AN EXPERIMENT IN THE PRODUCTION OF ARCHERY EQUIPMENT
IN PHYSICAL EDUCATION CLASSES AT NORTH TEXAS STATE
TEACHERS COLLEGE TO DETERMINE THE MOTIVATION
POSSIBILITIES AND THE PROCEDURE NECESSARY
IN THE PRODUCTION OF THE EQUIPMENT

APPROVED:

[Signatures]

Major Professor

Minor Professor

Director of the Department of
Physical Education

Chairman of the Graduate Council
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THESIS

Presented to the Graduate Council of the North
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by

Tommie W. Hendrick, B. S.

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CHAPTER I

INTRODUCTION

Purpose

The purpose of this study was to record the results of experiments made in the construction of archery equipment at North Texas State Teachers College in the school sessions from 1936 to 1940. The process of making archery equipment was described and followed in order that a person with no experience in archery or handicraft might interpret these procedures without difficulty.

Sources of Data

The data has been made and recorded from experimental work of the eight archery classes taught at North Texas State Teachers College from 1938 to 1940. Information was also taken from books on archery written by Shane, Gordon, Elmer, Reichart & Keasey, and from faculty members who have been interested in this program from its beginning.

History of Archery
at North Texas State Teachers College

Archery was introduced into the Physical Education Department at North Texas State Teachers College in 1927. The college bought two Lemonwood longbows, six arrows and one round target with a tripod stand. Archery was made a part of
the Light Work Classes of the Required Physical Education Program and was introduced into the Girls' Intramural Program of the Women's Athletic Association in 1937. In July, 1938, the College owned six Lemonwood flat bows, fifty arrows, two boxes made for holding arrows and two round targets with tripod stands. Before the summer sessions were completed, a number of bows and arrows had been added to the list of equipment.¹

In the fall of 1938, five stationary targets were made and placed at the south end of the archery range east of the Harriss Gymnasium. Ten bales of straw were used to make each target. Each was supported by a rack made of wood. They were covered with burlap and a four-foot regulation size scoring target was painted on each.

In the fall semester of 1938 an archery club for men was organized. It was made up of students and faculty members of the College. Each member was required to make his own archery equipment. This was the first organized group on this campus that made its own equipment. The club met twice each week in the college workshop until the equipment was completed. No satisfactory time was found when the members were free to meet and shoot, so the club was disbanded. Many of the members of this group, however, have continued with an active participation in the sport.

During the spring semester of 1939, a co-educational

¹Personal conference with Miss Beulah A. Harriss.
archery class, in which the students made their own equipment, was added to the Required Physical Education Program. This class was held in the Scout Cabin of Troop 67, the troop that is sponsored by the College. The students used the first part of the semester to make their equipment and the remainder of the semester to learn and practice the techniques of shooting. There were fourteen members in this class; six boys and eight girls. Co-educational Archery Classes of this kind have been held each semester, since the first one was organized.

At the beginning of the 1939 summer term, the archery workshop was moved to the field house under the west bleachers. One class was held each term. The class during the first term had eighteen members; eight boys and ten girls. The class of the second term had fourteen members; five boys and nine girls.

Archery was included on the College schedule sheet for the first time for the fall semester of 1939. Only one class was scheduled, but so many were enrolled for this class before it was closed, that the students were divided into two classes. The number of students in the archery classes had to be limited to a few, because of the inadequate space and equipment in the workshop. One class had fifteen members; five boys and ten girls. The other class had seventeen members; two boys and fifteen girls. At this time the workshop was moved back to the Scout Cabin.

Two archery classes were listed on the College schedule for the spring semester of 1940. Again a mistake was made.
during the enrolling and before the classes were closed, too many students had been enrolled for the two classes. The group was divided and a third class was organized. One class had twenty members; seven boys and thirteen girls. The second class had nineteen members; nine boys and ten girls, while the third class had nineteen members; two boys and seventeen girls.  

Light Work Classes have continued since they were organized in 1937. In the spring of 1939, the members of the Women's Athletic Association entered a team of eight that competed in the Women's National Inter-Collegiate Wireless Archery Tournament. This has been an annual affair sponsored by the National Archery Association. This year two teams have been entered in this tournament.  

Treatment of Data

These experiments were conducted in the archery workshop of North Texas State Teachers College. The equipment in this workshop consisted of seven large work tables, four of which accommodated eight people as they cut down their bows. A fifth table supported four arrow painters, in which the arrows were turned by electric motors. A sixth table supported three quiver racks that held thirty-five quivers while the paint dried. The seventh table was used as a storage place for arrow materials and for tools that could not be hung on the wall.

---

2Personal conference with Miss Beulah A. Harris.

3Personal conference with Miss Edith Mae Kubec.
The tools used in these experiments consisted of:

1. Three large planes.
2. Five small planes.
3. Four large rasps.
4. Three small rasps.
5. One hand saw.
6. Two hack saws.
7. One coping saw.
8. Two vises.
9. Two hammers.
10. One one-inch wood chisel.
11. Fifteen wood clamps.
12. Two six-inch rat-tail files.
13. Four eight-inch flat metal file.
15. Two pairs of pliers.
16. Three scrapers.
17. Eighteen fletching tools for feathering arrows.
18. Two razor-blade feather trimmers.
19. One tungsten wire feather trimmer.
CHAPTER II

BOWS

Bows have been made from many kinds of woods but those that have proved to be the best are those made from the timber of the Yew, Osage Orange, Red Cedar and Lemonwood. Most archery companies have handled these staves and the prices have varied according to the grade of the stave and their scarcity. The price ranges are shown in Table 1.

TABLE 1

THE PRICE RANGES OF BOWS OF DIFFERENT WOODS

Yew.................$3.00 to $15.00
Osage Orange.... 3.00 to 12.00
Red Cedar....... 2.25 to 12.00
Lemonwood....... 1.00 to 2.00

Since lemonwood has been found to be the easiest and most economical bow wood to work with, many people have chosen this wood for their first bows. Flat lemonwood staves, very few of which were found to be perfectly straight, were about six feet long, one and five-eighth inches wide and seven-eighth inches thick.

The first thing the students did was to determine which was to be the back side of the bow. The staves were placed
on a table, a floor or any smooth surface and if the middle of the stave touched the surface, it was turned over. A stave in this position is illustrated in Figure 1. The side of the stave next to the table was chosen to be the back side of the bow. This made the bow bend in the opposite direction from the natural bend of the stave which gave the bow a better cast and kept it from following the string too much. This side of the stave was smoothed with a large plane and a scraper.

FIGURE 1. Determining the back side of a stave.

The staves were then ready to be sawed in to the length in which the bows were to be made. The proper length of the staves was determined by considering the length of the student's draw and the approximate strength of the bow desired.

The length of a person's draw was determined by the following method: The students held pencils or sticks of a similar size in their left hands and extended their left arms full length at shoulder height from their bodies. They turned their heads far enough to the left that they could see the extended hand with the right eye. A yardstick was used to measure the distance from the middle of the person's chin to the pencil.

Students that had shot bows before knew about how strong they wanted their bows to be. Students, unaccustomed to shooting, found that with lighter bows, they could learn the correct form more easily, could shoot better scores,
would tire less, and would enjoy shooting more. A single table of bow measurements was not suitable for both men and women since a woman with a twenty-six inch draw did not care for as strong a bow as a man with the same length draw. The weaker bows were able to stand a longer draw than a strong bow of the same length, so it was necessary to make the stronger bows a fraction longer. The shorter bows had a better cast, so it was desirable to make the bows as short as possible without making them so short they were apt to break. The measurements of the bow staves for women and men are listed in Tables 2 and 3.

