat back of the blade, edge downward, to rest against the tip of the thumb; the blade should exert a slight backward pressure against the thumb. The tip of the thumb is lowered slightly to the reed in order to bring the blade in contact with the cane.

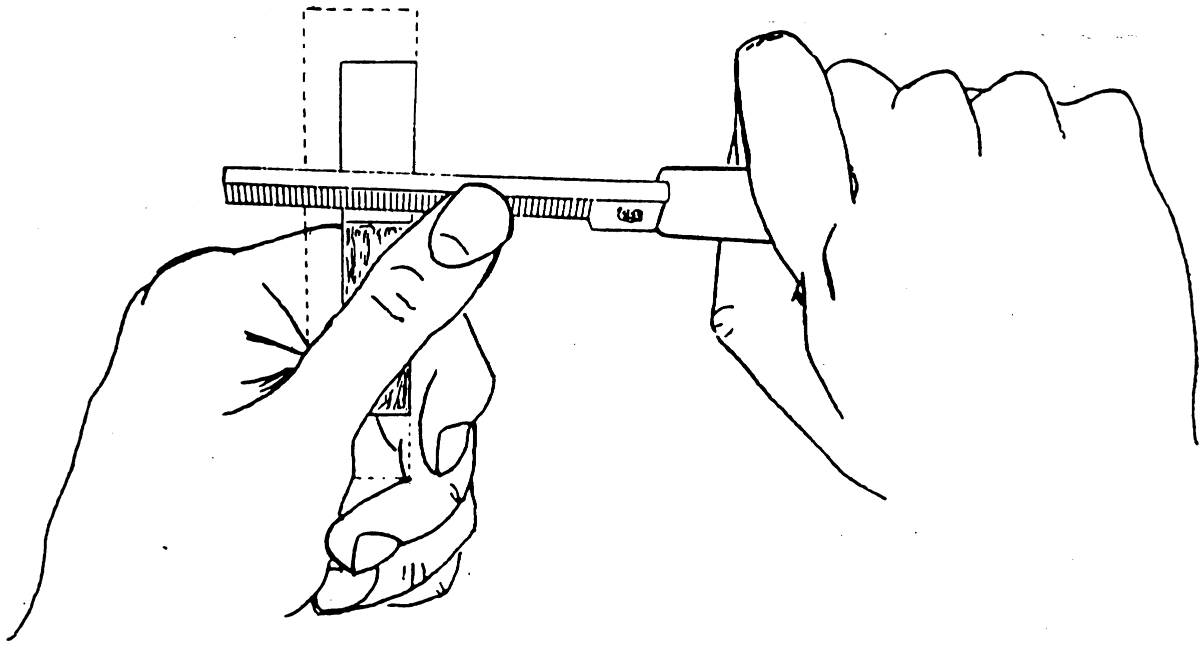

Figure 45. Holding the scraping knife.

To scrape the cane, the right wrist is rotated outward in a circular motion, with the edge of the blade actually coming away from the reed at the end of the stroke. The left thumb is only a fulcrum; although the blade always stays in contact with the thumb, it is the right hand which provides the motion. Inasmuch as the thumb remains stationary while the right hand is free to move, the blade may be placed at any angle on the surface of the reed, and may be rotated to any degree of tilt with the blank.

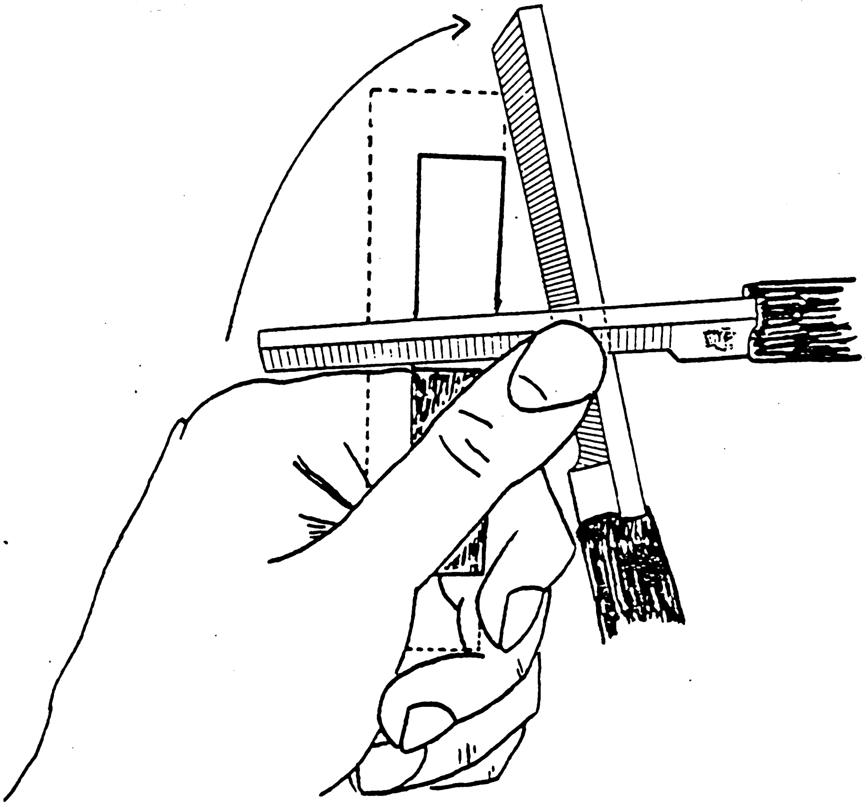

Figure 46. Range of available angles for scraping knife.

No downward force should be applied to the reed knife; the weight of the knife provides adequate downward force. Most gouging and tearing of cane results from downward pressure applied by either hand. While inexperienced reedmakers often feel that much more cane could be removed in a stroke if a downward pressure were exerted, they will discover that in the amount of time it takes to make one scrape with pressure, several strokes with no pressure can be made to remove just as much cane, and without the unwanted gouging.

To be certain that a smooth transition is made between the area to be scraped and the remainder of the reed, it is often helpful to start with the blade angled slightly toward the back of the reed, rather than exactly vertical.

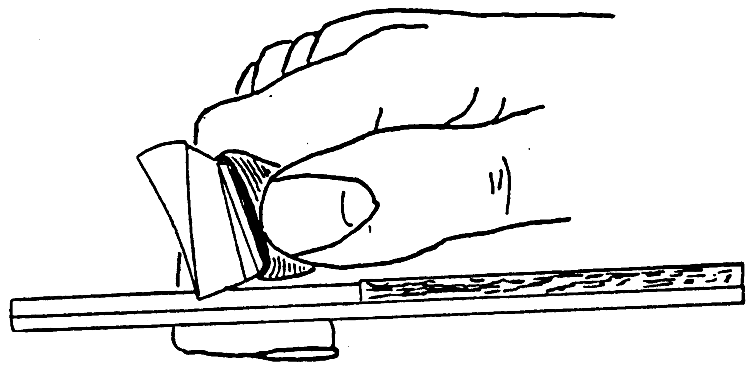

Figure 47. Blade angled toward back of the reed.

It is normally best to scrape diagonally outward, since the normal shape of the reed requires the reed to become thinner from center to sides and shoulder to tip (the "U" shape); diagonal outward motion usually promotes this shape. Additionally, the movement of the blade across the fibers rather than parallel to them minimizes the possibility of tearing the fibers. Scraping done in a straight line from shoulder to tip should be undertaken with great care, because it is very easy to tear a large amount of cane from the vamp if any downward force is inadvertently applied.

At two points in reedmaking, the straight scrape in the direction of shoulder to tip must be used; while differentiating the cut line from the vamp, and while finishing the tip. Extreme care not to apply downward pressure must be used at these times.

Although experienced reedmakers may find it quicker and easier not to use the plaque at some stages of scraping, the inexperienced reedmaker should always use a plaque, both for his own safety and to prevent gouging the reed. A common mistake of the beginning reedmaker is to attempt to scrape without a plaque while not taking the resilience of the cane into account, usually resulting in a disastrously gouged area. Especially when working at the tip, a plaque must be used to support the cane.

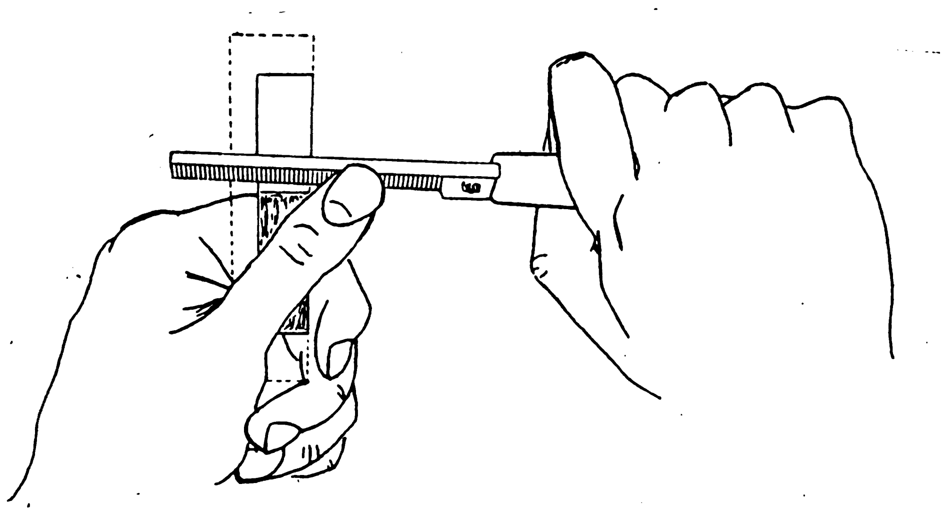

Figure 48. Blank aligned correctly with plaque.

While scraping, like sanding, is normally done with the reed wet, the experienced reedmaker will find that very occasionally it is advantageous to make very minor corrections when the reed is dry. This is especially useful if the cane is not of the best quality, and tends to tear easily.

Types of Scraping Knives

The knife shown in the illustrations is a double-hollow-ground knife similar to those manufactured by Herder Cutlery and Robert D. Gilbert, not the beveled-edge knife used by many single reed players.

