SCHOOL SHOP WOODWORKING EQUIPMENT

SCHOOL SHOP WOODWORKING EQUIPMENT

By

Darrel F. Stiles

Bachelor of Science

Central State College

Edmond, Oklahoma

1936

Submitted to the Department of Industrial Arts

Education and Engineering Shopwork

Oklahoma Agricultural and Mechanical College

in Partial Fulfillment of the Requirements

for the Degree of

MASTER OF SCIENCE

1950

SCHOOL SHOP WOODWORKING EQUIPMENT

Darrel F. Stiles

MASTER OF SCIENCE

1950

REPORT APPROVED:

C. L. Hill

Report Adviser and Associate Professor,
School of Industrial Arts Education
and Engineering Shopwork

David H. Hunt.

Head,
School of Industrial Arts Education
and Engineering Shopwork

Edward Stanley Ed

Dean, Oklahoma Institute of Technology

D. E. McIntosh

Dean of the Graduate School

ACKNOWLEDGEMENTS

I wish to express my gratitude to all who have given of their time and advice in writing this report.

To my adviser and teacher, Professor C. L. Hill, I am deeply greatful for his patience, criticism, suggestions, and for the time devoted to conference.

To my teacher and friend, Dr. DeWitt Hunt, I am indebted for many of the ideas for research and for professional encouragement while a student at Oklahoma A and M College.

To my wife, Agnes Stiles, I am indebted for her encouragement and assistance in development of this report.

DFS

TABLE OF CONTENTS

Chapter Page

CHAPTER I

THE PURPOSE AND TECHNIQUES

The nature of this report, the reference material used, and the methods used in gathering material requires an explanation so that the reader may better understand the report.

The Need for the Study. During the period of World War II many of the best instructors in the nations school shops moved to war production jobs leaving the shops and equipment in the hands of the poorly qualified instructors or in many instances in the hands of the janitor. Thus, much of the old equipment was mis-used. As a result many of our school shops lapsed into a deplorable condition in which to instruct boys and girls. At the close of the war there were thousands of dollars worth of surplus equipment from war plants donated to the school shops of America. This was good for many school shops but the instruction had to be adapted to the equipment instead of the instructor buying equipment that was adapted to the course of study. With the changing curriculum of the modern school, the instructor should be able to select the equipment that will most satisfactorily meet the requirements of the course of study and give the most satisfaction for the money invested. There is often the limited budget and the temptation of the inexpensive tool line, for the instructor

to consider.

Methods of Investigation. The method of research used in this report includes an analysis of written reports on the subject, discussions with leaders in the Industrial Arts field, and a study of articles found in the Industrial Arts and Vocational magazine on this subject, and a study of written information and specifications from various woodworking companies.

Text books and other books that could be found in the library on the subject were searched for valuable information on school shop woodworking equipment.

Review of Previous Studies. A helpful step in preparing this report was the reviewing of reports of a similar nature in the field of school shop equipment. In reviewing these reports the writer was interested in noting the purposes for which the reports were made.

The Hendrix Study. Grant Hendrix completed his masters thesis in 1941 entitled, " Controlling Principles of Woodworking Machine Selecting. "(11)

This study deals with the selection of woodworking machines for the Senior High School. In Chapter III Mr. Hendrix gives an analysis of the types of machines most commonly used in high schools. The machines most commonly found in the high school shops were selected at random and ranked in the order of their frequency, are circular saw,

jointer, grinder, lathe, band saw, jig saw, drill press, shaper, surfacer, and the mortiser. The report contains a discussion of points to consider when buying school shop machines.

The Waltrip Study. Gerald L. Waltrip completed his Master's report in 1946 entitled "A Study of Tool Holders"(24)

This study gives a critical analysis of fifty photographs showing methods of tool storage. These photographs are classified into four general groups which are: (1) Tool Panels, (2) Woodworking Tools, (3) General Metal Tools, and (4) Racks. This study presented the facts that there is very little published-material on this subject and there is a need for further study.

Purposes of the Report. The purpose of this study is to collect and bring together information on the development of woodworking equipment, the selection and placement of school shop equipment. It is the belief of the writer of this report that there is a need for woodworking in the Industrial Arts Program throughout the school system. Since the family depends upon industry and service establishments for practically all of their needs, the child no longer has the opportunity to get the tool experiences that he should obtain from the home. To help fulfill the purposes of general education the school must include some industrial arts shop work.

Limitations and Definitions of the Report. The selection and use of school shop equipment presents many problems which have vexed school officials and shop teachers since the beginning of the Manual Training Schools. During the career of the shop instructor he will sooner or later be confronted with the fitting of a new shop or replacing old equipment or adding equipment for a new unit or units of work. It is hoped that this report will be of benefit to those engaged in instructing boys and girls in school shops.

Definition of Terms. In order that the reader may understand more clearly the meaning of terms used in this report, the following definitions interpret these terms as used in this report.

> Education is the development of general intelligence by a system of study and discipline or by experience of life. Education includes not only systematic schooling and formal methods of acquiring knowledge, but also that enlightment and understanding which is gained through experiences. (15, page 26)

> Industrial Arts. The term industrial arts refers to all classes and courses of shopwork and industrial drawing taught in the junior or senior high school for general education and guidance purposes. Its purposes are primarily to orient the student in our current industrial civilization by means of experience in working with as many of the materials common to everyday life as possible. (22, page 1)

> Handtools. The small tools of the trade used to process material or service work by hand manipulation. (16, page 19)

> Machines. Stationary or movable devices, usually power driven for cutting, shaping, and processing various materials used in a trade. (16, page 19)

> Elementary Education. The period of formal education

beginning in childhood, usually at the age of 5 to 7 years, and ending approximately with adolescence, at the beginning of secondary education; variously defined as including grades 1 to 8, and sometimes nursery school and kindergarten, or as ending with grade 6, as in places in which the six-three-three plan are in common use. (10, page 149)

Elementary Industrial Arts. Is the informative and manipulative work offered in the first six grades, involving tools, materials, processes, and products of industry as they relate to home and community life. (10, page 261)

Junior High School. The lower part of a divided reorganized secondary school comprising usually grades 7, 8, and 9; less frequently consists of grades 7 and 8 or grades 8 and 9. (10, page 231)

High School. The school division following the elementary school, comprising most often grades 9 to 12 or grades 7 to 12. (10, page 201)

Shop. A term used rather commonly and somewhat loosely to refer to study or instruction in wood or metal work or other industrial laboratory skills and procedures; used also to refer to the laboratory and equipment used. (10, page 370)

School Shop. A shop in connection with the school system where boys and girls work with tools and materials under the supervision of a teacher.

Production Shop. A shop in which machinery, usually large machines, is used to produce articles of wood in large numbers according to trade and industrial standards.

Home Work Shop. A shop usually in or about the home equipped with small machines whereby one may make useful articles for pleasure or profit.

The Method of Reference. The credit to books and magazines from which quotations are taken is given by the number of the publication in the bibliography and the page of the reference as follows: (5, page 30-31)

The Plan of the Report. The history of woodworking equipment is developed in the following chapters. Chapter II is divided into a discussion on the history and development of hand tools, the history and development of woodworking machines, and a discussion of the current problems in school shop machine selection. Chapter III discusses the movements and philosophies leading up to the industrial arts program in the American school system. Chapter IV discusses some of the criteria for selecting tools.

CHAPTER II

EARLY HISTORY OF WOODWORKING EQUIPMENT

In discussing school shop woodworking equipment a short review should be made of the history of tools from the crude hand tools of the early cave man to the modern time. In the beginning of things the tools man had to work with were made of stone, and considering the crudity of these and the low level of his mentality man used them nobly and well. Thousands of years later came the "Bronze Age" and with it tools of a better kind, and it follows, man's skill as a woodworker showed much improvement.

By the time that iron was discovered the human race had advanced greatly in mental power, and with it, came the coordination of eye and hand. As man became wiser he also became quite a nimble-witted fellow who not only made fairly good tools but had learned to use them quite well.

Prehistoric man was making and using axes, awls, hammers, saws, drills, and harpoons before the Age of Metals. The same principles that these prehistoric men developed have remained about the same throughout the centuries, but there has been great advancement in the design and materials used in the manufacturing of both hand tools and machines.

PART A. A SHORT HISTORY OF HAND TOOLS

Since the beginning of history man has been making

things to ease his existance. As he progressed he devised any number of tools, each of which was designed to perform some specific operation. For our study we shall consider hand tools in the following general classes:

Measuring Tools. These consist of the rule, try square, framing square, bevel, marking gauge, dividers, and calipers.

It is a long step from the time when one inch meant the width of the thumb, and one foot meant the length of the foot, to the measuring of distances and angles which vary only by minute differences.

1. Rule. A rule is generally the first tool used by the woodworker. Rules may be secured in different lengths, but in all cases the unit of measure is the inch with its subdivisions into halves, quarters, eighths, and sixteenths. For convenience the rule is often hinged so as to fold. A rule is called "two fold" when it is made of two pieces, "four-fold" when made of four pieces, etc. For exact measuring, the rule should be placed on its edge and the scale points marked with a knife.
2. Try Square. The try-square is used to test out edges, ends, and sides of board and for the squaring of lines. The sizes are various and are indicated by the length of the blade. A convenient size for shop use has a blade 6" long.

3. Framing Square. The framing square is a right-angled steel measuring device which is useful, not only as a straight-edge and try-square, but also for a number of graduations and tables which are stamped on it.

There are various sizes of framing squares, but the one in most common use consists of a blade 24" X 2" and a tongue 16" X 1½" at right angles to each other.

4. Bevel. The T bevel is a try square having an adjustable blade and a thumb screw which holds the blade at any desired angle with the stock or handle. It is used to lay out angles other than right angles, as, for instance, on corner braces, dovetails, or side rails for chairs.

5. Marking Gauge. The marking gauge is made of wood or steel. The one most commonly used in the school shop consists of a bar called the "beam" about 8" long, on which a wooden block or head slides. This head can be fastened at any point on the beam by means of a brass set-screw bearing against a brass shoe. The beam is graduated in inches and is provided with a steel point or spur fastened near the end with a screw. This steel point scores the wood.

When using the marking gauge, move the gauge away from you and tip it slightly forward

while the head keeps contact with the edge or face of the stock at all times. The gauge is used to lay out accurate lines along the grain of the wood, parallel with the working edge.

6. Dividers or Compasses. The dividers or compasses consist of two legs hinged at a common joint and having sharpened points. A convenient form is the wing divider which can be accurately adjusted by set-screws. They are made in lengths of from 6 to 10 inches, and are used to scribe small circles.

Cutting Tools. The cutting tools consist of the chisel, knife, handsaw, and plane. The most primitive as well as the simplest of all tools for the dividing of wood into parts is the wedge. It was by means of the wedge that primitive people obtained wood, and the great change from primitive to civilized methods in manipulating wood consist in the substitution of cutting for splitting, of edge tools for the wedge. The function of all cutting tools is to separate one portion of material from another along a definite path.

1. Chisel. The chisel and the knife, one with the edge on the end, and the other with the edge on the side, are the original forms of all modern cutting tools.

The chisel was at first only a chipped stone, then it came to be a ground stone, later it was made of bronze, and still later of iron, and now

it is made of steel. In its early form it is known by archeologists as a celt, and at first had no handle, but later developed into the ax and adze for chopping and hewing, and the chisel for cuts made by driving and paring. (18, page 53-54)

The modern chisels are ground on one side. The chisel is used principally in fitting, shaping, and making joints by hand. With reference to handle construction, there are two types of chisels; tang chisels and socket firmer. The handle of the socket firmer chisel enters into the cone-shaped socket of the chisel, whereas the handle of the tang chisel has on it a ferrule; the tang of the chisel fits tightly into the handle. Socket firmer chisels are designed for heavy work.

