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Scope of Study: This study presents a brief history of the lumbering industry in Europe and shows the influence that it had on the development of this industry in the United States. This study also includes history of lumbering associations and their importance in the development of the industry. A survey was made to determine the kinds of lumber that are used in the industrial arts shop and what educational benefits the students receive from working with this material.

The material for this study was obtained from books and from brochures published by lumber companies and lumbering associations. The information pertaining to the uses of lumber in the industrial arts shops was procured by the use of questionnaires sent to industrial arts teachers in Oklahoma.

Summary: The lumbering industry is one of the oldest and is the second largest industry in the nation. There are sixty thousand sawmills and fourteen hundred plywood, shingle, and wood pulp producing plants in the United States. There are eighteen hundred wholesale and twenty-five thousand retail lumber establishments in this country. Six per cent of the nation's wealth is derived from timber. The lumbering industry pays seven billion dollars per year for salaries.

Conclusion: Often the industrial arts teacher fails to include the lumbering industry in the course of instruction. Very few students recognize the importance of this industry and the effect it has on the progress of the nation. Lumber has been one of the basic materials used in the industrial arts shops. It is doubtful if any other material can be used to afford the student more experiences. The industrial arts teachers should acquaint the students with the lumbering industry and the many occupations within the industry.

ADVISOR'S APPROVAL: L. H. Bengtson

THE HISTORY OF LUMBERING AND THE USES OF LUMBER IN INDUSTRIAL ARTS SHOPS

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By

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CHAPTER I

INTRODUCTION

An industrial arts teacher should have a knowledge of the materials used in the shop and should know something about the production of such materials. The teacher should acquaint the student with the opportunities of various occupations as a guidance service.

There are many operations and enterprises in the lumbering industry. Logs may be made into lumber, wood pulp, or plywood. Some grades of lumber may be processed into flooring; other grades may be made into boxes, crates, or other small projects. There is no method of measuring the effect that lumbering has had on the progress of our nation. The writer believes that knowledge of the development of such a large industry should not be omitted.

Purpose of the Study. The purposes of this report are: (1) to present a brief account of ancient history of lumbering leading up to the development of the lumbering industry in the United States; (2) to present a brief history of the development of machines used in the processing of lumber; (3) to present a brief history of the growth and development of the lumbering industry in the United States; (4) to emphasize the importance of such industry to the progress of a nation; and (5) to study the types of lumber most used and the activities conducted in the industrial arts woodworking shops.

Delimitations. This report is limited to the history of lumbering in Europe and the United States. Because of the tremendous scope, this study is general in content and does not reveal the details such as histories of companies and important men of the industry. The writer attempts to present the historical development from information obtained from books and from brochures from forty-two lumber companies and associations. A survey was made of industrial arts instructors to determine what types of lumber are used in the school shops.

Definitions. The following definitions are of terms used in this study and in the lumber industry. The writer believes such terms should be defined to clarify their use in this report.

1. Industrial Arts. The term industrial arts refers to all classes and courses of shopwork and industrial drawing taught in junior or senior high schools for general education and guidance purposes. Its purposes are primarily to orient the student in our current industrial civilization by means of experiences in working with as many of the materials common to everyday life as possible. -- Oklahoma Advisory Committee (24, page 1)

2. Lumber. Lumber is ordinarily thought of by the lumberman as all products of the sawmill. It includes boards, planks, sawed tier, scantlegs, framing material, sawed timbers, dimension stock, flooring, pattern stock -- all of which are measured on a board foot basis. (25, page 2)

3. Drain. In this study drain means destruction or removal of timber by insects, diseases, fire, and natural causes.

4. Check. Check is a lengthwise separation of the wood, most of which occurs across the rings of annual growth. (26, page 2)

5. Heart Check. This starts at the pith and extends toward, but not to the surface. (22, page 2)

6. Knot. A knot is a segment of a branch or limb embedded in the tree which has been cut through in the process of lumber manufacture. (26, page 3)

7. Pitch Streak. A pitch streak is a well defined accumulation of pitch in a more or less regular streak. (26, page 6)

8. Shake. A lengthwise separation along the grain, most of which occurs between the annual growth, is known as a shake. (26, page 7)

9. Warp. Warp is a variation from a true or plane surface. (26, page 8)

10. Cup. Cup is a curve across the grain or width of a piece. (26, page 8)

In Chapter II the writer presents the history and development of logging, sawmills, and the lumbering industry of the United States. Chapter III includes the history of lumber associations and the contributions these associations have made to the lumbering industry. In Chapter IV, the kinds of lumber used in industrial arts shops are discussed and the importance of the uses of these lumbers are emphasized. A philosophy of industrial arts and a list of objectives are presented in Chapter V. In the summary and conclusion, Chapter VI, the writer recommends a list of suggestions for additional study in the field of industrial arts woodworking.

CHAPTER II

HISTORY AND EVOLUTION OF LUMBERING

In the beginning the tree was the symbol of life. The Garden of Eden reminds us of trees. Prehistoric man found refuge in the forest and used trees for shelter and protection. With the passing of time the structure of the towering trees exerted so great an influence upon the human race that there came into being a crude but genuine architecture. The first columns and pillars were made of the trunks of trees, and various types of shelter were made from logs, timbers, and branches. "Hence, in the early days of the kings of Israel when King Solomon built the great temple, he sent 80,000 men into the woods to cut and hew fir." (2, page 168) Though the tools were crude, this was lumbering on a production basis.

Part A

The Forest

Forests are a friend of man. They have played an important part in the march of civilization. The progress of nations began with the clearing of timberlands. Virgin forests were cut to make room for homes and villages, and for farms and pasture lands, as the best farm land appeared to be in the dense forest. Colonial men thought there was no limit to the forests. They cut down trees, burned over the lands, and rooted out young seedlings while preparing for the age of agriculture which was to bring man higher standards of living.

Forests of Europe. The original forests of Europe were composed of hardwoods such as oak and birch, and conifer trees such as pine, fir, and spruce. The large forests were used excessively, and the shortage of forest products forced the people to try to cooperate with nature to insure the growing of more trees, thus creating forest management.

"Forest management has been practiced in Europe for more than a thousand years." (17, page 12) Zurich, Switzerland, has owned a tract of timberland since 853. It now ranks as one of the best-managed forests in Europe.

Wood Supplies in Germany. From as early as the Twelfth Century, Germany has been running short of wood supplies. Since 1820, there have been no real sales of state forests in Germany, although the state forests have been reduced by extinguishing the servitudes. When the systematic forest management based on working plans was started, German forests were in the worst of conditions. By World War II, the country maintained 800 forest enterprises.

Forests of France. France, like other European countries, used up her virgin forest supply, but later began artificial forestry. "The first forest school was started in Nancy, France, in 1824." (17, page 16) Teachers were brought from Germany, and in 1864 laws were passed to restore the timber land; thus, the famous pine forests of France were developed.

Forests in America. The early settlers who came to America marveled at the vastness of the forests. The United States has eight hundred and ten native species of trees which have high commercial value, while

Europe has only forty species. The settlers gloried in the strength and courage it took to clear away the forests. Gradually the timber began to be used excessively as the European forest had been. Great areas of land were cleared to make room for man, and the forests were replaced by agricultural crops, homes, and towns. Generally, the timber was cut from the forest and used as construction materials during the pioneer days in America. It was used for the building of homes, schools, and churches. The cities of the east were largely built of wood. Time has brought many changes, but American people still have their love for homes made of wood.

In three hundred years the United States has grown into a powerful nation with the highest standard of living of any nation in the world, and lumbering has played a vital part in every step of progress made in this country. Reforestration must be practiced if lumbering is to continue to add to the progress of the United States.

The United States forest is divided into two divisions: the Eastern legend and the Western legend. "The two forests contain 180 species of trees" which are very important commercially, and play an important part in the progress of the nation. (10, page 7)

What Happened to America's Lumber Supply? The first settlers of Jamestown and Plymouth found a continent that seemed to be completely covered with timber. The timber probably totaled eight trillion board feet. In three hundred and fifty years, twice as much wood has been cut as was standing when the English colonists landed at Jamestown, yet forests cover more than one-third of the land of the nation. There is enough timber for many years of future supply, because as man harvests

the trees, nature replaces them; and often, when nature fails to replace the trees, man does the replacing.

This is an estimate of what happened to America's forests in three hundred and fifty years, as shown in a bulletin published by the American Forest Products Industries, Inc. (20, page 5)

TABLE I

ESTIMATE OF AMERICA'S FOREST SUPPLY
OVER A PERIOD OF THREE HUNDRED AND FIFTY YEARS

Item	Board Feet
Original forest	8,125,000,000,000
Total growth	9,500,000,000,000
Total stock	17,625,000,000,000
Fire, insects, disease	7,150,000,000,000
Land clearing	2,449,000,000,000
Used for fuel	2,710,000,000,000
Cut for wood products	3,715,000,000,000
Total removal	16,024,000,000,000
Balance	1,601,000,000,000

Removal of the Forest. In 1918 the removal of sawtimber was 5.8 times that of the new growth. By 1944 the growth was catching up. The removal of sawtimber was only 1.02 times that of the growth, which is a safe ratio.

