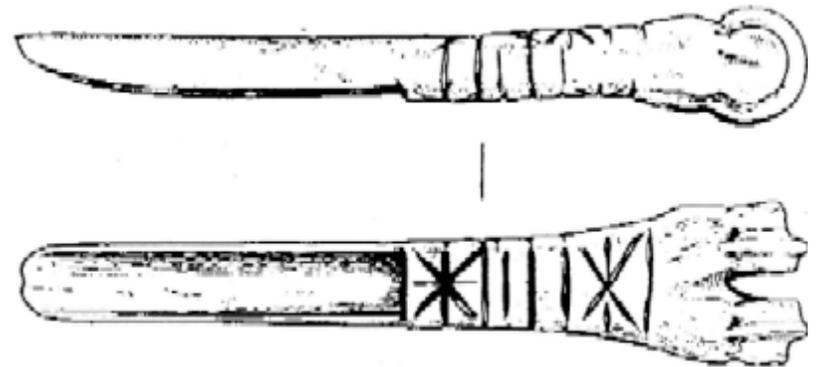


WORKING WITH HORN AND SKELETAL MATERIALS



NOTE: This booklet is now available in the Florilegium at <http://www.florilegium.org> , formatted for web viewing and 8 1/2 x 11 in. non-pamphlet printing.

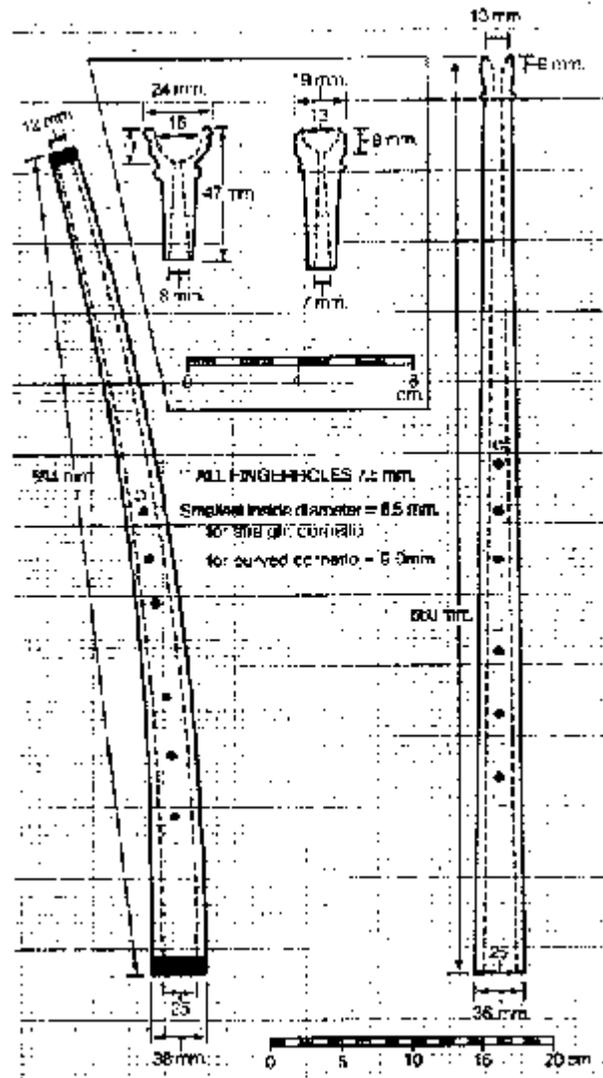
This booklet is dedicated to those artisans who diligently work at arts and sciences where the information is scarce and examples are few.

It is especially dedicated to my wife, Lady Lisete de L'Abbe St. Tronde, for her patience and support in this and all of the other projects that I clutter the house with.

NOTE: There are several places in this pamphlet where I generally refer to "in the Middle Ages" without referring to a specific place or time. Just to clarify, the techniques discussed here were used pretty much every where according to the availability of materials. Elephant ivory was very rare in Scandinavia but walrus and seal ivory were used there. By the beginning of the Middle Ages, very large antlers were scarce in the Mediterranean region but were still found in the northern regions. Whale bone was so scarce everywhere that in Scotland there was a law stating that whales that washed ashore belonged to the King. So please understand that when I make a general statement, it is usually because the technique was in general use.

Lord Mikal Isernfocar called Ironhawk
Mka Michael Labbe-Webb
6726 Axtel Drive
Canal Winchester, OH 43110
614-833-6085
mlabbewebb@yahoo.com

APPENDIX C - CHART FOR CORONETTO & SHAWM



According to archeologists, horn and skeletal materials were among the first materials utilized to make utensils by man. These materials, which were readily available and easily worked, have remained in use for both decorative and practical applications even into modern society. Artifacts made of horn, bone and antler were nearly as common to the medieval household as plastic wear is to the modern household. Bone came from common domestic animal such as horses, cattle, sheep, pigs and birds but from hunted animals as well. Antler was collected after the deer had shed their antlers naturally as well as from those killed in the hunt. Horn, from cows and oxen, sheep and goats, was also widely used as was whalebone, walrus ivory and elephant ivory.

Modern archeologists claim that only about 1/10th of 1 percent of any type of artifacts survive from medieval to modern times. Although somewhat plentiful, artifacts made from skeletal materials are not a common as those made of other materials. Skeletal materials in particular are more biodegradable than many other materials and unless conditions are just right, are less likely to survive to be found. As an example, "the Aberdeen Combworks alone employed more than 600 people in the middle of the nineteenth century and produced over nine million combs *a year* in nearly two thousand different varieties". That was a mere 150 years ago, yet very few of these combs exist today. In spite of the ease with which skeletal materials deteriorate, a great many articles survive. However, what artifacts we do have should be considered representational, not necessarily exclusive.

The most common artifacts made of horn, antler or bone surviving from the Middle Ages are combs, pins (used in both hair and clothing) and spoons, but many other articles made of these materials have been found. Whalebone (most of which was scavenged from whales which were washed ashore, although whales were hunted in the early medieval period) was used to make helmet plumes for tournaments for knights as well as more complicated articles like chests and caskets. Canes, toothpicks, powder horns, jewelry, religious articles, jewelry caskets, weapon and knife hilts, musical instruments, portraits, sculptures and even bone spurs are but a few of the items surviving from the middle ages.

This pamphlet will cover beginning work with some advanced techniques for working with skeletal materials and includes instructions for the construction of several articles. I hope it will be the beginning of many projects for you.

SAFETY

1. When grinding, filing, sanding or polishing horn, bone, antler or ivory, always wear safety glasses or goggles and a particle type filter mask. The dust from these materials is extremely abrasive and can cause eye and lung irritation. In extreme cases, you could get a scratched eyeball, set off a serious asthma attack or even develop “white lung” disease (a condition similar to the “black lung” disease that coal miners get.)
2. Working with skeletal materials will variously require you to work with sharp tools, abrasives, heated materials and/or chemicals. Care should always be used in handling these items in order to avoid injury or illness.

Disclaimer: Some of the techniques listed here are potentially dangerous to the health. The author and the publisher are in no way responsible for any accidents or illnesses occurring to anyone following these instructions.

IVORY

I will not cover working with ivory in this pamphlet since un-worked elephant ivory is hard to obtain legally. Mammoth and walrus ivory are legally available but can be prohibitively expensive for the beginner. I will say that the preparation and working of ivory is not very different from working with the materials that I will cover. In fact, ivory workers were and are usually trained by working first in bone.