**Table 2**

**Measurements of Bow Staves for Women**

<table>
<thead>
<tr>
<th>Draw of Bow</th>
<th>Weight of Bow</th>
<th>Length</th>
<th>Thickness</th>
<th>Width</th>
<th>Width of Handle</th>
</tr>
</thead>
<tbody>
<tr>
<td>22-23</td>
<td>18-24</td>
<td>5'</td>
<td>$\frac{1}{2}$</td>
<td>1</td>
<td>5/8</td>
</tr>
<tr>
<td>25-35</td>
<td>18-24</td>
<td>5'2&quot;</td>
<td>$\frac{3}{4}$</td>
<td>1 1/8</td>
<td>3/4</td>
</tr>
<tr>
<td>24-25</td>
<td>18-24</td>
<td>5'4&quot;</td>
<td>$\frac{3}{4}$</td>
<td>1 1/8</td>
<td>5/8</td>
</tr>
<tr>
<td>25-35</td>
<td>18-24</td>
<td>5'6&quot;</td>
<td>11/16</td>
<td>1 3/16</td>
<td>3/4</td>
</tr>
<tr>
<td>26-27</td>
<td>18-24</td>
<td>5'6&quot;</td>
<td>$\frac{1}{4}$</td>
<td>1 1/8</td>
<td>3/4</td>
</tr>
<tr>
<td>25-35</td>
<td>18-24</td>
<td>5'8&quot;</td>
<td>5/8</td>
<td>1 1/4</td>
<td>7/8</td>
</tr>
</tbody>
</table>

After the length of the bow was decided, the stave was examined to see if there were cracks, knots or defects in the wood near one end. If defects were found, the extra length of the stave was sawed from the defective end.
TABLE 3
MEASUREMENTS OF BOW STAVES FOR MEN

<table>
<thead>
<tr>
<th>Draw of Bow</th>
<th>Weight of Bow</th>
<th>Length</th>
<th>Thickness</th>
<th>Width</th>
<th>Width of Handle</th>
</tr>
</thead>
<tbody>
<tr>
<td>inches</td>
<td>pounds</td>
<td>feet &amp; inches</td>
<td>inches</td>
<td>inches</td>
<td>inches</td>
</tr>
<tr>
<td>23-24</td>
<td>25-35</td>
<td>5'6&quot;</td>
<td>5/8</td>
<td>1 1/8</td>
<td>7/8</td>
</tr>
<tr>
<td></td>
<td>36-46</td>
<td>5'8&quot;</td>
<td>5/8</td>
<td>1 1/4</td>
<td>1</td>
</tr>
<tr>
<td>25-26</td>
<td>25-35</td>
<td>5'10&quot;</td>
<td>5/8</td>
<td>1 1/8</td>
<td>7/8</td>
</tr>
<tr>
<td></td>
<td>36-46</td>
<td>5'10&quot;</td>
<td>11/16</td>
<td>1 1/4</td>
<td>1</td>
</tr>
<tr>
<td>27-28</td>
<td>25-35</td>
<td>6'</td>
<td>5/8</td>
<td>1 1/4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>36-46</td>
<td>6'</td>
<td>11/16</td>
<td>1 3/8</td>
<td>1</td>
</tr>
</tbody>
</table>

The stave was placed on the table on its back side. A yard stick was used to find the middle and a line, AA, was drawn across the stave at that point. Line BB was drawn one-inch from line AA and line CC was drawn three inches from line AA in the opposite direction from BB. These lines are illustrated in Figure 2.

![Figure 2](https://example.com/figure2.png)

**FIGURE 2.** Determining handle portion of stave.

The handle, the four-inch space between the lines BB and CC, was where the archer held the bow while shooting. One limb, an upper or lower half of the bow, was two inches longer than the other limb, and it was held up while shooting.

The staves were wider than the bows needed to be as determined by the tables on page 3 and 4. As is indicated in Figure 3, the staves were placed on the table. A portion
about twelve inches long, on the edge that did not touch the table, was scraped smooth. The distance that the width of the bow was to be was measured from the smoothed edge on lines BB and CC. These two points were connected as in Figure 3.

![Figure 3](image)

**FIGURE 3.** The bow stave measured to proper width.

With a plane the excess width of the stave was removed to the indicated line. The appearance of the staves is shown in Figure 4. The middle of the stave was measured on line AA and a pencil mark was made at that point perpendicular to the line. A string was extended from one end of the stave to the other so that it was directly over the pencil mark on line AA. The dotted line in Figure 5 indicates the string. A pencil mark was made on each end of the stave where the string crossed it, indicated by the letter F. This mark was not on the middle of each end of the stave unless the stave was perfectly straight and an equal width was removed from
from each side in order to get the stave to the correct width. Bows that were to be thirty pounds in weight or less were made three-eighths of an inch wide at the ends. Pencil marks were made three-sixteenths of an inch on each side of the mark at F. The bows that were to be stronger than thirty pounds were made one-half inch wide at the ends. One-fourth of an inch was marked on each side of the mark at F. A yardstick measurement was used to connect the marks on each side of F with the edge of the bow at the sides of the handle marks. Some of

![Figure 6](image1)

**FIGURE 6. A bow stave marked for final cutting.**

the staves had a defective portion near one edge. Figure 7 illustrates how these staves were marked off.

![Figure 7](image2)

**FIGURE 7. How bow staves with defective portions were marked off.**

With a large plane the excess wood was cut from each side. Figure 8 illustrates how the staves looked after this portion was removed. A piece of hard wood ten inches long, three-

![Figure 8](image3)

**FIGURE 8. Bow stave after final cutting on each side.**
fourth inches thick, and about one and three-eighths inches wide was glued to the front side of each stave and was extended three inches on each side of the four-inch handle section. Before the handle piece was glued on, the staves were cut to the proper thickness on the front side where the handle piece was to be glued on. It was found that any kind of hard wood served as a handle piece but that walnut made a more attractive handle. Figure 9 illustrates a side view of a stave cut to proper thickness and the handle piece glued in the proper place.

FIGURE 9. Stave cut to proper thickness and location of handle piece.

It was found that Casco glue, mixed to a thick paste, was suitable to use in gluing the handle piece. A thin layer of glue was applied to both surfaces and strong clamps were used to hold the pieces of wood together. In ordinary weather twenty-four hours were found to be sufficient for the glue joints to dry but in damp weather longer time was necessary. The clamps were removed after the glue was dry and the excess width that extended on each side of the handle piece was cut away with a plane. The width of these handle portions

FIGURE 10. Arrows point to excess wood on each side of handle piece that was cut away with a plane.
were indicated in the last column on the right of the Table of Bow Measurements on pages 8 and 9. Figure 11 shows how these portions were marked off. Marks were made on lines BB and CC that indicated the width the handles were left and parallel lines connected these points. An arc of a circle six inches in diameter was drawn on thin pasteboard. This portion of pasteboard cut out with scissors was used to extend the parallel lines from lines BB and CC to the side of the stave, one and one-fourth inches from lines BB and CC. A wood chisel and

![Figure 11](image-url)

**FIGURE 11.** How the handle portions were marked off to leave the proper width in the middle.

a hammer were used to remove part of this wood and a rasp was used to smooth this portion and cut the wood flush with the lines. Figure 12 shows how this portion of the stave appeared after the surplus wood was removed.

![Figure 12](image-url)

**FIGURE 12.** Back view of middle of stave after it was cut to proper width.

An arc of a circle sixteen inches in diameter was drawn on thin pasteboard and this was used to extend a line from each end of the handle piece to a point on the handle piece
even with lines BB and CC. A wood chisel and rasp were used to remove this portion of the handle piece. The two edges on each side of the handle piece were rounded with a fine rasp. The two corners at each end of the handle piece were rounded slightly.

![Diagram of handle piece and bow stave with labels B and A]

**FIGURE 13.** Marking each end of the handle piece.

Three cross sections showing the thickness of the handle piece are illustrated in Figure 14. A illustrates the thickness one-half inch from the end. B is two inches from the end and C is a cross section of the middle of the handle piece.

![Cross sections A, B, and C with labels]

**FIGURE 14.** Cross sections illustrating the thickness of the handle piece.

![Diagram of top view of handle piece with labels B and A]

**FIGURE 15.** Top view of shape of one end of handle piece.
In order to keep the handle pieces from breaking from the stave when the bows were drawn, it was found necessary to make the ends of the handle pieces thin. A small plane was used to round the two front edges of the stave and to cut each limb to about the same thickness as it was in the middle. One of the most common faults made by the students as they rounded these two edges was that they flattened the edges instead of rounding them.

![Figure 16](image)

**FIGURE 16. Cross section of one limb of bow flattened instead of rounded.**

Cross sections of the proper shape each limb of the bow was rounded to, is illustrated in Figure 17. A is a cross section at each end of the handle, B is the middle of each limb and C is a section two inches from each end. The back edges of the staves were rounded just enough to remove the cutting edges. About three strokes along these edges were found to be sufficient. The last six inches at each limb of the bows were rounded slightly more, as is illustrated in C of Figure 17.

A small plane was used to cut a very small amount of wood from the sides of each limb near the end to give a more
tapered and trimmer appearance. Figure 18 shows the portion removed in this step.

