

Name: Floyd L. Jack

Date of Degree: May 26, 1958

Institution: Oklahoma State University

Location: Stillwater, Oklahoma

Title of Study: THE HISTORY, INDUSTRY, PROCESSING, USES AND APPLICATION
OF WOOD VENEER

Pages in Study: 63 Candidate for Degree of Master of Science

Major Field: Industrial Arts Education

Scope of Study: Wood veneer may not be used as a school subject, but as related information associated with wood working materials. Today wood veneer is used extensively in the industrial arts program and other industrial fields. With its strength and beauty, it has won a never ending place in industry. This report concerns some of the Early Europe, early American, modern and current history of wood veneer. It includes the industry, manufacturing, selling, application and uses. It also tells of some beautiful figures and patterns that can be found in veneer. The advantages of veneering which is very important will also be found in this report. Materials used in this report were secured from books, pamphlets and periodicals obtained from manufacturing companies located in all parts of the United States. Some books were found in the library at Oklahoma State University.

Findings and Conclusions: Wood veneers are thin sheets of wood usually cut from rare and costly logs. The sheets of veneer are glued to more common woods to increase the strength and add to the appearance. Public taste runs in cycles, reflecting the spirit of the times. The art of veneering is easily adapted to the changing fashions. Rare woods are not available in large quantities, or if they were, might also be too delicate for solid construction. Modern machinery, enables reputable producers to bring to everyone the articles that once were the luxury of a few. Modern technology plus the use of plastic adhesives, products evolved through chemical research, has opened new frontiers. Today veneer and plywood is used for furniture, pianos, radios, aircraft, watercraft, railway streamliners, trailers, store equipment, elevator cabs, air conditioning units, to an estimated total for all uses, both decorative and structural, of well over two thousand.

ADVISER'S APPROVAL

C. R. Hill

THE HISTORY, INDUSTRY, PROCESSING, USES AND
APPLICATIONS OF WOOD VENEER.

THE HISTORY, INDUSTRY, PROCESSING, USES AND
APPLICATION OF WOOD VENEER

By

FLOYD LEROY JACK

Bachelor of Science

Oklahoma State University

Stillwater, Oklahoma

1952

Submitted to the Faculty of the Graduate School
of Oklahoma State University of
Agricultural and Applied Sciences
in partial fulfillment of the
requirements for the Degree of
MASTER OF SCIENCE
May, 1958

AUG 20 1958

THE HISTORY, INDUSTRY, PROCESSING, USES AND
APPLICATION OF WOOD VENEER

REPORT APPROVED:

C. L. Hill

Associate Professor and Acting Head
School of Industrial Arts Education

L. H. Benatson

Associate Professor
School of Industrial Arts Education

Robert Maclean

Dean of Graduate School

ACKNOWLEDGEMENT

In the interest of wood veneer I found that no one attending Oklahoma State University had compiled a report on this subject. The information was scarce and scattered to such an extent, I thought it would be of interest to collect what information I could and compile it into one report, so that industrial arts teachers could use it as related information associated with wood working materials.

Several acknowledgements are in order. First, I would like to acknowledge the assistance of Professor L. H. Bengtson and the use of his signature as my advisor on my letter of Inquiry.

To the Manufacturing Companies and Associations of Wood Veneer and the library staff of Oklahoma State University who so ably assisted in furnishing and finding the material for this study, I am indeed grateful.

Last, but not least, I wish to express my sincere appreciation for the excellent advice and assistance I received from Professor Cary L. Hill, my report advisor.

F. L. J.

TABLE OF CONTENTS

<u>Chapter</u>	<u>Page</u>
I	AN INTRODUCTORY STATEMENT 1
	Origin of the Study 1
	Need for the Study 1
	Method of Investigation 2
	Available Literature 2
	Definition of Terms 2
	Predicted Results of this study 3
II	THE HISTORY OF WOOD VENEER 4
A	The History of Wood Veneer in Europe 4
	Early History 4
	Medieval History 7
	The Renaissance 7
B	Inlay, Marquetry and Intarsia 10
	Process 11
	History and Development 12
C	Development of Wood Veneer in America 14
	Modern History. 14
	Current History 16
III	VENEERS AND VENEERING 18
A	Manufacturing Wood Veneers 18
	The Veneer Industry 19
	Customer of the Veneer Industry 23
	Method of Cutting Veneer 24
	Matching Veneers 31
	Figures and Patterns 33
B	Method of Veneering. 39
	Advantages of Veneering 39
	Preparation 41
	Hammer Veneering 42
	Caul Veneering 43
	Inlaying 44
	Hand Presses 46
	Machine Presses 46