Wood is removed from the forest in two ways. The harvesting of timber by man is called withdrawal, and the loss of trees to fire, insects, disease, and age is called drain. Timber drain is a complete

loss, largely avoidable under the tree farm management practiced and advocated by wood-using industries of the present. The last government report showed 10.9 per cent of last year's removal was caused by drain; 3.4 per cent by fire, and 7.5 per cent by insects and diseases. (20, page 11)

According to American Forest Products Industries, Inc.:

> Tree-killing fires, insects and diseases are becoming more effective each year. Current trends in forest management assure increasing wood supply for the future.
>
> America has entered a forest economy based on growing and harvesting of . . . crops of trees according to plan.
>
> Scientists continue to develop new uses for tree species and wood leftovers previously not utilized.
>
> New manufacturing techniques make it possible to get larger volume of useful material from each tree harvested. Educational programs are improving the forest practices of woodland owners everywhere. The cooperation of public and private agencies concerned with tree growing and forest protection is closing the gap between wood removal and wood growth.
>
> Tree farming, as established and advocated by the forest industries of the United States, is providing the wood this country needs today. At the same time tree farmers are growing wood for tomorrow. (20, page 31)

With tree farming and conservation programs, the nation can maintain its lumber supply. Our laboratories and workshops are divising many new products from wood according to a bulletin, Trees Tomorrow, "because nature, with man's help, can provide plenty of trees through the years to make things all of us want to use and wear". (21, page 44)

Other Forests. Forests of other countries are important to the progress of our nation. Some of the best furniture and cabinet lumbers grow in the distant forests. These forests are in the West Indies, South America, British Honduras, and other Central American countries,

Philippine Islands, Belgian Congo, and other African countries. These great forests add to the abundance and beauty of our nation's lumber supply.

Part B

History of Logging

The history of the lumbering and logging industry is a great drama in the development of a country and its culture. Logging has had a decisive part in the development of the United States and Canada. Many stories of courage and hazards have been told by the logger. The great prairies could scarcely have been settled and developed without the white pine of the lake states and the southern pine from the south. The last frontier of virgin timber is being removed on the west coast. Courage and expense are required to rebuild the forest where nature had provided it in abundance and at low cost. The North American lumberman is meeting the challenge of this new problem with the same pioneer spirit of the early days.

The importance of logging is apparent when one considers the large annual log output from sixty thousand logging operators throughout the United States and Canada. The stability of employment and the permanence of woods operations are of vital importance to the social and economic welfare of the country. Logging constitutes a very large part of the practice of forestry. Correct logging procedures have a beneficial effect on our future lumber supply.

Historical Periods of Logging. Logging may be divided into five historical periods.

1. The ancient or early stone age
2. The early iron age
3. The colonial period
4. Power skidding and railroad era
5. The present era

The Ancient or Early Stone Age. In the early Stone Age of the Palaeolithic men, tools made of stone were used. The ax was made by chipping flint stone and binding a wooden handle to the stone, "250,000 B.C." (2, page 13) The logs were cut with the stone ax and carried or sometimes floated to their destination, and at a later date, the Swiss lake dwellers felled trees with their stone axes and cut them into pilings some twenty feet long. With these, they built their houses, bridges, and home furnishings.

The Early Iron Age. As man learned to use iron tools, he became more efficient. As the woodsmen could fell more timber, there was a need for more and better transportation, making use of the ox and the raft. During the Iron Age, a period of more than one thousand years, man made many changes in the culture as logging and lumbering became more industrialized.

The Colonial Period. The colonial period was characterized by the stream driving and floating. Primitive and inexpensive methods were used. Accessible streams were used for log transportation. The winter sled haul in the north and the frequent use of oxen were peculiar to the earlier stages of development.

> The winter sled hauling and stream driving, the prevailing log transportation in Canada, Maine, and New York, are as they were one hundred to two hundred years ago. (5, page 134)

In the south, skidding by oxen and mules, wagons drawn by horses, and floating on rafts continued for many years. The latter part of this period was marked by the coming of the railroads, which eliminated the use of oxen for long distance hauling.

Power Skidding and Railroad Era. The power skidding and railroad era developed between 1890 and 1930 (5, page 135). With the diminishing of white pine forests of the lake states, logging was increased to a vast scale in the south, north, and west. The logging transportation became dominated by the railroad, particularly in the remote west which had been inaccessible. Timber adjacent to driving and floating facilities became exhausted except in the northwest. Power skidding, which was first developed on an experimental basis in the lake states in the latter part of the Nineteenth Century, was further improved, both in ground and overhead skidding methods. Animals were gradually replaced, and "lumber reached its peak production in 1909", according to Brown. (5, page 135) The motor truck came into use on an experimental basis in 1913, and gradually became a recognized transportation method. The tractor had been limited in its use until World War I caused it to become an efficient and reliable operating machine. During this period, practically all the large logging jobs were done by the railroads. The year-around mills replaced the spring season mills which were dependent on floated or rafted logs for their supply.

The Present Era. During the present era the development of the tractor and motor truck for logging purposes, improvements in felling, bucking, and loading devices, and the disappearance of animals, except for horses used in short distance skidding, are noticeable. Small and portable sawmills of the south, north, and east have caused a change in logging methods. In the west, south, and northeastern regions of Canada, railroads and streams are still utilized for long hauls. Power skidding still held its place in the regions of douglas fir, hemlock, stika spruce, and the red cedar of the west. As the highways and roads have been improved, the trucks and tractors have become more numerous in the logging areas. The railroad is a means of transportation, but its use is limited to large and long operations. Both the truck and tractor have been widely used, and have gradually replaced power skidding and the logging railroad.

Ax Felling. The ancient man with a stone ax felled only two or three large trees per day, or ten to twenty small trees of a "diameter ranging from six to ten inches". (2, page 14) "The metal ax was used almost exclusively as a felling tool during the later Iron Age and early Colonial period." (8, page 106) It is still used to fell small trees. In felling with the ax, the operation begins by undercutting a large notch on the side of the tree in the direction the tree is to fall. The upper cut is made on the opposite side of the tree until the tree falls. Wedges cannot be used when using the ax as a felling tool. This makes it difficult to direct the fall of the tree. Ten to twenty board feet of lumber are wasted in ax felling.

Ax and Saw Felling. According to Bryant, the ax and saw felling method is almost universally used for medium and large trees. (8, page 13) The use of the crosscut saw increases the number of trees a crew can cut per day by about ten per cent. Usually the ax is used to cut a guide notch in the tree, and then the tree is sawed on the opposite side until it falls. Wedges are used in the saw kerf to prevent the saw from pinching and to guide the fall of the tree.

Average Day's Work for Two Men Felling and Bucking. In the following quotation, Bryant writes a description of the average logging day.

> The average day's work for two men felling, bucking and swamping lodgepole, and other small timber running from fifteen to sixteen tons per thousand board feet is from 4000 to 5000 board feet; in small yellow pine timber, running from twelve to fifteen logs per thousand, from 7000 to 7500 feet, and where the logs run from six to ten per thousand, from 10,000 to 15,000 feet. Two fellers will average about 5,000 feet, log scale, daily, in eastern spruce, about 10,000 feet in southern hardwoods, and from 25,000 to 30,000 feet in douglas fir. Buckers on the Pacific Coast average from 12,000 to 15,000 feet per day. The amount of felling per day may be increased by the use of power saws. (8, page 103)

Power saws are used for many purposes such as stump sawing, timber cutting, removing underbrush, and bucking. Many farmers use the power saws as standard machines to do enormous jobs.

Felling with Power Saws. With the increase of wages and deficiency of labor, there have been more than thirty kinds of power saws developed. These include the chain saw, circle saw, and drag saw. One of the first large companies to make use of the power crosscut saw, which was a chain saw, was the Castman Gardiner Company, Laurel, Mississippi, in 1930. Pneumatic-power saws have been used experimentally for years. During World War II, the chain saws were developed and were used to clear large

areas for landing fields. Increasing mechanization has reduced the man-power hours per thousand board feet of logs from fifteen to twenty-two man hours in 1922, down to five to seven man hours per thousand board feet at the present time.

There are thirteen different types of circular saws, eight types of drag saws, and eleven types of chain saws. Most of them are gasoline driven. Some are powered by electricity, and some saws are pneumatic powered. In most sections of the country, few mechanical felling saws were used before World War II; whereas, there are thousands being used at the present time in all of the heavy timber sections. In bushy and swampy locations, the manual methods are still being used. Brown wrote that the lower cost and advantages of these various power saws are due to the following:

1. Greater productions of board feet per unit of time, than with manual labor.
2. Light weight for easy portability.
3. Durable machinery that stands up under vigorous and strenuous operation.
4. Low stumps, which increase the volume of trees felled, especially in the butt logs where the best lumber grades occur.
5. Less breakage and shattering of poles in felling.
6. Greater precision and therefore less loss of wood in log lengths.
7. All wearing parts of saws quickly and easily replaceable.
8. Saws readily replaced, repaired, or sharpened.
9. Relatively low initial cost which means low overhead and maintenance costs.

10. Nearly all types may be used to saw both horizontally and vertically with minor and quick adjustments. (5, page 103)

Considerable mechanical difficulties were encountered in the initial operation of some of these types of saws, and the services of expert mechanics were required. These difficulties have been largely overcome. The circle saws on wheels are used extensively in open timber where there is little underbrush and the timber is not too large. They can be operated by one man; whereas, the chain type must be operated by two or three men. There are many reasons why these types of saws are not more widely used. Some of the reasons listed by Brown are as follows:

1. Rugged and precipitous terrain, dense underbrush, and difficult ground cover, including windfalls, sometimes make it exceedingly slow and expensive to move power saws from tree to tree, and even to and from felling areas.

2. Cutters are not generally adapted to the use and repair of these machines. Some models require constant attention, replacement of parts, sharpening, and adjustments. In remote locations, repairs and parts cannot be readily secured. Woodsmen are generally not good mechanics.