2. Gouge. The gouge is similar to the chisel, but the blade of the gouge has a curved surface that runs lengthwise. They are spoken of as inside-bevel gouges and out-side-bevel gouges.

3. Plane. The plane is a modified chisel. It was first a chisel held in a block of wood. The first improvement was the addition of a wooden wedge to hold in place the "plane-iron" as the cutter was called. In this form, the cutter was made heavier at the cutting edge in order to help fasten it in the wooden plane stock by means of the wooden wedge. Then a handle was added for

convenience. Later came the chip breaker, the object of which is to break back the shaving and thus weaken it as soon as possible after it is cut. Finally there appeared the iron plane with its many adjustments.

There are several kinds of planes, each designed for a special purpose. For our purpose we shall consider the block plane, the smoothing plane, the jack plane, and the jointer plane.

The block plane is the smallest, being from 4" to 8" in length. It has only a single plane iron which is placed at a very low angle with the beveled side up. This plane is used for planing end wood and in places where an ordinary plane cannot be used.

The smoothing plane is larger than a block plane, being from 5½" to 10" in length. The smoothing plane is used on small, fine work.

The jack plane is the most useful, all-around plane in the shop. It is 14 or 15 inches in length, and consists of an iron body to which the plane iron is clamped. The main purpose of the jack plane is to rough out stock, to make surfaces level, and to straighten edges of short boards.

The jointer plane is from 18" to 26" in

length. The parts are similar to those of the jack plane. The jointer plane is used chiefly for planing the edges of long boards to be glued and for smoothing large surfaces.

4. Saws. The object of the saw is to cut through a piece of material. The first saws were made of stone. The saws made during the latter part of the stone age were ground into beautiful shapes on other stones. The ancient Romans were the first people to make saws which the present day saws resemble.

> The ancient Romans were the first people to make saws with regular shaped and set teeth. They also invented the plane, and made both tang and socket chisels, and developed the claw hammer. (12, page 3)

In general saws are of two kinds, ripsaws and cross cut-saws. Different types of these saws are used for different sawing jobs. For general purposes, the most common are the ripsaw, crosscut saw, backsaw, compass saw, and miter saw.

The rip-saw may be thought of as a series of chisels set in two parallel rows, which overlap each other, for each tooth is filed to a sharp edge which, at each stroke, chisels off a small particle from the end of the wood fiber. It is used to cut with the grain. This saw is made in two parts; the blade and handle.

Blades of ripsaws vary in length from 20 to 28 inches. They are always wider at the handle than at the end; in order to prevent them from bending when pushed through wood.

The teeth of all saws are bent out a little to make the cut or "kerf" wider than the thickness of the saw. This is called setting the saw. This is done so the saw will cut through the wood without binding. The size of a saw is indicated by the number of "points" to the inch; the number of teeth occuring in 1 inch less one. The number of points a saw contains is stamped on the blade near the handle of the saw. The teeth are filed approximately straight across.

The crosscut saw is used to cut across the grain. Although it is similar in appearance to the ripsaw, there is a distinct difference in the shape of the teeth. The cutting edges of the teeth are on the sides rather than approximately square across the points as on the ripsaw. The average shop cross-cut saw runs from 8 to 12 points to the inch.

The backsaw is a crosscut saw with a thin blade and fine teeth used for fine work. A heavy piece of steel fits on the back of the thin blade to give the saw rigidity. The backsaw usually has from 14 to 18 points to the inch.

The compass saw has a narrow, tapering blade so that it cuts on curved lines. The teeth are filed like those of the ripsaw. It is used to cut curves, circles, or a section from within the board.

The miter saw is a large backsaw which is used in a miter box to cut angles.

Driving Tools. Man's first tool for driving was a stone without a handle. As man advanced he made a hammer by fastening a rock to a stick.

> "A stone used for hammering was probably man's first tool. It didn't have a handle then."(9, page 1)

Man has improved the pounding tools until today there are many kinds suited to many types of work. We shall consider the hammer, mallet, and screwdriver.

The hammer consists of two parts, the head and the handle. The head is made of hard steel. The handle is of hickory. There are about fifty styles of hammers varying in size from a jeweler's hammer to the sledge-hammer, weighing twenty pounds or more.

The claw hammer is the type generally used by woodworkers. The face is used for driving nails and the claws are shaped for pulling nails. The weight of the head in ounces indicates the size of the hammer.

The mallet is a round-or square-shaped hammer, the head usually consists of wood, leather, or of a rubber composition. It is generally used to drive

chisels into wood or to tap joints together.

The screwdriver, while not a striking instrument, may still be considered a driving tool. They are made with blades from 2 to 18 inches in length. The screw driver is used to drive screws into wood. The end should be flat and square and only as thick as the screw slot. Screw drivers which are too thin for the slot or have rounded edges climb out of the slot and damage the top of the screw. The Phillips screwdriver and Phillips screw have been developed to speed work.

Boring Tools. The woodworker frequently needs to bore holes in wood. Making joints, boring holes for screws, and making holes for the insertion of saw blades all call for the use of the boring tools.

The first primitive boring tool consisted of a fish bone, or an awl made of bone set in one end of the cylindrical wooden stick and this was given an alternate rotary motion by holding it between the palms of the open hands and then rolling it forth and back between them. As a drill of this kind could only be used for making holes in soft materials prehistoric man improved upon it by fixing a bit of flint, or other hard stone, in the end of the stick. This kind of a drill point was good enough as a cutter, but the speed of it was slow and it required a lot of energy to keep it going.

The principle members of the boring tools are the brace, auger bit, expansion bit, and hand drill.

1. The brace is used to hold several types of boring tools and to furnish enough leverage to turn the tool in the wood. The size of the brace is determined by the diameter of the circle that the handle makes, which is called the "sweep." A ratchet attachment permits boring in places where a full turn of the handle is impossible.
2. An auger bit is used with the brace. They are screw-shaped tools consisting of three main parts, the twist, shank, and tang. The twist ends in a small screw point, which draws the bit into the wood, a pair of nibs that score the circle, and two cutting lips which remove the shavings. The threads of the twist are made in three different pitches--steep, medium, and fine. The steep pitch means quick boring and thick chips, and fine pitch means slow boring and fine chips. The shank ends in a square-tapered tang, which is held by the chuck of the brace. The size of the bit is indicated by a number stamped on the tang. Auger bits are measured in sixteenths of an inch and range from number 3 to number 16. A number 3 would be 3/16", a number 6 would be 6/16" or 3/8", and a number 16 would be 16/16" or 1".

3. The expansion bit has a movable cutter and is used to bore holes in various sizes from 1" to 4" in diameter. Expansive bits are made in two sizes. The largest-sized bit has three different-sized cutters which are interchangeable.
4. The hand drill is used for boring small holes rapidly. The chuck on hand drills has three jaws and holds only straight-shank drills.

Man has used his inguenity in developing tools to ease his existance. In the beginning he used simple tools made of stone. During the age of metals man improved these simple tools by making them of copper, bronze, and iron until now we have many well designed tools for all types of work.

PART B. A HISTORY OF WOODWORKING MACHINES

Man was not contented with using the crude hand tools so he began to experiment by applying power to these hand tools until he evolved a contraption which was called a machine.

Machines are something more complicated than a tool. A machine may be considered a combination of wheels, levers, and gears, which act together, to perform some useful work. Such simple machines as the lever, pulley, inclined plane, and wheels, are machines of which ancients knew and used. Usher tells us that in the second century A.D. (23, page 69)

> Hero of Alexandria describes five simple machines by which a given weight may be moved by a given force; the wheel and axle, the lever, the pulley, the wedge, and the endless screw.

Writers of this century write of these machines as a group which leaves the impression that they were all made upon the principles of the lever. Writers on mechanics up until the end of the sixteenth century represent these machines as the basis of all machinery.

Machines have always fascinated men and boys. This fascination with the desire to make labor easier has made for the development of crude hand tools into the modern production machinery driven by electrical energy.

The limited amount of material on the history of woodwork is shown by the statement of Carr: (4, page 58)

> A unit of woodwork machinery is found in almost every high school course of study and yet a good text is not available; in fact I found very little reference material for either the teacher or the student.

The Drill. The bow-string drill was perhaps the oldest of our woodworking machines. The drill is held with one hand. A cord is given a couple of turns around the drill and is operated by the other hand.

> The bow-string drill which was in use in prehistoric times was the basic instrument for many purposes: carpenters, furniture makers, ship wrights, sculptors, gem cutters, and all used this device for turning their tools. (23, page 106)

The woodworker used this method of cutting holes with sharp stones and teeth of animals.

Lathe. The lathe developed in early Egypt shortly after the bow drill. These old lathes consisted of a headstock and a tailstock fastened to a bed that consisted of timbers bolted together. The work to be

turned was turned by means of a string wound several times around it, one end fastened to a flexible pole fastened to the ceiling and the other to a treadle. When the treadle was pushed down the work would revolve toward the worker, and when releasing it, the pole would rotate the work back. Hjorth tells us that this lathe was invented about 740 B. C. (12, page 9)

> This lathe called the pole, was evolved from the most primitive or bow lathe, which was invented in Egypt, long before the Christian era (about 740 B. C.)

The pole lathe was improved by adding a pulley to the treadle so that a continous forward movement could be given the stock to be turned.

During the sixteenth and seventeenth centuries many of the nobility of both sex practiced wood turning as a hobby.

Saws. The ancient Greeks and Romans had a form of hand saw copied from jaw bones. Perhaps the first attempt to add power to a saw was made when a handle was put on each end and in this way two men could move it.

Hero of Alexandria speaks of a stone saw which was run by water power at the close of the fourth century. There is very little mention of power saws until early in the fourteenth century. Usher tells that Charters' references to saw mills

begin early in the fourteenth century. (23, page 144)

> In Germany sawmills are mentioned at Augsburg in 1337 and 1389. There were sawmills established on the island of Maderia in 1422; at Breslow in 1427.

These references lead us to believe that continous application of water power to sawmills was common in various localities.

Old documents of the fifteenth and sixteenth centuries tell of crude saws, in wooden frames, found in a few places on the continents of Europe and Asia. These first saws were of the straight type similar to the hand saw of today. Until the beginning of the Eighteenth century most work was done by the same laborous methods as in the preceding centuries and only a few attempts had been made at machine construction.

Hjorth makes the following statement concerning the history of the first circular saw:(12,page 1)

> The first circular saw was invented in Holland, but was not a great success because of the difficulty of making saw blades and bearings for it. A saw of this type, patented by Samuel Miller, a sailmaker of Southampton, was set up in England in 1777.

The first circular saws had for their base and table, heavy wooden timbers and were turned by water power. Today the modern circular saw has a heavy iron base which makes it sturdy and lessens vibration.

Carr makes the following statement about the

circular saw: (4, page 59)

> The first American sawmill run by water began work in 1643 on the falls of the Piscataqua on the line between Maine and New Hampshire.

The greatest problem that faced the makers of circular saws was the securing of steel that would withstand the high speed. Technical men have done much to perfect saw steel. The sawmakers have also done much to help themselves by perfecting raw materials to help themselves. Henry Disston, a mechanic, working in a saw plant in Philadelphia, realized that the quality of the steel available was not what he wanted so in 1855 started a small plant of his own where he made crucible steel.