<u>Chapter</u>	<u>Page</u>
C	Important Facts and Uses of Veneer 47
	Important Facts About Veneer 48
	Solid vs. Veneer 50
	Woods for Veneer 51
IV	CONCLUSION AND SUMMARY 56
	Summary 56
	Conclusion 56
	Recommendation for Further Study 57
	A SELECTED BIBLIOGRAPHY 58

LIST OF FIGURES

Figure		Page
1.	METHODS OF CUTTING VENEERS	26
2.	STANDARD VENEER MATCHING PATTERNS	32
3.	LOCATION OF VENEER CUTS	35

CHAPTER I

AN INTRODUCTORY STATEMENT

The material contained in this report covers the history and development of wood veneer. Wood veneer and plywood is being used more and more in the shops for building furniture and other industrial products. Some students take veneered wood for granted. Some think it a very new process, they do not know that it is an art 3,500 years old. During this century, inferior glues and workmanship caused surface veneers to come loose from core stock, some folks still have a prejudice against veneer. An attempt will be made to show the development of wood veneer from 1,500 years before the birth of Christ until now.

Origin of the Study. This study of the history, processing and application of wood veneer was undertaken to provide information, of an indirectly related type in conjunction with wood working materials. This material can be presented at a proper time that can make it interesting and to induce more interest and enthusiasm in the student's work.

Need for the Study. The author's desire for more information and to get the basic fundamentals back of veneering was the basis for this report. There is definitely a scarcity of information pertaining to the history and development of wood veneer. Many of the wood manufacturers and lumber companies have no such information on hand. This study is an attempt to assemble the historical development, manufacturing and application of wood veneer.

Method of Investigation. Letters were sent to a number of the leading lumber manufacturing companies and associations, requesting their assistance in securing information that would be of aid in this study. A list of these manufacturers can be found in Appendix B. Most of the companies responded with information. Those which were unable to provide helpful information submitted suggestions of where the needed information could possibly be obtained.

A diligent search was made through the Oklahoma State University Library and the Bartlesville Public Library in an effort to obtain helpful literature. Only a small amount of material was found which could be of use in this report.

Available Literature. There are very few books, in the libraries visited which pertain to this subject. These books are widely scattered and mention only briefly information that is of value to this study. Many of the wood manufacturing companies and associations have available booklets and pamphlets which would be helpful in a study of this type.

Definition of Terms. To make the reading of this report more meaningful to the reader, the following definitions should be studied.

a. Inlay

Inlay is a design in the surface of furniture formed by inserting woods, ivory, metal or other materials of contrasting color. These segments are set in tiny grooves or channels cut to receive them. Borders, ornamental patterns, flowers, medallions and other decorative effects are obtained by this means. (10, page 121)

b. Marquetry

Marquetry is the term applied when an entire surface (such as a table top) is covered with veneers or inlays in a close fitting pattern. Wood, ivory, mother-of-pearl or metal may be used. The design is often fitted into a

pattern on thin wood veneer, which is then glued to the furniture. (10, page 121)

c. Intarsia

Intarsia is an Italian type of decoration, similar to marquetry and inlay, where the design is sunk into the solid wood. Usually a much darker wood is used as a background into which varicolored segments are laid, often forming an entire scene as well as decorative design. (10, page 121)

d. Veneer

Veneers are thin sheets of wood usually cut from rare and costly logs. The sheets of veneer are glued to more common woods to increase the strength and add to the appearance so that the whole substance appears to be of the more valuable sort.

e. Veneering

Almost like Marquetry, only it does not have to be laid in any certain pattern. The act or art of veneering is overlaying a coarse or inferior substance with thin layers of superior substance; the covering thus laid on.

Predicted Results of this Study. It is hoped that this report will give the reader a better view point on the advantages of veneering and veneered furniture and the different things it can be used for as a material for woodwork.

Chapter two deals with the history of wood veneer from the early days in Europe up to the present. It gives the background of veneering by explaining the process, history and development of Inlay, Marquetry, and Intarsia. Chapter three of this report has to do with the industry, manufacturing, uses and methods of veneering.