Ivory and whale bone were used extensively for some articles in the middle ages. With the possible exception of large sculpture pieces, there is nothing that was made from ivory or cetacean bone which cannot be made from readily available bone or horn.

Pennsic is a great place to pick up horn, turtle shells, some antler and occasionally boars tusks.

For finished products try:

Abbey Horn of Kendal, Ltd. url <http://www.abbeyhorn.com> email abbeyhorn@mcmail.com address Kent Works, Kendal, Cumbria LA9 4RL, UK phone 01539 720291 fax as above description Selected items in Horn for mail order. Location:

http://www.pbm.com/~lindahl/merchants/d/abbey_horn_of_kendal.html

APPENDIX B - OBTAINING MATERIALS

Horn can be obtained at many local slaughter houses in raw form. Tandy Leather Co. still sells horn that has been sanded smooth.

The best way to get palmate antlers such as moose, red deer, fallow deer, elk, etc. is to contact your local exotic game ranches. There are three types: one is a zoo-like deal where tourists are allowed to drive through and view the wildlife; the next is an animal sanctuary or preserve which does not allow tourists, and the third is a commercial ranching venture.

Also, don't neglect the taxidermy shops and game meat lockers in your vicinity and in surrounding small towns. It is quite common for hunters to drop off their kill and then later realize they don't have the money to reclaim their trophy. Often you can get quite a bargain on horn and antler. Also, if the antlers are damaged, a hunter may choose not to keep them, but if you are making stuff from them, broken antlers are great, and these sometimes can be obtained for free.

"Dixie Gunworks". They are in Tennessee and cater primarily to the buckskinner crowd. Since antler was a heavily used item for the buckskinners, they used to carry it and may still. You can probably get their mail-order catalog (about \$5) at most gun-type stores.

For elk antler and bone - Lady Morgan the Celt de Artemis, MoAS, CFS, CMS (Teri Kennedy, B.F.A.) Aquarian Arts Studio, 2998 W.Wilson Dr., Flagstaff, AZ 86001, Voice: 520-779-1291, FAX: 520-779-3713, e-mail: aquarian@infomagic.com, Web Site: www.infomagic.com/~aquarian/

Bourget Bros. jewelry, craft catalogs. It has fossilized walrus ivory and tagua nuts (vegetable ivory). You can get copy of the catalog by calling 800-828-3024 or write Bourget Bros., 1636 11th St., Santa Monica, CA 90404

walrus and mammoth ivory are legal and may be obtained from: Rick B. Fields, 26401 Sandwich Place, Mt. Plymouth, FL 32776 Tele/Fax: 904-383-6270 ---or--- Alaskan Treasures, 205 E. Dimond #514, Anchorage, AK 99515 Fax: 907-248-2328

linen Micarta (an ivory substitute) may be obtained from Atlanta Cutlery in either block or slabs call: 404-922-3700

Butcher departments in grocery stores sell bones for a reasonably cheap price Pet stores also sell large beef bones (often completely cleaned of meat)

PREPARATION

In working with bone in particular, it is best to let the bone dry for at least one year before working it. Although this is not critical for all projects, you must follow this rule for anything that might be affected by shrinkage (thumb-rings, hinges, critical fittings, etc.).

The first thing that I always do before working with any skeletal material is to remove any remaining flesh still attached to it. This can be done in a variety of ways. One popular method is to bury the piece in an ant hill for several weeks. This method works quite well but is lengthy and you run the risk of having a stray animal decide that your project might make a nice lunch. Museums utilize a type of flesh eating beetle but most of us don't have the money, space or inclination to keep these critters around. Another method is scrapping and boiling. This is quickest and makes for a more sanitized piece but it can be very smelly. You can help the cleaning process by boiling the bone or horn in water with laundry detergent in it. The soap helps to break down the fat and clean the piece more quickly. Even so, it may take several hours of boiling or more than one session of boiling to complete the cleaning. In the end, scrubbing with a good stiff brush and a strong detergent is nearly always necessary. (I will describe the method for making horns "drinkable" later.) *NOTE: Boiled bone is OK, roasted bone is not. Roasting makes bones brittle and unsuitable for working in most projects.*

Hydrogen peroxide cleans organic material out of bones and also whitens it. Another good way to whiten and degrease bone is boiling in a soap solution (normal clothes washing soap). I have heard that soaking the bone in lemon juice also works but soaking in a solution of 1 part household bleach to 10 parts water supposedly does better. (The hydrogen peroxide does not break down the bone the way the chlorine bleach does.) Any of these solutions can also be used to clean horn but you should soak horn for less time than bone. All of these solutions also help to kill the smell of horn.

The second step that I usually follow is to smooth and polish the working surface. This is not completely necessary, particularly if you are going to carve the piece, but I find that carving is easier if the pattern is laid out on a smooth surface. I will cover several ways to smooth the surface both period and modern.

The easiest way to smooth the surface of skeletal materials is with a belt sander. This method is certainly not period but it is very fast and efficient. A belt sander will allow you to remove the roughest scale and knobs from horn and antler without hours of tedious work. A belt sander can also be used to rough form the piece. The biggest disadvantage of this method (other than it not being period), is that you can easily ruin a project in a matter of seconds. Most belt sanders run at high speed and you can sand right through the wall of a horn or bone or gouge deep grooves in the surface with only a momentary lapse in concentration. You could also use a power grinder, but you can ruin a piece even quicker with the grinder than with a sander.

A much safer (and much more period) method, albeit more time consuming, is to start with a file or rasp. Remove the roughest scale with a rough rasp. (The rasp I use is for rounding horses hooves. These are available from most farm supply stores.) After the roughest parts are removed you can progress to finer files or rough sandpaper to further smooth the surface and then to fine sandpaper. In period, sand stone was used or wet soft leather with damp sand of various grades in place of modern sandpaper.

An alternate method to use on horn is to scrape the outside of the horn using a very sharp knife. I use this technique just before I start the polish, after I have cleaned up the roughest parts with files and sandpaper. To do this, you hold the blade at a 90 degree angle to the surface and pull the blade along the surface. Doing this peels off very thin strips of horn leaving a very smooth surface.

It is at this point that I lay out and execute any carving that I am going to do. The surface is smooth enough to draw on (for laying out my pattern) but I have not done the final polish. I will describe carving techniques later. Right now I will finish describing polishing techniques.

The simplest, easiest and quickest technique is to use a power buffer. When I use this method, I use a hard cloth buffing wheel and start with Black Diamond polishing compound, then work through Red Rouge, Brown Rouge and White Diamond compound. I then finish up using just the bare cloth wheel. This leaves a bright polish on the horn that needs no further work. Polishing compounds were probably used in period for horn just as they were used on metals. Polished horn is very beautiful in its own right and is so slick that it used for spoons to handle chemicals in laboratories because virtually nothing sticks to it.