The saw slowly developed until it would cut timbers into suitable lumber and dimension material but it left this lumber rough and it had to be laborously hand planed.

Band Saw. This is another of the important shop machines both in industry and in the school shop. It is a continuous band with saw teeth cut on one or both edges. The large or saw mill type of band saw has teeth on both edges so as to cut both ways, while the small band saw has teeth only on one edge.

Band saws were not successful until its blade was made of a steel that would withstand the bending and the tension under which the blade operated.

> The band saw was invented in 1808 by William Newberry. It was an immediate success, because at that time the making and welding of saw blades was not very well understood. It was not until almost fifty years later, when the French perfected the manufacture of saw blades, that the machine came into general use. (12, page 7)

Planer. The first planer was developed, much as the first power saw, by simply attaching power to the hand plane. The planer of today uses the principle of the rotary cutter which is used on many of our modern machines. General Batham, an Englishman, patented the first planer along with other remarkable inventions.

> General Bentham, in English patent No. 1,838, of 1791, describes a rotary form of planer along with a great variety of other woodworking machines.
>
> Braman's planer, British patent No. 2,652, of 1802, was about the first planing machine of the nineteenth century. It is known as a transverse planer, the cutters revolving in a plane parallel with the upper surface of the board.(12, page 60)

The cutter head for this planer was square without a guard, which made the planer very dangerous. This square cutter head has been replaced with the cylindrical cutter head.

> The cylindrical cutter head for the jointers was developed in England and Germany about 1901 and was introduced in this country by the Oliver Machinery Co., in 1908. It was a great improvement over the dangerous square cutterhead, and greatly reduced the hazards in operating the jointer. (12, page 16)

PART C. SUMMARY AND MODERN TRENDS

America has become highly industralized. To meet

the demands of people for the finished product, machines have developed to a high degree of perfection. Metal working machines have developed at a much faster pace than the woodworking machines. In connection with the history of woodworking machines one must also mention the types of woodworking machines in general use in woodworking shops. These machines can be divided into three types. The three types of woodworking machines are: The production type, the school shop type, and the home workshop type. A short description is given in the following paragraphs.

Production Type Woodworking Machines. These machines are made to withstand the effect of continuous use. They are usually highly specialized. This type of machine is used mostly in the production shops and the furniture factories. Many of our schools and colleges work on a production basis and are equipped with this production type machine. A planer with a motor over five horse power is considered a production machine.

School Shop Woodworking Machines. Machines that are used in the school woodworking shops range from the small machine to the production type machine. There is a machine that is made somewhat smaller than the production that is most satisfactory for the school shop. This machine is built exactly like the larger machines and built to do the same work, but is made smaller to cut down on the first cost and the operating cost. This type of machine is built to withstand the

abuse that it will receive at the hands of boys. The school shop woodwork type of machine should be installed in the shop if at all possible.

The problems that bother teachers in equipping shops with woodwork machines are largely due to three things; first and most important is a clear understanding as to the place of woodworking equipment in the teaching program; second, the pride of possession of equipment which is little used, in order to have a large and spectacular equipped shop. Third, the natural desire of the manufacture to sell equipment.

Little thought is given to specific things that are to be taught with the equipment, or the time required, or the practice necessary to learn them. This is often the cause of an expensive installation which stands idle most of the time.

For the purpose of clarifying the thoughts of the instructor on the use of machines in the school shop, Selvidge has Classified machines as "Service" machines and "Instructional" machines.

> The "Service" machines. We have been a little muddled in our thinking concerning the use of machines in our instruction program, and we should get this cleared up. Undoubtedly "service" machines are needed in classes. This is particularly true in large schools, but it should be remembered that the use of such machines is not necessarily instructional in character..... It may be safely said that we should not permit boys to operate machines or engage in any kind of shopwork in school from which they would be excluded in industry on account of the dangers. In so far as the instructor is concerned this would exclude the

> use of certain machines in the junior high school in most states but would not interfere with their use by instructors for the preparation of materials or for the demonstrations of the principle of the machine and how it operates.
>
> "Instructional" machines. If we are to use machines in school for other than service purposes we must know exactly what we expect to teach on each machine and the approximate time required for the boy to learn these things. This is necessary to have a "balance" of instruction on machinery just as we would seek a balance of "production" in industry by installing the proper proportion of the different types of machines required. (21, page 381-382)

Home Workshop Type Woodworking Machines. With the advent of better working conditions and more leisure time, many people turned to hobbies. There grew up in nearly every city in America, hobby shops where many people spent their time for fun or profit. The home workshop is the outgrowth of these hobbies. In the last few years the home workshop movement has spread very rapidly. To meet the demands of the hobbiests there are several manufacturers who make small woodworking machines that are economical in cost and suitable for this type of shop. These machines are usually spoken of as portable or home workshop machines. Hjorth describes them as follows: (12, page 18)

> These small machines, which operate from a light socket, are generally as well made as the full-sized machines. They are economical, safe to operate, and capable of performing many different operations. When installed in production shops, they are great time and labor savers, because they reduce handwork to a minimum.

Prehistoric man made crude tools from stones, rock, sea shells, and bones for the purpose of making

his burdens easier. There is very little recorded evidence of much progress in tool making until the time of the Industrial Revolution. During this period man began to experiment with and make tools of metal. Many experiments were made by operating saws with water power. Saws were of very little success until improved methods of steel making were discovered. With improved methods of making iron and steel, tool and machine designs advanced until today we have well designed and constructed tools for all types of work.

The school shop teachers are faced with the problem of equipping school shops with several types of tools and machines.

CHAPTER III

WOODWORK IN AMERICAN SCHOOLS

A short review of the early history of education should serve to give the reader a better understanding of the place of woodworking in the industrial arts program of the modern school.

Out of the social and political turmoils of the eighteenth century came about an improvement in the living conditions of the majority of people. Educational emphasis was directed toward the needs of the individual.

Early Educational Leaders and Philosophies. Rousseau, Basedow, and Pestalozzi, did much to foster the philosophy, that education according to nature, uses natural instincts and the natural tendencies of the learner.

a. Rousseau (1712-1778), a French philosopher and writer, caused much sensation throughout the world with his book "Emile" published in 1762, in which he tells of the model education of an imaginary child in an ideal society. In "Emile" Rousseau announced that the education of the child comes from experiences rather than ideas.

Among other things, Rousseau stressed the importance of occupations in agriculture and the mechanical trades. Because he considered labor the duty of both the poor and the rich, he would have "Emile" to learn a trade.

"A trade for my son? My son a working man? What are you thinking of, sir? I want to give him a rank which he cannot lose, a rank which will always do him honour: I want to raise him to the status of a man, and, whatever you may say, he will have fewer equals in that rank than in your own." (19, page 159)

Rousseau furnished the philosophy for industrial arts, that has found a place in the modern school program, when he stated the following. (19, page 159)

"The great secret of education is, to make the exercises of the body and mind serve as a relaxation for each other."

b. Basedow (1723-1790), a German student and professor of philosophy was influenced by the writings of Rousseau. He directed his interest toward reforms for the elementary schools. From 1768 to 1774 he produced several books, the most important of which were his "Methodenbuch", and his "Elementarwerk". The "Elementarwerk" was completed in four volumes in 1774. In these volumes he brought out the belief of Rousseau, that the best way to obtain knowledge was through experiences.

With the help of Prince Leopold, he found an educational institution at Dessau in which the principles of "Elementarwerk" were put into practice.

"A regular part of the work included turning, planing, and carpentry for their educational values. This is the first record of handicraft training in school." (6, page 34)

Eighteenth Century Education in America. The ties between America and the old world were very strong. These ties had a great influence on education in this country before the Revolutionary War. There was in the New England

section an early tax supported system of common schools. The Middle Colonies left the matter of schooling to church groups, while in the South the English system of tutors or private schools for the wealthy and the pauper schools for the poorer classes prevailed. The lack of contact with Europe and the frontier conditions tended to lessen this country's dependence on the Old World and brought about the American form of education.

The efforts of early leaders resulted in broadening the educational philosophy to accept the value of handicraft training.

Early efforts to include shopwork in the school's program had its beginning, in this country, in the schools of higher learning.

Shopwork Instruction in America. There were any number of movements and early schools which pioneered shop instruction in America.

a. Vocational Education Movement. This program took the form of combined schooling and part-time employment such as advocated by Salzman, Pestalozzi, and Von Fellenburg.

Salzman (1741-1811) was the preacher of the school at Dessau, conducted the devotional exercises, and was in charge of religious instruction there for three years. He then founded a school at Schnepfenthal for the sons of people belonging to the higher classes of society. The emphasis of the school were placed on physical training and manual work.

> Pupils were given instruction in paper work, carpentry, basket-making, and turning by specially trained teachers in each subject, not by mere artisans. (1, page 85)

Pestalozzi (1746-1827), the son of a Zurich physician established an industrial school at Neuhof for the poor.

Conners states this about Pestalozzi. (6, page 36)

> His school at Neuhof in 1775 was probably the first industrial school for the poor. The students spent part of their time in raising farm products, spinning, and weaving and other occupations.

Von Fellenberg (1771-1844), of Berne, Switzerland, set about to reform and extend education by establishing the hofwyl.

> Fellenberg began the great work he had planned by devoting himself to the improvement of agriculture and by associating two or three pupils with his own sons, and employing private tutors in his own house. (2, page 131)

Among the Manual Labor schools were: (1) The Oneida Institute of Science and Industry, near Utica, New York and (2) The Manual Labor Academy of Pennsylvania at Germantown, Pennsylvania.

The purpose of these schools were not that of developing skills and knowledges that would be useful in employment but they provided the student with physical exercises that would provide him with good health and help his earnings to defray the expenses of school.

b. Mechanics Institute Movement. This type of institution had its origin in a society of artisins in Glasgow, Scotland, in 1823. The Mechanic's Institute became a strong influence in America. By 1870, the Mechanic

Institute Movement had done an important work in providing instruction in secondary and technical education subjects. One of the first to be organized in America was the General Society of Mechanics and Tradesman of the City of New York established in 1785. Other institutions were in Boston, Philadelphia, Rochester, and Cincinnati. These schools gave evening instruction and included both academic studies, laboratory work, and drafting. Shop work was also offered in some of these institutions.

c. Early Technical Schools. These schools provided practical work with theory. In 1871 instruction in both wood and metal was given in Illinois Industrial University, now the University of Illinois. Experiment with this type of work was carried on at Washington University, St. Louis and at Massachusetts Institute of Technology.

Colvin M. Woodward of Washington University and I. D. Runkle, President of Massachusetts Institution of Technology, were the greatest advocates of shop work in this country.

Dr. Woodward, an instructor of mathematics, started teaching woodwork when he discovered a lack of ability, and a knowledge of tools on the part of his students. To aid them in visualizing the objects being studied in mathematics he had asked them to construct such solids out of wood. He was surprised to find that very few were able to do this. As a result he asked the university carpenter to instruct these students in elementary woodwork. Woodward

saw the value of the orderly arrangement of tool instruction as evidenced by the Russian System.

> In every shop there hung: A board upon which were samples of the regular course of study pursued in that shop, (1) a board to which was fastened one of the regular bench set of tools, the name of each tool being on the board in large letters, (2) rules for the internal order of the shop, made by the manager of the shop and approved by pedagogical conference, (3) a list of the benches, vises, furniture, machines, etc., constituting the equipment of the shop, and (4) the daily program of work. (2, page 19)

The Russian system provided for progress from the simple experience to the complex experiences.