3. Owing to delays and lost time incident to setting up and operating the machines, together with the unwillingness of the cutters to change deep rooted customs, cutting in small timber, as in eastern Canada and other sections, is still done largely by manual labor with axes and saws. (5, page 109)

Table II, page 16, is an analysis of productive and non-productive time in northern hardwoods in New Hampshire. Some of the difficulties can be corrected, and it is likely that the use of power saws will increase as their mechanical efficiency is improved. Improvements of such machines are generally made as their use is increased.

Early Felling Methods. "The ax was the only instrument used until the end of the eighteenth century." (12, page 77) The saw was introduced

as a felling tool about 1775. The value of the low stump saw was recognized as a felling tool in Austria in 1776. (12, page 78) Earlier in 1750, the Hartz trees were dug, roots and all. Stump pulling machines were also introduced about the same time in Austria. Wood consumers

TABLE II

HOW TIME IS USED

Operation	Time Percentage
Felling	17.98
Butt off cut	2.04
Bucking into logs	9.98
Limbing with saw	.56
Total productive time	30.56
Intermediate movements	17.04
Moving generator	10.65
Equipment maintenance	3.18
Total semi-productive time	30.87
Saw pinch	1.19
Delays, mechanical	16.26
Travel	11.62
Eat and drink	9.50
Total non-productive time	38.57
Total of productive, semi-productive and non-productive time	100.00

chopped their own timber until the middle of the Seventeenth Century. Special wood choppers appeared to have been employed, "for in 1650, mention was made of the Saxaney men," who under oath were organized for the cutting of different kinds of wood. (12, page 79) Organization of the wood choppers took place in the Hartz Mountains in 1718. There is evidence that such an organization may have existed among the 80,000 men

King Solomon sent into the forest to gather logs approximately five thousand years ago.

Felling and Bucking Tools. Timber tools are characterized by the strength and durability of the work to be done. To understand the evaluation of logging, it is necessary to become acquainted with the tools used. The following descriptions of logging tools should be helpful.

1. Axes are used for chopping underbrush, notching trees, and removing limbs. There are two types of axes: the single bit, and the double bit. The single-bit ax has one cutting edge and a head which is used to drive spikes or wedges. It is used in small operations in the northeast and central states.

The double-bitted ax has a cutting blade and a splitting blade. Handles may range from a standard length of thirty-six inches to forty-eight inches. The longer handles are used in the western forests of larger trees. Broad axes are used by tie makers. They are used for hewing. The bits of a broad ax are from ten to twelve inches wide, and the handles vary in length.

2. Peavies and Canthooks are stout levers having large hooks approximately fourteen inches from the lower end of the levers. The peavy also has a sharp spike on the lower end of the handle, but the canthook has a flat end cuff with a duck bill pointing toward the hook. These tools are used for rolling logs, loading, unloading, and stream driving. The handles range from two to six feet in length.

3. Crosscut Saws have a length of four to nine feet. They may be one-man saws. The crosscut saw has four cutting teeth to one rake tooth. The rake tooth keeps the saw kerf clean and this saw is used extensively

in log felling.

4. Wedges are of three types: the felling wedge, middle wedge, and bucking wedge. The range in length is from three to twelve inches. The felling wedge is smaller, thinner, and sharper than other types. They are made of strong, hard metal. Often the woodsman will make wedges from hardwood.

5. Tongs are large pairs of hooks used in skidding and loading logs. They vary in size and weight with the logs to be handled. Tongs weigh up to 160 pounds, and are used in loading logs of lengths up to sixty-four feet or more.

6. Chains are a series of links or rings of metal connected with one another, which can be used to tie or support logs when being transported.

7. Dogs or Grabs are short heavy pieces of steel used in connection with chains or cables for such operations as skidding, rafting, and booming. They may be straight or curved with holes or dog rings attached to the top. Dogs are often coupled together for training logs one behind the other, and in skidding one or more logs.

8. Chokers are nooses or wire cables placed around the end of one or more logs and are widely used in power skidding. They are often used with dogs or grabs.

9. Pikaroons are short poles with a curved hook or spike on one end which are used in hand logging to pull or drag small logs or crossties.

10. Springboards are generally two by six or three by eight inch timbers. The springboard is inserted in notches of a tree and fastened

with a spur. The feller stands on the springboard while chopping or sawing large trees.

Part C

The Sawmills and the Saws

It may be thought that the sawmill has brought the destruction of timber, but many countries were almost without timber in the Middle Ages, hundreds of years before the invention of the saw. According to Thompson, "Italy was importing timber from Africa as early as the Fifth Century for the purpose of ship building, because their timber supply had been exhausted". (19, page 10) Also in the Fifth Century, "Charlemagne placed restraints on the clearing of land", and the restriction was in effect until the Ninth Century. (19, page 757) Many European countries had exhausted their timber supply before the invention of the sawmill.

Invention of the Sawmill. The geneology of the sawmill goes back to the Fourteenth Century. The inventor of the first sawmill of the ancient Greeks is not known, according to Horn. (13, page 135) There were sawmills driven by water power in Augsburg, Germany, in 1322, but it is doubtful whether or not these mills were efficient. Records show that from time to time during the Fifteenth and Sixteenth Centuries sawmills were built in Germany, Greece, Norway, and the Netherlands.

An unnamed Dutchman, in 1660, built a sawmill in London, England, but England was not ready for the machine age. The outraged pit sawyers destroyed the mill and sent the Dutchman on his way to Holland. In 1700 a Briton named Houghton attempted to build a power-driven mill, and again the pit sawyers took violent action. By the end of the century, a sawmill was built in England with Dutch machinery. The Dutch seemed to

have a monopoly on the sawmill machinery. The first sawmills brought to America were imported from Holland, with erectors and operators, about 1600. In 1633 the Dutch West Indies Company built three mills in New Amsterdam; two operated by water power and one by windmill. (17, page 136) It was stated by Brown that in 1625 a mill was built at Jamestown, Virginia, and one at Burnswick, Maine, in 1631. (14, page 1) This remained as the center of the lumber industry for more than two hundred years. By 1850 the lumber industry shifted to New York, and the American lumber industry built twenty sawmills along the Penobscat River and shipped their lumber all over the world.

The sawmill uses two types of saws: the circle saw and the band saw. The circle saw, which is older, may have removable teeth or solid saw teeth. The invention of the circle saw was the first real improvement over the mill saw. The sash saw and muley saw were mechanized applications of the pit saw. The circle saw brought a complete change in sawing; it was smoother cutting, faster, and more economical. "Credit for inventing the circle saw is generally given to Benjamin Cummins of Burtonville, New York," as written by Horn, "who in 1820 hammered out the first circle saw on his blacksmith anvil." (13, page 136) Besides being a well-qualified blacksmith, Cummins seems to have been a person of other interests and qualifications according to a newspaper sketch found soon after his death, as quoted by Horn.

> He was a first cousin to one of the presidents of the United States; a slave owner in New York State; a leading Mason, at whose table the very elect of the great state of New York feasted and drank freely of his choice liquors and wines; a vessel owner on the North River before the days of steamboats; a Captain in the War of 1812, where, after having horses shot from under him, with one stroke of his sword he brought his superior officer to the ground for insult and because he was a traitor and coward, and after having

> been court martialed, instead of having been shot, he was appointed colonel in his place. He constructed a mile and a half of the Erie Canal through a bed of rocks, and aided in the construction of the first ten miles of railroad built in the United States. (13, page 137)

Cummins died in 1843 and was buried in a cemetery near Richmond, Michigan, where he rests without benefit of a monument which it seems such a career deserves.

The band saw may have been invented by J. R. Hoffman, a lumber manufacturer of Fort Wayne, Indiana. Hoffman began experimenting with the band saw for log cutting in 1860, but he had trouble getting the correct metal in the United States. (6, page 68) After ten years of effort, he obtained a suitable band saw six inches wide and fifty feet long from France. He soon had the first band sawmill ever to cut logs into lumber in operation at Fort Wayne. The saw worked around wooden wheels mounted on a wrought iron column. Although crude, it was workable and demonstrated the practicability of log band sawing. The mill burned and was replaced by a similar mill which operated until recent years.

The number of sawmills in the United States is not known. According to the 1947 census in This Fascinating Lumber Business, there were 53,108 active mills and 8,442 idle mills in the United States. This does not include portable mills which produce a large amount of the nation's lumber.

Circular Sawmills. Circular saws are of various types and shapes. The saws are generally eight to ten gauge in thickness and have a diameter range of forty to sixty inches. The speed of the saw is a very important factor when sawing. Recommended speeds for circular saws,

as calculated by Browen, are given in Table III. (6, page 221)

TABLE III

SAW SPEEDS

Available Horsepower	Diameter of Saw in Inches	Speed Rotations Per Minute
12-15	44-60	300-350
16-20	44-60	350-400
21-25	44-60	400-450
26-30	44-60	450-500
31-35	44-60	500-550
36-40	44-60	550-600

Generally portable circular sawmills are operated by gasoline, diesel, or steam, and occasionally by a primitive water wheel. They may be operated by farmers who do custom sawing, operating spasmodically whenever convenient or necessary. The portable mill operator buys tracts of timber and moves his mill to the most convenient locality. Other and larger circular mills are established in permanent locations to make lumber from logs brought in from independent loggers. Many of the smaller mills sell their lumber rough and green. The larger mills may saw or dress to thickness, yard dry the lumber, and sell by the carload.