**Figure 18.** Back view of the end of one limb showing the amount to taper each end.

A six-inch rat-tail file was used to file notches in each end of the bow stave. This was a tedious job and it was found necessary for the students to practice making notches in a piece of wood shaped like the ends of the bow until they were able to make satisfactory notches. The notches were started one inch from the end of the limb on the back edge of the stave and slanted toward the middle of the stave as they were filed toward the front side of the bow. Figure 19 illustrates a correctly shaped notch. It does not meet on the back side of the stave as it does on the front side. A is a front view, B is a side view and C is a back view of the notch.

**Figure 19.** Front, Side and Back view of a notch in the end of the limb of a bow.

The next step was to shape the ends of the stave with a rasp. The top or long limb was pointed and the lower limb
was flattened. Ends properly shaped are illustrated in Figure 20. A and B are sketches of a front and a side view of the top end, and C and D are sketches of a front and a side view of the lower end. The notches in the ends of the stave had to be filed somewhat deeper after the ends were shaped.

![Figure 20 - Ends of bow properly shaped.](image)

Bow strings were needed to check the bend in the limbs of the bows and to determine the strength of the bows. Different strength bow strings were necessary. They varied with the strength of the bows, from fifteen strand strings on eighteen pound bows to twenty-four strand strings on forty-five pound bows. As it was stronger than hemp, flax thread was used to make bow strings. Three strands of thread were made. They were one and one-half feet longer than the bow. Each strand consisted of one-third of the number of threads that were put into the strings. Each strand was twisted separately in the same direction until they were twisted firmly together. These strands were rubbed with beeswax to preserve the string longer, then they were rubbed with a small piece of folded paper to rub in and smooth the wax. The three strands
were put together and twisted in opposite directions. This made a firm bow cord.

In order to shorten the time used in twisting the strands of the bow string, a device, illustrated in Figure 21, was made by which an electric motor was used to twist the strings. A is a sketch of an end view of this device and shows how it was connected to the motor with rubber bands. B is a side of the device. Numbers 1, 2, and 3 were spools that revolved on a spindle. These spools had hook-screws attached to one end by which a strand was attached to each spool. No. 4 was a hook-screw to which all three strands were attached. As the twisting of the strands shortened them, it was necessary to attach this hook-screw to a movable box. Strips of inner tube were attached to the opposite side of this box and to the table in order to keep tension on the strands as the box moved nearer the motor and as the strands were twisted. After sufficient twisting of the three strands, the strands on spools 1 and 3 were connected with spool 2 making all three strands connected at the same place. The rubber band uniting this spool with the motor was twisted one time. This made the spool turn in the opposite direction which was desired for the final twisting.

A noose had to be made in one end of the bow string. To accomplish this a portion of the string was wrapped or served with three strands of flax thread, twisted together and bees-waxed, starting two and one-half inches from the end of the
cord. The length of this wrapped portion varied with the strength of the bow, since the stronger bows had larger ends. The wrapped portion was made long enough to go around the end of the top limb of the bow.


The length of the cord between the served portion and the end was untwisted and an equal length on the other side of the serving was untwisted. This is illustrated in A of Figure 22. The served portion was twisted in a circle so that its two ends were together and each of the three loose strands were wrapped around a strand of the untwisted portion on the other side of the serving. Wrapped in the same direction, the three strands were twisted. This portion was twisted back
together, as is illustrated in Figure 22, with two strands of flax thread twisted together and waxed from the noose to the ends of the three strands twisted in.

![Diagram](image)

**Figure 22. Making the noose.**

Some of the students used a timber hitch to attach the lower end of the string to the notch of the bow while some preferred to make a noose in each end of the bow string. The strings were put on the bows and the bows were strung. Understrung or over-strung bows were those that the strings were more or less than six inches from the inside of the handle. The strings of the under-strung bows were twisted more and the strings of the over-strung bows were untwisted until they were the desired six inches from the handle.

In order to prevent wear on the strings, it was found necessary to serve a portion of the bow's string four inches
long where the arrow and three fingers were placed. The correct place on the string for this serving was determined by
nocking an arrow so that it rested against the bow in the proper place and was also perpendicular to the string. The proper
place for the arrow to rest against the bow is illustrated in Figure 24. Marks, one and three-fourths inches above the
arrow and two and one-fourth below the arrow were made on the bow string for this serving.

![Figure 24](image)

**Figure 24.** Proper place for the arrow to rest against the bow.

Serving tools were made in order that the serving could
be wrapped tighter and more evenly. The materials used in
making one of the serving tools were: a small piece of wood
shaped as in Figure 25, a sewing machine bobbin, a piece of
small spring one-half inch long, four small washers, a two
and one-half inch stove bolt and a small eye screw. Tension was applied to the string by tightening the stove bolt.

FIGURE 25. Serving tool.

Two strands of flax thread twisted together, a heavy button thread or an eighteen pound test casting line were used to serve the four inch portion. The serving thread was wound around the bobbin and passed through the eye-screw. It was tied to the bow string where the serving was to start and the bow string fitted into the groove at the end of the serving tool. As the serving tool was turned around the string, a smooth, even layer of serving was made on the bow string.

The best way to fasten the end of the serving thread is illustrated in Figure 26. A piece of flax thread about twelve inches long was doubled so that the two ends were together. This string was placed against the bow string when a distance of one-fourth inch was still to be wrapped. The serving was wrapped on top of this piece of flax thread. When the serving
mark was reached, the serving thread was cut about six inches from the bow string. The end of the serving string was pulled through the loop in the end of the piece of flax thread and when the ends of the flax thread were pulled, the end of the serving thread was pulled under the last quarter-inch of serving. The bow strings were rubbed with beeswax to preserve

![Diagram](image)

**FIGURE 26.** Method used to fasten the end of the serving thread.

the string for longer use. After waxing, the wax was smoothed by rubbing the strings with a small piece of folded white or brown paper.

A tiller was needed in order to check the bend of the bows. One was made from a piece of board thirty inches long, three inches wide and one inch thick. A tiller is illustrated in Figure 27. The end of the tiller was placed against the

![Diagram](image)

**FIGURE 27.** Tiller.

middle of the bow handle and the string was pulled back until it fitted into one of the notches on the tiller. Care was taken to keep the tiller from slipping toward either end of the bow.

The bows were several pounds stronger than desired when they were strung for the first time. The bend of the limbs
could not be accurately checked until they were strung and
drawn. By the use of the tiller, the bows were drawn and the
bend of the limbs studied for weak and strong places. The
strong portions had to be cut down or scraped until they bent
as much as the weakest portion of either limb. The limbs of
this type bow should bend in a perfect arc, the top limb being
slightly weaker than the lower limb.

Improper bending bows are illustrated in Figures 26, 29,
30 and 31. The strong portions of the limbs are indicated by
the spaces between the arrows. These portions had to be weak-
ened by cutting away some of the wood with a small plane.

![Diagram of a whip-ended bow]

**FIGURE 26. A whip-ended bow.**

Whip-ended bows, those bending too much near the end, were
found to shoot smoothly. There was very little recoil when
the bow was shot, however, this type of bow was very apt to
break near the ends of the limbs.

After the desired bend of the bow was reached, the owner
of the bow drew it and if it were too strong, each limb was
carefully cut down with a small plane until the correct
strength was attained. A scraper or a piece of glass with a
smooth edge was used to scrape the rasp and plane marks from the bow. Coarse sandpaper, No. 1, was used to smooth the bows. The places more apt to be over-looked were around the handle and the ends. After the bow was smoothed with coarse sandpaper, fine sandpaper, No. 3/0, was used to make the wood smoother.

**FIGURE 29.** Bow bending too much on each side on handle.

**FIGURE 30.** Bow with limbs bending too much near the middle of each limb.
FIGURE 31. Bow with the correct bend in each limb, but the top limb too strong in proportion to the lower limb.

FIGURE 32. Properly bending bow. Each limb bends in perfect arc, with the top limb slightly weaker than the lower limb.

Most of the students desired to print on their bows, their names or initials as well as the weights of the bows. These were printed on the back side of the top end just above the handle.
Some of the bows were finished with spar varnish applied with a brush. The remaining bows were finished with a French polish applied with a small rag. Students who had had no experience in using varnish found it hard to attain a smooth coat. After the varnish was dry, it was necessary to smooth the finish with pumic stone and an oil that was rubbed on with a piece of felt. Only one coat of varnish was necessary. French polish was made by making a mixture of equal proportions of white shellac, alcohol and linseed oil. It was found that three coats were necessary to obtain a good finish. Although the varnished bow had a nicer finish, it was found to follow the string more than the bow with French polish; therefore, losing some of its cast.

A leather covering was found desirable for the portion of the handle where the bow was held while being shot. A thin, tanned leather skin was cut into strips five-eighths of an inch wide and twenty-four inches long. A portion, the exact width of the hand, was marked in the middle of the handle.