In 1880 Woodward opened, in connection with the University, the first "Manual" training school in the United States.

> The course of instruction, the making of which was a most important factor in the success of the school and, in fact, constituted the distinctive features of this new type of secondary school, consisted of five fundamental lines of study carried simultaneously: (1) Mathematics, (2) Science, (3) Language, (4) Drawing, and (5) Shop work. (2, page 351)

Runkle observed that students entering engineering courses with some shop experience secured employment upon graduation more readily than those who did not have shop experience.

Woodward and Runkle saw the possibilities of systematic instruction for high school students and did much to make this instruction possible. Woodward stated, in explaining the general education philosophy advocated in shop work, the following from Conners.(6, page 65)

> An exercise, whether with tools or with books, is valuable only in proportion to the demand it makes upon the mind for intelligent, thoughtful work. In the school shop the stage of mechanical habit is never reached; the only habit is that of thinking.

During the ten years following the opening of Woodward's Manual Training School many public schools introduced this type of shopwork. By 1893 manual training was taught in high schools of more than 50 cities in the United States. By 1900 the number of manual training schools was one hundred and sixty-nine. By 1909 more than half the cities in the United States of four thousand or more population reported manual training in their high schools.

In the general academic high school woodwork was the most common form of manual training for boys. The usual time allowance was two 45-minute periods a week in the high schools. All the elementary and junior high school pupils were given woodwork but it was often optional with the high school pupils.

Manual training contributed much to education in establishing the fact that tools, machinery and the materials of the industrial world can be used for instructional purposes in a school. Manual training, in its evolution from these early beginnings, has played an increasingly important part in the school curriculum. It has taken on important exploratory and guidance values. At each school level the educational program should be fitted to the needs, interests, and abilities of the students. Newkirk and Johnson are in accord with this statement when they say, (17, page 5)

> Today in all sections of the country, school administrators are meeting the need for well-rounded education by making industrial arts an important subject at all grade levels.

Industrial Arts in the Public Schools. Man is responsible for many changes that have developed on the earth's surface. He has the power to think and reason and has highly developed hands. Life is much easier for our people today than it was for their forefathers. Much of their present day work is done by machinery or by service establishments. As a result children have little or no opportunity to watch people at work or to learn the essentials of construction by working with their parents. The children of today need that training which will help them make an adjustment to modern conditions of living. Complete preparation for life is the ultimate objective of education in the modern school.

School administrators are meeting the need for well-rounded education by making industrial arts an important subject at all grade levels. Industrial arts is an important part of general education for boys and girls while woodworking is perhaps the oldest and one of the important phases of industrial arts.

In a broad sense industrial arts may be defined as follows: (17, page 5)

> Industrial arts is the study of materials and of the desirable changes made by hand or by the several manufacturing processes from the raw state into products designed to meet the consumer's needs and comforts for daily living.

Boys and girls are endowed by nature with impulses which give them the readiness for industrial arts instruction. They enjoy using tools and materials, they like to investigate and learn why and how machines and tools work. The natural appeal of industrial arts courses to the native impulses of children leads to effective learning.

Newkirk and Johnson summarize the teaching aims of industrial arts in the following eight objectives, (17, page 17)

1. Develop the ability to plan and complete projects, a variety of tools and construction materials in a workman like manner.

2. Give experiences that will increase understanding of modern industry and that will lay the foundation for and help determine vocational interests.

3. Develop the ability to read and make working drawings, charts, and graphs.

4. Develop the ability to recognize quality and design in the product of industry.

5. Develop the ability to maintain and service in a safe and efficient manner the common products of industry.

6. Provide an objective medium for expression in mathematics, science, language, arts, and social science.

7. Gives experiences that will develop social understanding and the ability to work effectively with others either as a leader or as a member of the group.

8. Develop an interest in crafts as a valuable medium for expression in leisure time.

The emphasis that is placed on the above objectives will vary with the grade level, type of pupil, and community interest.

As the demands on the public education changed,

movements were started to adjust the school organization to its broader program. The changes which are still in progress take into consideration the psychological and physiological characteristics of the student as well as the needs of society. This organization which dates from the latter part of the nineteenth century, separates the traditional twelve years of schooling into three instead of the usual two units and is commonly known as the "6-3-3" plan. It provides for:

6 years of elementary school

3 years of junior high school

3 years of senior high school

This plan provides a better opportunity for adolescent youth to explore, try-out, and sample a wide variety of educational and vocational interests during that period of change from childhood to early adulthood. It provided an easier transition and adjustment to the more specific and purposeful high school program.

For the purpose of this report the "6-3-3" plan of education will be used, with the elementary education being divided into two parts; Grades one through three and grades four through six.

Industrial Arts in the Elementary School. The underlying theory and purpose for stressing industrial growth and to help the individual to adjust himself. Surveys show that children acquire knowledge through manipulative participation more easily than through the more conventional methods of teaching. These surveys also show that children through

manipulative experiences retain knowledge much longer. Aside from mental growth and learning facts, industrial arts develops in children creative thinking, planning, accuracy, and decision.

Bonser sought to help in reforming elementary education.

> In doing so he made full use of industrial arts. He asserted that industrial arts, when considered as a school subject, must justify itself on the same basis as other subjects. (2, page 454)

Industrial Arts in Grades One Through Three. Handwork as applied to the learning processes in the first three grades is the initial step in the industrial arts program. This program in the primary grades acquaints the child with ideas and interests pertaining to the environment of his home and neighborhood. Industrial arts provides the child with opportunities to become familiar with the use of common hand tools and to work with wood and other materials of industry. Participation in some form of manipulative enterprise fulfills the child's desire to express himself actively.

Most of the handwork activities of the first three grades can be carried on in the regular classroom. The traditional classroom with its fixed seats does not permit much freedom of movement and arrangement as does a room furnished with seats and desks that may be moved about the room. With a minimum amount of equipment, even the classroom with fixed furniture may be adapted for use in carrying

on handwork. A place may be found for a workbench with vises. Desks may be covered with oilcloth, or plywood for additional work space. Storage space for tools and supplies may be built of boxes or crates. It is often desirable to have access to a vacant room in which group work may be carried on. The suggestion of the activity unit should come from the children and should be carried out in correlation with the other school work. A minimum tool and equipment list for these grades will be found in another section of this report.

Industrial Arts in Grades Four Through Six. When children reach the middle grades they have sufficient maturity and background to profit by a regular course in industrial arts. Both boys and girls should be given the intermediate industrial arts instruction as a part of their general education. They have natural impulses to manipulate tools and materials and like to give expression to their ideas in an objective way. The industrial arts classes in the intermediate grades acquaint boys and girls with work in wood and many other materials. They should be given an opportunity to make craft objects for themselves and friends. The instruction should be centered around useful and attractive articles. The use of all tools should be taught in connection with making projects which have child interest.

The industrial arts shop in the intermediate grades should be a place where boys and girls work and live together.

The shop should be located on any floor of the building except in the basement.

According to Newkirk and Johnson, a well-designed elementary shop should have the following characteristics: (17, page 99)

> (1) a comfortable and appropriate place for assembling the entire class for demonstration and explanation, (2) a well-appointed demonstration table equipped with gas and water, electric outlets, necessary tools, and vises, (3) plenty of storage cabinets or similar space for tools and materials, (4) workbenches of the proper size to provide comfortable and efficient working conditions for each grade level, (5) a double-drainboard sink equipped with a hot-and-cold-water mixing faucet, (6) a stove with an oven regulator, (7) a jig saw, sewing machines, and a bench-type grinder, (8) wall benches or tables to provide additional working space, and (9) several convenient electric outlets.

Large classes in industrial arts are not fair to the pupils or the teacher and therefore should not be attempted. The class should not be larger than twenty to twenty-four.

The elementary industrial arts pupils in grades four to six should continue to work on projects that are integrated with social studies, arithmetic, and reading. If the school employs a special teacher, this teacher should plan the projects with the homeroom teacher. If the homeroom teacher is responsible for the industrial arts she should continue to correlate the work with the other subjects as in the first three grades with more and more responsibility for carrying out the project left to group planning.

In woodwork the boys and girls should learn to use the simple woodworking tools, simple fasteners, and finishing materials. Intermediate-grade children cannot be expected

to master fully the use of woodworking tools, but they will develop considerable skill and get a foundation for further development in the advanced grades.

For convenience a tool list of recommended tools and materials will be given in another section of this report.

Industrial Arts in the Junior High School. The Junior High School or grades 7, 8, and 9 are known to educators as a transition period for boys and girls between the elementary and senior high school. In the seventh grade the pupil encounters, for perhaps the first time, a different teacher and room for each subject. Home work and personal responsibility increases. Usually woodwork is offered only to boys as a separate subject in a separate shop for the first time by a specialized teacher. It is important that the teacher help the student in understanding the purpose of his woodwork as an integrated part of the total educational program. In the elementary school the industrial arts experiences grew out of the Social Studies work. In the Junior High School special emphasis and attention is given to help students discover their abilities and interests. The experiences in industrial arts should be so arranged that the student develops skills in the use of common tools and equipment found in the home and school shop. The student should develop through his industrial arts experiences the habit of orderly procedure in doing a job and his abilities to do minor jobs around the home.

Each student should show growth in desirable attitudes, such as pride in workmanship, and respect for authority and property rights. He should learn to work co-operatively with others and to assume responsibility for the care and safety of the shop.

> The interests of the adolescent in grades seven, eight, and nine are varied. It is difficult for him to give long-continued attention to any one thing. Accordingly an industrial arts program should afford the adolescent opportunities to satisfy his many and varied interests through a wide range of subject matter. He needs experiences through a wide range of subject matter. He needs experience with many kinds of materials, tools, and procedures. (17, page 193)

The Junior High School industrial arts can well be adapted to the same shop used by the senior high school. The equipment will be the same as for high school with the exception of the power equipment. Very little power equipment should be used by the junior high school student.

> It may be safely said that we should not permit boys to operate machines or to engage in any kind of shop work in school, from which they would be excluded in industry on account of the dangers. This would exclude the use of certain machines in the junior high school in most states. (21, page 381)

Industrial Arts in the High School. When the student reaches high school the emphasis is shifted from hand tools to machines. The experiences in using such equipment requires new stress on safety in the school shop and opens a wide field for the study of safety in industry.

Woodworking in the industrial arts shop can offer opportunity for creative work by the student applying his skill in the use of tools and working with materials. The pupil

may pursue his vocational interest to a point of specialization. At the high school level more stress is given to occupational practices and information relating to specific woodworking fields. Thus as the work advances it becomes more and more vocational.

> The broad objectives of industrial arts in the senior high school is general education, but as the work becomes more advanced it also becomes more specialized, with more emphasis on skill and technical information. (17, page 269)

Industrial arts lays the foundation for vocational preparation for those students who enter a field of industry. For those students not planning on an industrial career, industrial arts gives practical training for intelligent living and worthwhile hobbies.

Woodworking, one of the oldest forms of shopwork in the public schools, represents a large industrial area.

Students in the elementary school should be given an opportunity to express themselves with wood and other materials in coordination with the school subjects. It would be best to have a separately equipped room for the teaching of industrial arts in the elementary grades but if this is not possible the ordinary classroom can be adapted to the teaching of industrial arts by the addition of a workbench, cabinets, and tools.

When the student reaches the junior high school he should have access to a separate shop and be under a specially trained teacher. This is the age of many interests so the shop work should be such that the student can explore

many fields and have experiences with many hand tools.