The Band Saw. The band sawmill is a more elaborate type of manufacturing enterprise, involving a much larger investment than the circular mill and generally requiring more equipment for the refinement of its materials. It will generally have edgers, and other equipment such as a planning mill, dry kilns, and dipping vats. A single band saw is the more conventional unit, but operators with larger lumber demands may require greater use of the band saw unit. Capacity may be increased by installing a type of saw to make thinner lumber. In softwood mills the

head saw is frequently supplemented by a gang saw. This is a powerful arrangement of vertical saws which produce inch boards from scants, cut from the log by the head saw. Often two mills are placed together and are equipped with double or triple band saws.

The operator of a portable band saw tries to find a location as close as possible to timber, perhaps in the midst of it. The site is selected with regard to convenience and adaptability. An ideal millsite is perhaps on a slope where the logs may be rolled downhill onto the carriage.

Most portable mill operators do not saw for grade. The customary practice is to slab the log, slice off a few boards, turn the log or scant, and finish sawing into rough lumber. This is called "live sawing". Most of the sawyers practice sawing about one-eighth inch oversize for safety. Brown wrote, "Experience indicates that from ten per cent to twenty per cent more lumber will be obtained from a portable bandsaw than from a circular mill". (6, page 123) Up to 400,000 feet more lumber per year comes from the band saw than from the circular mill.

Other Machines in the Mill. According to Brown, there are many machines which prevent the saw from being a non-massproduction tool. Without the additional machinery, sawing would require almost as much labor as the pit sawmill. (6)

1. The Log Washer is used to clean the logs. The water is taken from a screened chamber and is pumped through six inch pipes at a pressure of more than one hundred pounds per square inch. The nozzles are generally arranged so that the water is forced obliquely against the log. Mills with log washers enjoy a substantial saving in saw repair.

2. Log Kickers are used to kick the logs into troughs which move the logs from one point of operation to another. There are several types of kickers, especially in larger double deck mills.

3. The Nigger is a machine used to turn the logs as required by the sawyer. It is also used to move the log from the deck to the carriage.

4. The Log Loader is made of long forged-steel arms which place the log on a downhill track and carry the log to the deck.

5. Cutoff Saws are used to trim the log to exact length. They are of both circular and drag type saws. The drag saw is generally used near the millpond and is operated by steam, gasoline, or electricity.

6. The Carriage is an assembly of arms, levers, blocks, hooks, tracks, and wheels or slides which carry the logs toward the saw. Many other machines are required such as the edgers, trimmers, slashers, wood hogs, lumber loaders, planers, log jacks, dry kilns, matchers, power units, and many other machines.

Part D

The Growth of the Lumber Industry

The production of materials for shelter has been intimately associated with the development of the economic life of any nation. Though coal, oil, and gas are the main sources of heat in the modern communities, most members of the human race depend upon wood for heat. Though modern cities use comparatively little wood, Europeans use five tons of wood to build a home; Americans use ten tons. Wood is the choice material for building modern homes where it is available. The construction is much cheaper than that of most other modern building materials. Homes

built of other construction materials generally use wood for doors, window frames, floors, and furniture.

More than two-thirds of the world's railroad mileage is laid on wooden sleepers or cross ties. Mines are supported by wooden pit props. Wood is the second greatest raw product of civilization. The following statement was made by Fernow in History of Forestry: "It is second in tonage even in the advanced technological system of the United States." (4, page 13)

Lumber, a Factor in the Nation's Development. Lumber is the oldest industry in the United States. It is a highly competitive industry in which the producer, wholesaler, commission salesman, retailer, and consumer operate independent of each other as a private enterprise system. The lumber industry has been of great importance in the development of the country. It represents the change of forest into homes, villages, bridges, artificial construction materials, and chemicals. It is a creator of national wealth and an aid to social and economic progress. It has created thousands of jobs where members of different races and nationalities worked together. In the Garden of Eden the tree represented the downfall of mankind, yet in the death of Christ wood was in the prelude of the resurrection of the soul of man.

Colonial Development. The settlers of the east were impressed by the tremendous forests. Trees were estimated to be five hundred to a thousand years old. According to Defebough, timber cutting was an established occupation as early as 1631. (7, page 21) The opportunity offered to manufacturing was great indeed. In 1634 a ship was loaded

on the Piscatoqua River and sailed for England with pine clapboards and oak staves. Small mills were brought from England and the lumber industry began to grow along the rivers. In less than fifty years the state of Maine had twenty-four saw mills producing lumber for England. These mills were similar to the water-powered mills which central Italy used in the middle Sixteenth Century.

Although the colonial lumbering was carried on to an extent along the Piscatoqua and St. Croix River, small and crude machinery was brought from England and erected at points convenient to navigable waters, while many pine masts and spars were cut and shipped to the mother country. Pine was the cheap timber cut, as it was most plentiful, although some oak and hackmatack were cut for ship building.

The white pine was being depleted so rapidly that by 1784 a law was passed making it a penalty of one hundred dollar fine to cut a pine tree on public land. It also forbade the shipping of anything other than edge boards and some eighteen inch shingles.

Growing towns and new settlements spread along the lumbering areas. Hundreds of such settlements were in the heart of heavy timber tracts, and there was great interest in converting wild lots into places of culture and habitation. Lumbering developed to the extent that in 1841 Maine lumber industries had an investment of four million dollars and employed two thousand men. (9, page 23)

Shipbuilding Timber. The excellent shipbuilding timber made Maine popular as a ship building industry region. The yards there have undergone many changes in keeping with the development of the country and the improvement in ship structure.

The Lumber Industry Moves. In 1850 the lumber industry shifted into the New York area. (7, page 5) Many of the lumbermen moved their families to the new lumbering area. That year New York produced nearly two billion board feet of lumber, one-fifth of the nation's production.

The Albany lumber market grew rapidly and is one of the oldest lumber markets. Today the old capitol empire is one of the greatest handlers of wood materials. In the latter part of the Nineteenth Century, white pine was selling in Albany for twenty dollars per thousand. Two-thirds of the lumber used was being shipped from Michigan. Because of the Erie Canal, Albany ran lumber through the yards at a handling cost of eight cents per thousand board feet, while the handling cost in other cities was more than two dollars per thousand. The Albany district may attribute its success as a lumber distributing center to this canal. It was not until 1853 that Albany assumed importance as a lumber center. It was then that the pioneers commenced buying the splendid white pine produced in southwestern New York, and transporting it to Albany for commercial sale. At that time, lumber boats could carry as much as fifty thousand feet of lumber.

Lumber Barons. Although there were approximately one hundred large lumber companies between the Hudson River and the lower reach of the Erie Canal, the lumber industry was generally controlled by two men for nearly half a century. (9, page 411) H. W. Sage, whose sons are still in the lumber business, and L. Thompson are the two men who controlled the industry. Some of the companies handled as much as forty million feet of lumber per year as early as 1855. According to a letter "Preserved by C. P. Williams and Company", lumber prices were up to forty-five

dollars per thousand. Five billion feet of lumber was cut from three hundred thousand acres in the northern states and Canada.

Lumber Industry of the 1870's. By 1870 the lumber industry had shifted into Michigan, Duluth being the lumber center. (15, page 251) Mills were being placed along the banks of the Mississippi River. Although Duluth was a buying center, it was more than a decade before mills were placed in the city. The mills moved as the log stock was exhausted. In 1887 the Duncan Brewer Company established a mill in Duluth. With this movement, millwrights, workmen, and lumber jacks moved into the capitol city. Before 1890 the industry spread over Wisconsin and through the southern states. (7, page 6) Since the southern yellow pine supplied twenty to forty per cent of the lumber cut, more lumber was being produced in the south and southeast than in any other section.

Lumbering in the South. When the south is referred to in the lumber business, it is necessary to make sure what is meant by the term. In the lumber industry it generally means south of the Mason and Dixon line in the territory which officially constituted the Confederate States.

The south has the distinction, as a region, of having been a continuous major source of lumber production longer than any other section in the United States. The lake states liquidated their lumber supply early and the western states were the last to become important in the lumbering business. In the south, most of the old timber has been harvested. A large part of the lumber supply is from second growth timber. The south constitutes a large proving ground for yielding lumbering.

According to Horn, forty per cent of the commercial forest area of the country is in the south, and twenty-two per cent of the country's raw supply is in the south. (13, page 98) Of the thirty-five billion feet of lumber which the nation grows annually, the south grows approximately twenty-one billion. The southern states grow forty-five per cent of the saw timber used in the United States. The larger operators of the south own their own timber land, but most of the timber is obtained from farmers. Most of the hardwood companies buy logs from outside sources. There are no open log speculation markets as there are in the northwest. Many small mills are still operating in this section, and they are considered strong rivals of lumber associations.

Southern pine history dates back three hundred or more years, as the earliest colonist recognized its versatility and strength, and became interested in its possibilities. As the country was settled, the development of pine timber extended down to the South Atlantic Coast and across to the Gulf of Mexico. According to tradition, the first steam-powered sawmill used in the south for cutting yellow pine was built at New Orleans in 1803. The construction of the mill was so strongly resented by pit sawyers that a mob destroyed it. The pit sawmills could supply the local needs and some for export. The pine produced in this area was called pit-pine. It was not until after the War Between the States that the production of southern pine showed signs of becoming a factor in the country's industrial progress. The lumber industry was one of the best aids in disposing of poverty and in the reconstruction of the country after the Civil War. According to Horn, there has been a wide fluctuation of the volume and export of southern

pine. (13, pages 100-108) As early as 1608, southern pine was being shipped from Jamestown to England. By 1740 the exporting business had moved south as far as Savanah. In 1841, Savanah exports of lumber had reached a volume of fourteen billion board feet and had increased to two hundred forty-five billion feet in 1906.