CHAPTER II

THE HISTORY OF WOOD VENEER

The art of producing and using veneers dates back to the earliest days of civilization, and it may be looked upon even as a standard of human development, since efficient veneering has always followed in the wake of human progress.

Part A

The History of Wood Veneer in Europe

In the tombs of the Pharaohs in the sands of Egypt begins the story of veneer - the story of an industry whose storehouse is the world, whose history is the history of the world and whose products combine the caprices of nature and the skill of man.

There, sealed from the outside world 1,500 years before the birth of Christ, have been found perfect specimens of plywood furniture, inlaid caskets and jewel studded boxes. Wood veneer is an art that was 30 centuries old when Christopher Columbus first sighted the green shores of the New World.

Down through the centuries, Babylonia and Assyria continued to advance the art of veneering. Influenced by the Egyptians, they, too, enriched plain, sturdy furniture with thin sheets of rare woods, precious metals, and jewels.

Early History. The earliest use of veneer has been shown to be largely for the purpose of display and ornamentation and to be little,

if any, for the purpose of artistic balance, mechanical perfection or durability. The records to be found regarding this early veneering are so fragmentary, that their process of manufacture and application are almost entirely drawn from an examination of the few masterpieces preserved in the tombs of Egyptian monarchs. Some of these pieces date from the 15th and 14th centuries before the Birth of Christ.

In addition to the furniture from Egypt, there are a few interesting relics of tools with which it was made. Votive offerings of workmen have been discovered under the foundations of many temples. It was the custom, when laying foundation stones, for those who were to work upon the buildings to be erected thereon, to place under the stones certain tools to propitiate the spirits of the temple.

It would appear that the use of veneer was regarded as a royal prerogative. In other words, veneered furniture was the best that could be made and, therefore, was only qualified for use in the palaces and courts of the reigning families.

Egypt and Nineveh knew of inlaying, veneering and cane work and there is evidence that their workmen achieved fame in those arts as have their many successors.

The furniture of Assyria has all perished, and it is only from sculptures that any of it can be understood. Furniture reproduced in pictures, or in the form of reconstructed models, may be of little interest to the home connoisseur, and yet it is worthwhile to inquire into the furnishings of the homes of the nations of the past, in order that the inspirations which have governed the artists of more modern days may be fully understood.

It has been noticed that the art of the Far East and of Asiatic

nations influenced Grecian artists, and that from Greece, artistic conceptions spread westward.

One of the most complete descriptions of the early use of veneer comes from the elder Pliny, who lived during the prime of the Roman Empire. During the lifetime of Augustus, from 63 B.C. to 14 A.D., Roman artisans found that beautifully marked woods could be chosen and matched to resemble exotic figures resembling "the spots of the leopard", "the swarm of bees", "the tawny lion", "the stripes of the tiger". This gave rise to a mania for fine veneered table tops. Pliny, the Elder, Roman naturalist, wrote that these tables were so expensive that they often figured in domestic quarrels. Roman women reproached their husbands with this extravagance when a spouse complained about his wife's vast outlay for pearls. Julius Caesar, ruler of the richest and mightiest empire the world has ever known, counted among his most prized possessions a beautifully veneered table.

History records that veneer was first used on an extensive scale for door frames and panels by the early Romans. It was the Romans who antedated the modern usage of plywood panelling seen today in the homes, shops and office buildings.

But whether the story of veneer is laid in ancient Egypt, Babylon, Assyria, or in Europe as late as the reign of Louis XV, there is one common fact that is significant: Veneers were a luxury, reserved for the rulers and the rich. The woods were expensive; the figures rare and beautiful. To employ them required the skill of experienced artisans, working with tools whose use required long years of training. Veneering was, in fact, considered one of the fine arts.

As an art, veneering rose and fell with the other arts. Peace and

leisure; love of homemaking; pride in craftsmanship, encouraged cabinet-makers to explore the never ending possibilities of veneer and plywood. Improved machinery, better glue, new methods of construction, different woods, unusual cuts and color, contributed to the advancement of the art which added beauty and quality to the furniture that went into the homes of the nobility.

Medieval History. With the coming of the Middle Ages, a shadow was cast over all creative work. Homes became hovels, their crude furnishings dictated only by necessity. Artistic expression, in the decorative use of veneers of wood, ivory and precious metals during the days of ancient splendor, was followed by some thousand years of turbulent strife and social unrest, a period in which all fine arts suffered, including the art of veneering.