When the student reaches the high school he will begin to specialize on one phase of industrial arts. He meets new experiences when the emphasis is shifted from the hand tools to machine tools. He should study and follow the ways of industry as far as possible as his shop work advances.

CHAPTER IV

PRINCIPLE OF TOOL SELECTION

Usually the administrators of a school have had little or no formal training in the selection of equipment. The teacher should be well informed in the principles of equipment selection, and take the lead in selecting and equipping the school shop. There are many things to consider in tool selection, several of which will be considered here.

PART A. CRITERIA FOR SELECTING TOOLS

Before tools and equipment are determined upon for a shop it is the duty of the person, who will select tools and equipment for the school shop, to acquaint himself with the conditions in other school shops presenting similar programs before the final decision is reached. New designs of more suitable tools and machines for school use are constantly manufactured and offered for sale. There is reason to believe that new designs have been based upon needs made evident by failure of available tools to function with perfect satisfaction.

Many Industrial Arts teachers have made the mistake of purchasing the largest machinery available. There are very few, if any, junior or senior high school shops that can justify the installation of the largest type of woodworking machinery. Machines should be no larger than absolutely required to help the instructor in attaining the objectives

of the course.

a. Size of Equipment to be Used in School Shops. In determining the sizes of equipment to be installed in any shop, be it Junior High School, High School or College the following factors should be considered:

1. The nature of the course or courses.
2. The maturity of the pupils.
3. The size and location of the rooms.
4. The probable amount of money available, both for the original purposes and for replacement and maintenance.

After making preliminary lists with these factors in mind, one should compare the same with the equipment installed in similar schools. One should then procure catalogs from various companies, and compare qualities and prices. Then continue to make a list of equipment without regard to cost. When the costs have been computed, if there is not enough money in the budget, omit the less necessary tools and plan for them at a later time.

> There is a widespread difference of opinion among shop teachers and administrators as to the size of equipment. In recent years manufacturers have been able to produce small dimension, light weight, less expensive machines which are quite practical for the school shop and commercial shop use. Where expenditures must be held in check, this equipment has decided advantages in that it can be easily installed with small installation cost, because of the smaller investment, it is possible to make more frequent replacements. However, for the school shop, the standard size and weight of equipment is to be preferred, because of its endurance and low cost. (16, page 40-41)

b. Standard Brands Tools and Machines Versus Other Brands. When the instructor or administrators are faced with the problem of selecting and purchasing tools and machines

much irreparable harm may come to the shop program unless an extensive study of tools and machines is made and they know and understand what weaknesses may be encountered.

School shop tools, because of the exceptionally hard years of service and many hands using them, must be of the highest obtainable type and the best suited for the type of work done.

Standard Brands. Manufacturers in most lines of tools have adapted trade names with which to brand their products. Because of the fact that so called "Standard Brands" have built up over the years with; Fair dealing, guarantees, service with repair parts, educational and design developments and unconditionally standing behind their products, the consumer should feel safe to specify such brands in requisitions. Some examples of name brands, tools and machines are;

Handwoodworking Tools: Atkins, Disston, Plumb, Stanley.

Woodworking Machines: Boise Crane, Delta, Oliver, Walker Turner.

Good name brands of tools will undoubtedly give the customer better service, stay sharp longer because of better steel, be more easily and conveniently repaired and help in making the student conscious of good tool names. One word of warning regarding name brand tools, is to watch for leader brands under well known names. Stanley manufactures the "4 Square",

Tools, Miller Falls the "Shelbourne line," etc. These tools are good for the purposes for which they are made, namely for home use and competition, but they are not good enough for school shop use.

According to Mayes and Casberg (16, page 34-40) the following points should be kept in mind when choosing machines.

1. Have proper materials been selected for the various parts and has enough material been used for strength rigidity?
2. Is the machine well guarded so that there is no likelihood that a pupil will be caught and injured by moving parts?
3. Are repair parts easily obtainable at reasonable prices?
4. Can broken parts be easily removed and replaced?
5. Can repairs or adjustments be easily made without taking the whole machine down?
6. Can bearings and parts needing oil be easily and properly lubricated?
7. Are bearings and other moving parts protected from dust and other injurious materials?
8. Are belt connections simply or awkwardly made?
9. Are gear trains awkward and difficult to reach?
10. Is the machine finished and pleasing in appearance?
11. Is excessive vibration eliminated by good engineering or using an unduly heavy frame?

Localized Non-manufacturer Brands. Many hardware distributors and wholesale dealers, have tools manufactured under their own brand names. Hibbard-Spencer-Bartlett

of Chicago, use O. V. B. as their brand name, Shapleigh of St. Louis use Keen-Kutter as their brand name for their local trade area. These wholesalers furnish the specifications and contract with manufacturers to make tools in large quantities. Usually the specifications are inferior to the well-known-brands and are manufactured for a competitive low price market. When buying these tools one must keep in mind that he may run into trouble in case of service, guarantees, and replacement.

c. Selection of Woodworking Benches. The bench in the woodworking shop is without doubt an indispensable piece of equipment. There are many types of woodworking benches available from various manufacturers, those that will accomodate one pupil or those that will accomodate two or four pupils. There are also the types that have no drawers to the types that have from one to eight drawers or twelve lockers. When purchasing benches all of these features must be taken into consideration, but first let us consider the construction detail of the woodworking bench.

Construction. Benches must be strong, heavy, efficient and practically indestructable. They must be made to withstand the battering and abuses that a school boy will give them.

Bench tops should be made of maple, two inch strips at least two and one quarter thick, tongue

and grooved and glued up with water proof glue. Bolts should be used to reinforce the top. A bolster should be fastened to each end of the bench. This should be mortised and tenoned and bolted to the main working surface. A five inch bolster is common on the vise end and a two and one-half one on the other end.

The frame should be made of maple, mortised and tenoned together. These joints should be glued and reinforced with tie bolts. Provision should be made for tightening these bolts with ease.

Benches containing drawers are paneled on the sides and back preferably with three-eighths maple or birch.

Drawers are an important item when selecting benches. They must be strong enough to stand abuse and support weights not usually placed on other drawers. They should be of hardwood construction with one inch fronts and three-quarter inch sides and backs.

Types of Benches. When considering the purchase of benches several things should be taken into consideration besides the construction. The cost, the working area available, the number of students to be accommodated, the lighting of the work area, and whether or not the bench is to be used for storage, are all important factors governing the type to be selected.

Single woodworking benches without a drawer are the most economical. They should be sturdily built

of maple or birch with a twenty-two by fifty-two inch top. The standard height of all woodwork benches is thirty-two inches. These benches are available with a tool well in the top and one large tool drawer.

More expensive benches may be purchased with two large drawers for storage or one large tool drawer and two, four, or six drawers for storage for the individual pupil. These small storage drawers are equipped with locks and are master keyed.

Next in price is the double woodworking bench to accomodate two pupils working at opposite corners. These bench tops are thirty-two inches by fifty-two inches with a tool well between the two working surfaces. They come with two large drawers, and eight small drawers or two large drawers and twelve small drawers. Again the drawers are equipped with locks and are mastered keyed.

The latest type and most expensive of the woodworking benches is the four vise twelve locker type. This bench will accomodate four pupils at one time and is equipped with twelve large metal storage lockers built into the base. The top is fifty-four inches of built up maple. There are no tool wells and the overhang of the top is sufficient to enable each pupil to work up close to the bench without interference by the legs or drawer. It is claimed that this type of

bench is more economical when the floor space is at a minimum. Besides concentrating the working space of four pupils all of the space beneath the top is used. In this space are twelve lockers, twelve inches wide, fifteen inches high and twenty-one inches deep. This is an excellent size storage locker for unfinished work.

The final possibility to be considered, is that of a class project in bench making. If the students and equipment are available the making of the benches in the shop will afford an opportunity for production training. Benches produced in the school shop can readily be produced to equal the commercially produced benches and easily adapted to the particular shop situation.

Selecting benches is an undertaking which needs much consideration. Purchasing or producing the best type of bench possible is more economical in the long run, as a well made, well cared for bench will last many years. (20, page 1-2)

d. Selection of Wood Working Vises. The woodworking vise is an essential piece of shop equipment and much care should be exercised in its selection. The following things should be considered when making a selection.

Brands or Trade Marks. As in the selection of other pieces of equipment it is the best policy to purchase from established companies whose products have proven

successful over a long period of time. The advantages of a major company behind a product is a large factor. Some of the best known brands of woodworking vises are Abernathy, Toles, and Morgan.

Size. Select a vise of suitable size to fit the needs. Woodworking shops in the junior and senior high schools should be equipped with a 4 X 7 X 10 inch or a 4 X 10 X 12 inch vise. In the senior high school it will be best to select the larger of the two. The four inch depth of the jaw grips the material firmly and holds it in a vertical position. The 10 inch width will keep the material from being forced up or down easily and allows more width for fastening the vise to the underside of the bench top.

Types of Action. Woodworkers' vises may be divided into the continuous screw type and the rapid acting type. The continuous screw vise has a solid nut that is always engaged. The advantages are positive action, greater strength, greater holding power and trouble free service. The disadvantages are the time lost and the energy expended in moving the jaws from one position to another. The rapid action vises may be subdivided into three groups; the half nut, the roller nut, and the rack with the buttress teeth. The roller nut is the most desired of the three and the rack type the least desirable. The roller nut is a hollow iron cylinder three or more inches in length

with an inside diameter larger than the screw thread. A section of threaded bronze is dovetailed into the inside of the cylinder and one reverse turn releases the action. This section should be wedged shaped and easily replaced. The half nut works in conjunction with intercepted threads on the screw and one-fourth of a turn counterclockwise releases the vise action. The rack type releases with a quarter reverse turn but is noisy and soon wears enough to slip if not handled properly.

Wearing Qualities. The wearing qualities of a vise will depend upon the design of the parts, and the materials from which these parts are constructed. The jaws may be made of cast iron, grey iron, or semi-steel castings. Choose jaws of semi-steel as they will withstand shock and distortion best.

Provisions for Fastening Vise to Bench. The vise must be provided with an adequate casting so that it can be fastened securely. Holes are provided for wood screws, lag screws, or bolts. Lag screws are probably the best. Wood screws are usually used to fasten the back jaw to the bench edge.

Dogs. The front jaw must be provided with a substantial dog one half inch thick and one inch wide. This dog should push down flush with the top of the jaw when not in use, but should be easily raised to any desired height and maintain this position by means

of a spring tension device.

Handles. Handles are usually found to be one of three types. The metal handle made of rectangular bar stock, the pipe or round steel handle and the wood handle. The bar stock handle has knobs projecting out at right angles that are dangerous. The pipe or round handle will drop down from end to end causing much noise and may pinch the fingers. The wooden handle is in all probability the best. (8, page 1-2)

PART B. WOODWORKING EQUIPMENT FOR SCHOOL SHOPS

The tools that children use should be of good quality in the primary grades as well as in the shop. The equipment can be very simple or quite elaborate, depending upon several factors; as the money to be spent, objectives of the school, and the teacher of the children.

a. Woodworking Equipment in Grades One Through Three: The woodworking equipment in the primary grades may be very simple. A packing box or two saw horses crossed with two heavy boards may serve as a work bench. This bench, whether bought or made, should be of the correct height for the children and be of a substantial type. It will be well to arrange for storage beneath the bench.

The following suggested list of tools for grades one through three may be added to as the need arises. This list should serve for a group of twenty-five pupils.