Today pine is being exported to Europe, South America, Africa, and other allied nations, and is used for dock construction, ship building, heavy construction, and furniture making. The volume of pine lumber was unsteady during the Twentieth Century. In 1899 the output was ten billion board feet. The next eight years the annual average was eleven billion, increasing the average to sixteen billion by 1909. The following ten years the average decreased to fourteen billion, and declined to eleven billion by 1929. As in many other industries, the thirties were depression years to the lumber industries. The output of southern pine fell to seven billion feet, but increased again to eleven billion by 1942. (13, page 100) Today the south holds two hundred billion board feet of ready-to-saw pine which seems to be a safe supply for the future.

The writer would not lead you to believe that pine is the only lumber of importance in the south. As early as 1797, Savanah was including hardwoods as being important to the lumber industry. As years passed, mills were placed in the hardwood regions of Tennessee, Kentucky, Mississippi, Arkansas, and West Virginia for the purpose of sawing hardwood such as walnut, oak, elm, hackberry, maple, magnolia, pecan, willow, ash, hickory, chestnut, yellow poplar, beech, and birch. Timber men went into the woods to scout, buy, and brand selected individual trees, with walnut gaining the first decisive wave of popularity as use in

expensive furniture in the United States and Europe. According to Horn, the West Virginia hardwood was untouched until 1880, but this condition did not remain long. (13, page 110) In 1882 two hand mills were built in Charleston, bringing rafts of logs down the Ohio River, and by 1890 the big scale operators from the Appalachian Mountains began to move into West Virginia. Since the state of Ohio has been recognized as an important lumber producing state, as it is the home of the largest hardwood plant, the Medow River Lumber Company at Ranelle.

William M. Ritters, today recognized as dean of the hardwood manufacturing industry, placed a hardwood mill in West Virginia in 1890 and it has operated continuously in the Appalachian and the southern field. William M. Ritters has retired from active management, but keeps in touch with the company's activities, which has a timber holding of one-half million feet. The company expects continuous operation as the basis of its holdings. "An older company which had great influence on early hardwood lumber industries was the Vansant Kitchin Company, established in eastern Kentucky in 1880". (13, page 11) This company specialized in paper production and for many years owned large tracts of poplar timber and other hardwoods. For many years poplar gained prestige as being favored for use in siding, interior trim, wagon boxes, and vehicle bodies. As the supply of poplar decreased, cottonwood took its place. For the last twenty years southern hardwoods increased more in their uses as shipping containers than any other group of lumbers. Because of the economy and high versatility, the southern hardwoods are vital to industries where strength and durability are desired for crating at a low cost.

Western Lumbering. The first settlers of Oregon and Washington beheld the magnificent forests, not settling to harvest them, but to fulfill their desire for farming, growing food, and raising animals. Little could they foresee the Pacific Northwest as a principal source of the world's lumber products. The forest industries have always been the mainstay of the northwest economy. Thousands of products lie near the feller's ax, logger's tractor, and the sawyer's mill. Lumbering is the origin of the northwest economy and supplies more than half the payroll in the region. This region consists of more than thirty million acres in Washington, Oregon, and California, furnishing lumber for homes, bridges, furniture, dams, aircraft, or any other purpose for which lumber can be used.

"In this region, the Nevada Mountains of California hold the oldest living thing", according to Douglas and Roberts. (10, page 5) In the Sequoia National Park, the General Sherman Tree, a redwood which is from three thousand to four thousand years old, was discovered by James Wolverton, August 7, 1879. It is interesting to read its dimensions as written by Douglas and Roberts.

DIMENSIONS OF THE GENERAL SHERMAN TREE

Height above mean base	272.4'
Base circumference	101.6'
Greatest base diameter	36.5'
Diameter 60' above ground	17.5'
Diameter 120' above ground	17.0'
Diameter 180' above ground	14.0'
Diameter of largest branch	6.8'
Height of largest branch	130.0'
Estimated weight of trunk	625 tons
Total volume of trunk	50,010 cu.ft.
Number of board feet in trunk	600,120 bd.ft.

It has been estimated that the General Sherman Tree contains enough wood in its trunk to build forty houses of five rooms each, as much lumber as twenty acres of average forest, and is taller than the National Capitol Building in Washington, D. C.

During the decade of 1870 to 1880, there was a growth in the size of mills and an increase of production in the hardwood states. (11, page 36) The Atlantic seaboard trade increased one hundred per cent and declined sharply in the northwest while increasing in California. During the next decade, capitalization tripled, and the number of workers, the total wages, and the price of lumber more than doubled. California, Oregon, and Washington showed a substantial increase of lumber exported, but this did not prevent the east and south from leading in exportation. The west doubled its exports during the following decade by winning the Pacific markets.

Lumbering in the west spread through Idaho, Montana, Wyoming, Utah, Colorado, Nevada, New Mexico, Arizona, and South Dakota. These states contain twenty-three per cent of the forest area of the United States, and sixty-five per cent of the nation's footage of saw lumber. In this section timber is bigger and the sawmills are larger, with Washington enjoying the largest mill in the world, the "Weyerhaeuser Mill at Longview, which dates back to 1860", according to the history of the Weyerhaeuser Company. (28, page 1)

With the growth of the lumber industry and the farm-seeking pioneers, the beginning of the Twentieth Century brought waste and exploitation of the timber as it had never known. Exports were going to British North America, Mexico, Chile, Peru, and Australia. The exploitation was the highest in the history of lumber.

> The decade from 1900 to 1910 was the one of the greatest importance to the lumber history of the country. It was in this period that extreme exploitation of forest resources and liquidation of timber stands created a revulsion against private ownership of forest lands and timber stands. (13, page 37)

Tremendous changes took place during that time. The west coast and particularly the northwest had been steadily gaining the lumber prestige. From 1920 to 1930 the northwest led, although in individual species yellow pine was ahead of douglas fir. The northwest produced about thirty per cent of all the lumber output, with douglas fir comprising twenty-five per cent of the national output.

It has been contended that direct relationship is maintained between a nation's production and its exports. During the depression, exports declined along with production. The decline was less to China than to Japan, South America, or Mexico. The disturbance in timber trade was less in non-industrial countries than in industrial countries, and less in respect to one-crop countries. The more lumber produced, the less "economic" control is held over its distribution. During the thirties lumber which could have been sold on the open market was channeled to the export markets, often on consignment, and many times lumber got a foot-hold in foreign markets by the practice of selling at any price.

The west coast lumber can be classified into three divisions: "Douglas fir and its associated species, such as western red cedar, hemlock, and spruce; the western pines-panderosa, Idaho white and sugar; and redwood". (13, page 70)

Douglas Fir and Associated Species in Oregon. This strip of country consists of Washington and Oregon between the Cascade Mountains and

the Pacific Coast, from one hundred and fifty miles long, and one hundred and fifty miles wide. In this area is the nation's oldest timber, a stand of five hundred and five billion feet. "The first export of commercial development in this section was in 1788 when Captain John Mears set sail for China with a ship load of logs, but he failed to reach China." (13, page 73) The idea was not a failure as others followed in his footsteps. Another influence on this section was the gold rush to California in 1849. The gold rush gave the douglas fir wide advertisement, and brought eastern lumbermen to the fir forest with their machinery which dotted the shores of Puget Sound, Grays Harbor, Willipa Bay, and the Columbia River, but oversized timber presented a problem which was overcome with the development of new machinery and better transportation. "As early as 1928 more than one and one-half billion feet had been shipped through the Panama Canal to the eastern lumber markets." (13, page 77) By 1940 an average of one billion feet per year was going through the canal. During World War II intercoastal trade was shut off, but by 1949 it was back above the billion foot mark.

Western Pine Region. The western pines are widely distributed with long pole pine, spruce, and white fir in the douglas fir region and in South Dakota. Panderosa pine is also distributed over this section, while the sugar pine grows only in northern California and southern Oregon. The Idaho white pine, Engelman's spruce, and long pole pine grow in Washington and Western Montana, along with the hemlock. The development of this lumber region started about 1830 with a total production of nearly four hundred million board feet by 1869. In 1947 the three western pines produced more than six and one-half million feet of

lumber with eighty-five per cent being ponderosa.

> Forest survey findings for the western pine area (including the redwood region) show a total of 81,430,000 acres of commercial forest land, of which 45,445,000 acres are classified as saw timber area. In this area there is a total of 537,625,000,000 feet of timber, of which 185,025,000,000 is ponderosa pine. (13, page 83)

The new growth in this region is almost as much as its total annual output. Ninety-five per cent of the cutover land is restocking satisfactorily.

The Redwood Region. The redwood region is in the fog belt of the Sierra Nevada Range across California to the north of the Oregon state line. It yields less than two per cent of the nation's lumber supply, although single acres have been known to produce one and a half million feet of lumber. Single trees have produced up to three hundred thousand board feet. No one knows why the redwood grows so big. This region was slow to develop as a lumbering industry because of the tremendous size of the trees. With the present sawing and forestry practices, the redwood can probably produce a billion board feet of lumber per year.

World War II. During the war years the United States stopped nearly all exports to the Far East except in limited amounts called for by military consideration. Other allocations were made to allied nations who were to reciprocate with supplies or native raw material. The war cost the United States more than twenty-five billion feet of lumber through agencies such as Lend-Lease. In 1945, the nation's experts totaled three hundred ninety-four million board feet, while the total production reached near thirty billion feet. In Table IV is quoted a lumber bill for Lend-Lease (page 37).

This lumber bill reveals the quantitative effect the war was having upon the lumber industry, and the abundance of the government requests in 1946. Of thirty-five billion feet, only six hundred fifteen and eight-tenths millions were exported.