APPENDIX A - TOOLS

Period Tools

Saws - bow saws were the type most likely used - coping saws and hacksaws are acceptable substitutes
Bow drills - used for both drilling holes and incising designs (a hole saw can be made by filing teeth in one end of a piece of pipe then making the pipe into a bow drill)
Hot iron drills - heated rods used to burn holes in bone
Wood carving tools and knives - Many small carving tools can be easily and cheaply made from masonry nails, needles, broken epee blades, broken needle files and hacksaw blades.
Files in various sizes
Bow lathe
Sand and ash with soft leather pieces for smoothing and polishing (dampening with water helps the polishing)
Sharkskin - used in period for sandpaper
Mitre box
Leather sandbag (for holding work on while you carve or scrimshaw)
Jeweler's V-block
Tongs and pliers for handling hot horn
Vise with wooden and iron (mild steel) jaw inserts
gloves

Non-Period Tools

SAFETY GOGGLES

DUST MASK

Dremel

Xacto set - the reason this is listed here is the number of somewhat exotic tools you can get for xacto handles

Modern band saw or jigsaw

Modern power drill with standard twist bits

Modern hole saw with the center bit removed -

Belt sander

Sandpaper in various grades

Steel wool

Propane torch (possibly with a copper pipe extension)

Power buffer

"Who's a Horn? What's an Antler?: Crafts of Bone and Horn" - Janet Potter
D'Amato

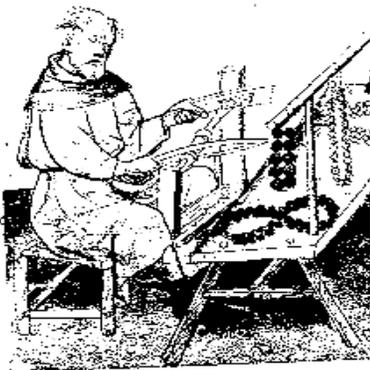
"Working in Plastic, Bone, Amber, and Horn" _ Borglund, Erland, 1894- and Jacob
Flauensgaard. [Ed. Clara Fried Zwiebel] New
York: Reinhold Book Corp., [1968]

Other techniques for polishing horn utilize very fine wet sandpaper (the kind used in auto body work), buffing cloth or fine steel wool. One period technique (which is very time consuming) is to start the polish with fine charcoal or pumice powder mixed with water then progress to fine wood ash (from burnt soft woods) and a cloth followed by buffing with chamois and finally by rubbing with the hand to polish the surface. Modern ivory workers often do the final polish with goose down. Another period technique is to 'burnish' the outside of the horn using a piece of bone or deer antler. Finally, you can use applied finishes such as wax, paint or polyurethane. The only time that I personally recommend (or use) these methods is when I have engraved and colored the surface of a piece and need to protect that design. Designs that are just engraved (not filled in with paint or inked) can be polished without applied finishes.

CARVING AND WORKING

Skeletal materials can be worked both two dimensionally (like scrimshaw) and three dimensionally (like sculpture). They can be sawn, carved, drilled and turned on a lathe. As before, the quickest and easiest technique uses power tools. If you want to carve skeletal materials with very little effort and don't care about using period techniques, a Dremel tool is the easiest method I know of. The various carving, grinding, sanding and polishing tips are ideal for doing horn, bone and antler work.

However, if you want to practice a period method I suggest that you use small wood carving tools or small jewelry tools, jewelers saws and hacksaws. One thing that you must be aware in carving skeletal materials is that you must take smaller cuts than most cuts you would in carving wood. Skeletal materials are much denser and tougher than most wood and the grain must be given more consideration. Skeletal materials require a slower, more concentrated effort to carve and saw. It will save materials and time if you saw slowly and are careful not to cause the saw to bind and bend as that may result in breaking the piece you are trying to saw. It is also helpful to shape the piece as much as possible with the saw as this tool will remove large amounts of bone fairly quickly. Have patience and soak the materials in water for at least 24-48 hours before carving. This softens even bone making the carving easier. Some sources say that horn and bone were soaked for months before working but this is unnecessary. Horn can be made flexible enough to flatten merely by soaking in water. I soaked a piece of antler in vinegar to determine the length of time to make it flexible. 48 hours softened the surface enough to make carving easier but it took 9 months to soften the antler enough to bend it.



"Ivory and Related Materials: An Illustrated Guide" - O. Krzyszkowska

"Ivory Carvings in Early Medieval England" - John Beckwith

"Ivory Workers of the Middle Ages" - Anna Marie Elizabeth Cust London: George Bell and Sons. 1902. ISBN 0404565379

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"The Liverpool Ivories: Late Antique and Medieval Ivory and Bone Carving in the Liverpool Museum" - Margaret T. Gibson

"A Mariner's Fancy: The Whaleman's Art of Scrimshaw" - Nina Hellman, 1992

"Masterpieces of Ivory from the Walters Art Gallery" - Richard H. Randall, Jr.

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"Musical Instruments" - Karl Geiringer, Unwin Brothers Limited, UK

"Musical Instruments" - Alan Kendall, Hamlyn Publishing, Bridgehouse, Middlesex UK, 1972

"Musical Instruments Through the Ages" - Anthony Baines,, Penguin Books/Walker and Co., NY, 1971

"Remains to be Seen: The Use of Bone, Antler, Horn and Ivory Throughout History and in Contemporary American Art" -

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"Stone, Bone and Jade" - Donn Salt

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"Ways With Hazel and Horn" - Bob Griff Jones and Meurig Owen, Gwasg Carreg Gwalch, Iard yr Orsaf, Llanrwst, Gwynedd, Wales, 1995 (English test 1996) ISBN 0-86381-367-4

"Chinese Art Ivory" - Barry C. Eastham

"Craft of Ivory: Sources, Techniques and Uses in the Mediterranean World AD 200-1400 (Byzantine Collection Publication #8) - Anthony Cutler - ISBN 0884021475

"David Le Marchand, 1674-1726" - Charles Avery (This is a biography of an ivory artist)

"Diverse Arts" - Theophilus - 12th Century manuscript (I don't know where you can get a copy of this).

"European Musical Instruments" - Harrison & Rimmer ed., Studio Vista, London, 1964

"Extant Medieval Musical Instruments" - Frederick Crane, University of Iowa Press, Iowa City

"Folk Art of Early America - The Engraved Powder Horn" - Jim Dresslar, Dresslar Pub., Bangersvill, IL 1993

"Golden Age of Ivory: Gothic Carvings in North American Collections" - Richard H. Randall, Jr. ISBN 1555950760

"Goths in the 4th Century" by JP Heathers

"Handbook of the Collection of Musical Instruments in the United States National Museum" - Francis Densmore, Da Capo Press, NY

"Hand of the Master: Craftsmanship, Ivory and Society in Byzantium (9th - 11th Centuries)" - Anthony Cutler ISBN 0691033668

"Images in Ivory: Precious Objects of the Gothic Age" - Peter Barnet ISBN 0691016100

"Introduction to Medieval Ivory Carvings (Victoria and Albert Museum)" - Paul Williamson

"Instruments of the Middle Ages and Renaissance" - David Munrow, Oxford Press Music Department, London, 1976

"Ivory: A History and Collector's Guide"

"Ivory and It's Uses" - Benjamin Burnack

Skeletal materials of all types were turned on the lathe in period. Beads, buttons, toggles and handles for knives, swords and tools were made of turned bone, antler, horn, whalebone and ivory.