QUANITY	NAME OF TOOLS	SIZE
1 Set	13 Bits auger	¼" to 1"
1	Brace	8" or 10" Swing
6	Clamps, Wood Hand	6" opening
6	Hammers, Claw	10 ounce
2	Plane, Block	4"
3	Rule	12"
4	Saws a. 1 Cross-cut b. 3 Coping	 18" No. 8 6" frame
3	Screw, drivers	4"- 6" - 8"

The expendable materials should consist of an assortment of soft woods. There should be a generous supply of sandpaper, small nails, glue, and an assortment of wood screws.

b. Woodworking Equipment in Grades Four Through Six. The children of grades four through six are growing rapidly and for the most part they need tools that are somewhat larger than the list suggested for the primary grades. Perhaps the tools should not only be larger but there should be more of a variety of tools. However, the same tools listed for the primary grades can be successfully used with this older group of children. The following suggested list of tools should be sufficient for a group of twenty-five pupils.

QUANITY	NAME OF TOOLS	SIZE
1 Set	13 Bits, auger	¼" to 1"
1	Braces	10" Swing
6	Files, half-pound	10"
1	Gouge	Small, round nose
6	Hammers, Claw	12 ounce
1	Knife, Sloyd	3"
1	Plane, Block	4"
6	Rules	12"
	Saws	
14	a. 1 Cross-cut	18" No. 8
	b. 1 Rip	20" No. 7
	c. 12 Coping	
1	Try-Square	6"

c. Equipment List. The equipment for the junior and senior high school woodworking shop should be selected with a planned program in mind. It is only possible to make a suggested list of equipment as the program of each school will vary to some degree. The following is a suggested equipment list to be used for a combination hand and machine woodworking shop. Since this list is for a class of twenty students, the small tools may be decreased or increased with the size of the class. This maximum list may be used for both the junior and senior high school.

Woodworking -- Machines and Storage Equipment

QUANITY	NAME OF TOOLS	SIZE
7	Benches	
	a. 5-- Woodworking Hardwood top to be 1 3/4 thick or over to be equipped with rapid acting vises	4 Station 52" X 52" X 28"
	b. 1-- Demonstration Hardwood top with rapid acting vise	1 Station 22" X 52" X 28"
	c. 1-- Glue Metal covered top with clamp storage shelf below	
1	Book Case	
	a. Sectional or door type to be closed	
1	Bulletin Board	
	a. Cork or fiber board	
5	Cabinets	
	a. 1-- Drawer type for filing purposes	4 drawer type
	b. 1-- Supply cabinet for expendable hardware	
	c. 1-- Finish cabinet, metal for finish storage	
	d. 1-- Tool cabinet	Large enough to accommodate all small tools not kept at work stations
	e. 1-- First Aid and supplies	
1	Drill Press	
	a. Bench type with tilt table 10" X 10" built in depth gauge, slow-speed model, complete with motor, pulleys, and belt	14"
1	Glue Pot	
	a. 1-- Electric or gas heated	1 qt.

QUANITY	NAME OF TOOLS	SIZE
2	Grinder	
	a. Woodworker's pedestal type, motor in head. One fine grit wheel, one medium grit wheel, and one coarse grit wheel. Two speed with plane blade grinding attachment	
	b. Bench type, motor in head. One fine grit and one coarse grit wheel. Grinder to be completely guarded. Motor to be 110 or 220	
2	Jointer	
	a. 1-- Portable type table to be fitted for rabbitting. Safety cylinder type, equipped with safety guards	6" or 8"
	b. 1-- Direct motor drive type cylinder to be of safety-head type. Table to be fitted for rabbitting. To be completely guarded	12" or 16"
2	Lathes	
	a. Motor-in-head or motor-in-base speed lathe to take 24, 36, 48, or 60 in between centers. Each to be complete.	6" to 12"
1	Mortiser	
	a. Direct-motor-drive hollow chisel with foot feed. Table to be of tilting type.	
1	Planer	
	a. A motor driven, single surface. Safety-head cylinder, three knife type, fitted with good grade steel knives. Motor to be for 110 or 220 electricity	24"
3	Sander	
	a. 1-- Belt direct motor drive. To be guarded.	8" X 4"
	b. 1-- Disc direct motor drive	14"
	c. 1-- Portable hand type.	10"

QUANITY	NAME OF TOOLS	SIZE
5	Saws	
	a. 1-- Band saw Motor drive, wheels to be completely guarded	14"
	b. 1-- Band saw Motor drive, both wheels to be completely guarded. Motor to run off 110 or 220 current	30"
	c. 1-- Scroll saw Four speed, on steel stand, complete with motor and belt.	24"
	d. 1-- Universal saw bench Motor driven. To be equipped with ripping fence and miter cut off gauges	10"
	e. 1-- Variety saw bench, motor driven, tilting table with universal sliding table. The arbor is to be fitted for a dado head. The saw is to be equipped with ripping fence and miter cut off gauges.	12"
2	Shaper	
	a. 1-- Motor drive, single or double spindle. Table to be equipped with removable center plates. Motor to be equipped with reversible switch. Shaper to have sufficient guards and an assortment of shaper knives.	Large capacity
	b. 1-- Router Portable with a suitable selection of knives	

Woodworking -- Small Tools

QUANITY	NAME OF TOOLS	SIZE
6	Awls	
	a. Brad	Assorted
8	Bevels	
	a. 6-- Protractor	
	b. 2-- Sliding T	8"
41	Bits	
	a. 14-- Auger	3/16" to 1" inclusive, by 16ths.
	b. 6-- Auger	3/16" to 1/2" inclusive, by 16ths.
	c. 8-- Drill	1/16" to 1/2" inclusive, by 16ths.
	d. 2-- Countersink (for wood, rose pattern	1/2" and 5/8"
	e. 1-- Expansive	7/8" to 1 1/2"
	f. 1--Expansive	7/8" to 3"
	g. 3-- Screw driver Regular, square shank	3/8"
	h. 4-- Screw driver Phillips	No. 2
	i. 2-- Gauge, depth	
4	Braces	
	a. 2-- Ratchet	10" Sweep
	b. 2-- Ratchet	12" Sweep
38	Brushes	
	a. 20-- Bench duster	10 in.
	b. 4-- Glue, round	1/2"
	c. 4-- Paint	1"
	d. 4-- Paint	1 1/2"
	e. 4-- Paint	2"
	f. 2-- Wire	10"
2	Burnishes	
	a. 2-- Oval or Round	4 1/2"
5	Cans	
	a. 1-- Oily Waste	6 gal.
	b. 2-- Oil (Straight Nozzle)	1/2 pt.
	c. 2-- Oil (Flexible Nozzle)	1/2 pt.
4	Calipers	
	a. 2-- Inside	8"
	b. 2-- Outside	8"
1 Set	Carving Tools	
	a. 1 set of 6 tools	

QUANITY	NAME OF TOOLS	SIZE
23	Chisels	
	a. 2-- Cold, machinists'	3/8" and 1/2"
	b. 6-- Mortising chisel and bits	1/4" to 5/8" by 16ths.
	c. 6-- Socket firmer, bevel edge	1/8", 1/4", 1/2", 3/4", 1", 1 1/2"
	d. 3-- Socket firmer, plain edge	1/2", 3/4", 1"
	e. 6-- Tanged firmer, bevel edge	1/8", 1/4", 1/2", 3/4" 1", and 1 1/4"
68	Clamps	
	a. 6-- Bar	24"
	b. 6-- Bar	36"
	c. 6-- Bar	48"
	d. 6-- Bar	60"
	e. 4-- Hand-screw	4"
	f. 4-- Hand-screw	5"
	g. 4-- Hand-screw	6"
	h. 4-- Hand-screw	7"
	i. 4-- Hand-screw	8"
	j. 4-- Hand-screw	10"
	k. 4-- Hand-screw	12"
	l. 4-- Hand-screw	14"
	m. 4-- Malleable-iron C,	4"
	n. 4-- Malleable-iron C,	6"
	o. 4-- Malleable-iron C,	8"
4	Dividers	
	a. 2-- Wing	6"
	b. 2-- Wing	10"
1	Dressers	
	a. 1-- Grinding Wheel	
3	Draw Knife	
	a. 3-- For Wood	7"
3	Drill	
	a. 2-- Hand	1/4" capacity
	b. 1-- Yankee, (automatic)	3/16" capacity
17	Files	
	a. 6-- Auger bit	Assorted 6"
	b. 2-- Cabinet	8"
	c. 2-- Cabinet	10"
	d. 1-- Card and brush	1 1/2" X 5"
	e. 2-- Flat, wood,	10"
	f. 2-- Mill, bastard cut,	12"
	g. 1-- Taper, slim	5 1/2"
	h. 1-- Taper, slim	7"
20	Gauge	
	a. 20-- Marking, metal or hardwood	6"

QUANITY	NAME OF TOOLS	SIZE
1	Glass Cutter	
	a. 1--	
10	Gouges	
	a. 5-- Tanged firmer, outside ground	Assorted
	b. 5-- Tanged firmer, inside ground	Assorted
2	Hacksaw	
	a. 2-- Adjustable	8" to 12"
14	Hammers	
	a. 2-- Ball peen	16 oz.
	b. 6-- Claw, Bell faced	12 oz.
	c. 6-- Claw, Bell faced	16 oz.
1	Hatchet	
	a. 1-- Bench	4" cut
5	Knives	
	a. 1-- Putty	
	b. 4-- Sloyd	3" blade
1	Levels	
	a. 1-- Wood	24"
6	Mallets	
	a. 4-- Hickory	3" X 5" head
	b. 2-- Rubber	24 oz.
6	Nail Sets	
	a. 4-- 1/32" point	
	b. 2-- 2/32" point	
3	Oilstones	
	a. 1-- Combination	1 X 2 X 8 in.
	b. 1-- Gouge slip, medium	4 1/2" X 2 1/2" X 5/8" X 5/16"
	c. 1-- Gouge slip, fine	3 X 2 X 3/8 X 1/8 in.
28	Planes	
	a. 6-- Block, adjustable	6" long, 1 5/8" cutter
	b. 1-- Circular	10"
	c. 21-- Jack	14", 2", cutter
	d. 1-- Jointer	24"
6	Pliers	
	a. 4-- Roundnose	5"
	b. 2-- Side-cutting	6"
4	Rasps	
	a. 4-- Half round cabinet	10"
20	Rules	
	a. 20-- Bench, graduated by 8ths and 16ths	2 ft.
32	Saws	
	a. 6-- Back	12", 14 points
	b. 4-- Band	To fit power machine
	c. 1-- Combination, Circular	10" with 5/8" arbor hole

QUANITY	NAME OF TOOLS	SIZE
	Saws (continued)	
	d. 1-- Combination, circular	12" with 1" arbor hole
	e. 2-- Compass	10"
	f. 6-- Coping	6 1/2"
	g. 2-- Cross cut	8 point, 22"
	h. 2-- Cross cut, circular	10" with 5/8" arbor hole
	i. 2-- Cross-cut	12" with 1" arbor hole
	j. 2-- Keyhole	10", 10 point
	k. 2-- Rip	7 point, 22"
	l. 2-- Rip, circular	10" with 5/8" arbor hole
	m. 2-- Rip, circular	12" with 1" arbor hole
	n. 1-- Set	10 point per inch and finer
	o. 1-- Miter Box, saw	24" X 4" saw, 7" capacity at the miter
14	Scrapers	
	a. 6-- Cabinet	
	b. 6-- Hand	3" X 5"
	c. 2-- Hook	
21	Screw Drivers	
	a. 4-- Cabinet makers'	3"
	b. 4-- Cabinet makers'	6"
	c. 4-- Cabinet makers'	8"
	d. 2-- Phillips	No. 1
	e. 3-- Phillips	No. 2
	f. 3-- Phillips	No. 4
	g. 1-- Quick return, spiral ratchet	
1	Snips	
	a. 1-- Tin	2 1/2" cut
27	Square	
	a. 1-- Bevel	8"
	b. 2-- Combination	12" blade
	c. 20-- Try, iron handle	8"
	d. 2-- Steel, framing	16" X 24"
	e. 2-- Steel	8" X 12"
3 Sets	Turning Tools	
	a. 3 sets wood	Assorted
22	Vise	
	a. 21-- Woodworking, quick acting	10" X 12"
	b. 1-- Machine	4" X 4 1/2"

QUANITY	NAME OF TOOLS	SIZE
8	Wrench	
	a. 1-- Crescent, adjustable	8"
	b. 1-- Crescent, adjustable	10"
	c. 1-- Crescent, adjustable	12"
	d. 4-- Combination, Box and open end	7/16", 1/2", 9/16", 5/8"
	e. 1 set, Allen	

The equipment for any shop should be purchased with a planned program in mind. The equipment should be of good quality from well established firms. When such equipment is purchased the children learn to work and care for the best. The tools should be stored so as to be within easy reach of the work areas. It is well for the instructor to remember that it is easy to over-equip if the objectives of the shop course are not kept in mind.