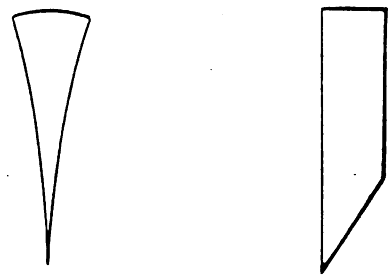

Figure 49. Double-hollow-ground and beveled-edge blades.

While the double-hollow-ground knife is most often associated with oboists, it has many advantages for the single reed player. Because of the shape of the back of the knife and the ease with which it is possible to see the exact edge of the blade and contact point with the reed, it is easier to control the knife more exactly. The (normally) lesser weight of this knife as opposed to the beveled-edge knife is not a disadvantage, but an advantage, since it is easier to control the fine scraping required for very gradual final adjustments. While it is easier to remove large amounts of cane with a heavier beveled-edge knife, the single reed player rarely needs to remove a large amount of cane, since most such rough work has been accomplished in the profiling stage.

Additionally, many players find that it is easier to keep a double-hollow-ground knife sharp, because the motions used for sharpening seem to be easier than those required for sharpening a beveled-edge knife, and the quality of steel used is very often better than that used by makers of most beveled-edge knives.

Many reedmakers have noticed a dramatic improvement in their knife techniques when a good quality scraping knife was obtained. Whether a hollow-ground or beveled-edge knife is used, it must be of the best quality possible to obtain the best results, and it must be kept sharp at all times.

Sharpening the Scraping Knife: Hollow-Ground

The hollow-ground knife may be sharpened by using either a hard Arkansas stone or a leather hone. If a sharpening stone is used, a thin layer of honing oil should be used to lubricate the stone. The knife is held at the handle by the right hand and at the tip with the left hand. The edge of the blade is placed against the stone, and the top of the blade tilted back to form approximately a 40^{o} to 45^{o} angle with the stone. The tip of the blade is held closer to the body than the handle, so that the blade faces outward. The blade is pushed lightly forward and across the stone.

For the return sharpening stroke, the edge faces the reedmaker, forming approximately a 20^{o} angle with the stone. The tip of the blade is further away from the body than the handle. The knife is drawn lightly across the surface of the stone toward the reedmaker.

To sharpen the knife, these two operations are repeated alternately, making sure that the final sharpening stroke is the first mentioned, with the blade being pushed away. Reedmakers often test a blade for sharpness by drawing it across a thumbnail; burrs or dull spots on the blade can be felt easily.

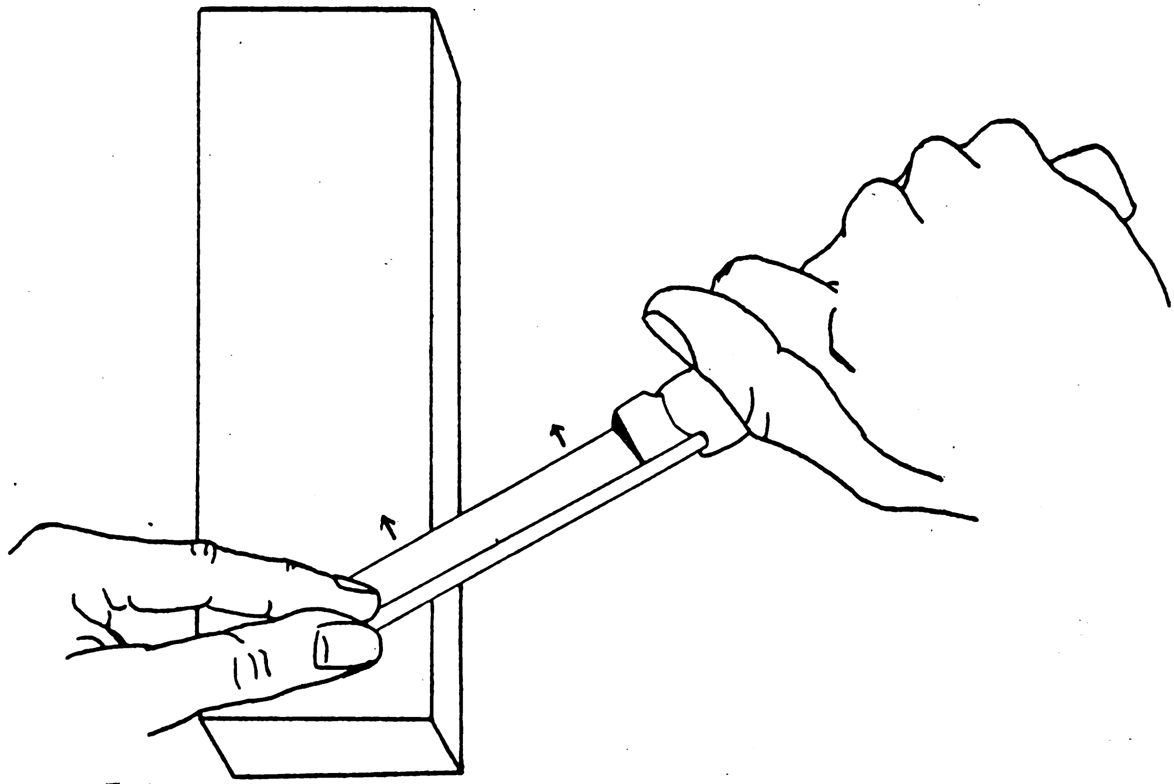

Figure 50. Sharpening hollow-ground knife on stone, first stroke.

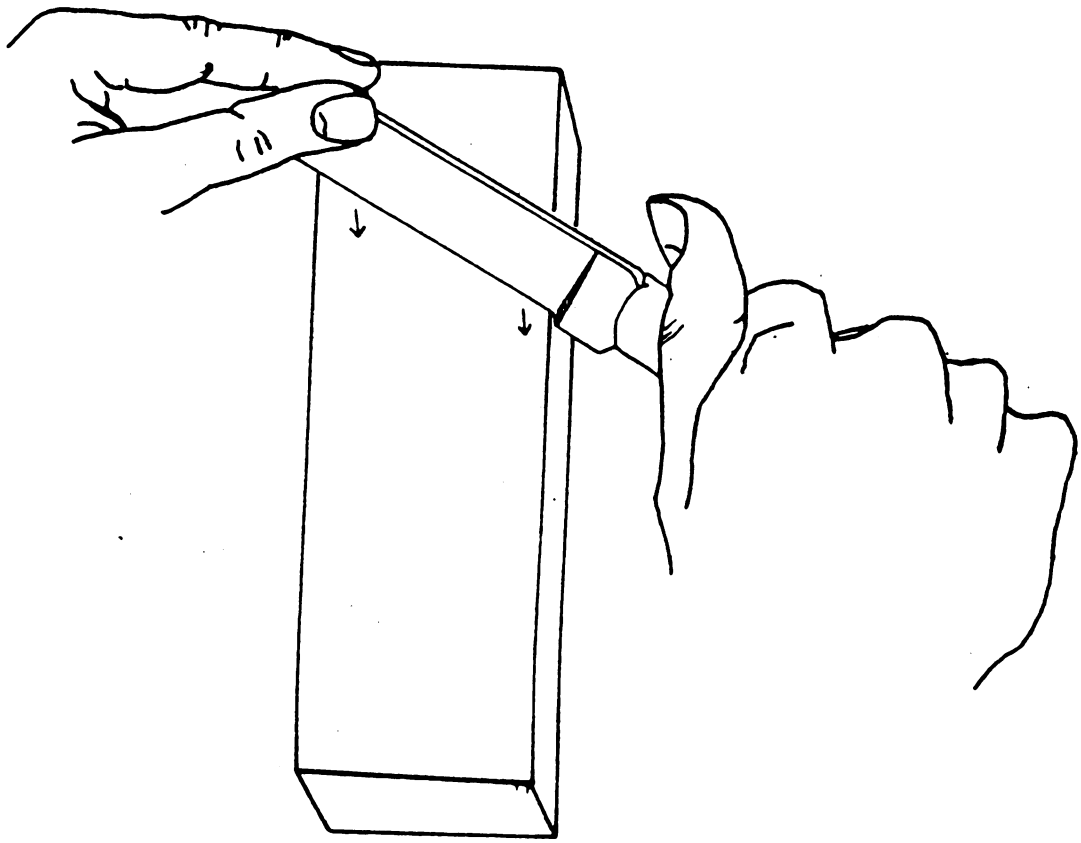

Figure 51. Sharpening hollow-ground knife on stone, second stroke.

Razor hones, readily available from reed tool suppliers, barber supply houses, and precision tool companies, are normally a strip of leather mounted on a wood backing. A layer of abrasive paste must be applied occasionally to the leather; many of the best hones have two sides so that a coarser and a finer grit may be used as necessary depending on the amount of sharpening required. When the blade is drawn across the leather, it will be instantly apparent if the wrong direction is being taken, because a cut in the leather will result.

To sharpen with the razor hone, the knife is first aligned as it was in the first step of sharpening with a stone -- the edge is placed on the leather, forming a 40° to 45° angle, and the tip is held closer to the body than is the handle. However, the knife is placed at the farthest away point on the hone with the area from the handle to mid-blade on the leather, and the blade is drawn back toward the reedmaker, not pushed away. This stroke is repeated as needed, usually about fifteen to twenty times.

The other stroke needed when using a razor hone involves alignment of the knife with the edge against the leather and pointing to the reedmaker. An approximate 20° angle is formed between the knife and the leather, and the tip is held farther away from the body than the handle. The knife is aligned at the near portion of the hone from the edge near the handle to mid-blade, and the knife is pushed away in an outward motion. The stroke should be repeated about as many times as the first stroke.

For the final stage of sharpening, the first type of stroke used should be repeated several times.