TABLE IV

WORLD WAR II LUMBER BILL BY THE UNITED STATES AGENCY*

Agencies	Lumber (in thousands)	
	Board Feet	Dollars
War Department	19,480,160	1,000,723
Navy Department	4,745,219	226,449
Maritime Commission	492,570	25,477
Defense Plants Corporation	78,091	3,926
War Shipping Administration	39,361	1,731
Panama Canal Zone	38,032	2,301
Distribution Yards	556,491	30,527
Treasury; Lend Lease	343,051	25,873
Veterans Bureau	3,936	195
Miscellaneous	149,623	71,375
Total	25,926,534	1,388,577

*(11, page 48)

Because of the scope of the lumbering industry, this chapter has only touched the historical development. Many foreign countries not mentioned have had a great effect on the industry, especially on the lumbering trade. The United States buys or sells lumber in most foreign countries. The lumber industry is the second largest in tonage of the

nation. It developed as the country developed, with European tradition being the starting basis. Therefore, this chapter has been limited almost entirely to the development of lumbering in the United States. The writer has omitted the development of lumber companies because each large company has an extensive company history. Therefore, a short chapter will be devoted to lumbering associations which may furnish valuable information to those interested.

CHAPTER III

HISTORY OF LUMBER ASSOCIATIONS

Lumber associations have had an important effect upon the great lumber industry. During the last fifty years the progress of lumbering can be attributed to the lumber associations. Unlimited knowledge of selling, handling, and processing of lumber has been provided by these associations. They observe the highest ethical principles and cooperation with individual groups of loggers, cutters, mill operators, wholesalers, and retailers. Each respects the rights and business privileges of the others. All of the organizations have similar purposes and aims of experimenting, gaining useful information, standardizing products, and the unifying of trade practices. The associations are maintained by assessments or contributions. The contributions range from one cent to fifty cents per thousand board feet of lumber produced. These associations have contributed much to the progress and development of our nation.

Northern Pine Manufacturers' Association. The Northern Pine Manufacturers' Association is one of the oldest in existence, according to Horn. "This group was organized as the Mississippi Valley Lumbermens' Association in 1891." (13, page 294) It was merged with the Wisconsin Valley Lumber Association in 1906, forming the Northern Pine Manufacturers' Association. Its present obligations and activities are those of keeping its members informed of grading rules, government regulations,

and statistics on lumber stocks, orders, prices, and maintaining an inspection service. The Association encourages the cultivation of second growth timber as the virgin timber is harvested, although it was originally formed for the purpose of establishing uniform grading and inspection.

Southern Pine Association. The Southern Pine Association was formed in 1915, and has its headquarters at New Orleans. It is composed of 157 companies located in Louisiana, Mississippi, Texas, Arkansas, Alabama, Florida, Georgia, and Oklahoma. The purpose of the Association is to publish statistics of sales, volume, shipments, production, and stocks on hand, and to sustain a program of advertising, forestry, and public relations.

Western Pine Association. "The Western Pine Association began in 1903 as the Western Pine Shippers' Association", which changed its name in 1906 to Western Pine Manufacturing Association. This Association consolidated with the California White and Sugar Pine Association in 1931 to form the Western Pine Association. The following objectives are outlined:

1. To foster cooperative effort in the lumber manufacturing industry within the Western Pine region, in order to further the interests of the members, and to that end to secure a full understanding of conditions surrounding the lumber market in their distributing territory;

2. To establish standard sizes and uniform grades as a basis of recognized values, and an adequate inspection service to maintain the integrity and uniformity of these grades;

3. To procure and furnish its members such statistical and other information as will appraise them fairly of the condition of the industry, and of their markets;

4. To promote a greater and more widespread use of the products of its members, and to foster and protect the interests of consumers in such use;

5. To conduct a research program with the object of improving the manufacture, distribution and use of those products;

6. To secure just and reasonable transportation charges and to guard against discriminations by railroads and other carriers;

7. To promote conservation and sustained production of forest resources; and generally to adopt or sponsor from time to time such measures as may be deemed necessary to protect the industry. (13, page 299)

National Hardwood Association. This association which was established in 1893, is one of the oldest lumber associations. Its inspection certificates are recognized by the United States Army, Navy, and State and Federal Government departments. Many of the softwood associations have affiliated with this group. The National Hardwood Association is represented in Canada, the Philippine Islands, and other foreign countries. It is predominately a manufacturers' organization, yet wholesalers and distributers have a substantial associate membership. Its principal function is to maintain grading standards, and inspection services which are very valuable to its associates.

National Retail Lumber Association. The National Retail Lumber Association was formed in 1916. It is composed of state and regional producers, and has headquarters in Washington, D. C. The retail lumber dealers are recognized as an important economic group because they have more personal contact with the consumer than any other group. The association has sixteen thousand members selling not only lumber, but brick,

paint, paper, cement, and any material used for construction purposes. The Association exchanges ideas with others, and cooperates to better understand the problems of retail trade.

The National American Wholesale Lumber Association. John B. Veash, President, states that in 1902 a group of lumbermen met in St. Louis to organize the National Lumber Manufacturers' Association. (21, page 1) The Association represents wholesale trade, and is primarily interested in distribution and extensive trade promotion programs. Many governmental agencies recognize and depend on the Association for valuable and statistical information. Its members are required to be wholesalers only. Its annual reports are on file in most university libraries throughout the country as a contribution to education.

The West Coast Lumbermens' Association. Roberts stated that six associations were organized in the west coast region between 1891 and 1896. (27, page 1) None of these groups existed after 1897. The boom in lumbering abroad created problems that individual operators could not handle. These problems caused the Pacific Coast Lumber Manufacturers' Association to be organized in 1901. In 1905 the Oregon Washington Lumber Manufacturers' Association was formed with headquarters in Portland. These had been preceded by the Southwest Washington Lumber Manufacturers' Association. These three associations combined in 1911, and formed the West Coast Lumbermens' Association. The headquarters of this Association are located at Seattle, Washington. The Association represents approximately two hundred companies in the western region, which hold over half the remaining timber of the country. Its activities are confined to lumber grade standards, inspection, transportation, making and

filing statistics, accounting service, national advertising, trade and extension service, public relations, sponsoring and producing educational programs, and forestry services.

Other associations have contributed to the progress of the lumbering industry. In each recognized lumbering region, local lumbering associations exist and most of these are associated with a national association. The associations are working toward common goals, which are the promotion of the industry and progress of the nation.

CHAPTER IV

KINDS OF LUMBER USED AND THEIR USES IN INDUSTRIAL ARTS SHOPS

Lumber seems to be a basic material used in the industrial arts program. Its many uses make possible a variety of experiences and activities in the shop. The information for Part A of this chapter was obtained from industrial arts teachers of Oklahoma. Forty questionnaires were mailed to industrial arts teachers to obtain information and general opinions. The questionnaire was very general and since the response was only fifty per cent, the writer does not attempt to use the information as statistical proof, but only to show variation and general opinion.

Part A

Kinds of Lumber and Uses

In this survey of the industrial arts teachers, both large and small schools were included which had an average class enrollment of eighteen and four-tenths students. The average amount of lumber used by each pupil per year was twenty-three board feet. According to the survey, more schools use walnut than any other lumber, with cedar being second, and pine, mahogany, and oak in descending order. The survey shows that white pine and mahogany ranked first in the amount of lumber used, cedar ranked second, and oak third; and that walnut, magnolia, cherry, gum, ash, and poplar ranked low. The survey indicated that thirty different kinds of lumber are being used in the shops. These lumbers, according to the survey, are used to construct thirty-two types of projects. Also,

the teachers listed forty-one different benefits the students received from the woodworking shop.

Walnut. According to the survey, eighty-six per cent of the industrial arts shops used walnut lumber, but only six and seven-tenths per cent use more walnut lumber than other kinds of lumber. Black walnut has been classified as a royal cabinet and furniture wood since 1700. The North American walnut, which is dark brown and grayish brown in color, lends itself readily to a beautiful finish. Walnut was the leading wood of the Queen Ann, Windsor, Regency, and the Baroque design of 1700 to 1725. (22, pages 2-4) It also took the lead in the Georgian, Louis XV, and Rococo. It led as the wood most used in the Louis XV and Classic Revival periods of 1775 to 1800. But from 1800 to 1850 it was not the leader of periodical furniture, although it did maintain a high popularity. It regained the lead again in Inlaid Mother of Pearl and the Civil War period furniture during 1850 to 1900. The decline in the use of walnut for furniture making was during World War II, but it was used extensively during this period for the making of gun stocks. From 1947 to 1950 the use of walnut has made a rapid recovery of approximately eight hundred per cent. The past popularity of walnut, its resistance to temperature changes and warping, and its finishing qualities probably are the causes for its use in so many industrial arts shops. The high price probably limits the amount used in the shop. Many pupils have a deep appreciation for the beauty and working qualities of walnut.

Mahogany. A wide variety of species of mahogany which grow in Cuba, Central America, the West Indies, and Africa are used in the industrial

arts shop. The color range is light red to a dark red or brown. Mahogany has very fine working and finishing qualities. According to the survey made of school shops, it is used in sixty-seven per cent of the shops, and forty-six per cent of the shop teachers listed it as the lumber most used.

Mahogany has been very popular as a wood used in the construction of period furniture and ranked highest in use in the Chippendale and Martha Washington styles from 1750 to 1775. It was used more than any other wood in the production of period furniture from 1800 to 1850, and it is used in large amounts in modern furniture. Mahogany has been an important wood and used in designs such as Queen Anne, Early Georgian, Robert Adams, George Hepplewhite, Sheraton, Louis XV, French Empire, Colonial American, Duncan Phyfe, and the Federal American. Honduras and Philippine mahogany have very fine working qualities and can be finished to many colors which are attractive to the pupils. Because of the price, Philippine mahogany is most used by pupils of the woodworking shop.