The Renaissance. In the 14th century, however, the light of the renaissance dispersed these shadows and revived an interest in culture and refinement among all classes - builders, artists, writers, teachers and religious leaders. Cabinet-making joined the upward surge.

There is no substantial evidence of the resumption of the ancient art of veneering until the late Renaissance period. In the late Jacobean or Carolean period, there can be found whorled or 'oystered' veneer made from the transverse slices of small alder boughs, and also was first discovered the use of walnut veneer in limited quantities when this wood was expensive and still regarded as one of the semi-precious woods.

The presumption is that the veneers of this period as well as those of antiquity were produced by hand-sawing wood as thin as this

operation would permit, followed by a hewing, shaving, adxing, or planing process to the required degree of thinness. There is some evidence to show that certain veneer craftsmen attached the heavier sheets of veneer to the base by the use of glue and plugs, and then worked these thicker sheets down to the desired thinness. When it is realized that the most artistic figures in wood are the result of cross-grain or the exposure of end-grain, it gives an idea of the enormous amount of hand labor and patience involved in the making of veneer by the old and crude hand methods.

From its beginning in Italy, where it stimulated painting and sculpture, the Renaissance spread with the aid of the momentous events of the 15th century - the invention of printing and the discovery of America.

In 1660 the restoration of Charles II brought about vast changes. Many foreign craftsmen who had learned the art of veneering in their own countries settled in England, and this, coinciding with the introduction of walnut as a furniture wood, caused a new technique to be developed. It brought into being the cabinet maker who specialized in furniture making as distinct from the carpenter who turned his hand to anything made in wood.

All veneers were cut by hand with the saw, and were thicker than those familiar today. The probability is that a two-handled saw was used to cut them, the sawyers standing one at each side of the wood. In this way each man could keep his eye on the passage of the saw on his side of the wood and thus minimize the risk of its starting sideways and so shattering the veneer. There is no confirmation of this, but it seems a reasonable supposition, especially when it is recalled

that all boards had to be cut by hand with a long, two-handled saw.

Veneers were laid on grounds of either oak or pine. There seems to have been no fixed idea in this connection, for both were used at the same time - sometimes both are found in the same piece.

From Charles II's time and during the reign of William and Mary walnut continued to be used, and it reached its zenith during Queen Anne's time.

Today, the course of this revival can be traced in the exquisitely veneered desks, cabinets, highboys and lowboys, commodes and beds preserved in the world's museums.

Best known of these masterpieces, perhaps, is the "Bureau du Roi Cabinet of the King", designed by Jean Henri Riesener for Louis XV and labored over by the most skilled artists and woodworkers of France for nine years before it was finished at a cost of over one million francs! In the Louvre in Paris, in a state of perfect preservation after almost 200 years, it stands today admired for its royal lines and faultless execution of its design. Most important is the construction. The Bureau du Roi is made of plywood throughout and is completely surfaced with veneers of the finest woods. It is a living monument to this type of construction and method of decoration.

It was not until about the year 1700 that manifestations of duplicate patterns or figure matching were found, both of which required the use of veneer to permit the pairing, halving or quartering of patterns, by the use of adjacent and almost identically marked sheets of veneer. Two adjacent boards of substantial thickness will seldom show the same figure, but six or eight thin sheets of veneer will be so much alike that it is often hard to tell the order in which they were cut from

the log.

The vogue of spacing into panels, generally formed of an oval with four triangular corners . . . probably owes its conception to the copying of the Jacobean carved panels of the period immediately preceding the accession of William III. Furniture was designed usually with flat surfaces to permit the veneers being easily laid down without splitting or the marquetry 'springing'.

References to history of the furniture of the 18th Century indicate the popularity of marquetry and other forms of veneering in French furniture, and the extensive use of mahogany and satinwood for veneering in the Georgian Period.