It was found that if the end of the leather strip was cut at an angle, as illustrated by the dotted line in A of Figure 33, the first round of the leather would lap smoother over the end. The edges of the leather were wrapped close together, but not lapped over. After the proper distance was wrapped, the last round of leather was loosened and the end of the leather strip slipped under and pulled tight. The way the leather strip was started and finished is illustrated in B and C of Figure 33.
FIGURE 33. Wrapping the leather strip on the handle portion.

Before the final wrapping was applied, students found it necessary to become familiar with wrapping the leather strip. Quick drying glue was used to glue the leather strip to the bow handle. The glue was applied to the bow, not to the leather. When the wrapping was completed, the end of the leather strap stuck out between the last two rounds at the bottom end of the wrapping. A sharp pocket knife was used to trim away the excess leather strip.

In order to lessen the danger of breaking, the bows were limbered up before arrows were pulled to full draw and released. The students stood ten yards from the target and shot about six arrows from their bows pulled to half-draw. Eighteen or twenty arrows were shot from each bow, thus gradually increasing the length of the draw before full draw was reached.
CHAPTER III

ARROWS

In this experiment the classes studied and tested various kinds of wood used in the production of arrows. Their final choices were in accordance with Gordon who states, "The three woods classed as best for making arrows are: Fort Orford Cedar, Norway Pine and Douglas Fir." Arrows used in this experiment were made of Fort Orford Cedar, Douglas Fir and Spruce. The Cedar and Fir arrows were found to be the best because they were more stable; however, the Fir arrows split more easily than the Cedar. The Spruce arrows were the hardest to break but the shafts were not as straight as those of the Fir and Cedar. Arrows must be accurately grouped in order for an expert archer to shoot a good score. "Arrows should be matched in spine and in weight to make the best possible set." The maximum variation of the balance point should not exceed three-sixteenths of an inch."

It was found that the spine was more important than the weight or the point of balance when the arrows were shot with a strong bow. When lighter bows were used, it was found more

\[5\] Ibid., p. 251.
\[6\] Adolph Shane, Archery Tackle, p. 80.
important to have the set of arrows matched in weight and in point of balance. However, in order to make the arrows as near perfect as possible, the arrows in each set were made to match in the spine, the weight and the point of balance. "The spine of an arrow is its rigidity, resilience, and return in desirable combination."7 In other words, it is how much the shaft bends and how soon it snaps back straight when the bowstring is released. "When testing a shaft for spine, the shaft should always be tested with grain vertical (reed or grain-striking sides--)."8 Figure 34 illustrates the method by which the arrows were checked for spine. Two rests, which were two inches shorter than the shaft, were made by driving two nails to a plank and the shafts were placed across the rests. A two-or-three-pound weight was hung on the middle of the shaft. The distance this weight moved the shaft from a straight line, was read on a short piece of ruler set vertically behind the shaft.

![Figure 34](image)

FIGURE 34. Method by which spine of shafts were checked.

The more flexible shafts were used to make arrows for the lighter bows and the stiffer shafts were used to make arrows for the stronger bows. From a bunch of arrow shafts of the

7Gordon, op. cit., p. 408.
8Ibid., p. 279.
desired spine, eight shafts of the same weight were selected. A set of balance scales was used to match the shaft's weight. If balance scales were not available, a suitable balance was easily made from a yardstick.

**FIGURE 35.** Balance made from a yardstick.

Two short pieces of wood were glued to each end of the yardstick, one-eighth of an inch apart. This was to be sure that the shaft would rest at the same place on the yardstick. Two small nails were driven through the middle of the yardstick. When one end of the yardstick was heavier than the other, a small piece of wood was glued to the lighter end at such a distance from the middle in order to balance the lighter end.

It was found that when a small hole, two and one-fourth inches, was drilled into the center of the head end of the shaft and a piece of finishing nail of the same length glued into the hole, the arrows would shoot truer and have a more even flight especially on windy days. This also made the arrows less likely to break as it strengthened the front of the shaft where the arrows were often broken by hitting a solid object.

**FIGURE 36.** Hole drilled in front of shaft for fitting nail.
Glue was applied to the shafts with a fine brush and a small drop of glue was placed inside the tip, then the parallel points or tips were forced on to the shaft. If the point did not fit tight, a small piece of string was fitted over the end of the shaft to increase its circumference to the desired size. It was almost impossible to glue the points securely enough to prevent the loss of a point occasionally in the target. In order to make the point more secure a small nail hole was driven into one side of the point.

Each student cut his set of shafts the same length of his draw. The arrows were measured from the shoulder of the point to the bottom of the nock. The nocks were either filed in the end of the shaft or pyroxylin nocks fitted and glued at the end. It was found that arrows with pyroxylin nocks lasted longer than other arrows. Arrows that were in the target were frequently hit in the nock by another arrow. This usually broke one side of a pyroxylin nock but the damaged nock could be burnt off and another put in its place. If the nock had been filed in the end of the shaft, the shaft was split and ruined when hit in the nock with another arrow.
lyroxlin nocks were glued, perpendicular to the grain of the shafts, with a quick-drying glue. Quick-drying glue had acetone in it, which tended to melt the inside of the nock. When it dried, the nocks were cemented on. These nocks, if glued with a slow-drying glue, did not stick securely.

The spruce shafts used were slightly larger than the points and nocks; therefore, a small amount of the shaft had to be filed away in order to slant the shaft to the size of the points and nocks. The dotted lines in Figure 39 indicate where the shafts were filed.

![Figure 39. Portion to be filed to slant the shaft to the size of the points and nocks.](image)

A six-inch flat metal file was used to smooth each side of the bottom of the nock to prevent the edges from cutting the bow string. The shafts were sanded with fine sandpaper until they were smooth. When a grain of the wood was picked up by the edge of the sandpaper, it was glued and held down by a piece of string or rubber band wrapped around the lifted portion until the glue was dry.

At this time the shafts were re-checked for spine and if a shaft was discovered that had a stiffer or stronger spine, it was sanded in the middle until its spine matched the set. An arrow with a slightly stronger spine could be sanded in the middle portion enough to weaken the spine until it would
match the others without decreasing the weight enough to disturb the weight balance.

In order to match the point of balance of the sets, a razor blade was stuck in a crack in a table so that one edge of the blade extended about one-fourth of an inch above the table. Each one of the shafts were marked with a pencil at the point where one end of the shaft balanced the other. A shaft, balanced on a razor blade and marked at this point, is illustrated in Figure 40.

![Figure 40. Razor blade used to check balance point.]

A piece of wood with a straight edge was nailed to the table. The shafts were placed side by side, perpendicular to this straight edge with the points resting against it, and the point of balance marked on the side that was up. This step is illustrated in Figure 41.

![Figure 41. Checking the point of balance.]

The balance point of a shaft was changed by sanding one end of an arrow. As the sanding lightened that end of the
shaft, the balance point was moved away from that end. A shaft was picked with the balance point about one-third closest to the point end of the set of shafts and the other shafts were sanded on the proper end until the points of balance matched to within three-sixteenths of an inch. Seven or eight inches of an end of a shaft were sanded to change the point of balance without changing the spine of the shaft.

In the set of shafts illustrated in Figure 41, shaft #6 was used as a key shaft. Shafts #2 and #3 were sanded on the point end and shafts #1, #4, #5, #7, and #8 were sanded on the nock end to make the point of balance match with #6. There were two reasons why a shaft with the balance point about one-third closest to the point end was picked as the key shaft. They are as follows:

1. The balance point nearer the point end makes the arrow steadier in flight.

2. There is more wear and strain on the front end of the shaft and much sanding on that end would make it more apt to break.

The shaft closest to the point end should not be chosen for the key shaft unless there is slight variation in the point of balance as too much sanding on the nock end would weaken it too much. The shafts were re-checked for weight. When a shaft or two were found to be a little heavy, an equal portion was sanded from each end until they matched the others in weight. The point of balance was re-checked often to be sure that it did not change.
Three sections of feathers, two and one-half inches long were glued to each shaft. There were two hen feathers of the same color and a cock feather of a different color. The feathers were spaced an equal distance around the shaft with the cock feather perpendicular to the notch in the nock. Figure 42 illustrates the three feathers and the relationship of the cock feather to the nock. Turkey feathers were used and as six or seven feathers at the end of each wing were stiffer than the other wing or tail feathers, only the end feathers were used. The feathers had a natural curve and this served to make the arrow spin or rotate in flight as the rifles in a gun barrel serve to make a bullet spin and go straight. Care was taken to put all three feathers on each arrow from either the right or the left wing of the fowl. Arrows with both right and left wing feathers did not keep a true course in flight. As the feather sections near the outer end of the feather had more curvature, these sections were put on one arrow, the middle sections on another arrow and the bottom sections of three feathers on another.