Lastly, you can scratch a design in the outside of the horn, bone or antler using a tapestry or carpeting needle, a sharpened awl or a small, very sharp carving knife such as the Xacto #28 curved blade. This design can then be colored with indelible ink or paint. Unpolished horn and bone take ink very well. Since there are many books commercially available on the art of scrimshaw (see the reference list in the back of this pamphlet), I will not cover that subject here.

HOT WORK TECHNIQUES

The techniques discussed so far utilize horn in its natural state. While horn, bone and antler can all be physically altered by cutting and combining pieces with glue or riveting, horn can also be physically altered by heating. Horn can be heated to the point where it becomes very pliable. In fact, the word 'plastic' first appeared in the late middle ages as a description of the flexible state of heated horn. Horn can be molded into a great variety of shapes and can even be "ironed" together to make larger sheets. In Europe, these sheets were utilized to make windows. In China and England, large horn lanterns were made.

One heating technique is boiling in water. While this is an easy and common technique, it is the most time consuming. Thin horn will take one and one-half hours or more and, of course, the thicker the horn the longer it takes. Watch your piece carefully for signs of flexibility. You need to boil the horn long enough to obtain the plasticity you need but not so long as to reduce it to jelly. (Actually, gelatin, the kind used to make jellies and Jello, is made by boiling horn and hooves in water for several hours until the rigid material breaks down.) Fresh bone may also be softened to a bendable state by boiling. This generally takes even longer than horn. Bone also turns into a jelly if boiled long enough.

A much quicker method for making horn plastic is heating by fire. While a campfire will do for this, by the late middle ages boneworkers had advanced to the point of utilizing charcoal braziers, ovens or torches similar to those used to do glass lamp work. Today, a much more controlled technique is to use a blow torch, propane torch or gas stove

If you use a propane torch, try to obtain one of the torch heads with no air holes in it. These create a "soft" flame. A "hard" flame is too hot and will burn a small area before the heat has a chance to soften the horn.

To use this method, light the torch and turn it very low. With a pair of tongs, hold the piece of horn in the flame until it becomes very flexible. Move the horn around to prevent one spot from overheating before the rest of the piece gets warmed up. At this point you can flatten the piece or mold it into a variety of shapes. Professional horn workers often soak and/or boil the horn prior to heating it over the flame. This helps to pre-soften the horn and to keep the horn from drying out while it is being heated over the fire. I have found that it also helps to lessen the smell from heating the horn.

Another method of torch heating horn is a method used by modern musical instrument makers to bend wood. Make a heating "tube" by taking a one foot section of 2"ID copper pipe and brazing a reduction fitting onto it to hold the torch head. Clamp the pipe in a vise (open end facing away from you) and heat the pipe with the torch. By rubbing the strips of horn over the heated pipe, you can safely and bend them with little fear of burning. Please be careful any time that you work with open flame!

Another way to heat the horn quickly and with little odor is to boil it in tallow or lard. (Do not use vegetable oil as this will cause the surface of the horn to become "fuzzy"). I recommend that you use a temperature controlled electric skillet for this. The optimal temperature seems to be between 250 and 300 degrees. At 325 degrees you must be very careful not to leave horn in too long. Do not heat above 325 degrees as this will quickly turn a thin piece of horn into a very crispy "potato chip".

Cut the piece of horn to the size that you want and drop into the heated lard. When the piece becomes pliable, remove it from the lard and place into whatever mold you have prepared. You can also rough cut the horn with a saw before heating it and then trim it with tin shears or heavy scissors while it is hot.

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- "Catalogue of Musical Instruments, Victoria & Albert Museum, Vol II" - Anthony Baines, Her Majesties Stationary Office, London,

BONE CLAPPERS

This is the easiest instrument to make although not the easiest to play.

Cut two flat pieces of bone 8-12 inches in length and approximately two inches wide. Round the ends, sand both pieces smooth on both sides and polish or decorate if you wish.

CONCLUSION

There were many other items made from bone, horn antler & ivory which were used in everyday life in the middle ages, too many to describe in detail here. So I will leave you to discover how to make hinges, arrow heads, clamps, clothes pins, spindles, shuttles, statues and many, many other items on your own. I hope you have as much joy in the discovery as I have.

COLORING

Some of the coloring techniques listed here are hazardous and are not recommended for beginners.

All skeletal materials can be colored with various organic substances. In period, just about anything that was used to color cloth was probably used to color ivory, bone, antler and horn however, the most popular colors on surviving artifacts are natural, red, green and black. Both bone and horn were bleached to whiten them and there are also examples of horn pieces stained with walnut juice, oils and other applied stains. As long as the surface is not polished to a high gloss, color will bind to the fibers in the horn coloring it. Much of the art of coloring horn as it was done in period has been lost due to the reduction in the horner's industry and to the use of modern chemical dyes in what is still produced.

Certain mineral salts will produce a variety of shades of amber, red, green and blue on any skeletal materials. India ink is used to provide a variety of colors, especially for engraved work.

Bone can be dyed red by soaking or boiling it in madder. Boiling in raspberries will produce a brilliant red, sumac berries result in a russet shade. Reddish brown is achieved by boiling mixture of pearlash (potassium carbonate), quicklime, red lead (litharge) and dragon's blood (*the plant*) in water for 1/2 hour. On horn, this should be applied hot to an unpolished surface and left until dry or nearly dry. Repeated applications will deepen the color. A blacker brown is produced by omitting the dragon's blood. (Hardwick)

"According to the *Plictho* of Gioanventura Rosetti (Written in Venice, 1548), bone could be dyed green in a solution of red vinegar containing copper filings, Roman vitriol, roche alum and verdegris.....an alternative method was to place the bones in a copper vessel containing a mixture of goat's milk and verdegris, which was buried for several days in a mound of horse manure to keep it warm."(Macgregor) A less disgusting method is to boil the horn or bone in a vegetable dye known to yield a green color.

White horn will develop a greenish hue as a result of the intense heat and the removal of sulfur if you flatten it by pressing between hot plates.

(Hardwick) White horn can be colored green by boiling it in muriatic acid or colored yellow in a solution of nitric acid in boiling water. These are simple processes but in truth should only be attempted by those who are trained in handling chemicals. Should you try this, be certain that you are in a well ventilated area and that you have all the necessary safety equipment. *(NOTE: After treating horn with acid, subject it to an alkaline compound to neutralize the action of the acid which would otherwise destroy the horn.)*

Silver nitrate will turn horn or bone jet black when exposed to light but soot black from a kettle bottom is more period. There is also evidence of ivory and bone being 'smoked' over wax candles to give a wax black finish. Scrimshaw is often colored black using boot black or black gunpowder or sealing wax rubbed into the scratches.

There are also many modern chemical dyes which work very well on horn and bone but as they are out of period and many of them are extremely hazardous, they will not be discussed here.

CURING DRINKING HORNS

Probably the first thing that most people in the SCA think of when horn work is mentioned is a drinking horn. The earliest surviving drinking horns date from the early seventh century and were found sealed in a bronze tub in the grave of an Anglo-Saxon chieftain. I have already described the methods for working the outside of the horn so before I go into other projects, let me now cover how to make cow horns "drinkable".

When making a drinking horn, do all of the work on the outside (except applying chemical finishes) first. I recommend this so that if you have a problem with the decoration you have not wasted the time in finishing the inside.