Part B

Inlay, Marquetry and Intarsia

Inlay is more often confined to woodwork, and the art of decorating the surfaces of furniture or wall panelling with small pieces of wood, ivory, tortoise-shell, the surface. The term "inlay" is often confused with and sometimes used for the word "marquetry". Marquetry is composed of pieces of very thin wood, or other material of equal thickness, laid down upon a matrix with glue. Thus marquetry is a veneer process, while true inlay is what the term implies "a laying in" of one material into another material called the "ground". Marquetry is a later development of the ornamental inlays of wood known by the name of Intarsia, which, although a true inlay as opposed to the thin veneer of marquetry, furnishes many examples wherein the process follows that of marquetry. For example, in the cathedral of Ferrara, Italy, the backs of the stalls show the perspective lines of some of the subjects traced

upon the ground where the marquetry has fallen off, but none of the "sinkings" would be there if the panels had been executed as true inlays instead of veneers. (23, page 367)

Process. The design for a panel is drawn on paper, the lines being pricked through to underlying sheets to make the necessary number of copies, or the pricked sheet is dusted over with a colored powder which passes through the perforations and marks the design faintly on the paper underneath. The pieces of paper are then cut up and stuck on several pieces of wood which form the design, one whole print being reserved to paste complete on to the ground or field. Each piece may be cut separately, but they are all bound to fit into the complete pattern when this is cut out of the ground, because all are cut from the same prints. In true inlay the pieces to be inserted are cut out of wood $1/8$ to $1/4$ in. thick. The surface into which these separate designs are to be set is carved out the required depth with wood-carver's tools, and the pieces making the design are driven in.

In marquetry two panels are sometimes made of the reverse colorings by sawing through the ground and the veneer at the same time. At one time it was quite a common occurrence to produce two pieces of furniture in which one was brass inlaid in the black, and in the other case the pattern was black inlaid in the brass, thus utilizing what would otherwise have been very costly waste material. Although this method of cutting through two or more pieces of wood clamped together, and simply dropping one piece into the opening made by the other, is not generally considered as fine work, many excellent inlayers like Bou Boulle in the time of Louis XIV., did their inlay work, or marquetry,

in just that way. When all the parts have been cut and fitted together face downwards, paper is glued over them to keep them in place, and the ground and the veneer are carefully levelled. The ground is then wetted with glue at a high temperature and the surfaces squeezed between the frames called "cauls" until the glue is hard.

History and Development. Probably the earliest examples of inlay were found in the Venetian work of the 14th century, when wood was inlaid on ivory boxes. Other materials were used at an early date. One of the most beautiful forms of inlay executed by the Italians was with ivory upon walnut wood or black wood. In the 16th century the Italians made inlays of marble in various colors, and in the 17th century a combination of tortoise-shell and metal was not uncommon.

Most of the examples found in England are importations, either from Holland or France. The reputation of the Dutch marqueteurs was so great that Colbert engaged two, Pierre Bale and Vordt, for the Gebelins at the beginning of the 17th century. Jean Mace of Blois, the first Frenchman known to have practised the art, who was at work in Paris from 1644 (when he was lodged in the Louvre) or earlier, till 1672, as a sculptor and painter, learned marquetry in the Netherlands. His daughter married Pierre Boulle, and the greatest of the family, Andre Charles Boulle, succeeded to his lodging in the Louvre on his death in 1672. The members of this family are perhaps the best known of the French marqueteurs. Their greatest triumphs were gained in the marquetry of metal and tortoise-shell combined with beautifully chiselled ormolu mountings. It is thought by many that Boulle carried the work of inlaying too far. The 18th century commode of late Louis XIV period, of

tortoise-shell, mother-of-pearl and colored ivories inlaid in brass, and example of which may be seen at South Kensington, is characteristic. (23, page 367)

The Stuart period produced a good deal of marquetry in England, often pieces of real excellence. Long-case clocks, cabinets, chests of drawers and various other pieces of furniture were subjected to this kind of decoration. A shallower form of marquetry and some inlay work were also extensively used in the latter part of the 18th century. With the increase in luxury and display in the 17th and 18th centuries in France and Germany, cabinets and desks became objects upon which extraordinary talent and expenditure were lavished. Perhaps the most beautiful examples of the art in Italy are the panels of choir stalls or sacristy cupboards, though marriage coffers were also often sumptuously decorated in this manner.

Nearly a century later, America was to bring forth excellent examples of marquetry and veneering in somewhat more democratic settings of grandeur. The Pullman cars. Many whose memories go back to that "plush" era can recall some of the famous designs of the wood panelled berths: "the pineapple", "The bird in the bush", and many others. Inlay, marquetry and intarsia decorations are ancient arts which have been in use for thousands of years. Today painted patterns and thin painted lines are sometimes used to imitate inlays. Lithograph transfers are sometimes used to simulate marquetry. Careful feeling with the fingertips should reveal whether actual inlaid materials have been used or whether the design has been applied.