**FIGURE 42.** The cock feather and two hen feathers in relation to the nock. (This figure was taken from Paul H. Gordon's *The New Archery*, Figure 113, p. 287.)
Since the cock feather is perpendicular to the notch of the nock, it has to be on one of the two-edge grain sides. To determine the proper side for this feather, the arrow shaft was held with the point end to the left and with the notch of the nock perpendicular to the floor as it is held in shooting. If the grain ran out or lifted toward the nock end of the shaft, it was turned to the opposite side which made the grain lift toward the point end of the arrow on the top side of the shaft. The side next to the person holding the shaft was marked for the cock feather. Left-handed persons put the cock feather on the opposite side of the shaft. Figure 43 illustrates a shaft turned so that the grain lifts toward the point end of the shaft. The cock feather was put on this side because the bottom side of the arrow slid over the archer’s hand when it was shot. If the grain lifted toward the point end on the side that slides over the hand, it was apt to stick in the archer’s hand as it passed. With the grain lifting toward the nock end on the bottom side, it merely passed over the hand.

A few minutes before the shafts were to be feathered, two or three drops of thin quick-drying glue, was rubbed on the seven inches of the shaft next to the nock. This made the
feathers and wood fibers stick to the shaft. This portion of the shaft was to be painted later and if the fibers were not glued down, the paint made them raise, and produced a rough unsightly crest.

Quick-drying glue was used to stick the feathers to the shafts. Fletchers were used by the students to help them feather the arrows. Ground base feathers, secured from archery companies, were found to be better than feathers stripped from the stem. Arrows feathered with ground-base feathers were completed more quickly, the feathers remained straighter and were not easily torn off.

Thirty minutes was sufficient time for the glue, that held the feathers to the shaft, to dry. The arrows were taken from the fletchers and the feathers were trimmed. The students used a feather trimmer, secured from an archery company to trim their feathers into one of the two shapes illustrated in Figure 44.

![Figure 44](image)

**FIGURE 44.** Two shapes to trim feathers.

The trimmer was a small metal form attached to a small block of wood. Two double edge razor blades were fitted into the metal form that bent the blades in the shape illustrated in A. The arrow was placed along a soft piece of wood with the feather extending on the wood. When the razor blades were
pressed firmly against the feather, the blades cut the feather into this shape.

A hot wire feather trimmer was used to trim the feathers into the shape illustrated in B of Figure 44. A feather trimmer of this kind is illustrated in Figure 45. Two small blocks of wood with grooves for the arrow to fit in, were attached to a plank. Two metal posts, three inches apart, were secured to the plank near the block of wood at the left end of the plank. A piece of Tungsten wire, five inches long, was bent into the shape desired and attached to the two metal posts. An extension cord was used to connect the two metal posts to an electric light socket. When the switch was turned on, the Tungsten wire became hot. An arrow was rested in the grooves of the two small blocks of wood. As the arrow was turned, the feathers came into contact with the Tungsten wire and the wire burned the feathers into the shape it was bent. At first the Tungsten wire became so hot, it set the feathers on fire. A heating coil, similar to those used in electric heaters was connected between the tungsten wire and the light socket. This served to lessen the amount of current passing through the Tungsten wire and the feathers were safely trimmed. With a feather trimmer of this sort, any shape feather could be trimmed by bending the Tungsten wire into the shape desired.

Feathers trimmed to the shape of B in Figure 44 seemed to have a more even flight, and seemed to be more accurate. Feathers required a little smoothing at the end of the base.
toward the point of the arrow. As one of the feathers passed over the bow hand when the arrow was shot, a sharp obstruction would cut or scratch the hand. Fine sandpaper was used to

\[\text{FIGURE 45. Tungsten wire feather trimmer.}\]

smooth the base of this end of the feather. One of the four designs, illustrated in Figure 46, was usually used; however, some of the students preferred to use an original design. As a four-hour enamel dried in less time than paint and made a better finish, it was used to paint this portion of the arrow. Two colors were usually used and a narrow stripe, about one-thirty-second of an inch wide, of a different color, was painted between the two colors.

\[\text{FIGURE 46. Four designs for painting crests of arrows.}\]

The first two colors were usually put on at the same sit-
ting. A space, the width the stripe was to be, was left between the two colors, as they ran together if they touched. After the other colors were dry, the narrow stripes, which were usually red, white, green or black, were put on.

Cheap water-color brushes were satisfactory for painting arrows; however, a brush small enough to paint the narrow stripes could not be obtained. A satisfactory brush, to paint the stripes, was made from a water-color brush. This was accomplished by cutting away, with a knife or scissors, all but the middle eight or ten hairs.

Four arrow painting racks, in which the arrow shafts were turned by an electric motor, were made. The brush with enamel on it was held against the arrow at the place to be painted and as the shaft was turned by the motor, the enamel was spread evenly around the shaft.

An arrow painting rack of this sort is illustrated in Figure 47. A plank thirty inches long and six inches wide was used as a base. A, B, C and D are small blocks of wood. Holes slightly larger than the shafts, were bored through the center of blocks B and C and half-way through blocks A and D. D was a movable block that fitted snugly into a slot made by nailing two short pieces of plank to the base of the paint rack. When an arrow was to be painted, block D was removed and the arrow was slipped into the holes on the blocks. Block D was replaced in the slot with the nock of the arrow in the hole half way through D. As the point of the arrow was passed
between blocks C and B, a spool was slipped on the shaft. The spool was wedged to the shaft with a small piece of folded paper or a small V-shaped piece of leather. A rubber band connected the motor to the spool. Unless the spool was used, the shaft was turned so fast that some of the enamel was slung from it.

A surface finish such as varnish was not satisfactory for arrows because it soon wore off. A finish that would penetrate the surface of the arrow shaft was desired. A mixture of white shellac and alcohol in even proportions was found to be very satisfactory. The thinned shellac was applied to the shaft with a small piece of cloth. Three coats were sufficient to protect the arrow. Care was taken not to get the shellac on the painted crest as it would melt the enamel. Fine steel wool was used between the applications of the coats of paint to smooth the grains of the shaft that had been raised by the shellac. There are slight variations in the performance of arrows matched in spine, weight and point of balance. Students that knew the individual characteristics of each of their arrows were able to shoot better scores.

The following method, somewhat similar to the method suggested by Gordon was used by the students to plot their arrows. Circles representing the target face were drawn with a compass on a regular size sheet of typing paper. The arrows were numbered with a pencil on the cock feather side near the nock. The students came down to the shortest distance
they shot, established a point of aim or adjusted their bow sight, and, with great care to hold on to their point of aim or sight properly, loosed their arrows.

![Diagram](image)

**FIGURE 47.** Rack in which arrows were painted.

Each student took his or her sheet of paper with the circles drawn on it and wrote the number of the arrow on the paper target face at the approximate place it had entered the target. After all the students shot their arrows three or four times and recorded the places the arrows hit the target, they were able to decide which arrows were shooting high or low, to the right or left, and approximately how far from the bulls-eye they hit. The students then knew which way each arrow would shoot from where it was aimed and allowance was made for it.

Another method, although considerably more trouble, was found to be more satisfactory to make the set of arrows group together. When an arrow is released, it bends under the string's impetus. If the arrow is the least bit crooked, the shaft will bend in that direction. If the shaft bends toward the bow, it
will rub against the side of the bow, and make the arrow shoot to the left. If it bends away from the bow, it will go slightly around the bow and shoot to the right of the bullseye. The first thing done to remedy this condition, was to heat the shaft and bend it so that the arrow would bend either up or down when the string was released. This made the arrows shoot in a line perpendicular with the ground to the bullseye. Those arrows that bent upward when released, shot low. The ones that bent down, rubbed against the band, making them go high. After the arrows were made to shoot in a line up or down from the bullseye, their elevation was controlled by the weight of the nail in the front end of the shaft. The points were taken off of the arrows that shot above and below the bullseye and a heavier nail was put in the front end of the arrows that shot high; this made them shoot lower. A lighter nail was put in the ones that shot low and this made them shoot higher.