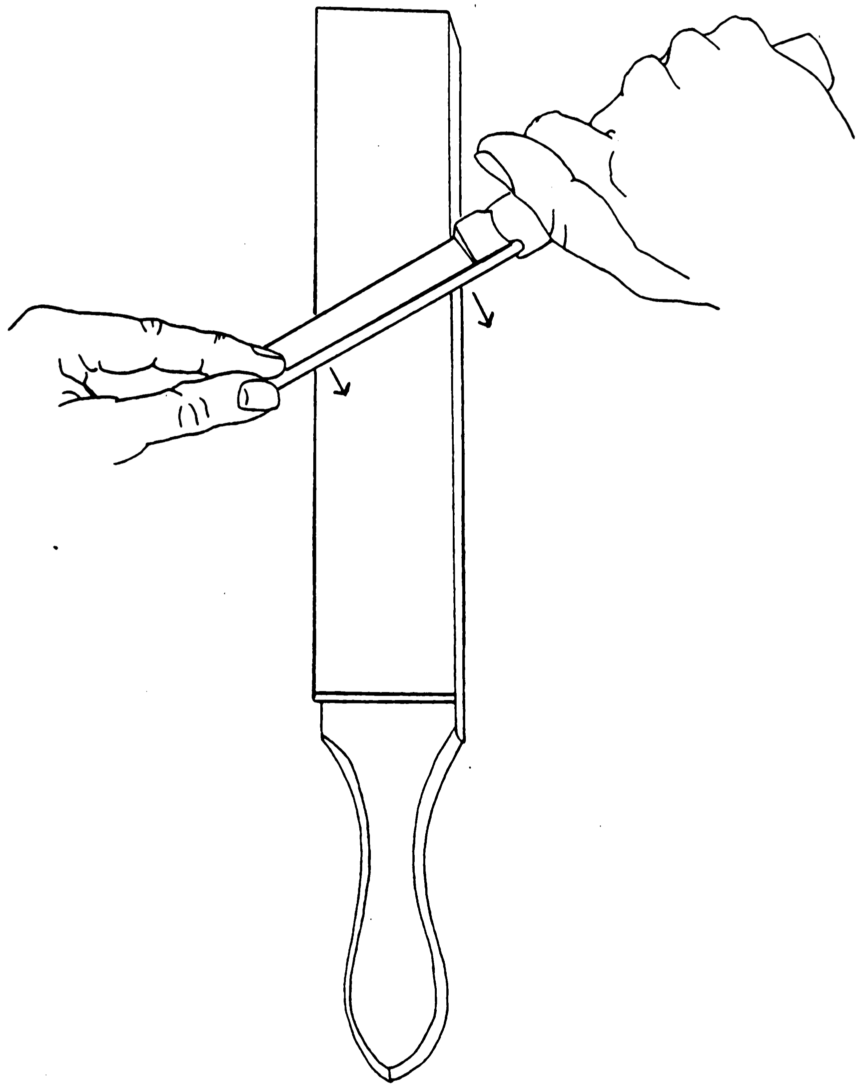

Figure 52. Sharpening hollow-ground knife on hone, first stroke.

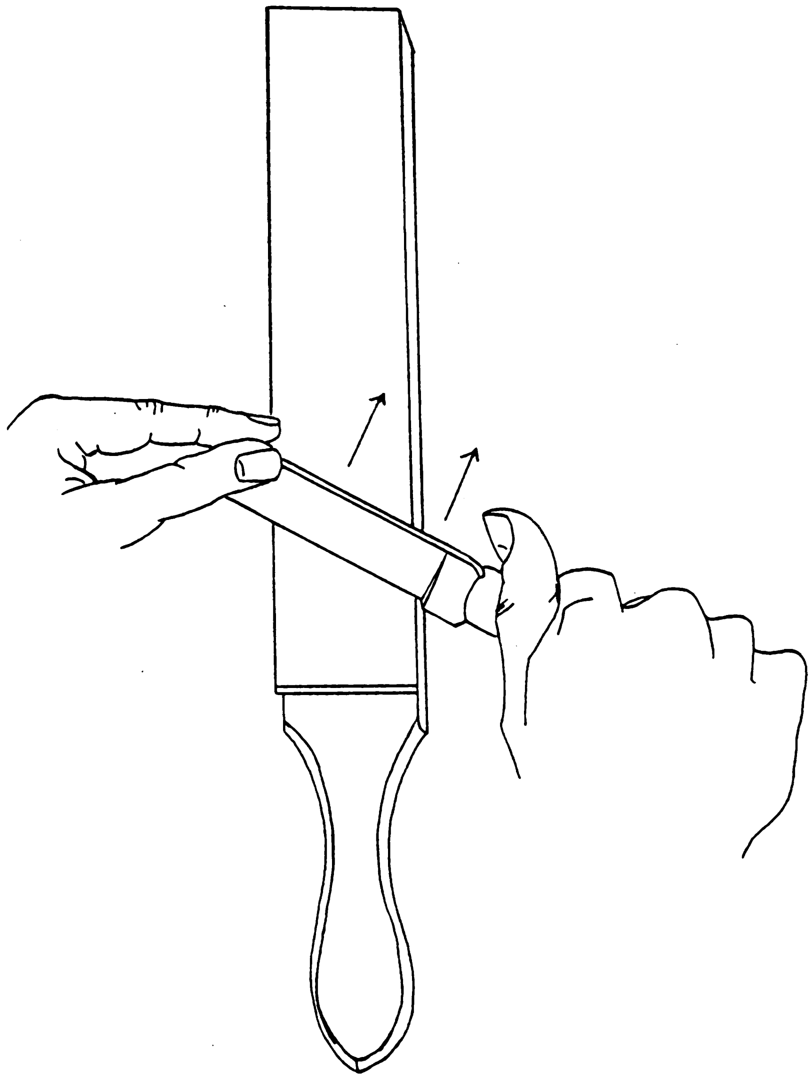

Figure 53. Sharpening hollow-ground knife on hone, second stroke.

Sharpening the Scraping Knife: Beveled-Edge

To sharpen the beveled-edge knife, the knife should be placed with the angled face flat against the further end of the sharpening stone surface. The face remains in contact with the stone throughout the stroke as the knife is drawn back across the stone toward the reed-maker. Since most knives have a longer blade area than the width of most sharpening stones, the knife will have to be aligned alternately from tip to mid-blade and from mid-blade to handle on the stone.

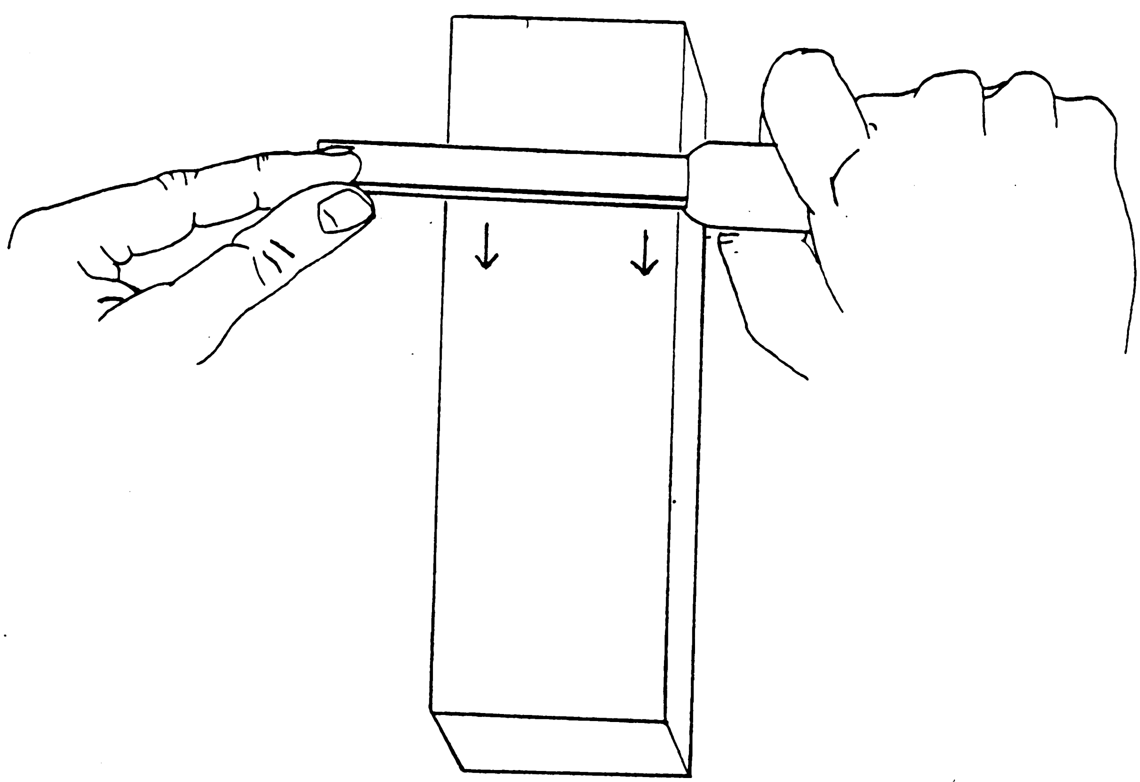

Figure 54. Sharpening beveled-edge knife, first stroke.

After enough strokes to re-sharpen the edge, the long flat side of the knife should be placed flat side down on the stone with the edge

pointing to the reedmaker; the knife then is pushed away and across the stone to remove the burrs formed by the first step.