Part C

Development of Wood Veneer in America

History has been written on veneered surfaces. Napoleon planned his strategy at a plywood and veneered desk which accompanied him from one end of Europe to the other through 20 years of strenuous military campaigning. Today, it remains in almost perfect condition, as does the desk on which he signed his abdication. The founders of this country wrote the Declaration of Independence at a veneered desk, and the "father of our country", in his home at Mount Vernon, enjoyed the beauty of veneered furniture. From the Mississippi steamboats of the days of Mark Twain to such modern miracles as the "Queen Elizabeth" of the Cunard Line, veneer has figured in the decorative schemes of ship and boat builders. The job of panelling the "Queen Elizabeth" required approximately 50 tons of veneers, representing a surface of about 23 acres!

Paradoxically, the very instruments which furnished the uses of veneer, nearly caused its downfall. During the 17th century a saw was invented which could cut thin veneers. This started the use of large panels of classic simplicity. But veneered furniture was still largely hand constructed and exceedingly costly. Artistry and prideful craftsmanship continued into the 18th century which saw veneering and marquetry at their peaks. This was the age of the master craftsmen whose names now are the hallmarks of the finest in period furniture styles: Chippendale, Hepplewhite, Sheraton, the Adam Brothers, and Duncan Phyfe.

Modern History. However, hand made furniture could not hope to

keep pace with the rapidly expanding America. The invention of the circular saw took place about 1805 (shortly after the advent of the steam engine), all previous sawing having been done by means of the hand or stroke saws. It was not until after this invention that the first type of slicing or shaving machine was developed for cutting thick shavings of wood that were used for boxes and for ornamental purposes. This machine was a large power-drawn plane, operated by means of a steam engine, but this method of making slices of veneer was not extensively used, and in fact, the power plane device could hardly be considered a success at that time. In 1840, a few manufacturers, bent only upon mass production, began to make furniture mostly by machinery. The hand craftsman was unknown in their factories; workmanship was shoddy. Many defects had to be covered, so veneers were applied to conceal poorly made joints or badly joined lumber. Simplicity gave way to gingerbread and ornate inlay as the makers tried to hide inferiority.

Of course, many companies continued to make good furniture. They used machinery where machines could do a good job fast and accurately, but the master craftsmen still supervised all details of construction. These quality producers continued to select their lumber and veneers from the best native woods. They bought choice logs, imported from far away countries. Constantly, they sought ways of improving their products.

Among other things, they discovered that they were unable to use in solid form many of the most beautiful woods. Burls and crotches, which could be so advantageously employed in matched designs, would crack and break if they were not applied to a more substantial base.

Rare woods often were not available in large quantities, or if they were, might also be too delicate for solid construction.

Modern machinery, which, in the hands of unthinking manufacturers almost sent veneering into eclipse, today enables reputable producers to bring to everyone the articles that once were the luxury of a few.

The prototype of the modern circular saw was found to destroy, in sawdust, a thickness considerably greater than the resulting veneer, and this led eventually to the segment saw, which consists of a series of thin segmental toothed saw sections bolted around a center disk or hub.

The sawing process of producing veneer was supplemented in the latter part of the 19th century by the slicer, a knife across which a log is drawn, producing a shear cut, and resulting in a shaved sheet of thin lumber. This slicer was the original method and is still used for cutting the most valuable veneers where figure and texture are important.

Current History. The most recently developed method of veneer cutting is the rotary lathe, producing sheets of substantial width and length, peeled off cylindrically from a log in one continuous piece. This has now become the chief means of veneer production in all except figured woods.

Modern technology plus the use of plastic adhesives - products evolved through chemical research applied to an old principle, i.e., strength of wood laminations, has opened new frontiers. By using three, five, seven or some other odd number of plies, each at right angles to the adjacent ply, a balanced construction results that gives maximum strength and rigidity with minimum weight. Plywood is stronger than any ordinary piece of wood - stronger, in fact, weight for

weight - than steel! (2, page 194)

Despite the amazing technological advances in the industry since World War II, some people still cling to the false notion that all veneered furniture is inferior furniture.

Despite its trials, the art of producing and using veneer, and the production of plywood survives. Today it is better, more beautiful, more useful, more popular and more available than at any other time in its 3,500 years of history.

Today, over 90% of all case goods sold by retail furniture dealers is of plywood construction.

The common man has inherited the earth and the fullness thereof. The loveliest woods of all the world are easily within the reach of all who have the taste to value them. With the history of wood veneer as the background, attention is now directed to more important facts about veneer industry, manufacture and uses.