PART C. SPACE REQUIREMENT IN LOCATING SHOP EQUIPMENT

When figuring the space required in locating shop equipment, one must plan with the following points in mind: The working area required by the machine, the sequence of operation, light, and the aisles of travel.

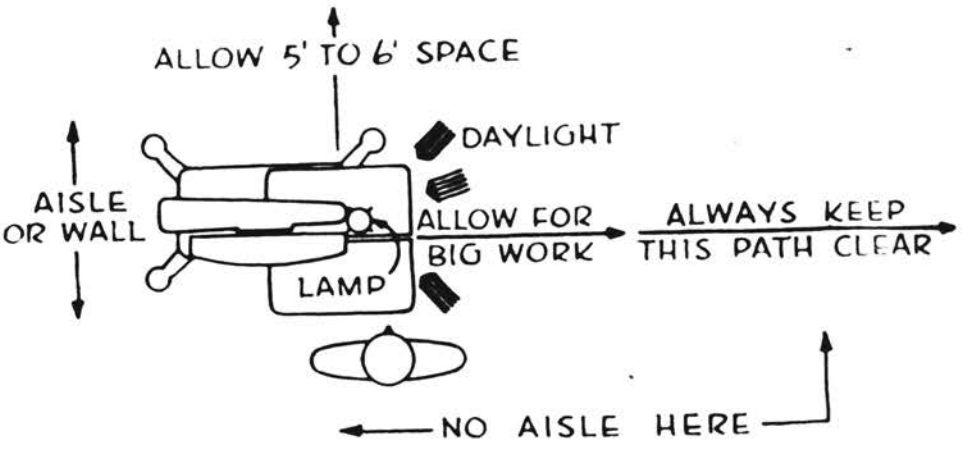
a. Working Area Required by the Machine. No two machines in a shop will require the same working space. When planning a shop, it is of paramount importance that each machine and the operations to be performed by this machine be considered. One cannot tell just by looking at the physical size of the machine how much space is required. We must consider the operation to be performed.

b. Sequence of Operation. The sequence in which a job is done is also a deciding factor in arrangement of equipment. The best results can be obtained from this arrangement with the least amount of confusion and manual labor.

c. Light. Another factor in consideration of shop planning is proper lighting. Equipment should be arranged to eliminate both shadows on or near work surfaces, and glare anywhere in the line of the worker's vision.

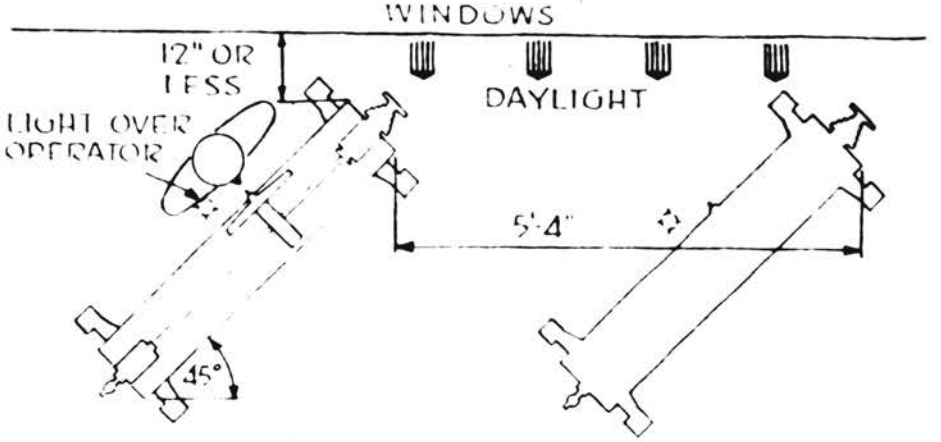
d. Aisles of Travel. When placing equipment, ample room must be given consideration for aisles of travel. These aisles should be arranged so that a student going from his working area to some other part of the shop will not disturb or interrupt some other student who is working.

e. Time Saver Standards. The drawings of the next few pages, as presented by "School Shop," (7) should be of value to the experienced teacher as well as the inexperienced teacher. The character, a circle with a wing on each side represents working position of the operator at the machine.



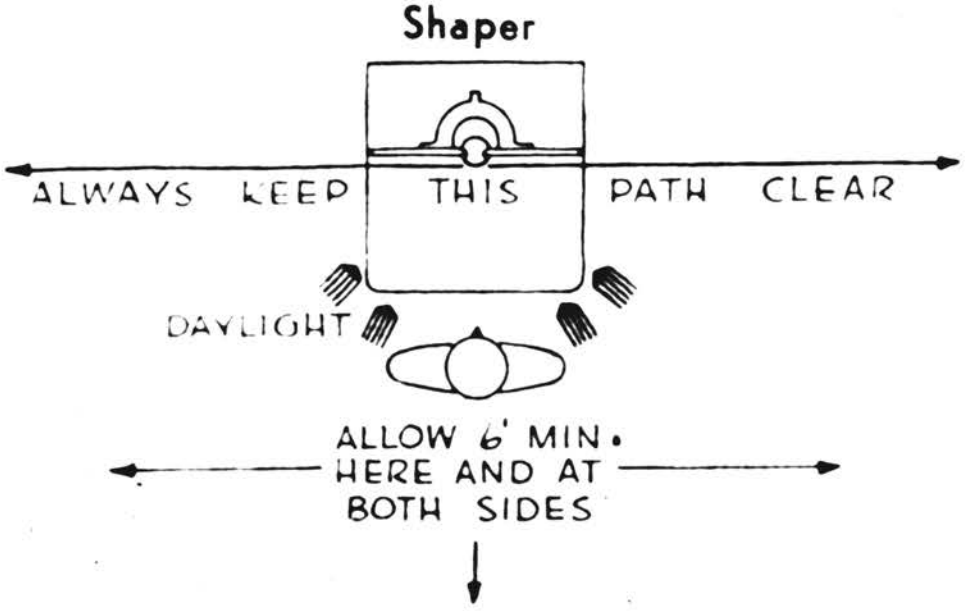
Band Saw

The band saw should be placed so that there is an aisle to its left or the back of the machine, but in no case should there be an aisle to the right or the front of the machine because of the possible interference with the operator. The machine should be lined up so that the path of the saw will not be in line with other operators or boys at their benches.



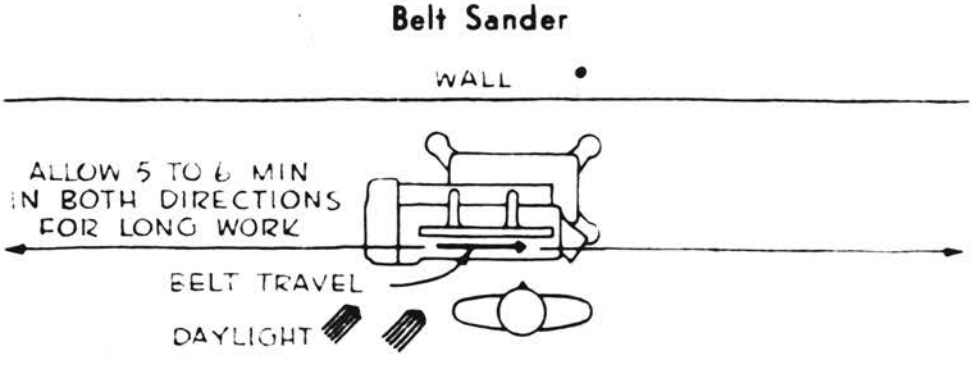
Wood Lathe

In placing a wood turning lathe it is quite important to have proper illumination because the operations are of various character and should be properly illuminated at all times. If the lathe is set at angle of 45 degrees from a windowed wall the light will flow upon the entire lathe bed.



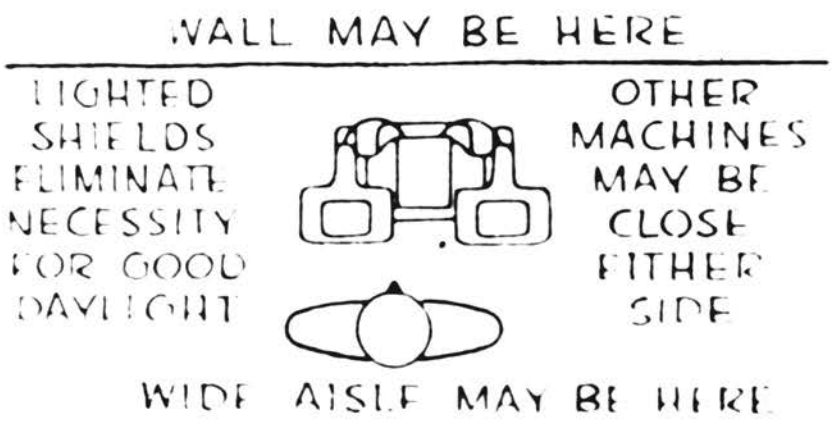
Shaper

The shaper must be carefully operated and for this reason it should be so placed in the shop where it will have absolutely no interference from any passing student. Light should come from the front and both sides. There should be an allowance of at least six feet in front and both sides for the operator.



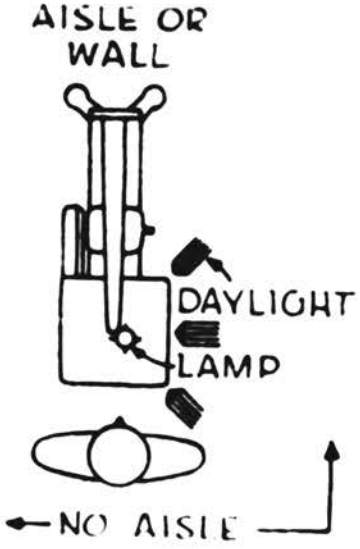
Belt Sander

In all cases there should be enough room so that long work can be passed over the moving belt. Daylight should come to the machine from the front. There should be an aisle along the side of the machine where the operator stands.