Wash the horn with dish washing liquid and a bottle brush to clean out all residue inside the horn. Now boil the horn for at least 15 minutes. This can be a smelly process but it is essential to purifying the horn. After you have boiled the horn, dry the outside. Brace the horn upright and put in one to three tablespoons of baking soda. Now slowly pour in enough apple cider vinegar to fill the horn to the top. You will notice that this mixture boils and foams.

Center drill the top as before only on this instrument use a 3/16 drill bit.(You may still need to ream out this hole a little later on to make the reed fit properly). Now use the conical stone to bore out the pirouette. The pirouette should extend to within approximately 1/4 inch of the main cavity and should be long enough to cover slightly more than 1/2 of the reed.

On this instrument, I utilized measurements from a pattern provided in "Amateur Wind Instrument Maker" to begin the finger holes. The finger holes in the shawm are much smaller than the ones in the cornetto. I was a bit concerned with the hole placement since the bore of each horn is different. The shawm measurements listed in Mr. Robinson's book indicate a bore ratio of 1 to 22 (i.e. for every 22 increments of measure down the bore the diameter increases one increment). Much to my surprise when I figured the bore of the horn I used, it turned out to be a 1 to 21 ratio. I therefore felt very comfortable in drilling the holes using the suggested measurements and diameters. (See the chart for approximate finger hole sizes and placement.) Insert a bass oboe reed and you are ready to play.

RATTLES

Rattles are very easy to make and are common to every society in one form or another. Clean, polish and decorate the outside of a cow's horn as you wish. Shape a plug of wood to just barely fit the open end of the horn (this will be glued and pinned in place) or if you wish to use hot forming, make the plug just slightly larger than the end of the horn. Add your rattle material (dried peas, small gravel, lead shot, small ball bearings, whatever) to the horn but fill the cavity no more than 1/3 full. Apply glue to the edges of the plug and gently push it into place.

I used melted beeswax on the plugs for my rattles then drilled small holes in the horn and pushed brass pins into the wood to hold it in place. The beeswax waterproofs the wood as well as helping to hold it in place. You can use wood glue instead of beeswax, if you wish. If you heat the horn and force the plug in, glue and pins may not be necessary.

result of the Crusades, the trade through Constantinople and the Moorish occupation of Spain.

To quote David Munrow in the "Instruments of the Middle Ages and Renaissance", "The typical oriental shawm is a keyless instrument a foot or so long with seven finger holes and a thumbhole. The essential features are its double reed and expanding conical bore. Although the wide flared bell is the instruments most recognizable feature it makes comparatively little contribution to the tone or volume. Whilst the length and shape of the bore govern the pitch, it is the small reed and the way it is used which account for the shawm's amazing carrying power, helped in performance by the way many folk players blow upward on the instrument in the manner of a jazz trumpeter.'

The oriental shawms are loud, raucous and shrill. They utilize a softish reed which is mounted in a staple which passes through a metal disk before entering the main body of the instrument. The player presses his lips against the metal disk and does not control the reed by the lips at all but only with air pressure. This results in an instrument which is really only suitable for playing out of doors. Indeed, the 14th century English romance 'SIR DEREVANT' links the shawm with the trumpet and drum in performing military and ceremonial music.

The emerging European shawm, however, would be of a much different sound. In addition to a greater variety of sizes which would eventually result in one shawm so large as to be called a bombarde (a name formerly given to an artillery piece), the Europeans would eliminate the disk of the oriental shawm and replace it with a pirouette and enlarge the reed. By enlarging the reed, the overall sound of the instrument was made less shrill. Sinking the reed into a pirouette made it possible for the player to have some control over the reed itself when playing. By 1235, the changes were great enough that the Abbot of St. Albans was received 'with the minstrelsy of shawms' used alone and to 'double the voices of the choir.'

The construction of this instrument is much the same as the cornetto already discussed. The horn is smoothed and polished and the interior cleaned. After finding the top of the cavity, cut the horn about 2 and 1/2 inches up to leave some additional solid horn material to form the pirouette from.

This organic chemical action is cleaning out the last of the organic residue in the horn. Leave this mixture in the horn for about an hour. Wash the horn out again using dish washing liquid and a bottle brush. Brace the horn upright again and fill it with your favorite drink. My personal preference is a strong, cheap, sweet wine but beer works very well or even Kool-aid. (One warning about Kool-aid, though, it has a tendency to stain the inside of the horn to whatever color the Kool-aid is. I have a horn that the inside is colored a dark red by Kool-aid. This color is nearly impossible to get rid of so if you cure your horn with Kool-aid, make sure it is a color you can live with.) Leave this liquid in the horn for 24 to 76 hours to fully 'flavor' the interior of the horn.

If you are finishing the outside of the horn with a chemical coating, do this after the inside is cured. Do not cure the inside of the horn with any kind of chemical coating. You can not tell what kind of reaction a beverage you put in the horn will have with the chemical coating and it really is un-necessary. If you must coat the inside with something, use bee's wax but remember that you can never put hot beverages in the horn after that.

Note: There is a carving on the Franks Casket (a bone sculpture made in Northumbria around 700 CE) which depicts Wayland The Smith, a legendary English hero, making a drinking cup from an enemy's skull but I won't go into how to cure that skeletal material for drinking.

CARE OF HORN ITEMS

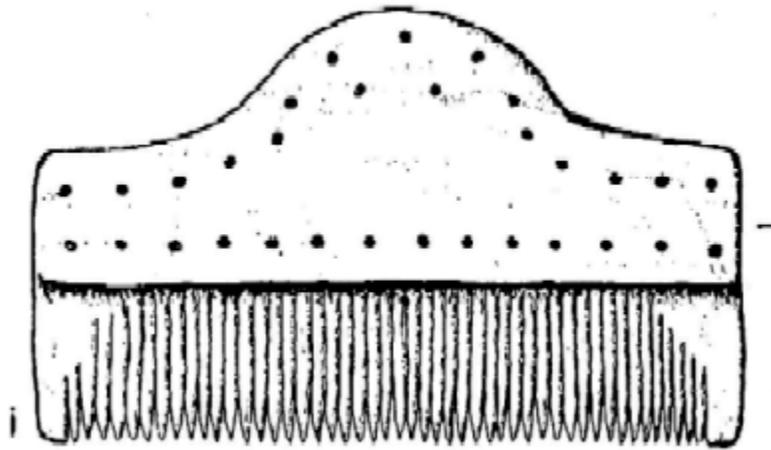
Horn and skeletal materials have three real enemies - extended damp conditions, extended excessive dry conditions and microscopic beetles. The damp conditions promote the attacks by the beetles. Keep your articles of skeletal materials in a cool, dry spot. Keep them clean of collected dust and dirt but don't be over-zealous. Horn that is not being used to contain food can be treated with Neatsfoot oil. All horn products that have not been coated with a chemical coating can be treated with beeswax cream with no silicone or you can simply rub them in your hands with a little clean grease or tallow. Bone and ivory articles can, for the most part, be treated the same as horn but be careful, being more porous, bone and ivory have a greater chance of discoloring from oil than horn does.

CONSTRUCTION OF USEFUL ITEMS

Following are instructions for the construction of various items found in daily life in the Middle Ages.