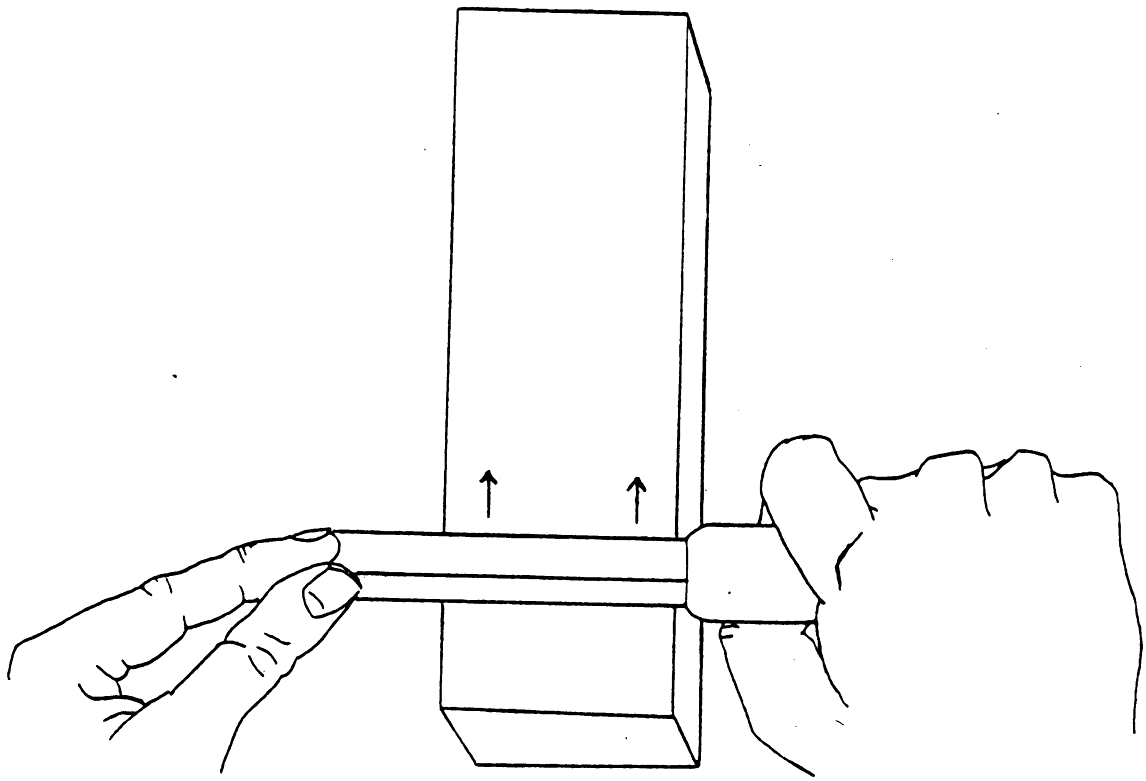

Figure 55. Sharpening beveled-edge knife, second stroke.

After several strokes in this direction, the original stroke is repeated several times to raise a very slight burr on the edge.

APPENDIX B

THE REED BLANK

While good quality reed blanks are available from several suppliers (see Appendix D), many players prefer to have the total control of the blank's dimensions afforded by making the blank from tube cane. In particular, it is difficult to find commercial blanks which are consistently of adequate thickness.

ROUGH SIZING OF THE BLANK

Roughly sizing and splitting the tube cane requires no specialized reedmaking tools; only a rather long thin-bladed knife such as X-Acto blade #26 and a small hobbyist's hand saw such as X-Acto razor saw blade #35 are needed. Both blades fit the X-Acto #5 or #6 handle which was used with a #25 blade as the cutting knife.

Most makers of clarinet reeds prefer a blank which is approximately 70 millimeters in length, 13 millimeters at the tip, 11 millimeters at the butt, and somewhat over 3 millimeters in thickness, to allow for the thickness of cane which will be lost when the blank is sanded flat; the cured blank is usually about 3 millimeters thick. The arc formed by the bark of the cane should rise to its highest point in the center of the blank, and should be symmetrical; i.e., the thickness of the blank should be equal at points an equal distance from the center line.

Figure 56. Symmetrical and asymmetrical blanks.

While it is possible to make a good reed from an asymmetrical blank, it is far easier to make one from a symmetrical blank, since the symmetrical blank when profiled will require no additional work to preserve symmetry from side to side.

Because tubes of cane rarely have the perfect roundness of circumference and lengthwise straightness which would be desirable, it is necessary to exercise care in the initial rough sizing of the blank to ensure that optimally shaped blanks are produced. Tubes of cane which have walls thick enough to allow single reeds to be made from them are usually large enough in circumference to be split into four arcs. Occasionally, a tube of rather small diameter may have thick enough walls, and can be used by splitting it into three arcs. Tubes of cane are usually long enough to allow two to four sets of four or three blanks to be made.

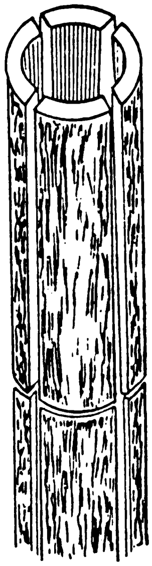

Figure 57. Tube of cane split into arcs.

The best blanks are symmetrical from side to side, and the fibers running the length of the blank are straight for its entire length.

Many reedmakers also prefer a blank with as large a top arc as possible; the great differential in thickness between the center and sides of the reed simplifies reedmaking, since once the bark is removed and the basic profile is put in the blank, little work is required to put the sides in the proper proportion.

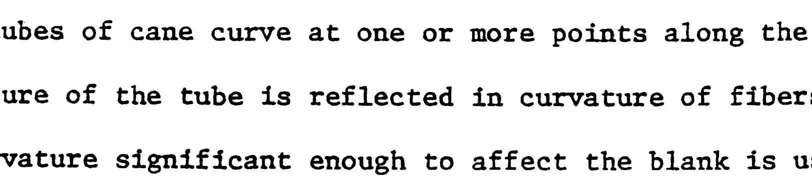

Figure 58. Symmetrical large-arc and small-arc blanks, profiled.

Most tubes of cane curve at one or more points along the length. This curvature of the tube is reflected in curvature of fibers of the blank. Curvature significant enough to affect the blank is usually evident by eye, or may be detected by aligning the tube with a flat surface and rotating it. Because of the possible curvature of the tubes, it is usually better to cut the tubes into sections of appropriate length which avoid areas of extreme curvature before splitting them, since what appear to be the best points for splitting the tube in one section may not be the optimum points in another section.

Tubes of cane very often decrease in diameter near the end of the tube. If the length of the tube is such that avoiding the use of this area will result in the loss of a blank's-length section of cane, it is still possible to use this cane. The end should be marked in such a way that it can be used as the butt end of the reed blank, so that the curved fibers will not be used as the vibrating portion of the reed. If a blank with curved fibers is made, it should be flattened so that the arc at the tip end is symmetrical.

To cut a section from the tube cane, the proper length of the blank plus one millimeter should be measured and marked on the tube with a pencil; the extra millimeter is usually lost in the sawing process. Using the razor saw, the reedmaker should make a nick in the bark at the pencil line, and the stroke should be repeated to form a shallow groove. The tube should be rotated slightly, and the groove continued. This process should be repeated with periodic checks to be sure that the groove is maintaining the original distance from the end of the tube, until the shallow groove spans the entire circumference of the tube. The reedmaker may then saw off the section marked by the groove from the rest of the tube. The use of the groove as a guide for sawing is the easiest way to be sure that the section of tube will be the same length on every side.

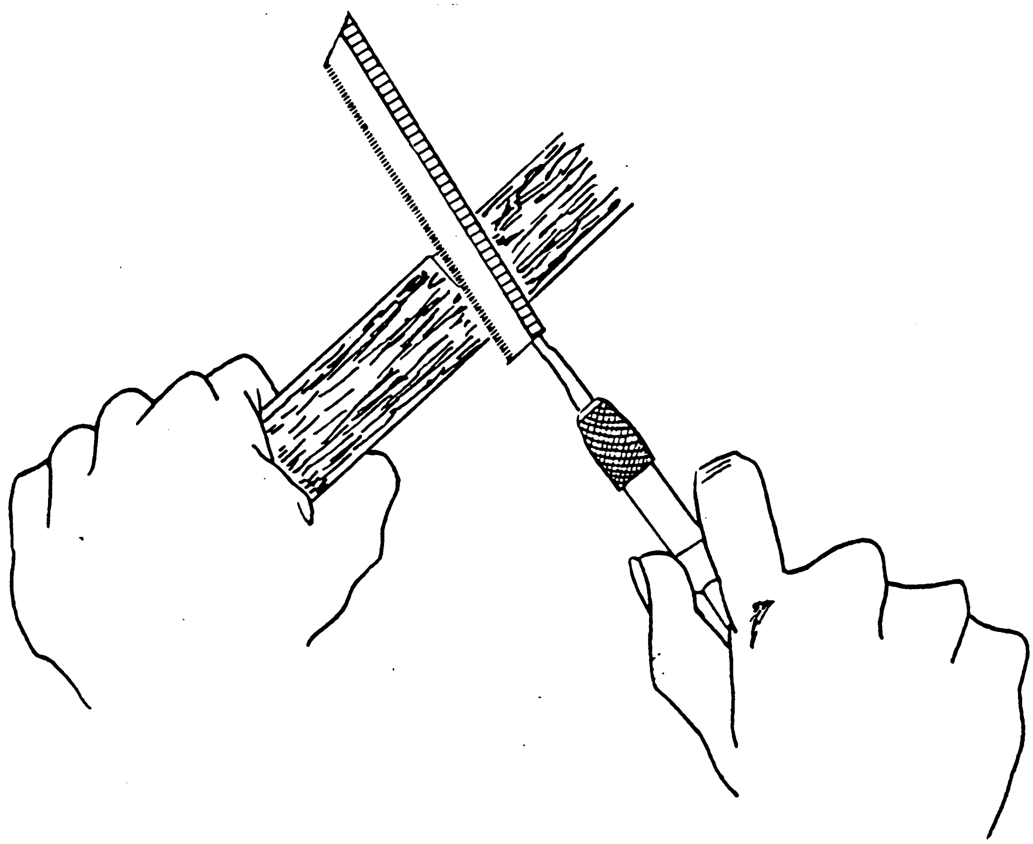

Figure 59. Forming a groove with the saw.

When a section of tube cane has been cut to blank length, the best direction to split the cane may be determined. Since tubes are usually not perfectly circular, a carefully chosen split of the cane may result in formation of symmetrical blanks, while a random splitting may form virtually unusable blanks. The end of the tube should be inspected to determine where the centers of symmetrical blanks may be found, and these centers should be marked with a pencil.

