TUNING A LONG BOW

The purpose of this paper is to act as a guide for Long Bow archers and coaches. It contains some rules of thumb, which spells ROT so do not expect them to always be the answer. Good old experimentation, believing in your own judgement is the key. Hopefully it does provide a relatively simple and systematic approach to your tuning. Any feedback, and wrinkles that have been missed, would be welcome.

Some people think that the only tuning that can be done to Long Bows is arrow matching. This approach means you get a bunch of arrows and if they don't seem to fly straight, you buy another set either stiffer or whippier and you try these until you get a set that seem to fly properly. Not all of us have pockets deep enough to try this approach and most archers end up with a set of arrows without having any means of reassuring themselves that the choice was correct. Whilst arrow matching is the most important facet, other aspects of tuning can make a significant impact!

All the illustrations are for the right-handed archer. Our left-handed brethren are clever enough to work it out for themselves.

Before we look at tuning the archer's paradox needs to be explained, because the paradox is very real for the Long Bow archer.

**The archer's view at the target**
The paradox is that the arrow will fly at the target even though it is pointing to the left of it.

**The arrow flight**
The arrow bends, making the pile turn in towards the target, as the force is given to the back of the arrow. The initial bend into the target comes from the finger release. This means if a thumbring was used, then the arrow should be placed on the other side of the bow!
Parts of a bow

nock - horn

sight - rubber ring
(some archers think this is unnecessary)

belly - inside of bow
(wood under compression)

nocking point - where the nock end of the arrow should be placed

bracing height - distance from stick to string

handle

dip - optional feature that reduces vibration

back - outside of bow
(wood under tension)

tiller – distance “A” should be greater than distance “B” by 1/2 inch

nock - horn
MECHANICS

It is useful to know what goes into the different designs of bows and the purpose a bow was made for, before we look at tuning in detail. The mechanics of the Long Bow can be considered by looking at the materials used and its construction. Firstly it is made of wood, which is an organic material. This means that it is difficult to find exactly the same properties from one wood type to another, let alone within each wood type. It is subject to more change in use, both in the short and long term, than the inert materials that are used in the recurve or compound bows.

MATERIALS

An overview of the most common woods used in Long Bows are:

YEW
1/ recovers best of all the woods between shoots, i.e. one day and the next
2/ minimal following of the string, i.e. having a bend in the stave after use
3/ the fastest bow wood
4/ pausing the bow at full draw markedly affects its performance
5/ affected by weather conditions, particularly if the sun shines on it

DEGAME / LEMON WOOD
1/ the most consistent of all the woods between shots
2/ follows the string quite markedly, which should settle down after about 100 arrows. This means the bow gets lighter in poundage (draw weight) than when purchased
3/ the slowest bow wood
4/ the bow can be paused at full draw, i.e. less than a second, without affecting the performance
5/ hardly affected by weather conditions

OSAGE ORANGE
Similar to YEW, but with not quite the peak performance and a degree of the benefits of DEGAME.

GREEN HEART, PURPLE HEART
Similar to OSAGE ORANGE but moving towards DEGAME.

BAMBOO
This grass has been allowed to be used as a bow wood. Its biggest advantage is that it works in tension, whilst other bow woods work in compression. This means that a bow made from bamboo can be very fast. If used on the belly of a bow some have been known to 'let down', lose poundage, between arrows!

HICKORY
This wood is normally used to back a bow. Its purpose is not to add to the performance of the bow, but to ensure the wood that is under compression performs well and does not splinter.
CONSTRUCTION
The construction has two facets:
1/ how it is made - a single piece or several pieces - SELF-BOWS or LAMINATES
2/ how it is designed - pre-stressed, recurved, whole length working, dips

SELF-BOWS
These bows are made of a single piece of wood, utilising the heartwood and sapwood to the best mechanical advantage, i.e. the sapwood is under tension and the heartwood is under compression. The most common material used for SELF-BOWS is YEW and the verdict on the line is that they are either "crackers" or "dogs", but all can fling arrows at a fearsome speed and distance.
A version of the SELF-BOW is a BOUGH BOW. This is a piece of wood from the branch (bough) of the tree and it is usual to make these bow 'wet', i.e. unseasoned. This means that the bow increases in poundage (draw weight) the older it gets.

LAMINATES
This is the most common form of Long Bow. The bowyer is trying to take advantage of the properties of the various woods depending on the use required of it. They can be joined in the middle, or only the belly is jointed.
These types of bows tend to be consistent and stable in most circumstances, but there a drop in the maximum performance (speed and cast) as a consequence.

DESIGN
If a bow is made to bend through the handle, or is very straight when unstrung, then some of the energy of the bow will be absorbed by the archer through their bow arm. This can be very painful if shooting a lot of arrows in a day. As a consequence some archers shoot these bows with a slightly bent arm. The fact that a bow has taken a set means that the bow limbs will absorb most of the vibration after the shot has been made.
Many bows are made with 'dips', which is a rapid increase in the thickness of the bow above and below the handle. The purpose of dips are to reduce the vibration going through the archer's bow arm. Some bows are made with extra laminations in the handle, and this is a very obvious form of dip.

Bows can be made pre-stressed, i.e. glued against the way the bow will be bent when shot. Often these types of bows quickly get a set not matter what the wood being used. This is not a new idea as drawings from medieval manuscripts show that they made bows like this in the heyday of the Long Bow.