COMBS

There are two methods of making combs. The simplest is to choose a suitable piece of horn, clean and flatten it or to find a large enough piece of flat bone (shoulder, jaw bone or antler). Shape the outside of the comb first (square, rectangle, rounded back). Now saw the teeth in the comb very carefully using a hacksaw or jig saw. It is best to saw the teeth in line with the grain of the material as the teeth will be stronger this way. Examples of this comb exist from very early Roman times in wood, ivory or bone. Examples of **horn** combs of this type are not known before 1400.



The more complicated method is to piece the comb together out of antler or bone. This method was very popular in the 500-1400 time period, particularly in northern regions. It slowly disappeared after 1400 mostly replaced by one piece horn, wood or metal combs.

After completing the polishing of the horn, determine where the upper end of the horn was by inserting a stiff wire into the cavity. Using this as a guide, cut off the solid tip of the horn approximately one inch above the cavity. Center drill the solid portion to pierce the cavity with a 1/4 inch drill. Using a smooth conical stone, bore out the mouth piece. (I used a modern cornet mouthpiece as a reference for size and depth.) After completing the mouthpiece, file a groove around the mouthpiece with a round file. (I don't know why this was done but the existing period pieces all have it.)

The next step is to mark the position of the finger holes. It is best to reference a chart or an existing instrument for this, but the placement does not have to be exact. If you drill the holes small and enlarge them with a ream while tuning the instrument, you can place the holes by placing your hands on the instrument in a comfortable position. Using a 6.5 mm drill bit, drill six holes in the top surface and a thumb hole on the bottom surface as you hold the instrument in the positions you will play it in. The holes will be reamed to the right size for tuning. See the chart in the appendices for approximate placement and size of holes.

Next, using an electronic tuning device (or your ear, if you have good pitch), tune the instrument starting with the bottom hole of the six. Tune the lower holes slightly sharp, as tuning the holes above them will flatten the tone of the ones below.

If you place a hole in the wrong place or drill it too big, don't worry. Simply make a plug of horn or antler, glue it in place and redo the hole. After all this is done, file and sand any plugs to bring them in line with the walls of the instrument and re-polish the whole thing.

SHAWM

When the Christian knights of the first crusade first encountered the Saracens in combat, there must have been a great deal of surprise on both sides. Part of the astonishment (and perhaps downright terror) invoked by the sight of the Muhammadans was their use of the military band, replete with drums, trumpets and shawms. If you have never heard this predecessor to the modern oboe, all it takes is one good blast on this instrument to understand why. Although scholars disagree on the time frame of the invention of the Shawm (somewhere between 200 and 800 AD), all agree that the shawm spread through Europe as a

CORONETTO

"A simple horn is one in which the length of the column of air is always the same. Such a horn produces only the fundamental tone and its harmonics. The longer the column of air (to a certain extent) the lower will be the fundamental tone of the horn and the greater the number of harmonics. On a simple tube it is impossible to produce the diatonic scale except in the highest harmonics which are extremely fatiguing to play and faulty in their intonation. Hence mechanical means were devised for lengthening or shortening the tube, whereby a lower or higher series of natural harmonics could be obtained and the gaps in the range of the instrument filled. (One means of obtaining a complete scale is by holes) pierced in the side of a tube and covered with the fingers as in the flute, changing the length of the column of air. One of the instruments constructed on this principle is called a cornet or coronetto. These instruments came in various lengths and shapes, so as to form a complete choir among themselves. The simplest form of this instrument is the tenor cornet, a straight conical tube having six finger holes and a thumb hole" (condensed quote from Bulletin 130, United States National Museum)

The medieval cornet was a widely enough used instrument that there are quite a few surviving examples in collections around the world. In addition, there are quite a number of paintings, illuminations and tapestries that depict these instruments. Examples include 'ANGEL MUSICIANS' by Hans Memling (c.1435-94, Triptych of Najera (left panel), Musee Royal de Beaux Arts, Antwerp) and 'THE ANGERS TAPESTRY OF THE APOCALYPSE' made in 1350 for Louis, First Duke of Anjou. The Beauchamp window in St. May's Church, Warwick has beautiful stained glass panels designed in 1447 which show an angelic consort with cornet, harpsichord and organ. There is also an example of a mute coronetto made from an antelope horn in almost the exact manner of the one presented here in the Leslie Lindsey Mason Collection at the Museum of Fine Arts, Boston (number 160, pages 159 & 160 and plate IV of the catalog).

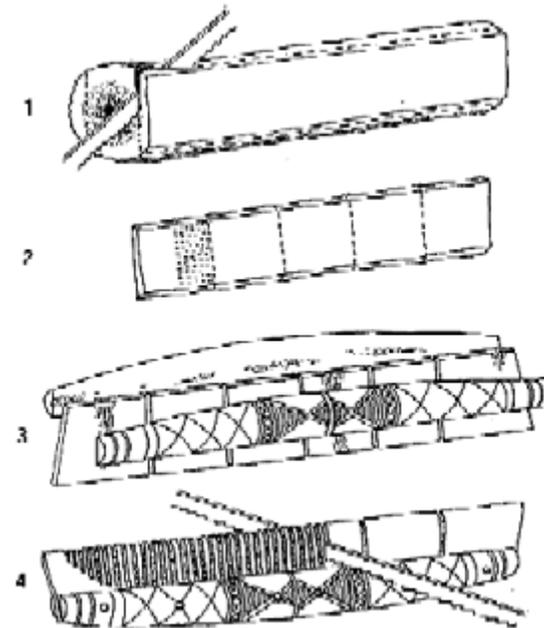
The coronetto described here is made from a gemsbok antelope horn. It is of the style known in the middle ages as a mute coronetto.

Obtain a gemsbok horn preferably already cored and dried. Start by cleaning and polishing the horn as already described and straighten the opening which will be the mouth of the bell.

Choose a piece of antler to serve as the spine of the comb. Saw this piece in half lengthways. Now slice off pieces of antler from the outside of the branch or cut pieces of bone, enough to fill the length of the spine and extend beyond the ends. Trim the pieces so that they lay snugly against one another and lay them on one piece of the spine. Lay the other piece of the spine on top and hold the pieces firmly together in a vise or with clamps. Carefully drill holes through the spine and the comb pieces and secure them together with rivets. In period, bronze, iron and copper were all used. (If you use standard copper rivets, cut off the large flat head and peen both ends. Be careful not to hammer too hard - the copper expanding inside the bone can split it.)

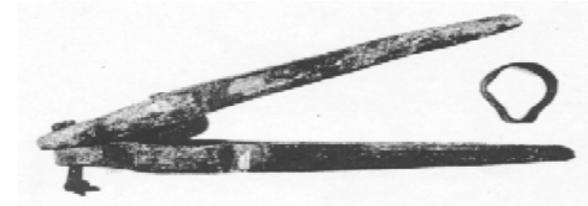
After the spine and pieces are securely riveted together, carefully saw the teeth in the comb. In period, some comb makers used a saw with two blades fastened close together. This tool made getting the teeth even fairly easy. An alternate method was to use a template to keep the teeth even.

Leave a section of uncut comb area at both ends to strengthen the comb. Decorate as you see fit.