The process which made the arrows shoot at the proper elevation was a trial and error one until one arrow of each set had been adjusted. The stronger the bow, the more weight was needed to make them shoot higher. When a thirty-six pound Yew recurved bow was used at thirty yards, arrows with nails in the point end shot approximately eighteen inches lower than arrows without nails. At sixty yards there was approximately three and one-half feet difference. When a fifty-five pound bow was used, the distances in elevation were approximately ten and twenty inches.
Arrows that grouped together at one distance did not always group together at different distances; therefore, it was better, if possible, to group a set of arrows for each distance the archer desired to shoot. Arrows constructed and grouped according to the above procedures, were more satisfactory for use by amateurs, semi-professionals and professional archers.
CHAPTER IV

ACCESSORIES

Other accessories for archery are the quiver, wire-stand, armguards, finger tabs and targets. Quivers for holding arrows were made from pasteboard cylinders or tubes that were obtained from the dry goods stores. They were about two inches in diameter and when made into quivers would hold as many as twelve arrows.

A portion of the tube, seven inches shorter than the student's arrows, was cut from the cylinder with a sharp knife or hack saw. A circle of wood about one inch thick was fitted into one end of the tube. Fine sandpaper was used to smooth the ends and any rough portions of the tube.

A one-inch paint brush was used to apply enamel to the pasteboard tubes. The students obtained a better paint job by painting inside the open end first, reversing the ends of the quiver toward the open end. When only a few inches of the quiver remained unpainted, it was placed on one of the holders on the quiver painting rack, as illustrated in Figure 48.

The quivers were found to be rough when the first coat of enamel was dry. They were sanded with old sandpaper and a second coat applied. A third coat was applied after the second was dry. It was found that it was hardest to get a good
finish on the white quivers and that four coats were usually necessary.

Stripes of different colors, which circled the quivers, added to their appearance. Some students preferred to paint the stripes on their quivers. It was found that one-inch paper sealing tape, painted and stuck on the quivers, made neater and better looking quivers. A strip of this tape was taken and the ends were stuck on a piece of plank. The strip was painted with one coat of enamel, allowed to dry and cut into sections seven and one-half inches long, which was long enough to circle the quiver. A piece of cloth was wet with water and folded. The sticking side of the pieces of painted tape was pressed against the wet cloth and then stuck around the quiver. Three circles or stripes at each end of the quiver, spaced about one-half inch apart, made an attractive quiver. A shoe string, tied from one end to the other of the quiver, was used to carry it. A quiver of this type is illustrated in Figure 49.

A wire stand, sometimes called a ground quiver, was found to be very desirable to hold arrows while target shooting. A
section of smooth (§8) wire was cut the length of the person's
draw. One end was sharpened with a metal file and a two-inch
circle was bent in the other end at right angles to the stem
of the quiver. A wire stand of this kind is illustrated in
Figure 50.

![Figure 49. Quiver made of painted pasteboard cylinder.]

![Figure 50. Wire stand or ground quiver.]

Armguards and finger tabs were made from leather scraps.
Armguards were found to be necessary to protect the wrist of
the bow hand from the string. A piece of leather was cut
about seven inches long and three and one-half inches in the
middle portion, shaped as the pattern in Figure 51. Three
holes were punched in each side with a leather punch or with
a knife. A shoe string was used to lace the two sides in the
same manner as a shoe is laced. The armguard with the narrow
end next to the hand was laced to the inside of the wrist of
the bow hand. Finger tabs, used to protect the three fingers
that pull the bow string, were cut from leather, shaped by the
pattern in Figure 52.
FIGURE 51. Arm guard.

FIGURE 52. Finger tabs.
This pattern of a finger tab was for a girl with medium sized hands. The tabs were made one-fourth of an inch longer for boys.

Targets were made from ten bales of straw. A rack was needed to support the bales of straw. The rack was made from two-by-fours and one-by-sixes. A of Figure 53 illustrates a front view of the rack, B a side view and C a back view. In order that the center of the target would be more solid and the ends of the bales on consecutive layers would not join at the same place, three of the bales were cut into smaller bales. One bale was cut into one-half and two bales were cut into one-
third and two-third portions. Burlap sacks were used to cover the straw. The seams of eight sacks were unraveled and binder twine used to sew the sacks together in the pattern shown in Figure 55. The burlap was stretched over the hay and tacked to the top, the bottom and the sides of the rack.

![Figure 54](image1.png)

**FIGURE 54.** Baled straw stacked on target rack.

![Figure 55](image2.png)

**FIGURE 55.** Eight burlap sacks sewed together for covering of target.
The height of archery targets on a shooting range was adjusted so that the center of the bullseye was four feet above the ground. Scoring faces four feet in diameter, which was regulation size, were painted on the burlap with enamel that had been thinned with turpentine. The bullseye was nine and six-tenths inches in diameter and each of the other rings were four and eight-tenths inches across. The colors, from the center out, were yellow, red, blue, black and white. A petticoat, a bordering circle one inch across, was painted green outside of the white circle. Nine, seven, five, three, and one were the scoring values of the target. An arrow that broke the line of two colors counted for the higher value. An arrow that passed through or bounced from the scoring face of the target counted five. A hit in the petticoat had no scoring value.
CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The results of this experiment having been compiled and recorded, the following conclusions have been reached:

1. Lemonwood was found to be most satisfactory for beginners to make their first bows.

2. The modified flat bow, with consistency and less tendency to break, had qualities of both the long bow and the flat bow.

3. The best arrows were made by using shafts of Port Orford Cedar, Douglas Fir and Spruce.

4. Each set of arrows should be matched in spine, weight and point of balance.

5. A two and one-half inch portion of #10 finishing nail, fitted into a hole drilled in the point or front end of the arrow shaft made the point of balance nearer that end and made the arrows shoot more accurately.

6. Parallel points, glued on with Iron Glue and pyroxlin nocks glued with quick-drying glue, were found to be more durable.

7. Turkey feathers from near the ends of the wings were stiffer, and thus more substantial.

8. One cock feather and two hen feathers, two and one-half inches long, from either the right or the left wing should be used on each arrow.

9. The cock feather must be placed on the correct side of the arrow so that the grain of the shaft would lift toward the point end of the arrow, on its top side to avoid sticking a lifted grain in the bow hand.

10. Arrows with its feathers trimmed as shown in B of Figure 44 were more even in flight than arrows with the feathers trimmed as illustrated in A of the same figure.

11. The base of the feathers next to the point end must
be smoothed with sandpaper or other material to protect the hand in shooting.

12. It requires at least three coats of thinned shellac to finish an arrow.

13. The arrows should be shot and checked to find how far and which way from the bullseye they hit.

14. Arrows that shot to the left or to the right of the bullseye crooked slightly sideways.

15. When the crooked arrows were heated and warped so that they bent up or down when released, they shot near a line through the bullseye perpendicular to the ground.

16. Arrows that shoot above the bullseye can be made to shoot lower by placing a heavier nail in the point end of the shaft.

17. Arrows that shoot below the bullseye can be made to shoot higher by placing a lighter nail in the front end.

18. The accessories necessary for effective arching are,

a. a quiver for carrying arrows,

b. a wire stand to hold arrows when target shooting,

c. an arm guard to protect the wrist of the bow hand from the bowstring,

d. a finger tab to protect the three fingers that pull the bow string,

e. a target to shoot arrows into.

19. Targets may be made with ten bales of hay supported by a rack. The hay may be covered with burlap and a regulation size target painted on the burlap with enamel that has been thinned with turpentine.
Recommendations

Since the interest in archery has increased so that it was necessary to add an additional class each of the last two semesters, and which classes were soon closed, there was no accurate estimate of how many students really desired to take archery courses. Since the main purpose of the physical education program is to interest the students in games and sports that have a carry-over value, and since archery seems to have some of the best of carry-over elements, the following recommendations are made:

1. That archery be recommended as one of the best exercises for teaching correct postures.

2. That the students be encouraged to take up archery as a hobby, since they can prepare the necessary equipment at very low cost.

3. That archery be retained on a co-educational basis since men and women can compete on more equal basis than most other sports.

4. That the size of the classes be limited to fifteen students because of the limited space and equipment in handicraft and since in making archery equipment students need much individual help.

5. That advanced classes be taught in which the students that have their own equipment may spend their entire time to learn and to practice the technique of shooting.

6. That extra periods be arranged so that the students that have learned to make their own equipment may have access to the archery shop in order that they may make other bows and arrows.

7. Since the interest in archery has increased to such an extent, a workshop for this activity alone should be made and properly equipped to handle the situation.

8. That instead of the individual targets on the shooting range, a solid rack, forty feet long, should be made
and bales of hay stacked on this rack to present a solid front; the hay then be covered with burlap and target faces painted on this.