All bows are tillered and should be checked for when buying new. Often you can see Long Bows that have reversed tillered. The way the bow has taken its set has counteracted the bowyer's intention. These bows can shoot consistently providing the nocking point has been adjusted.
**TUNING**
The following sequence is recommended for tuning Long Bows, but if there is a major adjustment to a later item it is important that the earlier steps are gone through again.

1/ **EQUIPMENT SELECTION**
2/ **ARCHER'S TECHNIQUE**
3/ **NOCKING POINT**
4/ **BRACING HEIGHT**
5/ **ARROW MATCHING**

**1/ EQUIPMENT SELECTION**
This first thing to consider is all the equipment used in shooting, namely:
- **Bow** - any change
- **String** - number of strands, material, endless / inlaid / traditional
- **Tab** - glove, ordinary, platform, finger stalls
- **Arrows** - any change

Review the tuning if you make any permanent change to your equipment.

**2/ ARCHER'S TECHNIQUE**
It is very important to be aware that the Long Bow archer is very often over bowed in order to achieve a reasonable sight mark at the longer distances. This is a compromise they need to know they are making. Being over bowed has presents considerable problems for consistent shooting and therefore tuning.

A change to the archer's technique will affect the tuning. Tuning must be reviewed if there is any change is made:

- **Hand position on bow**
- **Finger pressure on tab**
- **Method of Draw**
- **Draw Force Line**
- **ESAR - Eye, sight, arrow relationship**
- **Face Location**
- **Speed of Draw**
- **Follow through**

String walkers should initially tune with three fingers just under the string and then plot the characteristics of groups when the fingers are placed differently.
3/ NOCKING POINT
It is best to have a slightly higher nocking point to begin with, to avoid feathering your top finger (this means leaving bits of feather in the 2\textsuperscript{nd} and 3\textsuperscript{rd} knuckle). A good starting point is 1/4 inch above the handle. If the archer raises the arrow above the grip/handle with his bow hand then put the nocking point 1/4 inch above the bow hand. If the archer has an inconsistent grip - describe in some detail the fun of extracting shards of feather from knuckles and this should remedy the problem. If the arrows hits the bow hand it is vital that the nocking point is raised immediately - wearing a glove disguises the problem without sorting it out.

Final adjustment can be made by shooting through paper at about twelve yards. Do not worry about right or left tears as this will depend on the loose and the archer's paradox.

Nock too low  Nock too high

4/ BRACING HEIGHT
If given no guidance from the bowyer, then a good starting point is six inches bracing height for a six foot Long Bow. Keep the relationship the same for different size bows, i.e. a five foot bow will have a five inch bracing height.
The exact bracing height for the bow is really a matter of trial and error as the bow, the archer's style, the draw length need to matched. It would surprise most Long Bow archers how much their groups will improve by even small changes to the bracing height. This is because the bracing height affects the poundage (draw weight) being delivered by the bow. By adjusting this you are better able to match the arrows to the bow.

5/ ARROW MATCHING
There are three aspects to consider.
a/ matching arrow to the bow  
b/ manufacture of the arrows 
c/ matching arrows to each other
a/ matching arrow to the bow
Most people follow the dealer’s or fletcher’s recommendation. If you buy from the Archery Centre or Quicks make sure the arrows are spined 10-20 pounds less than the bow weight. This does depend on the loose, as the smoother the loose the greater this difference can be. Whippy arrows flies faster than stiff arrows and due to the difficulty of reaching the longer distances, a Long Bow archer wants the least stiff arrow possible. However you can always group stiff arrows but whippy arrows are only hand-me-ons or paint stirrers.

b/ manufacture of the arrows
To start with it is important that the nocks are placed so that the cock feather runs with the grain. For target shooting the piles should make the centre of gravity be forward of the centre of the arrow. Barrelled arrows make the arrow lighter for the spine but harder to be consistent from one to another. Footed arrows make the arrow stronger and less prone to breakage at the pile end but harder to be consistent from one to another.

c/ matching arrows to each other
There are various methods recommended for this and Bert Smith's book is excellent for the other methods. A simpler but more costly in arrows is to dynamically tune them. All this means is that you shoot them for groups and select accordingly.

dynamic tuning
Shoot at a distance where you expect your arrows to go into the red or gold on a 122cm target, when you make a good shot. This distance can be 15, 20, 25, 30 etc. up to 60 yards depending on your standard of shooting. Shooting at least 10 arrows make sure all your arrows are numbered. Using a blank target score sheet record each arrow on a separately. After you have shot each arrow about six times a pattern will emerge, if not you are shooting too far away. From these individual patterns you should find at least 4 have a similar group, but these might not be the ones that are in the middle. These four arrows are your master group and should be the ones you should use. Adjust your sight and these will now be the arrows that hit the middle consistently. The arrows that are not used can be adjusted by positioning the nock on another fletching other than the original. You might find this makes another two fall into your master group. You can rotate the nock around again and see if this makes any of them join your master group. Any that fail can be adjusted by the methods used in Bert Smith's book or kept to form its own group when you make subsequent sets of arrows. From this you will accumulate sets of arrows that have group characteristics that are known and can be adjusted for when shooting.

CONCLUSION
Not only can you tune a Long Bow, it is essential that you do!

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