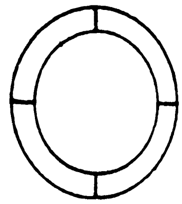

Figure 60. Centers marked form four symmetrical blanks.

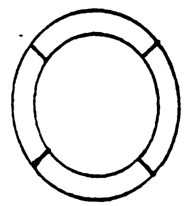

Figure 61. Centers marked form four asymmetrical blanks.

If the tube is to be split into four sections, a point fairly near the tip of the long #26 blade of the X-Acto knife should be placed on a midpoint between two of the lines indicating the planned centers of the blanks; the other end of the blade should be placed on the midpoint between two of the center lines on the side of the tube opposite the first midpoint. A slight downward pressure should be applied to form a shallow groove, and the blade should be forced downward for the length of the section. If necessary, the knife blade may be hammered lightly.

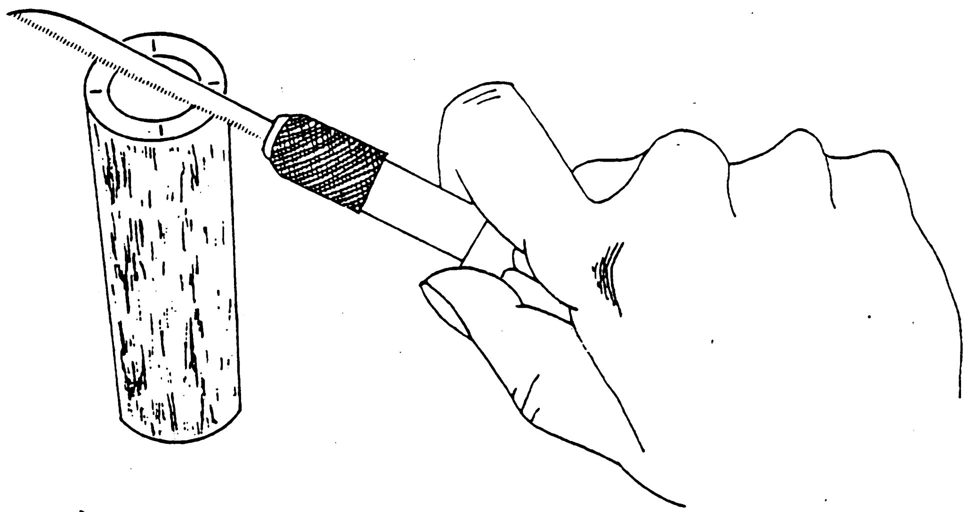

Figure 62. Knife angle for splitting of cane.

The resultant two semicircles may each be split at the midpoint between the center lines to form the rough blanks.

If the tube is to be divided into only three sections, or if the tube is so irregular in shape that lining up two midpoints with the blade is impossible, each of the midpoints may be split individually.

Very often the reedmaker has a choice between making four imperfect blanks or two or three excellent ones from a section of cane. Because the shape of the blank is so important to the quality of the reed, it is more efficient in terms of good reeds produced to make two or three good blanks, and to discard the inferior pieces.

SHAPING AND FLATTENING THE BLANK

Blanks may be shaped to their proper dimensions using only a cutting knife and sandpaper or a file, but the use of a good quality plane immensely simplifies blank making. All of the operations described below can be performed also by using a small, hand-held plane with a blade width of one to two inches; however, a reedmaker who plans to make all his own blanks will find that it is worthwhile to use a larger plane which has been mounted in a vise so that the plane side is up, or, even better, mounted in a wooden box, which has the advantages of holding the plane very solidly and catching the wood shavings as they are produced.

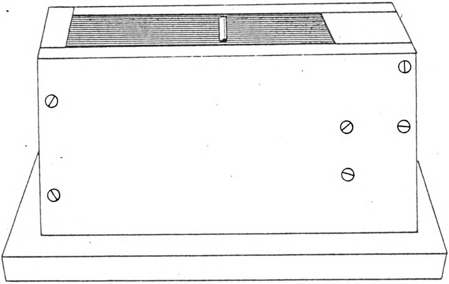

Figure 63. Plane mounted in box, exterior view.

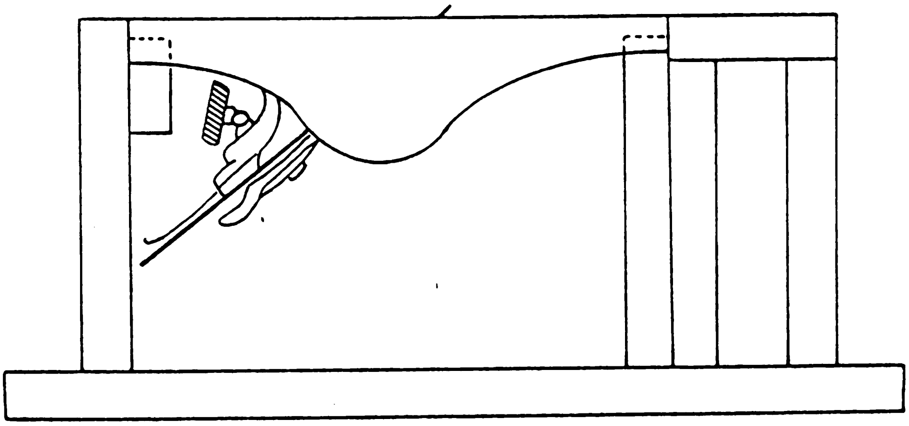

Figure 64. Plane mounted in box, cross-section.

Blanks are always pushed outward over the plane blade, since pulling of the blank tends to splinter the cane.

Use of the Plane

The first step in shaping the blank should be to pass each edge and the cane side of the blank over the plane blade several times, since the extremely sharp edges of the cane present a hazard to the reedmaker. The cane side of the blank then should be inspected to determine if the fibers run straight for the entire length of the vamp, or whether they curve at one end. If curvature is present at one end, that end should become the butt end, since it is important that the fibers at the tip end do not curve.

When it has been decided which end will be the butt end, the first rough shaping of the blank may begin. To taper the blank, the edge of the blank five to ten millimeters from the end of the blank should be placed on the plane blade, tip outward, and the blank should be pushed forward.

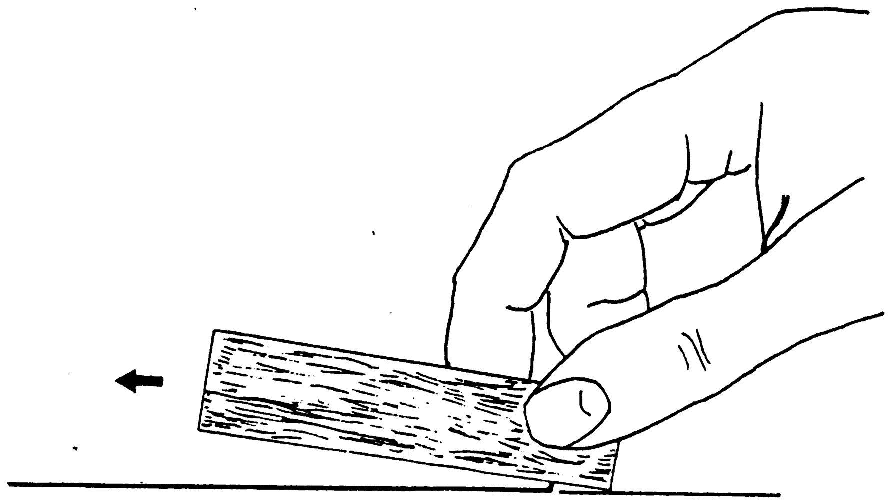

Figure 65. Tapering the blank, first planing.

The area of the edge just planed should be placed on the flat of the plane between the reedmaker and the blade, and the blank again passed over the blade; a longer tapered area will result. This process should be repeated until the entire side of the blank is tapered in width, and the process then repeated on the other edge of the blank. This process is not intended to make the blank exactly correct in width, but merely to roughly shape the blank. For a clarinet reed, the blank at this point should be left 15 to 16 millimeters wide at the tip.

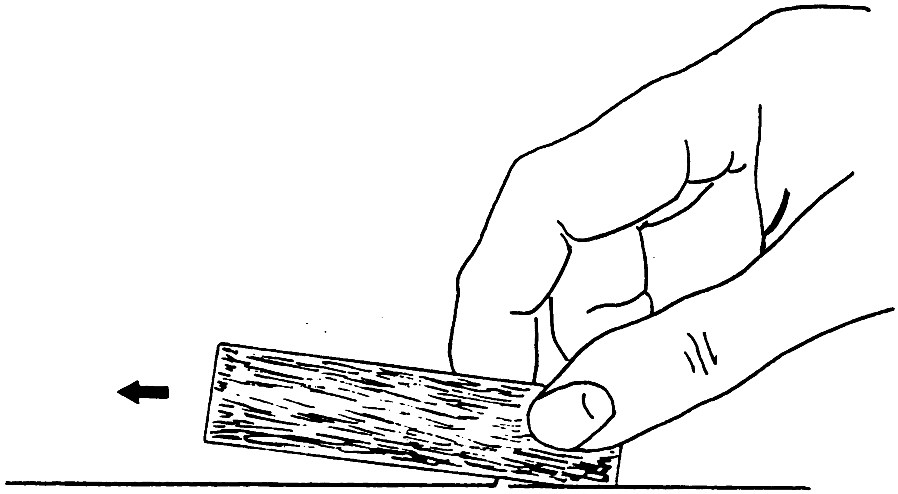

Figure 66. Tapering the blank, second planing.

The butt of the reed should be inspected to be sure that the arc of the top of the blank is symmetrical. The rough blank is passed next over the plane blade cane side down to flatten the bottom of the blank, with care taken to maintain the symmetry of the blank. Often, because of curvature of the tube, one side of the blank is thicker than the other, and to maintain symmetry it may be necessary to pass only the thick side of the blank over the plane blade until equality of thickness is achieved.