9. Lights should be installed to make night shooting possible.

10. That a full time instructor should be employed to teach four beginning classes, two advanced classes and to supervise the archery activities on the campus.

11. That an indoor range should be constructed in order that archers could enjoy this sport the entire year.

12. It is further recommended that the students be furnished with a glossary such as is included in the Appendix in order that they will be prepared to discuss archery activities in archery language.
APPENDIX

Addressing the target—Standing in a position of readiness for shooting with the body turned at right angles to the target.

American round—Thirty arrows at each distance of 60, 50 and 40 yards.

Anchor point—A definite point on the face contacted by the index finger. In general, the point contacted by the drawing hand during the act of aiming.

Arbalist—A crossbow.

Archery golf—Adaptation of the use of the bow and arrow to the game of golf.

Arm guard—The bracer to protect the bow-arm from the blow of the bow string.

Arming—The material about the bow’s grip.

Arrow guide—A grooved contrivance attached to the bow or bow-hand to enable the archer to draw a short arrow past the bow.

Arrow-hand—The hand with which the bow is drawn.

Arrow-horn—A wedge of horn, hardwood, fiber or composition set into the arrow to receive the neck.

Arrow-hound—One who finds lost arrows quickly or the member of a target group whose job it is to recover arrows that miss the target.

Arrow-mark—The painted bands.

Arrow-plate—A thin form of horn, hardwood, pearl, or other material let into the bow where the arrow passes.

Arrow-rest—A little shelf attached to the bow at the handle top to provide support and uniform placement for the arrows.

Arrowsmith—One who fashions metal arrow-heads.
Arrowstand--A cylindrical or ring-like ground stand for holding arrows.

Arrow-Steave--A square (usually) of wood from which the round is formed.

Artillery--The Archery (or the bows and arrows used by them) classified as an artillery arm of the military in ancient and medieval times along with the arbalisters, slingers, and the missile-throwing engine corps.

Back--The surface of the bow held away from the archer in shooting. The flat surface of the long or flat-limbed bow.

Backed Bow--A bow which has a thin strip of wood, rawhide or other material glued on the back throughout its length designed to add strength.

Backing--Any material suitable for backing a bow.

Barbed Arrow--An arrow, for war or the hunt, the head of which has barbs.

Barbs--The two receding points of some kinds of arrow-heads. Of a feather, the thin bristle-like plates that comprise the vane.

Barreled Arrow--An arrow that is thicker in the middle than elsewhere.

Bearded Arrow--Same as barbed arrow.

Belly--The surface of a bow nearest the archer in shooting. In the traditional long or flat-limbed bow, it is rounded.

Bend--To brace or string a bow.

Billets--Short pieces of wood to be spliced together to make a bow.

Black--The target ring of that color, or a hit in it. Value 3.

Blue--The target ring of that color, or a hit in it. Value 5.

Bobtailed Arrow--One whose diameter decreases toward the nock. (Also called Taper-fashion or Tapered arrow.)

Bolt--The quarrel, the short arrow shot from the cross-bow.

Bone--The stiff cellulose layer of softwoods.
Boss—The straw back of a target or clout made by binding and
sewing the straw into a compact circular mat. Bales of
straw stacked together to make a boss.

Bow—The weapon itself, or its length used as a unit measure.

Bow-Arm—The arm in the hand of which the bow is grasped.

Bow-Hand—The hand in which the bow is grasped.

Bowman—An archer.

Bow-Ribbon—The string-keeper. The loop of ribbon, cord,
thong, etc., that keeps the bow string straight and trim
when the bow is unbraced.

Bowshot—The bow’s range with a given arrow. The distance as
a unit of measure.

Bow-Stave—The piece of wood from which the bow is made.

Bow-Tire—Diminution of cast in a bow that is punished by too
much use within a short period, that is affected by hot
weather, or that is held (just before loosing) overlong.

Bowyer—A bow-maker.

Bowyer’s Knot—Archer’s name for (see) Timber Hitch.

Brace—To string or bend a bow.

Bracer—See Armguard.

Brash—Brittle or frash (of an arrow or bow wood). Unresilient.

Breast—That part of the arrow (roughly) that rests against
the bow when it is nocked. (Also called Chest.)

Breasted Arrow—One form of barreled arrow; one whose great-
est diameter is at the breast.

Brilliant—Of a bow’s cast or action, quick, sharp, alive.

Broad-Arrow—The barbed arrow or its conventional representa-
tion in art or ornament.

Broadhead—A flat steel blade with sharpened edges, used for
hunting.

Bullet—Arrow—An arrow whose flight is limited by a string
tied to the bow; from the hollow end of which a loose
pellet or small stone is expelled when the arrow stops.

Butt—A mound upon which a shooting mark is pinned.

Butty—An archer's companion or opponent at the butts.

Carriage Bow—Any type of bow that can be dismounted or otherwise shortened for convenience of carriage.

Cast—The distance a bow can shoot. The speed at which the arrow travels as it is shot from the bow.

Check—A longitudinal crack in wood. Usually developed in drying.

Chest—Same as Breast.

Cheated Arrow—One that tapers from the feathers to the head.

Chrysal or Chrinal—A crush, pinch or fret on the belly of a bow frequently caused by stacking. Compression incident to the draw causes the wood to buckle or crack across.

Close-Backing—Backing with glue in order to unite bow and backing.

Close-On—Of an arrow-head, filled tightly all about by the shaft.

Cloth Yard—The statutory length of the English war arrow, 27½ or 28 inches.

Clout—A white object such as cloth, placed on a stake as a mark for long distance shooting.

Clout Shooting—Shooting at a clout target, thirty-six arrows are shot at a distance of 180 yards for men and 120 yards for women.

Clout Target—A target 46 feet in diameter, laid out on the ground, the center of which is marked with a clout.

Cock Feather—The feather at right angles to the nock, usually of a different color.

Columbia Round—For women, twenty-four arrows at each distance of 50, 40 and 30 yards.

Composite Bow—A bow made of layers of more than one kind of material. Usually has a sinew back, wood center and horn belly.
Creep--To relax the tension of the drawing-hand just before loosing, causing the arrow to move forward.

Crest--The archer's distinctive arrow decoration. The painted bands.

Crested Head--One with a ridge about it that can be felt in drawing.

Crib--A stand or quiver constructed to keep arrows separate.

Cross-bow--A bow so arranged that it is shot similarly to a gun with a groove or barrel which directs the arrows and a trigger which releases the string.

Crow-Bill--An arrow head of horn.

Cull--An inferior material or product that has been discarded.

Cut the Gold--Of an arrow, to seem to cross the gold as it falls. Also (in common usage, for the other colors as well) to cut the inner color and earn the higher value for the hit.

Double End--The end consisting of shots in opposite directions, as when the English shoot between Double Targets.

Double Round--Any round shot twice in succession and scores added.

Double Targets--Targets set at both ends of an archery range, for Double-End shooting.

Down Wind--A wind toward the target. (Opposite, Up Wind, toward the archer.)

Draw--The distance a given bow is properly pulled, or the effort (expressed in pounds) required to draw it. The bow's (see) Weight or Drawing weight.

Draw a Feather--To strip the feather's vane from the quill.

Drawing Fingers--When employing the Mediterranean Release, the three middle fingers of the drawing-hand.

Drawing-Hand--The hand with which the string is drawn.

Drawing-Point--The point (on face, neck, or breast) to which the arrow neck is drawn.

Drift--The windage, and its effect on the arrow's flight.
Elbow—Of a reflexed bow, the part of the limb that bends sharply away from the string.

Elevation—The height of the arrow's head above its nock in aiming.

End—In formal shooting, the number of arrows shot consecutively or otherwise by each archer before the score is taken. Six arrows in the United States and three in England.

Eye—The spliced loop of the bowstring that runs free on the bow's upper limb, also called Noose.

Face—Of a bow, the belly (Also called Front.) Of a target, the painted scoring surface.

Feather—A whole feather or one of the sections on an arrow.

Feather in—To shoot the arrow up to its feathers in something.

Field Captain—The officer in charge of a tournament or formal shoot.

Finger Stalls—A form of protection for the drawing fingers that encloses them like thimbles. Also called Finger Tips.

Fish, Fish Joint, or Fish-Tail Joint—A V-shaped joint the length of a bow's handle for grafting billets or staves, as in the making of a yew bow. Hence, Double Fish, Double Fish Joint, etc.—A W-shaped joint made in the same way and for the same purpose.

Fistmele—The correct distance of the string from the grip of a braced bow. Place the bottom of the fist against the handle of the bow and extend the thumb as far as it will go (about six inches).