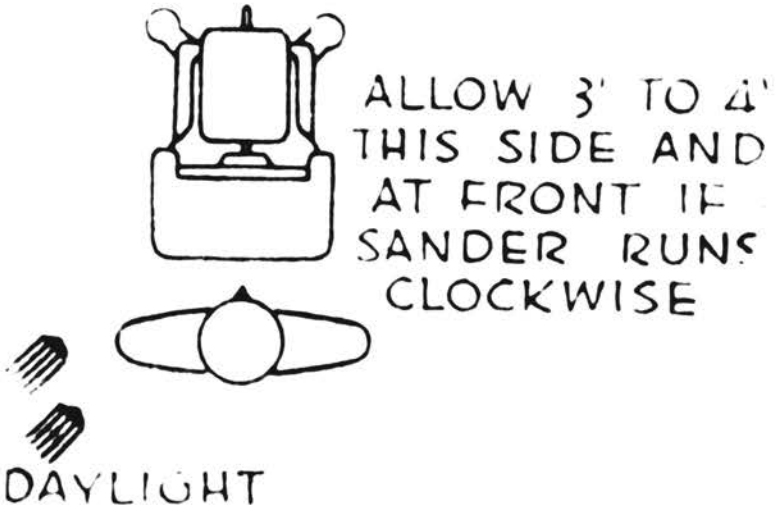
Drill Press

In the woodworking shop the drill press should be located in the center of a wall with enough space allowed on each side so that when mortising work is done enough room is available to handle reasonably long stock. There should be an individual light attachment on this machine.



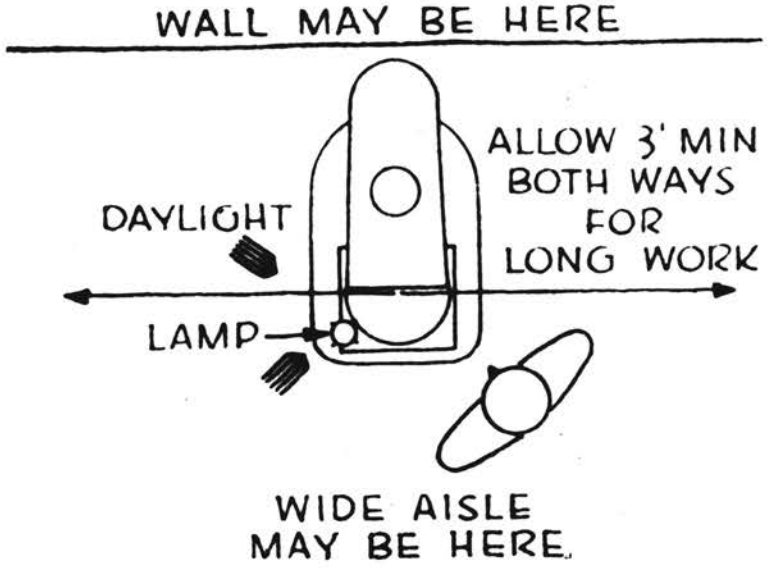
Scroll Saw

The scroll saw should be centrally located so that all students may have easy access to to. An individual light is supplied so that the line which the saw follows is very well illuminated.



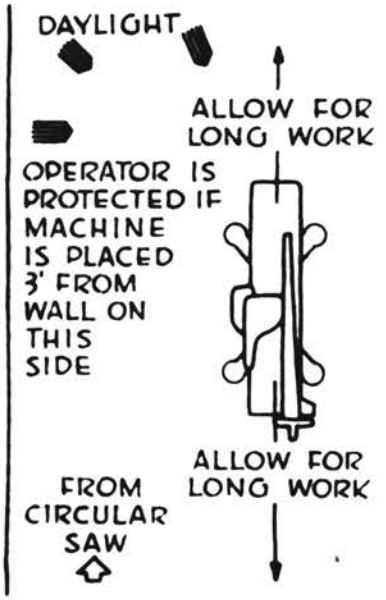
Disc Sander

Three or four feet in front and to the side of this machine is generally enough space for most operations. Daylight should come from the right hand side and onto the disc so that the operation can be carefully watched.



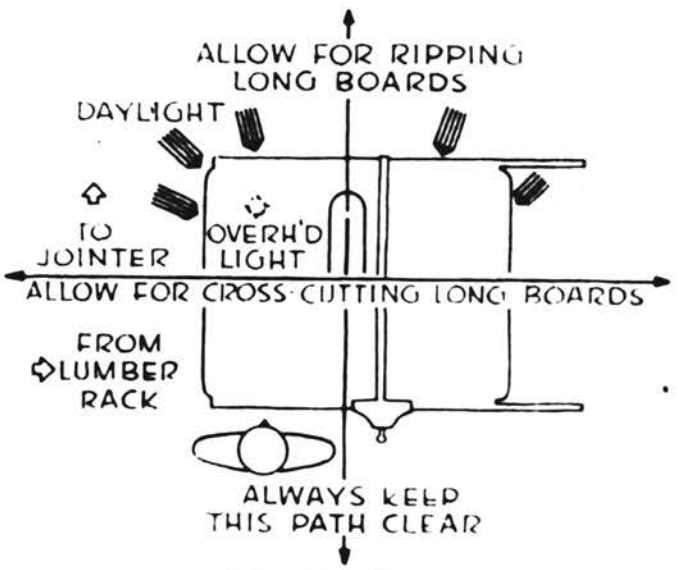
Grinder

The grinder should be placed fairly close to the drill press or the lathe since it is most often used to sharpen tools for these two machines. The grinder is supplied with patented light shields so may be placed in corner or against a dark wall.



Jointer

The jointer should be placed in close proximity with the circular saw. Light on the jointer should come from the left and back. Enough room in front and back of the jointer for running the size of boards generally used in the individual shop.



Circular Saw

The natural light should come from the left hand side and back. Artificial light should be from the back of the blade and to the left. Allow enough room for ripping long boards. There should be enough room on each side for cross cutting long boards.

CHAPTER V

SUMMARY

This report contains a brief history of the hand woodworking tools and machines that are commonly used in the school industrial arts shop. There is a discussion of some of the early leaders, and their philosophies, which served as a justification for the establishment of shop work in the American Schools. There is also certain criteria for the selection and arrangement of school shop woodworking equipment.

Summary. Since the beginning of man's existance he has been devising ways and means of easing his burdens. Though very crude and made of stone, the first woodworking tools were in use about 300,000 years ago. Woodworking tools made of stone have been found in all parts of the world. In the latter part of the stone age man had advanced until he made better tools of stone by grinding them on other stones. This prehistoric man was making and using axes, awls, hammers, saws, and drills before the Age of Metals.

During the Age of Metals, the first tools were made of copper. As time passed it was discovered that tin could be added to the copper to make bronze which was harder and better for tool making. By the time that man learned to use iron practically all the carpenter's tools had been invented with the exception of the plane and brace.

After man learned to make steel, the tools invented by these early people have been redesigned until today we have tools for practically every job that man performs. The hand tools are discussed under general heads. With the development of hand tools came certain power driven machines which was attained by applying power from water, wind, or foot force to the hand tools. The modern development of woodworking machinery began less than two hundred years ago. The greatest inventions in the field of woodworking machinery were made in England by Sir Samuel Bentham, who discovered the principle of rotary cutting. The principle of the rotary cutter is used in all modern planers, jointers, and shapers. The principal woodworking machines discussed are; drill, lathe, circular saw, band saw, and planer. Present day demands find manufacturers making three types of woodworking machines; the production type woodworking machine, the school shop woodworking machine, and the home workshop machine.

The third chapter is devoted to the early educational leaders and their philosophies which helped to bring about the teaching of woodwork in the public schools in America. The writer shows why woodwork should be taught in the industrial arts program throughout the public school system.

Chapter four contains a discussion on the criteria of tool selection for the woodworking shop. This chapter also contains a suggested tool list for the elementary grades as well as for the junior and senior high schools and a group

of drawings, entitled "Time Saver Standards", for the placement of the most important woodworking machines.

It is the hope of the writer that this information will be of some benefit to teachers that are confronted with such problems as tool selection and placement.

APPENDIX A

A SELECTED BIBLIOGRAPHY

1. Bennett, Charles A., History of Manual and Industrial Education to 1870, The Manual Arts Press, Peoria, Illinois, 1926, 401 pages.

2. Bennett, Charles A., History of Manual and Industrial Education 1870-1918, The Manual Arts Press, Peoria, Illinois, 1936, 401 pages.

3. Bonser, Frederic G., Industrial Arts for Public School Administrators, Teachers College, Columbia University, New York, New York, 1930, 100 pages.

4. Carr, John H., "History of Woodworking Machinery," Industrial Arts and Vocational Education Magazine, 28, February, 1939.

5. Cassidy, G. L. Gordon, "Size of Equipment to be used in School Shops." Unpublished paper prepared for Industrial Education 571, Bradley University, Peoria, Illinois, summer 1948, 2 pages.

6. Conners, S. Grant, Introduction to Vocational Education, Industrial Teacher Training Staff, New York, New York, 1947, 166 pages.

7. Dasey, Homer H., "Time-Saver Standards-Woodworking Machines," School Shop, Vol. V. June 1946.

8. Durham, J. Byron, "Selection of Wood Vises." Unpublished paper prepared for Industrial Education 571, Bradley University, Peoria, Illinois, summer 1948, 2 pages.

9. Frankle, Lee, Basic Tools for Woodworking, Prentice-Hall Inc., New York, 1948, 119 pages.

10. Good, Carter V., Dictionary of Education, McGraw-Hill Book Company, Inc., New York, New York, 1945, 495 pages.

11. Hendrix, Grant, Controlling Principles of Woodworking Machine Selection, Thesis, Oklahoma A & M College, 1941, 94 pages.

12. Hjorth, Herman, Machine Woodworking, The Bruce Publishing Company, Milwaukee, Wisconsin, 1947, 367 pages.

13. Hjorth, Herman, Principles of Woodworking, The Bruce Publishing Company, Milwaukee, Wisconsin, 1946, 445 pages.

14. Hunt, Charles, "Standard Brand Tools and Machines Versus other Brands, Unknown Brands and Local Brands." Unpublished paper prepared for Industrial Education 571, Bradley University, Peoria, Illinois, summer 1948, 3 pages.

15. Johnson, William H., Fenn, Isadore M., Fundamentals of Industrial Arts and Vocational Education, The Goodheart Wilcox Company, Chicago, 1943, 138 pages.

16. Mays, Arthur B., and Casberg, Carl H., School Shop Administration, The Bruce Publishing Company, 1943, 218 pages.

17. Newkirk, Louis V., Johnson, William H., The Industrial Arts Program, The Macmillan Company, New York, New York, 1948, 355 pages.

18. Noyes, William, Hand Work in Wood, The Manual Arts Press, Peoria, Illinois, 1919, 217 pages.

19. Rousseau, Jean Jacques, Emile, J. M. Dent and Sons Limited, London, England, 1938, 444 pages.

20. Schultz, Arthur H., "Selection of Woodworking Benches." Unpublished paper prepared for Industrial Education 571, Bradley University, Peoria, Illinois, summer 1948, 2 pages.

21. Selvidge, R. W. "Woodworking Machines in the School Shop," Industrial Education Magazine, June 1931, page 382.

22. State Department of Education, A Course of Study in Hand Woodworking, Oklahoma City, 1943, 36 pages.

23. Usher, Abbott P., A History of Mechanical Inventions, McGraw Hill Book Company, New York, New York, 1929, 382 pages.

24. Waltrip, Gerald L., A Study of Tool Holders, Report, Oklahoma A & M College, 1946, 36 pages.

25. Wilbur, Gordon O., Industrial Arts in General Education, International Textbook Company, Scranton, Pennsylvania, 1948, 362 pages.

Typed by: Mrs. Agnes Stiles