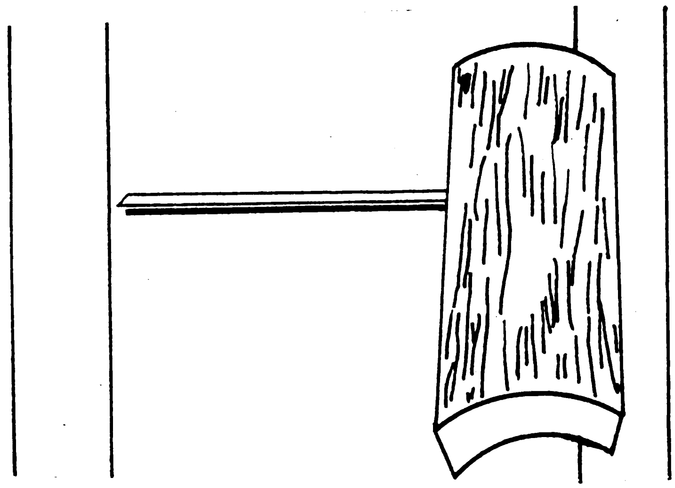

Figure 67. Passing only thick side over plane blade.

Even thickness of the blank for its entire length may most easily be achieved if the direction of the blank, tip first or butt first, is reversed on every pass over the plane blade. The last few passes, however, should be made tip first, since there is a tendency for the cane to tear at the end of a stroke.

If the thickness of the tube walls is close to the desired thickness of the blank, it is sufficient to use the pressure of the fingertips on the bark to move the blank over the blade. If the reedmaker is so fortunate as to have cane so thick that a millimeter or more of cane must be removed after the blank is flat, it is much safer to use a block of wood to push the blank across the blade; a groove approximately the size of the blank is cut in the wood to hold the blank firmly. For a clarinet blank, the groove is approximately 16 millimeters in width, 70 millimeters in length, and 2 millimeters in depth, so that the cane and not the block of wood is planed off. The use of the block allows the blank to be planed more evenly, since pressure is applied evenly over the length of the blank.

When the blank is slightly more than 3 millimeters thick, the blank should be sanded flatter with #220 sandpaper; further flattening with #400 and #600 sandpaper occurs during the process of curing the blank.

Tapering of the blank may be corrected by a few more passes of the edges of the blank over the plane blade, but the blank should be left slightly too wide so that the final shaping may be done with sandpaper.

Narrowing the Blank with Sandpaper

For greatest control and smoothness of the sides, the final shaping of the blank should be done with sandpaper rather than the plane. The procedures described below may also be applied to finished reeds whose taper must be altered.

#220 sandpaper should be used is a large amount is to be removed, #400 sandpaper if a moderate amount is to be removed, and #600 sandpaper used for small amounts. #600 should always be used for the last several strokes to make the edge as smooth as possible. As always, sanding is done with both reed and paper wet.

If the blank is to be narrowed by the same amount along its entire length, it is placed on edge, tip pointing outward, on the appropriate strength of sandpaper. Holding the blank in the middle with the thumb and middle finger on the bark and bottom, and the index finger on the other edge of the reed, the reedmaker should draw the blank back carefully, being careful to maintain the perpendicular angle of the blank with the paper. Only very light downward pressure should be used, since excessive pressure may raise burrs on the edge of a blank, or, on a nearly finished reed, may crack or fray the thin tip area. This process is repeated until the desired amount of material is removed from that side, and the process then is repeated on the other edge of the reed. The tip of the reed is never pushed forward on the paper, but is always drawn across it.

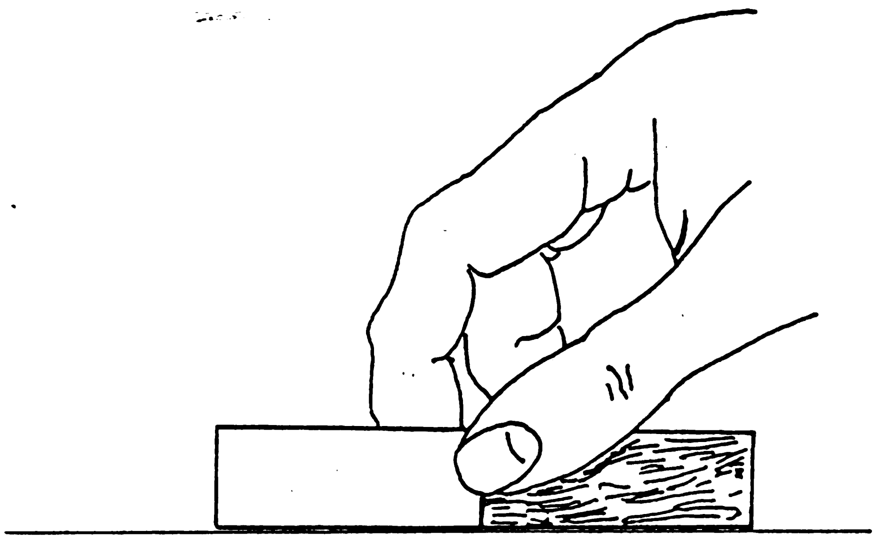

Figure 68. Narrowing the blank evenly down the length.

If the taper of the reed or blank is to be altered, the reed is placed on the sandpaper as before, but the reed is held at the area which is too wide; extra weight at that area and lesser weight on the rest of the length of the reed allows the area which is too wide to be sanded more than the remainder of the reed.

If a large differential in the taper is desired, a more extreme procedure may be required. For instance, when putting a large taper in a blank where the tip and butt are virtually the same width, as is the case with many commercial blanks, it is most efficient not to place the entire edge of the reed on the paper, but to hold the reed at approximately a 30° angle with the paper, with the butt end in contact with the paper. The initial strokes will cut a great deal of cane from the area near the butt, and cut no cane from the areas closer to the tip. In the successive strokes, the angle of the reed with the paper is reduced gradually, so that a straight line is again formed along the edge.

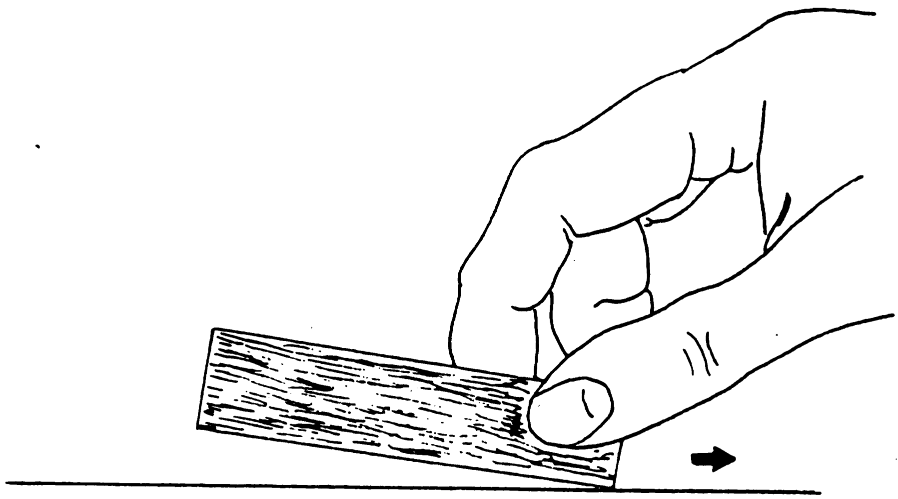

Figure 69. Narrowing taper by sanding -- angle of first strokes.

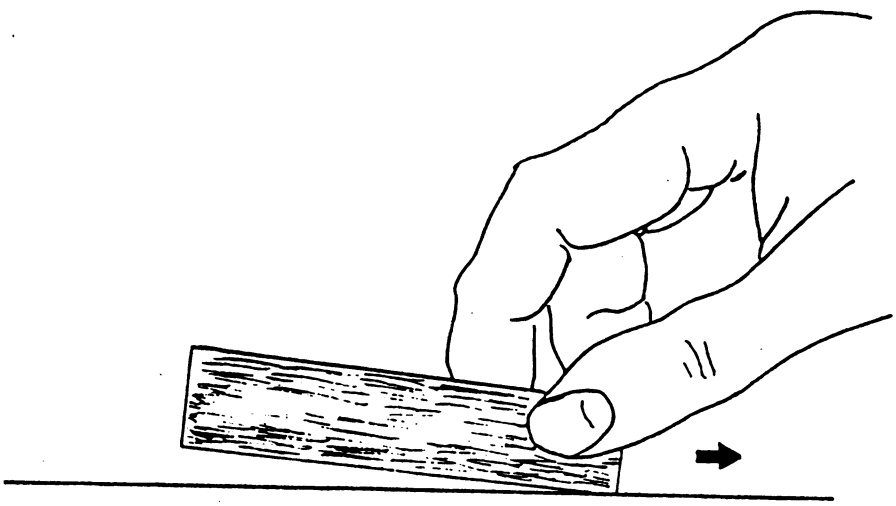

Figure 70. Narrowing taper by sanding -- angle gradually reduced.

After a finished reed is narrowed, the rails should be checked carefully for correct proportions. If any significant amount of narrowing is done, the rails almost inevitably will need to be corrected.

The width and taper of the blank are important dimensions for the reed. While shapers for single reed blanks similar to oboe and bassoon reed shapers are available, hand shaping of blanks allows the maker to leave the blanks slightly too wide, so that each blank's taper or width may be altered to the best configuration for that reed. One more element of reedmaking is thus under control.

APPENDIX C

ADJUSTING COMMERCIAL REEDS

The principles of adjusting commercial reeds are the same as those described for adjusting the profiled reed, but there are several specific problems commonly encountered with commercial reeds.

Since the blank used for commercial reeds is not cured and the reed is made over a short period of time, the commercial reed has a much greater tendency toward warpage than does the hand-made reed. The breaking-in process for the commercial reed is extremely important to improve the quality of the reed.

After the reed is soaked in water for the first time, the fibers of the vamp are particularly susceptible to warpage, since they have not been wet before. The small fiber tubes running lengthwise down the blank have been cut diagonally during the formation of the vamp of the reed, and so are able to absorb water. Both to press the openings of the tubes closed and to re-align fibers which may tend to warp out of their original positions, the blank should be placed on a flat surface such as glass or the plaque, and a fingertip should be used to press down on the vamp in a motion always moving from the shoulder to the tip. For at least the first few days, this process should be repeated each time the reed is soaked.