Cedar. The survey revealed that eighty per cent of the industrial arts shops use cedar. Because of the uses listed by instructors, the writer assumes the cedar was eastern red cedar. Twenty-one per cent listed cedar as the lumber used most often. This cedar grows in the eastern forest zone and is widely employed for making chests and clothes closets. The moth-proofing odor, reasonable price, and variety of colors make it very attractive to the shop students.

Pine. The response of the questionnaire indicated seventy-four per cent of the school shops use pine lumber, with forty-six per cent listing white pine as a wood used most. Pine, which grows in both the

eastern and western regions, has many uses. The price range is very wide; eight cents to forty-five cents per board foot. The white pine is the higher priced. The many uses, finishes, working qualities, and wide price range cause white pine to be used by many pupils, especially in the junior high school shop.

Oak. Oak was listed as being used in fifty-three per cent of the shops and used most in only thirteen per cent. Oak is a wood possessing many fine qualities. It is heavy, stiff, hard, and will take a number of finishes. Oak is probably one of the best known hardwoods. For thousands of years it has maintained its reputation for durability and has many uses such as construction of buildings, furniture manufacturing, building of truck beds, trailers, and cabinets where strength and durability are required.

Oak is easily obtainable by most industrial arts shops. The red oak is used in making dark furniture and white oak in making light furniture. Its durability and strength add to its industrial arts shop uses. Pupils will avoid its use because of the hardness which makes the work difficult for pupils who are lacking in experience.

Table V (page 48) shows the per cent of schools that use each kind of lumber. The per cent of schools is determined by dividing the number of times a lumber was listed by the number of schools. The per cent is not expected to total one hundred per cent because the instructors listed more than one lumber each.

Table VI gives the per cent of schools in which each kind of lumber was rated as being used most. A few instructors rated two kinds of lumber as used most. This table (page 48) will show more than one hundred per cent.

TABLE V

THE PER CENT OF INDUSTRIAL ARTS SHOPS USING EACH KIND OF LUMBER

Kind of Lumber	Per Cent of Schools	Kind of Lumber	Per Cent of Schools
Pine	74	Cherry	33
Mahogany	67	Maple	47
Cedar	80	Walnut	86
Birch	22	Oak	53
Gum	27	Western Cedar	7
Korina	13	Willow	7
Hondurous Mahogany	7	Sycamore	27
Philippine Mahogany	21	Ash	21
Magnolia	21	Hickory	7
Red Gum	7	Holly	7
Sap Gum	7	Poplar	21
Yellow Pine	7	Elm	7
Pecan	7	Balsa	7
Basswood	7	Veneers	13

TABLE VI

THE PER CENT OF SCHOOLS RATING EACH LUMBER AS BEING USED MOST

Kind of Lumber	Per Cent of Schools	Kind of Lumber	Per Cent of Schools
White Pine	46	Mahogany	46
Cedar	21	Oak	21
Magnolia	13	White Oak	7
Poplar	7	Red Oak	7
Gum	7	Walnut	7
Ash	7	Cherry	7

There are many reasons why pupils' choice of lumber will vary as shown in the preceding tables. As considerations are being made and lumber is chosen, the following questions may be presented:

1. How difficult is the lumber to work?
2. What kind of finish can be used?
3. Will it match the furniture at home?
4. What kind of lumber is usable in the selected project?
5. Will mother or father approve of certain lumbers?
6. What tools are available?
7. What will it cost?
8. Is the lumber available?
9. What is being used by other students?
10. What does the teacher think about it?

When the lumber is available there will be almost as many choices of lumbers as of personalities. Often the choice of lumber is influenced by choice of friends. The boys that play together, work together, take the same courses, and visit each other may choose the same kind of lumber.

Projects and Use. There are many uses of lumber and a variety of projects can be made from these materials. According to the survey made by the writer, industrial arts students build more furniture projects than any other type of woodworking projects. It seems that the woodworking projects are approximately the same in rural schools as in city schools. Probably the reason for this is the beauty of furniture, school shop tradition, influence of teacher, amount of working space, and influence of parents. Among the projects listed were lamps, end tables, chests, cedar chest, coffee tables, shelves, book shelves, smoke stands,

television tables, lawn chairs, bedstead, gun racks, desks, telephone tables, bedroom suites, knife holders, towel racks, hall trees, magazine racks, picture frames, footstools, small toys, cutting boards, jewelry boxes, small buildings, feeders, lumber racks, benches, and repairing and matching old furniture. These projects furnish a wide variety of experience which has a valuable carry-over into other subjects and occupations.

Benefits Pupils Receive. According to industrial arts teachers, the pupils benefit from woodworking or from the use of lumber in many different ways. A few of these benefits are as follow:

1. The pupil learns how to choose wood most suitable for a project.
2. Develops the ability to select grades of lumber.
3. Learns to draw and work according to the drawing.
4. Learns the location of forests.
5. Gains knowledge of different kinds of wood.
6. Learns creative design.
7. Learns how to use woodworking tools and to respect them.
8. Learns to change the shape of materials and to increase their value.
9. Learns to apply a variety of finishes.
10. Develops a pride of achievement.
11. Develops appreciation for the beauty of wood.
12. Develops consumer knowledge.
13. Develops ability to stay with a job until it is finished.
14. Develops confidence and general appreciation.
15. Has the satisfaction of taking something home made with his own hands.

16. Does something where a result can be seen.

17. Has a way of relieving tension.

18. Sees a need for other subjects and instruction.

19. Learns to work with others and respect their individual rights.

With what material does a pupil have more opportunity for improvement? Or in what class can more experiences be gained? If the industrial arts teacher is more interested in the student's future than the project, the pupil may benefit from an informal guidance program while working with wood.

Part B

Lumber Grading

As an industrial arts teacher is required to order lumber, it is essential that he know something about lumber grades and standards. It is important that the pupils of the woodworking class be taught some of the basic rules of grading lumber. The standards of lumber are a part of the progressive outcomes of the lumber associations. As lumber grading is a difficult occupation, the writer does not attempt to discuss all details, but attempts to give enough information to enable the purchaser or pupil to obtain the materials desired.

Softwood Grading. The grading of lumber cannot be considered an exact science because it must be graded in part by the reasonable judgment of the inspector. The dimensions of lumber can be more specific than the quality grading because of standard measurements. When grading lumber, the inspector must consider many things other than dimensions and surfaces dressed. The amount of imperfections such as pitch pockets, shakes, splits, stains, wave, warp and cup, and also heart wood and

sapwood must be considered when inspecting lumber. The lumber is then classified by the amount of lumber clear of imperfections on one side.

Classifications. There are three common classifications as listed below:

1. Yard lumber is manufactured into sizes, patterns, and grades required of ordinary construction.

2. Structural lumber is two inches thick or over, and four inches wide or over, and is intended for use where stresses are applied.

3. Factory or shop lumber is intended for use in further manufacture, based on the per cent of clear lumber and minimum size and quality. According to the Southern Pine Association, yard lumber grades are of two grades: select and common. (26, page 20) Selects are divided into that which can be finished natural and that which is suitable for painting. The common is divided into that which can be used without waste and that which permits or requires waste. These are divided into three grades: A, B, and C. Lumber which is A grade must be practically clear and up to twelve inches in width. Small imperfections are admitted in wider lumber. B grade permits small checks, slight cup, one short end split, small knots, fifteen per cent pitch with heart pitch not to exceed five per cent. Only two pitch streaks are permitted. C grade may have more and larger but still limited imperfections. Structural lumber is graded according to fiber blending, compression, and shear which the lumber will adhere to. These grades are select structural, prime structural, merchantable structural, structural square edge or sound, and No. 1 structural. Shop grades are numbered. No. 1 must saw or rip sixty per cent clear and No. 2 must saw or rip forty per cent clear with

moisture content not to exceed fifteen per cent. The lumber may be ordered S1S or S2S, which represents faces surfaced. The lengths are from eight to twenty feet. Shop grades may be ordered in six foot lengths. Table VII indicates the thickness and width of standard lumber.

TABLE VII

THICKNESSES AND WIDTHS
(Southern Pine Standards)

Dimensions in Inches				
Thicknesses			Widths	
Nominal	Dressed		Nominal	Dressed
	Yard	Industrial		
	15/16		3	2 5/8
	7/16		4	3 5/8
	8/16		5	4 5/8
	11/16		6	5 5/8
1	25/32	13/16	7	6 5/8
1 1/4	1 1/16		8	7 1/2
1 1/2	1 5/16		9	8 1/2
1 3/4	1 7/16		10	9 1/2
2	1 5/8	1 3/4	11	10 1/2
2 1/2	2 1/8		12	11 1/2
3	2 5/8		over 12	off 5/8

The industrial arts teacher who is acquainted with lumber standards may often prevent waste and buy lumber more suitable for given projects. Without such knowledge the teacher may order unusable lumber because of defects such as loose knots, end checks, stains, warp, cup, and shakes.