SPOONS

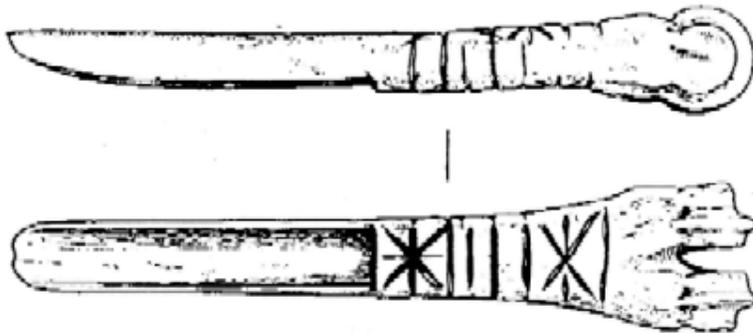
One of the most common items molded out of horn today is the spoon. Begin by carving two wooden blocks into a press mold for spoon. I suggest you use a metal spoon of the same size you wish to make your horn spoon as a pattern. Pre-cut a piece of horn to nearly the shape of the spoon you are making. Now, heat the horn until it is flexible. Place the heated horn in the mold and clamp the mold into a vise or hold it shut with C-clamps. Wait until the horn cools and sets before opening the mold. Finish by cleaning up the edges and polishing the spoon.



Spoon mold

SCOOPS

Scoops for powder or grain are easily made from the leg bone of a cow, deer, etc. Thoroughly clean the outside of the bone to be used then cut off one end. Mark a length from the end which was not cut off to be used as a handle. Saw the bone lengthwise down from the end you cut off taking off as little bone as is necessary to open the scoop. (In other words, only take off the top portion, leaving as large a cavity as possible to use as a scoop.) Cross cut the top at the handle mark to remove the scrap piece. Clean out the marrow using a scraper and a bottle brush. (You may want to also use hydrogen peroxide.) Round the corners at the end that was cut off.



Prepare the horn by cleaning the interior and smoothing and polishing the exterior according to the directions previously given.

Prepare the horn to receive the strings. Harp tuning pins, which are available through many hobby and hardware shops, are the easiest to use, not likely to split the horn and more authentic than modern mechanical turn keys. Tuning pins which require the use of a tuning key were in use all the way back to the fifth century through the Brehon Laws of Ireland which had a passage specifically setting aside penalties for not returning a harp key. (The Story of the Harp, W. H. Grattan Flood, page 11-12).

Mark the placement for the holes in the upper (solid) section of the horn, keeping the centers of the holes at least 1/2 inch apart. You may choose to separate the strings further. Drill the holes for the pins slightly large and force wood dowels into them and glue them in place. Then drill the holes for the pegs themselves making them slightly smaller than the pegs. The reason for this is that the wood will grip the metal pegs better than the horn.

Use string and tape to mark where the holes will be drilled in the lower portion of the horn. These holes may not be the same distance apart as the holes on the upper section. It is more important that the strings be parallel than that the holes be equal distances.

Drill the soundbox holes large enough to allow strings tied around a metal stay. (Look at a modern guitar string for this arrangement.) Then file a slot in each hole on the upward slop of the horn to make a T-slot to hold the strings. This allows the strings to be mounted without having to reach inside the horn to thread them through the holes and hold the strings in place when they are tightened.

String the harp, using metal strings. Bronze, silver and horsehair strings as well as gut strings, were in use in Ireland, Wales and Briton at least as far back as the sixth century (ibid) but you will get a much clearer sound out of metal strings on this small harp.

HORN SELF HARP

In 1511 Sebastian Virdung wrote, "What one man calls a harp, another calls a lyre" and indeed in the early middle ages, it would have often been difficult to tell the difference between the two. Of the many carvings, illustrations and paintings which survive of harps, sizes and shapes vary greatly.

The construction of the harp presented here is unique in that the sound box is made of a single horn with no frontice post. I believe that the Irish may have made harps of this type any time prior to 600CE for the following reasons:

A: Harps of this type were made out of both ivory and wood in Egypt and northern Africa from at least 3000 BCE until modern times.

B: The Irish and central Europe had contact with Spain (which was heavily influenced by northern Africa) and northern Africa itself during this time period.

C: Our European ancestors utilized every part of the animal in their daily lives. In fact, cattle were sacred to many (not as cattle are sacred to the Hindu, but as the source of their livelihoods).

D: The natural shape of the cow horn is similar to the shape of the harps in Egypt and northern Africa.



This harp is easiest made from a water buffalo horn.

EAR SCOOPS

In the middle ages, they did not have cotton swabs. The way people cleaned their ears (other than with fingers and sticks) was with an ear scoop. Several examples were recovered from the wreck of the Mary Rose. While I don't recommend using them, here is how they are made.

Take a piece of horn or bone 4 or 5 inches long and about the thickness of a chopstick. At one end, carve a miniature spoon. Finish the rest of the piece as you see fit. Most of the pieces surviving from the middle ages have been rounded and appear to have been turned on a lathe but there are some pieces with square or rectangular cross-sections (rather like some chop-sticks).

NEEDLES

Obtain and clean a piece of bone or antler and use a saw to slice off an appropriate size strip. Once the basic needle shape is obtained, a file can be used to give the needle its final shape. Flat needle files work the best. You may want to make a wood block with carved grooves to hold the needle blanks while you do the finish work.

After the final shape is obtained, carefully carve the eye in the needle using the smallest chip knife point you have. You can also cut the eye using a very fine drill. Smooth the inside of the eye by running strong thread through it that has been wet and rolled in abrasive powder or polish paste.

After the eye is carved and polished, complete the final polish of the outside of the needle.



HORN BOOKS and TABLETS

One of the uses for horn in period was the horn book. A piece of horn was cleaned and flattened then scrapped thin enough to be transparent. (Heating the horn and applying pressure to it in greased iron vise plates will help to increase the transparency of the plate.)

The lesson to be taught (often the alphabet and/or the Lord's Prayer) was then written on a piece of parchment and glued to a board. The piece of horn was then attached over this with tacks and sometimes leather edges to protect the parchment. The "book" could now be used over and over again without fear of damage.



A horn "tablet" can be made by flattening a thick piece of horn and hollowing out a rectangular portion with a chisel (or a Dremel) then filling it with beeswax. The wax could then be written on with a bone stylus and erased by rubbing. Two or more of these tablets could be laced together to make a 'book' or 'codex'.

Horn and bone are stronger than comparative thicknesses of wood and resist shrinking, warping and cracking to a greater degree. This is additionally evidenced by the fact that many instruments both in and out of period use bone or ivory fittings at joints to insure a proper fit. For stringed instruments, a sound box can be made by cutting, shaving, sanding and joining horn or bone much the same as wood, or horn can be used in its natural form. Tortoise or turtle shells are easily used as sound boxes in their natural state with leather, wood or horn used to cover the opening as the Egyptians and the Greeks did.

CONSTRUCTION OF MUSICAL INSTRUMENTS

TRUMPETS OR CALLING HORNS

Trumpets or calling horns are very simple to make. Clean out the core and smooth, polish and decorate the exterior as you wish. Insert a stiff wire into the horn to determine the depth of the cavity. If there is enough solid tip on the horn, cut the tip off approximately 1 1/2 inches above the end of the cavity. Center drill this solid piece using a 1/4 inch drill bit then using a conical stone, bore the mouth piece. If you wish to have a 'tunable' horn, hold the horn to your mouth in the position you would normally blow it in, place three of your fingers in a natural position along the curve of the horn and mark the positions. Drill 1/4 inch holes at these spots then ream the holes to tune the instrument.