If the vamp seems to be much rougher than that of the average reed, it may be necessary to rub a small piece of #600 sandpaper down the vamp from the shoulder to the tip to remove the rough fibers. To help control swelling and compress the fibers on the bottom of the reed, the reed may be drawn across flat glass, butt first, while considerable downward pressure is exerted along the length of the reed.

Although corrections in the reed's shape normally should not be made the first few days the reed is played, for almost every commercial reed it is necessary to make a few basic corrections the first time the reed is wet, since drying of the reed with these areas uncorrected may encourage great warpage.

Most commercial reeds do not have a straight cut line, but an unevenly curved one; in some brands of reeds, the bark has been removed, but the layer below the bark has been left on. If necessary to form a straight cut line, the line should be re-defined by rocking the knife across the back of the reed, and the profile should be corrected so that the layer of cane beneath the bark is removed and the reed is tapered evenly from center to sides and shoulder to a point behind the tip.

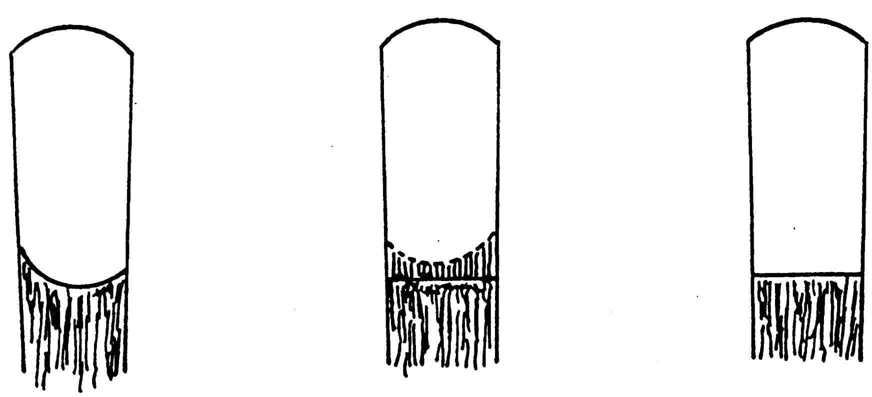

Figure 71. Incorrect cut lines of two commercial reeds; corrected.

Failure to remove this cane may cause the reed to have too much support down the sides; the sides may then warp upward. The sides of the reed also may be too supported if the rails are far too thick; if inspection of the rails establishes that they are in fact very much too thick, they should be corrected by using #400 or #600 sandpaper.

Other alterations should be made on the reed the first day only if the imbalances or improper proportions are so great that warpage will occur if they are not corrected. After the reed is played for no more than five minutes, it should be rinsed in water, again rubbed from shoulder to tip while on a flat surface, and stored in a reed case.

Reeds should always be stored in a proper case, preferably one which has a glass surface for the bottom of the reed, and which places a very light downward pressure on the tip area of the reed. Reeds left to dry on flat glass with no such pressure are very susceptible to changes in humidity, and warpage often results simply because one side dried faster than the other. A satisfactory reed case may be made easily from a hinged cigarette case: a piece of glass may be cut for the bottom of the case, and a strip of foam rubber may be attached to the lid in the appropriate area so that it will press on the tips of the reeds when the case is closed.

After the reed has been played for about five minutes on each of about three days, the cane should have stabilized enough so that conclusions about the reed's quality can be made with some degree of accuracy. Corrections should be made on the reed following the conceptual model of reed motion and the same principles of reed shape used for the hand-made reed.

Dimensions which should be checked carefully on commercial reeds are the width and taper of the sides; some brands are extremely wide, taper very little, or may not maintain a straight line down the edges from tip to butt. It is particularly important to correct the latter problem, since totally unsupported cane fibers are left to vibrate freely, causing many adverse effects on both tone and response. Many commercial reeds are too wide overall, and improve dramatically when narrowed. It should be remembered that rails will probably have to be altered when the reed is narrowed.

Flatness of the bottom of the reed is a dimension with which the user of commercial reeds must be concerned. Drawing the reed across the flat glass for the first few days the reed is soaked may help to flatten the blank and help stop warpage, but occasionally the reed appears to be warped enough to affect seriously the playing quality. If such a situation appears to be present, the first step is to check the vamp, and particularly the rails of the reed, to determine if any imbalance is present, especially one which causes too much support to be present for an area of the reed.

If no corrections on the vamp are possible to reduce the apparent warpage, the bottom of the blank may have to be adjusted. Many players as a matter of course sand the bottoms of all their reeds because of a desire to have the flatness possible to acquire with a hand-made reed. However, sanding the bottom of the reed is a serious operation which greatly alters the proportions of the entire reed, and should not be undertaken unless there is reason to believe that no other alterations will result in a playable reed.

When a blank is sanded on the bottom, cane is removed evenly from the entire length of the blank, and the reed profile is made to account for the thickness of the blank. When a reed is sanded on the bottom, however, an increasingly greater percentage of cane is removed moving from the cut line to the tip; while the thick area from the fulcrum to the butt loses only a small amount of cane in terms of percentage when sanded, the same amount removed in front of the fulcrum is a large percentage of its thickness. Extensive re-making of the reed may be a consequence of sanding a significant amount of cane from the reed.

Some players attempt to minimize the removal of cane in the forward part of the reed by keeping that area of the reed off the paper while sanding. Depending on the shape of the warpage and the skill of the players, this approach may be more successful, since excessive thinning of the tip area is avoided. The final few sanding strokes, however, should be made with the tip of the reed also on the paper, so that any ridge formed between the sanded area and the tip is removed. If sanding of the bottom must be attempted, the pressure from the fingers should be very light and centered only on the bark area of the reed, to lessen the amount of cane removed in the front of the reed. In this case, sanding should be done on dry, not wet, #600 paper; wet-or-dry paper used wet cuts too efficiently for the small amount of cutting desired.

Avoidance of sanding the bottom of the reed does not mean that the common practice of polishing the bottom of a commercial reed may not be performed. It is often helpful to smooth the bottom of the reed by placing it on dry #600 paper or very fine emery paper, and taking a few extremely light circular strokes; if the tip is rather thin before polishing is attempted, it should be off the paper for all but the last one or two strokes. However, this type of sanding is very different from sanding intended to make major changes in the flatness of the bottom of the reed.

Playing time on the reed should be increased gradually from day to day as the cane fibers become accustomed to the vibrating motion. When playing, it is helpful to change reeds every fifteen minutes or half hour, both to prevent waterlogging of the cane and to avoid dependence on one reed.

APPENDIX D

SOURCES OF REEDMAKING SUPPLIES

Peter Angelo P.O.Box 4005 Greenwich, CT 06830	Knives
W. Bhosys 123 109th Avenue South Ozone Park, N.Y. 11420	Maker of reed tools
William Brannen 908 Hinman Evanston, Ill. 60202	Knives
John Caputo 1522-24 First Avenue New York, N.Y. 10021	Knives
Christlieb Products 3311 Scadlock Lane Sherman Oaks, CA 91403	Knives
Forrest Band Instruments 1908 Shattuck Avenue Berkely, CA 94704	All supplies
Mme. Marcelle Ghys Nationale 7 Cheruim de la Parouquine Antibes (A.M.), France	Tube cane
Robert D. Gilbert 943 North La Cienega Blvd. Los Angeles, CA 90069	Knives, blanks, razor hones
A. Glotin 15 Rue du Progres Ezansville, France	Tube cane, blanks
Herder's Cutlery, Inc. 32 West King Street Malvern, PA 19355	Knives

Luyben Music 4318 Main Kansas City, MO 64111	All supplies
Kalmen Opperman 17 W. 67th Street New York, New York 10023	All supplies
Charles Ponte Music Co., Inc. 142 West 46th Street New York, N.Y. 10036	All supplies
Jack Spratt Woodwind Supplies 199 Sound Beach Avenue P.O.Box 277 Old Greenwich, CT 06870	All supplies

APPENDIX E

MEASUREMENTS OF SAMPLE REEDS

Masurements given are for two reeds made from symmetrical blanks and two reeds made from asymmetrical blanks. All reeds played satisfactorily on a Charles Bay professional model mouthpiece with a "medium open/medium length" facing. Measurements of the mouthpiece's facing are given in standard units: thickness of feeler gauges is measured in thousandths of inches, and distance from the tip is measured in 0.5 millimeter units.

Table 1. Facing measurements of Charles Bay mouthpiece.

Thickness of Gauge (inches)	Left Side Distance (0.5 mm units)	Right Side Distance (0.5 mm units)
0.035	6-	5+
0.034	6+	6
0.030	9	9-
0.025	11	11-
0.024	12+	12
0.020	14+	14
0.015	18	18-
0.010	22	22-
0.005	27	26+
0.003	30	30-
0.0015	33-	32

Tip opening: 1.11+ mm (111+ one/one-hundredth millimeters)

The measurements of the reeds in the tables below are given in the units most commonly used in published listings of reed dimensions. Width of reeds is measured in millimeters; thickness is measured in thousandths of inches. Distance from the tip in terms of millimeters is given in the left-hand column; the very tip is represented by zero. Measurements of thickness were taken at the center line, at both quarter lines, and on both sides of the reed down a line one millimeter from the edge. Reeds were measured after being soaked, rubbed on flat glass, and moisture wiped from surfaces. Reeds were used in the extremely dry climate of central California.

Table 2. Symmetrical reed number 1.