Five Points—The five essential considerations of good shooting form—standing, nocking, drawing, holding, and looking (Roger Ascham).

Flat-Limbed Bow—One with high-stacked, narrow grip and wide, shallow, spatulate, tapering limbs.

Flemish Release—A traction release accomplished with the index and second fingers. Employed generally by French and Belgian archers.

Fletch—To prepare and apply the three feathers to an arrow.
Fletcher—One who makes arrows or feathers them.

Flick—Of an arrow, flight marked by a sudden deviation from the true trajectory.

Flight—How far an arrow flies. Many arrows flying together.

Flight Arrow—A short arrow (used with an arrow guide) or a long, light arrow designed, in either case, to fly far.

Flight-Bow—A strong or brilliant casting bow capable of great distance.

Flight Shooting—Shooting for distance.

Follow The String—An expression used to describe the curve taken on by a bow if it does not return to a straight line when unstrung.

Footed Arrow—An arrow which has a piece of hard wood spliced on the point end, designed to give it additional weight and strength.

Free Backing—One that is not glued to the bow. The process of so backing a bow.

Front—Belly or Face of a bow.

Gadding—Of an arrow, preforming in an erratic or inconsistent way.

Gall—A growth in wood resulting from nature's effort to repair an injury.

Gold—The center of our regulation archery target, or a hit in it. The value of such a hit, 9.

Gone—Of an arrow, having missed the mark.

Grafted Bow—A bow made by splicing the two limbs together in the handle.

Grease-Box—A little box formerly carried by archers. The grease was for the finger protection, to make loosing smooth and easy.

Green—The archery range. The petticoat of a target, or a hit in it. facetiously, a miss (when the arrow lands on the ground or green).

Grip—The handle of a bow, or the way it is held.
He! He!—(pronounced Hey! Hey!). Supposedly an old call employed by archers to hail each other; also to give warning when about to shoot (as "fore" is used in golf).

Head—Point of the arrow.

Heart-Wood—The relatively dry, old inner part of a tree as distinguished from the sap-wood or recent growth.

Hen Feathers—As distinguished from cock feather, the two feathers that sit near the extremities of the neck and, with the cock feather, form three equal angles about the shaft.

Hip—The thickest third of a bow’s limb, starting at the grip.

Hit—To strike the target for a score.

Hold or Holding—The act of pausing for aim with the bow fully drawn, just before loosing.

Horn—A bow tip of that material.

Horn Spoon—The petticoat of a target, or a hit in it. A booby prize in that form.

Kick—A bow’s shock or jar in the hand, due to improper balance, bending handle, etc.

Knee—The middle third of a bow’s limb.

Lady Paramount—Female assistant to or equivalent of Field Captain.

Laminated Bow—A bow built up of strips of wood glued together.

Let Fly, to—To release an arrow.

Limb—The upper or lower half of a bow.

Longbow—Generally any bow, not a cross bow, five feet or greater in length. Since the advent of the flat-limbed bow—a bow over five feet in length whose mid-limb depth from back to belly is almost as great as its width at the same point, and whose width is nowhere greater than at the grip.

Long-Out—A distant rovers mark.

Loose, Loosing—Of shooting, the act of releasing string and arrow simultaneously.
Master-Of-The-Green—The person responsible for the range and its appointments (for a formal bow meeting) as distinguished from the Field Captain who conducts the shoot.

Metropolitan Round—For men: thirty arrows at each of the following distances: 100 yds., 80 yds., 60 yds., 50 yds., 40 yds. For women: thirty arrows at each of the following distances: 60 yds., 50 yds., 40 yds., 30 yds.

Mid-Rib—The quill of a feather.

National Round—For women: 48 arrows at 60 yds., and 24 arrows at 50 yards.

Nock—A groove in the end of the arrow for the bowstring.

Nocking-Point—The place at which the arrow nock engages the string.

Noose—The loop in the end of a bowstring.

Overbowed—Using too strong a bow.

Overdrawn—Of a bow or arrow, drawn too far.

Parabolic Feather—One whose shape is a smooth parabolic curve, suggesting a balloon. (Also called balloon-feather.)

Peep-Sight—A device, usually on the bow, by the setting of which the gold is sighted directly, eliminating point of aim.

Petticoat—The narrow painted circle that bounds the white of the regulation target, marking the limit of the scoring area (it has no value).

Pile—The narrow tip or point of an arrow.

Pinhole—The very middle of a target face.

Point-Blank Shooting—Shooting at the distance (or less) at which no allowance has to be made for the effect of gravity on the arrow—at which the arrow flies straight to the mark.

Quarrel—The short arrow shot by a cross-bow.

Quiver—A bag, case or tube for carrying arrows.

Raise a Pin—To leave a little swelling about a pin or fault in the making of a yew or Goose-Grange bow, to compensate the weakness at that point.
Range--The shooting field. One of the distances of a round.
   The greatest distance of which a given bow is capable.

Range-Finder--A stick or card used as an aid in locating the point of aim. It is marked for various distances, and the approximate position of the point with reference to the gold is sighted by holding at arm's length, as the bow is in shooting.

Red--The target ring of that color, or a hit in it. Value 7.

Reflexed Bow--A bow so constructed that the limbs assume a concave or angular relation when it is unstrung.

Release--The manner or method in which the shaft hand releases the arrow in flight.

Return--A factor of spine--The arrow's ability to straighten quickly after the release.

Round--A definite number of shots at definite distances constituting a form of game.

Rovers or Roving--A form of archery game in which the archer or archers progress from mark to mark; or the mark shot at in this fashion.

Sap-Wood--The light-colored wood next to the bark, as contrasted with heartwood.

Self Arrow--An arrow made from a single piece of wood.

Self Bow--A bow made of one kind of wood.

Serving (of string)--A wrapping of thread around the bowstring where the arrow nock and drawing fingers come in contact with it.

Set An Arrow--To straighten it by heat and pressure.

Shaft--Of an arrow, the wood part. Of a feather, the quill.

Shaft-Arm--The arm with which the bow is drawn (the one that pulls the string).

Shooting Line--The line astride which the archer stands, and which marks a specific distance.

Sight--A device on the string or bow enabling the archer to aim directly at the gold.

Slash--Of the draw or loose, to perform it in a sudden manner.
Snake—Of an arrow, to bury itself in grass.

Spine—Of an arrow or arrow shaft (with reference to its diameter, length, and weight), rigidity, resilience, and return in desirable combination.

Stagger—Of an arrow, to be unsteady and erratic in flight.

Stance—See Standing.

Stand—The tripod on which the target hangs.

Standing—The correct footing and attitude assumed by the archer before beginning to shoot.

Standing Bow—One that does not weight or cast with ease.

Stele—The wooden part of shaft of an arrow.

Stopping—The solid bottom inside a pile or head.

Striking Side—The side of an arrow that runs on the bow.

String—The bowstring. To String, to brace the bow.

Stringer—Bowstring maker.

Swell—Bow—To leave it thicker to compensate weakness due to a fault, as in raising a pin.

Tab—A flat piece of leather worn on the right hand to protect the fingers from the string.

Tackle—Archery equipment, in the same sense as fishing tackle.

Taper—Fashion (Tapered) Arrow—One that decreases in size toward the nock.

Tassel—Companion piece to the grease-box. A tassel of colored yarn worn at the archer's belt for cleaning his arrows.

Target Face—The painted front of a target.

Tiller—Essentially a stick with a rest at one end for the handle of a bow and series of notches for the string along its side, for holding the bow bent while its shape is studied.

Timber Hitch—The correct knot for securing the string at the lower nock of a bow.
Toxophilite—One who studies the backgrounds of archery.

Trajectory—The path of an arrow in flight.

Turtle-Neck Shooting—Shooting high so that the arrow falls upon its mark. A trick at which some savages are highly adept.

Two-Piece Bow—A backed or grafted bow or one of the carriage genus.

Underbowed—Using too light a bow for one's strength.

Understrung—Of a bow, with a bend less than fistmele or too low.

Up Wing—A wind toward the archer.

Vane—The section of feather ready to affix or already affixed to the arrow. The soft, blade-like part of the feather to either side of quill.

Wand—A stick thrust into the ground for a mark. In the wand shoots of the N.A.A. it is 2 inches wide and 6 feet above ground.

Weight—(of Bow)—The number of pounds required to draw the bowstring the length of its arrow.

White—The outermost scoring circle of the target, or a hit in it. Value, 1.

Yard Round—Twenty-seven arrows at 100 yds; Forty-eight arrows at 80 yds; Twenty-four arrows at 60 yds.
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