If your horn does not have enough solid tip to make a mouth piece, you can either drill and carve a mouthpiece in the side of the horn (a common practice) or you can drill a larger hole in the tip of the horn and insert a mouth piece of wood, metal or one made of the cut off tip of another horn.

MUSICAL INSTRUMENTS MADE OF SKELETAL MATERIALS

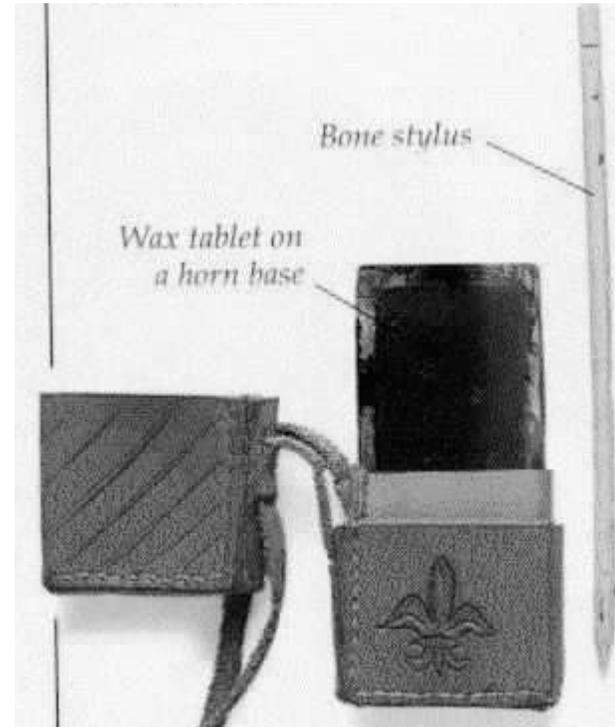
Horn and bone are logical materials for using in the production of musical instruments whether they are wind, string or percussion.

The instrument of horn most mentioned in medieval records (and one often found in museums) is the sounding or hunting horn. From Pwyll's horn which sounded to open the door between the worlds in the *Mabinogion* to Roland's Oliphant to the calling horn of the city of Ripon in North Yorkshire, England (in documented use from 880 C.E. when it was given to the city by Aelfred the Great to mark the granting of legal tenure of the Liberty, freeing the city of Royal taxes), evidence of the sounding horn is easy to find.

It is reasonable to assume that many wind instruments were first created in skeletal materials then later in wood or metal. There are extant examples of flutes, cornettos, trumpets and pipcorns made of skeletal materials. For sounding horns, an instrument may be produced by merely cleaning out the core and cutting off the sharp end at a point far enough down the cavity to create a hole. Or, as with many African horns, a hole is bored into the side of the horn. The sounding horn of Ripon, England is made of a large cow horn with silver fittings and mouth piece. The Victoria and Albert Museum has a sixteenth century ivory horn of French origin which has carvings of hunting cupids on one side and six stops for modulating the notes carved into the other.

The ancient civilizations of Rome, Greece and Egypt have all provided examples of musical instruments made of skeletal materials. Greek murals show examples of lyres with the sound box made of a turtle shell and the string posts made of antelope horn. Indeed, the Greeks believed that the first lyre was made by Hermes the messenger of gods by plucking the shell off of a turtle, placing antelope horns on it and stringing the whole with horse tail hairs. The Egyptians made harps with the sound box and post entirely out of ivory and lutes utilizing tortoise shell for the sound box. The use of leg bones of sheep, cattle, horses and humans to make flutes, clappers and rasps spans all European, Asian and African histories to modern times.

The advantage of wood in making sound boxes is that it provides a very fine resonant sound which can be easily duplicated from one instrument to the next. The disadvantage is that wood is highly susceptible to changes in the atmosphere, especially moisture. Horn and skeletal materials provide a resonance of sound as good as wood without the susceptibility to moisture.



WINDOWS AND LANTHORNS

Large sheets of horn for making windows or lanterns ('lanthorns') were made by ironing pieces of horn together. Joining pieces by "ironing" is accomplished thusly. Prepare two pieces of horn by cleaning, heating and flattening. Heat the two pieces of horn to be joined until they are very pliable. Meanwhile, heat two pieces of iron or copper to about 325 - 350 degrees. Remove the metal from the heat and place on the jaws of a vise. Grease with tallow. Now place the horn pieces on the heated metal with the edges you wish to join one on top of the other. Apply pressure. When the edges start to 'run', apply more pressure. Leave in the vise until cool. This particular method of working horn requires a lot of practice to get right. Learning the correct temperature to heat your 'irons' to requires practice and experience.

HORN CUP

A cup is different from a drinking "horn" in that it has a flat bottom and may have a handle. I have already described how to clean and cure the inside of a horn for drinking. You can follow those directions for this cup also.

Find a suitable horn for the cup and clean the outside and the inside. Sand or file the opening of the horn until it is uniformly flat (i.e. when you hold the horn on a flat surface with the open end down, there are no gaping holes visible between the rim of the horn and the surface you are holding it against). Next, decide how tall the "cup" portion will be and mark this height parallel to the rim of the horn. Use a rigid measuring device for this to insure that the lip of your cup will be parallel to the table when it is finished. Now cut off the tip of the horn at the end of the cavity. (You can use a piece of coat hanger wire to find the end of the cavity.)

On the inside of the curve of the horn and between the rim marking and the tip you cut off, mark the width of the handle you will make. Using a saw, first cut around the horn at the rim mark (do not cut through the handle), then cut the horn lengthwise along the handle marks. Sand all these cut edges smooth.

Next, choose a piece of wood (oak works very well) about 1 1/2 to 2 inches thick to insert into the large open end of the horn to serve as the base of your cup. Stand the horn on the piece of wood and mark the shape of your horn on the wood. Cut out this pattern then file and sand the wood until it just barely begins to fit into the base of the horn.

Boil the horn in water until it becomes flexible enough to bend the handle. While the horn is boiling, prepare a form to bend the handle over (this can be as simple as a piece of rolled up cloth or leather or you can cut a piece of wood for the form). Remove the horn and tamp the wood plug gently in place then bend the handle around the form and tie it in place with string or rubber bands until it cools.

When the whole piece has cooled, do the final polish and whatever other finish work you care to. It is not necessary to utilize any coatings on the inside of the horn but you may wish to apply bee's wax or Enviro-tex to the outside of the wood.

A different cup can be made from a straight horn. Choose a horn with no curve to it. Clean the inside, smooth the outside of the horn and finish the lip of the opening. Pick a location on the taper of the horn where the diameter is approx. 2/3 the diameter of the open end. Cut off the tip of the horn at this point. Set aside the larger piece and take the piece you just cut off and cut off the solid tip. Cut open the hollow portion that is left and flatten it.

Working with the smaller end of the large piece, carve a groove inside the horn approx. 1/4 inch from the end. This groove does not need to be very deep but should be as wide as the flattened piece of horn is thick. Place the small end of your cone on the flattened piece of horn and draw or scribe around it. Cut out this circle being careful to saw outside the circle. Smooth the edges of the circle with sandpaper and even out any high spots that won't fit in the groove you made. Soak both pieces in water for 24-48 hours or heat until the smaller piece is very pliable.

Gently push the circle into the cone from the large end until it 'snaps' into place in the groove. Polish & cure your beaker.