Hardwood Standards. Standards of grading hardwood are so complex it is almost impossible to understand and explain. Different hardwoods may have different variations, but have a common aim as to utility. Cutting grades are based on the amount of clear cutting lumber. The National Hardwood Association established rules of grading and measurements which are followed by most hardwood producers and distributors in the United States. The top grade of hardwood is a combined grade of first and second (FAS) six inches wide or more. The clear cutting may vary in different kinds of wood, but will yield an average of around eighty-five or ninety per cent clear cutting with a minimum of four inches wide by five feet long or three inches wide by seven feet long. Lumber is graded according to the poorest side. The second grade is No. 1 selects, although some companies mix selects and sell it for first and seconds one face (FASF) which means FAS graded on the best side. The select grade has a minimum width of four inches and a minimum length of six feet. Thirty per cent of lengths must be six to eleven feet. The average cutting clear is not as high as FAS. No. 1 common will yield approximately sixty-seven per cent clear cutting with minimum dimensions of four inches by two feet or three inches by three feet with a minimum per cent allowable. Some hardwood grades are as low as No. 2 and No. 3 common. The lumber may be plain sawed or quartered. The widths and lengths are random. The hardwood thicknesses are shown in Table IX, page 55.

Industrial arts teachers should emphasize the complexity of lumber grading as some pupils may become interested and choose lumber inspection as an occupation. Information on grading and classifying lumber would be helpful consumer's knowledge for anyone.

TABLE IX

STANDARD HARDWOOD SURFACED THICKNESSES

Dimensions in Inches		
Rough Thickness	Plain Hardwoods	Quartered Hardwoods
5/8	7/16	7/16
3/4	9/16	9/16
1	25/32	25/32
1 1/4	1 1/16	1 1/32
1 1/2	1 5/16	1 9/32
2	1 3/4	1 11/16
2 1/2	2 1/4	
3	2 3/4	
4	3 3/4	

CHAPTER V

PHILOSOPHY OF INDUSTRIAL ARTS

As civilization progressed people developed skills in the methods of using their hands at arts and crafts. People have always learned by living together, imitation, working together, and scientific thinking. Through exploration of arts and crafts, people became more industrially minded, thus becoming scientific in thinking and promoting industry by creative work. Even the savages developed skill to devise clothing, shelter, weapons, and tools with which to protect and feed themselves.

Part A

Historical Background

Industrial arts have been a recent development as a phase of general education, although people used various handicrafts long before the development of formal education. Knowledge of skills has been passed on from one generation to another.

Handicrafts. Handicrafts occupied a place of respect in the Homeric age of Greece, because much of the agricultural and difficult physical labor was done by slaves. Artists who worked for pay were in the class with bakers, shoemakers, and other craftsmen. "Socrates, 470-399 B.C., is credited . . . . for the attitude of contempt toward the mechanical arts." (16, page 15)

The curriculum of the Monastic Schools was a system of education in which work with hands was very important, with its prescribed hours of

reading and worship. Only a few of the monastaries offered studies other than religious writing, although a few offered the seven liberal arts. Outside of the monastaries, participation was the principal means of education and was recognized as such by the schools. Until the Nineteenth Century the majority of the people received no education except what learning was acquired by working with a tradesman or by social contact, which was generally an apprentice and skill laborer combination. Apprenticeship dates back to the Fourteenth Century.

The British Industrial Arts. In 1830 the British became interested in industrial arts. The House of Commons appointed a committee to establish the best means of extending arts and the principles of design to the people of the manufacturing population. In 1837 the new school of design was opened at the Somerset House in rooms formerly occupied by the Royal Academy. The object of the school was

> . . . to afford the manufacturers an opportunity of acquiring a competent knowledge of fine arts, in so far as these were connected with manufacturers, and steps be taken to limit the students to these interests. (3, page 385)

This was a philosophy of industrial arts. Many philosophies have been developed since that time.

Part B

Philosophy of Industrial Arts

Before a course of study can be planned in industrial arts, the teacher must have a belief in the things to be accomplished, and must believe the undertaking is worthwhile, necessary, and contributes to the pupil's education. When making a statement of belief it is difficult to avoid criticism of the beliefs of others, yet the teacher must

be ready to defend the principles of his own beliefs. Philosophy must contain "the study and knowledge of principles", "practical wisdom that comes from knowledge of general laws and principles". (16, page 55)

Industrial Arts. In industrial arts, boys of every social group work together in an instructive and constructive environment. The class may gain insight of how more than fifty per cent of the people earn their living. It is the teacher's duty to try to convince the pupils that it is a right of every individual to earn a fair standard of living, and each person should respect that individual right. The teacher should strive to prevent any of the pupils from becoming an occupational misfit. It is the writer's opinion that being an occupational misfit, in many cases, is the cause of poor citizenship, broken homes, crime, and unhappiness. Industrial arts, through its influence, should assist a boy or girl in choosing an occupation. If a person spends approximately one-third of his time as an occupational misfit, what may happen during the other two-thirds?

Industrial arts is a phase of general education and should be exploratory in nature, through tryout experiences, studies of related vocations, and general guidance. Industrial arts should also add to happiness through mechanical devices, civic improvement, consumers' knowledge, design, materials, workmanship, satisfaction, basic skills, social improvement, economic improvement, avocation, and general appreciation. Industrial arts should appeal to youths and adults. For one person it may be an avenue of escape; for others it may mean the satisfaction of producing or the development of a new industry. Whatever the interest may be, a broad industrial arts program has a place of

interest for the individual personality.

Objectives. Objectives cannot be over emphasized because of their importance. Every industrial arts teacher should write a list of objectives at the beginning of the school term and strive to obtain the goal of the objectives indicated. This list should indicate the direction in which the instruction should move. William A. Bakamis has listed the following woodworking objectives:

1. To develop the student's woodworking ability to use common woodworking tools.

2. To develop the student's ability to make and interpret simple drawings.

3. To develop the ability of the student to recognize the common woods and to know their characteristics and uses.

4. To develop the ability of the student to do simple refinishing.

5. To develop the student's ability to select, purchase, and care for woodworking tools for a home workshop.

These objectives are not complete. They will suggest to the teacher the type of statements that will be most helpful in organizing a course of study. (1, page 77)

When making a list of objectives for industrial arts, the teacher should list those which have a direct purpose, and any content which would not contribute to the desired goal should be omitted.

Industrial Arts Objectives.

1. Exploration

2. General guidance

3. Household mechanics

4. Avocations, hobbies

5. Social habits and insights

6. Consumer's knowledge and appreciation
7. A degree of skill
8. Correlation or integration
9. Vocational purposes (18, page 16)

The writer believes that to these objectives should be added the development of the pupil into a useful citizen. There are many lists of objectives of industrial arts leading to the same general goal. As a rule, the men and women who are unemployed are those who have not had a broad education. Therefore, the industrial arts program should provide many experiences for the pupils.

CHAPTER VI

SUMMARY AND CONCLUSION

Lumber was one of the first needs of man. Scarcely can a few pages of history be turned without noticing a picture, drawing, or statement which indicates the use of lumber in some form. Lumbering was one of America's first industries, and definitely one of the first needs of the pioneers. It has been a contribution to the nation's wealth, needs, and luxuries. The lumbering industry today is recognized as the nation's second largest industry. It produces many other materials that are seldom recognized as a product of the lumber industry. Through lumber associations, valuable information is contributed to the public concerning the uses of lumber and related material. The importance of the lumber industry cannot be overlooked or forgotten.

Recommendations for Further Study. The following is a list of suggestions for additional study in the field of woodworking:

1. History and development of veneers.
2. Study of the development of materials relative to the lumber industry.
3. Study of the West Coast lumber region as to development.
4. History of wood in relationship to period designs.
5. Study of woods imported to the United States.
6. Comparison of woodworking shops to other unit shops in industrial arts.

Conclusion. The lumbering industry could not exist except for the abundance of forests and the desire of people all over the world for shelter. The last fifteen years have brought about an increase in the value of timber and its related materials. The lumbering industry is making progress and more wood is being used than before World War II because more uses have been found for wood products. Since closer logging has found more values in woods, long range forestry is being developed to make possible the survival of wood-using industries after the old growth timber has been depleted.

APPENDICES

A. A Selected Bibliography

B. Letter of Inquiry

C. Questionnaire

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OKLAHOMA INSTITUTE OF TECHNOLOGY
OF THE
Oklahoma Agricultural and Mechanical College
SCHOOL OF INDUSTRIAL ARTS EDUCATION
AND ENGINEERING SHOPWORK
Stillwater, Oklahoma

March 1, 1955

Dear Sir:

I am starting a research project as a part of the requirements for a Master's degree. A study is being made of "The History of Lumbering and the Uses of Lumber in the Industrial Arts Shop".

This problem is being prepared under the direction of L. H. Bengtson, Associate Professor, School of Industrial Arts Education and Engineering Shopwork, Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma.

I would like to secure all available information on the history of lumbering and the uses of lumber in the industrial arts shop. This may include bulletins, circulars, and statistics pertaining to the subject.

If possible, please send two sets of information; one to Prof. Bengtson, who is also Superintendent of the Cabinet and Production Shop, and one to my mailing address.

Your immediate attention to this request will be greatly appreciated.

Very truly yours,

Glendon S. Davis
Box 61
Fay, Oklahoma

Approved: L. H. Bengtson
L. H. Bengtson, Advisor

Appendix C

Name of School _____

Shop Teacher _____

Average number of pupils per class _____

Types or kinds of lumber used in your shop _____

_____

Approximate number of board feet per student per year _____

The type or kind most used _____

Uses of lumber in your shop _____

_____

_____

_____

_____

_____

_____

What is the greatest benefit your students receive from the use of lumber? _____

_____

_____

_____

_____

_____

_____

_____

REPORT TITLE: THE HISTORY OF LUMBERING AND THE USES OF LUMBER IN THE INDUSTRIAL ARTS SHOPS

AUTHOR: Glendon Silas Davis

REPORT ADVISOR: L. H. Bengtson

TYPIST: Dorothy Watkins