Distance	Left Side	Left Quarter	Center	Right Quarter	Right Side
0			3		
1		5	5	5	
2		8	9–	7+	
3	8	10	11	9	7+
4	10	11+	13	11+	9
5	11+	14	15	13+	10.5
6	13	15.5	17	16	12
7	15–	18	20	17+	13
8	18+	20	22+	19+	15
9	17+	22	25	21	16
10	18+	24+	27	23–	18
11	20+	27	29+	25	20
12	22+	29.5	32	27+	22–
13	25	31+	34+	30–	23+
14	27.5	34+	36.5	32.5	25–
15	30+	37–	39	35	27–
16	33+	39.5	42.5	39	29
17	37–	43–	46.5	41–	31
18	39+	47	48+	44	33
19	42–	50–	52+	46	37–
20	44.5	53	56	48.5	40–
21	47.5	57+	61–	52	43
22	50–	60–	62.5	55	46
23	54	63+	65	58	49
24	58+	68	69–	61	52.5
25	61	71	74	66	55
26	63	75	77	69.5	58
27	65	80+	82	74	61
28	68	86	87	78	65.5
29	72	91	91	85	69.5
30	80	95+	97	89	73
31	87	97+	103	94	75.5
32	92	101	111	102	77
33	93	108	115	111	86.5
Bark	95	114	124	114	95

Length: 33 mm.

Width: 12.9 mm tip
8.8 mm butt

Table 3. Symmetrical reed number 2.

Distance	Left Side	Left Quarter	Center	Right Quarter	Right Side
0			4-		
1		6	7	7-	
2		8	9	8+	
3	9	11	11	10.5	10-
4	10+	12.5	13	12	12
5	11	14	15-	14-	13
6	12	15+	16.5	15	15-
7	13	18+	18.5	17	16
8	15-	20.5	21	18.5	18-
9	17	22+	23	20	18
10	18	24+	26-	22	20-
11	19	26.5	28	23.5	21
12	21-	29.5	31	25	23
13	24	32	34-	27	26
14	27	34.5	36.5	29	27+
15	29	37	39-	32	30
16	30+	39	42.5	35	33-
17	33	42.5	45.5	38	35+
18	35	46	48	40-	38
19	36.5	48	50	41	40
20	39	50.5	53.5	44	42
21	45	54	56	48+	44
22	48+	59	60-	50+	46+
23	51.5	62	63+	52	50
24	55	66	67	56	52
25	59	69	71	61	54
26	61	72.5	75	63	57
27	63-	77-	80	67	59
28	64	79+	83	71	60.5
29	67	84-	87.5	74.5	64
30	70	86	91	79-	69
31	73	89	97	84+	71
32	75	93	103	89+	75
33	78	100.5	109	98	78
34	81	106	118	105	83
Bark	91	121	125	120	90+

Length: 34 mm.

Width: 12.7 tip
9.5 butt

Table 4. Asymmetrical reed number 1.

Distance	Left Side	Left Quarter	Center	Right Quarter	Right Side
0			4		
1		5-	5	7+	
2		7+	7+	7+	
3	5	9	10	10	6
4	6	11	12-	11	8
5	7	14	14+	13+	9
6	8+	16+	17-	15	11
7	10	18+	19-	18+	13
8	11	21	22-	21+	14
9	13	23	24-	23+	15
10	15	24+	25.5	25.5	16
11	16	28-	28-	27+	17
12	17	30-	30+	30	19
13	18+	32	33	32	20
14	20-	35-	35+	35	21
15	21	37	38-	38	22
16	22	40.5	41-	40+	23
17	24	43-	44-	43	25
18	25	45.5	46+	46	28
19	29	48	50	49	33
20	31	51	53	52	34+
21	34	54+	56	55+	36+
22	36.5	57-	59	58	39
23	40	59+	62.5	60	42
24	43-	63-	66+	63	46
25	45+	66	69	66	46
26	47+	69	72	70	52
27	50-	73	76	74-	55
28	51	77-	81	77	58
29	55	81-	84	81	61
30	58	84.5	87	85	65
31	59	89	91+	89	68
32	61	91	95	92	72
33	62	95-	98	95+	74
34	63	98.5	103	100	76
Bark	76	103	112+	104	85

Length: 34 mm.

Width: 13 mm tip
11 mm butt

Table 5. Asymmetrical reed number 2.

Distance	Left Side	Left Quarter	Center	Right Quarter	Right Side
0			4		
1		5	5	5+	
2		7	7	7	
3	8	8	8+	8	8
4	10	10	10.5	10	10
5	11	12	12+	11+	11+
6	12	14	14	13	12+
7	14	15+	15.5	15-	13
8	16	18+	18	16	14
9	17+	21	21.5	18	15
10	19	23.5	23.5	20+	17
11	20	25	26.5	23	19
12	21	28	29	25	21
13	23	29+	31	27	23
14	25	32	34	28	25
15	26	35	37	30.5	28
16	28	38-	40+	33	30
17	30	41+	44-	36	32
18	32	44+	47	39	34
19	35	49-	50-	42-	36
20	38	51.5	53+	44-	38
21	40	55+	57+	46+	39+
22	43.5	60-	61	49	42+
23	47+	64-	64	51	45
24	51	65	68	54	50
25	54.5	69	71	56	54
26	58	73-	77	61	57
27	61	80-	80	64+	60-
28	68-	82	84	66+	63-
29	73	85+	88-	70.5	66
30	75	89.5	93-	75	69
31	78-	93	97	77+	73
32	83	100	103	81-	75
33	80	108	108.5	86	79
34	85	112+	113	91-	83
35	89	118	119	97	83
Bark	109	128	129	115	95

Length: 35 mm.

Width: 13.0 mm tip
10.3 mm butt

BIBLIOGRAPHY

BIBLIOGRAPHY

Backus, John. The Acoustical Foundations of Music. New York: W.W. Norton, Inc., 1969.

____________. "Acoustical Investigations of the Clarinet." Sound -- Its Uses and Control, 2, No. 3 (1963), 22-25.

____________. "Behavior and Properties of Clarinet Reeds." Journal of the Acoustical Society of America, 33 (1961), 1652.

____________. "Influence of the Reed on the Vibration Frequency of Clarinet Tones." Journal of the Acoustical Society of America, 33 (1961), 862.

____________. "Small-Vibration Theory of the Clarinet." Journal of the Acoustical Society of America, 35 (1963), 305.

____________. "Studies of the Vibrations of Clarinet Reeds." Journal of the Acoustical Society of America, 32 (1960), 935.

____________. "Vibrations of the Air Column and the Reed in the Clarinet." Journal of the Acoustical Society of America, 32 (1960), 1493.

____________. "Vibrations of the Reed and the Air Column in the Clarinet." Journal of the Acoustical Society of America, 33 (1961), 806.

Bonade, Daniel. "Principles of Clarinet Reed Fixing." Symphony, IV, No. 1 (January, 1950), 6.

Brymer, Jack. The Clarinet. New York: Schirmer Books, 1977.

Collis, James. "Hard or Soft Clarinet Reeds." The Instrumentalist, XX, No. 5 (December, 1965), 69-70.

____________. "On Fixing Clarinet Reeds." Woodwind World, III, No. 12 (April, 1961).

Coppenbarger, Roger Dean. "An Investigation of the Vibrating Clarinet Reed Utilizing High Speed Cinematography." Dissertation Abstracts, XXXI (February, 1971), 4196-4197.

Dawson, James. "Selection, Preparation, and Adjustment of Single Reeds." The Instrumentalist, XXIV, No. 3 (October, 1969), 53-55.

Heim, Norman. "Clarinet Reed Adjustment." The Instrumentalist, XVIII, No. 11 (June, 1964), 53-54.

Intravaia, Lawrence J. and Robert S. Resnick. "A Research Study of a Technique for Adjusting Clarinet Reeds." Journal of Research in Music Education, 16, No. 1 (Spring, 1968), 45-58.

Jaffrey, K.S. "Burnishing Reeds." Woodwind World, VIII, No. 3 (May, 1968), 7.

Kroll, Oskar. The Clarinet. London: Batsford, 1968.

McGinnis, C.S. and C. Gallagher. "The Mode of Vibration of a Clarinet Reed." Journal of the Acoustical Society of America, 12, 529-531.

Merriman, Lyle C. "Clarinetist, Spare That Reed." The Instrumentalist, XXII, No. 6 (January, 1968), 28.

O'Connell, Thomas S. "The Short Scrape Concept for Clarinet Reeds." The Instrumentalist, XXVII, No. 3 (October, 1972), 44-45.

Opperman, Kalmen. Handbook for Making and Adjusting Single Reeds. New York: Chappell and Co., Inc., 1956.

Rico Corporation. Reed Cane: the Facts and the Legends. Hollywood: Rico Corp., 1967.

Schoepflin, H.J. "The Developing Clarinetist -- Back to Basics." The Clarinet, I, No. 2 (1974), 6.

Spratt, Jack. How to Make Your Own Clarinet Reeds. Stamford, CT: Jack Spratt Woodwind Shop, 1956.

Stein, Keith. The Art of Clarinet Playing. Evanston: Summy-Birchard Co., 1958.

Stubbins, William H. The Art of Clarinetistry. Ann Arbor: Guillaume Press, 1965.

Teal, Larry. The Art of Saxophone Playing. Evanston: Summy-Birchard Co., 1963.

Tenny, Wallace R. "The Clarinetist's Dilemma." Woodwind Magazine, IV (October, 1951), 6.

Waln, George. "Clarinet Reed Mastery." The Instrumentalist, XXI, No. 3 (October, 1966), 70-71.

__________. "Selecting Reeds." The Instrumentalist, VI (November, 1951), 16-17.

Webb, Robert K. "Compendium of Clarinet Reed Selection and Adjustment." National Association of College Wind and Percussion Instructors Journal, 19, No. 4 (Summer, 1971), 51-54.

Weerts, Richard K. "Some Ideas on Breaking-In and Adjusting Single Reeds." Woodwind World, VII, No. 4 (June, 1967), 4.

Willaman, Robert. The Clarinet and Clarinet Playing. New York: Carl Fischer and Co., 1954.

Willard, Raymond D. "Hand-Made Reeds -- Why Not?" Woodwind World, XIII, No. 2 (Spring, 1974), 28-29.

Wright, James. "Reed and Ligature." National Association of College Wind and Percussion Instructors Journal, XVII, No. 4 (Summer, 1969), 39-50.