CHAPTER III

VENEERS AND VENEERING

The story of veneers may begin in our own country, or in far off Africa, or Australia, or South America. To name the more prominent woods in use today is to make a trip about the world - American walnut from the Middle West of our own country, myrtle burl from the Pacific Northwest, oak from the South and East, maple and birch from the North, aspen from the East Coast, mahogany from Mexico, Honduras, Cuba, Peru and the Amazon region of South America and Africa, harewood from England, orientalwood from Australia and New Guinea wood from New Guinea and nearby islands. Then, there is the redwood burl from our West Coast, red gum from the Southern States, prima vera from Central America, rosewood from Brazil and the East Indies, the Carpathian elm burl from Central Europe, avodire, ayous, sapeli, tigerwood, zebrawood, and thuya burl from Africa, paldao and narra from the Philippines, and satinwood from Ceylon, India and the East Indies.

These are just some of the 175 species carried in the inventory of the Veneer Industry.

Part A

Manufacturing Wood Veneers

Wherever the story may begin, prime trees are carefully selected, felled, and shipped to the veneer manufacturer. Most times they go in log form, either whole or half. At other times large trees are hewn into rough squares or flitches, with the thick sapwood trimmed away, to

save cost in transportation.

The Veneer Industry. The Veneer Industry is an industry which manufactures veneers. Veneers are thin sheets of wood usually cut from rare and costly logs. The sheets of veneer are glued to more common woods to increase the strength and add to the appearance. When several sheets of veneer or other woods are glued together so that the adjacent grain runs at right angles, the wood is called plywood.

Manufactures of hardwood veneers are divided roughly into three classes, according to the product they make; (1) face veneers, (2) commercial veneers, and (3) veneers for packaging and boxing. This report deals only with the first two.

Face veneer manufacturers are located primarily in and around the following centers:

Louisville - Indianapolis - Cincinnati, St. Louis, Boston - New York City - Baltimore - Philadelphia - Norfolk, and Chicago. There are several mills in northern Wisconsin and Michigan, Tennessee and North Carolina. Altogether, about fifty companies actively engage in manufacturing or producing face veneers. A "manufacturer" buys logs and cuts them into veneers at his own mill. A "producer" buys logs, but has someone else cut them for him. He does not own a veneer mill. (This distinction applies only to face veneer companies. Commercial veneers are always made by manufacturers.) There are several mills that do nothing but cut for others. They are called "custom-cutting mills", and are conveniently located, each in a different section of the country, at Indianapolis, Norfolk, and New York City. (15, page 3)

Commercial veneer manufacturers are generally located at a point convenient to good native timber, for they cut only domestic woods. Those who manufacture veneers of red gum, tupelo, poplar and oak have mills at various points along the Ohio and Mississippi River valleys in Kentucky, southern Illinois, Tennessee and Louisiana, and in the states of Georgia, Alabama, West Virginia, and North and South Carolina.

Manufacturers of the northern woods, birch, maple and basswood, are scattered throughout northern Wisconsin and upper Michigan. Altogether there are about twenty-five manufacturers of commercial veneer who do an interstate business. A manufacturer may have one mill, or he may have several mills at different locations.

In addition to these two, there is another group composed of commercial veneer manufacturers that do an intrastate business - that is, they sell only within their own state, to the local furniture or plywood plants. Members of this group are located primarily in the Southeast, mostly in Virginia and North and South Carolina.

A fourth group is composed of mills who manufacture both veneers and plywood. They use the veneers they make for their own plywood, and, therefore, have none to sell. Except for face veneers, they seldom purchase veneers from other manufacturers. The few manufacturers who sell veneers as well as plywood have been included in the figures given for face and commercial veneer mills, since they are the exception to the rule. The majority are of no concern in the study of the Veneer Industry and its customers.

Face veneers are sometimes known as "fancy" veneers. They are cut from very select logs of those species that provide attractive grain and color. These may have been chosen very carefully from the entire domestic production; or they may have been imported from far-away countries. Sometimes the logs are piled and stored in the yard for months. Generally, however, they are cut into veneers long before the face veneer manufacturer receives the order from his customer.

The buyer of face veneers bases his selections mainly upon the attractive appearance of the veneers, and the "cutting" they will

produce, i.e., whether he will be able to cut them into such sizes as he will need, match these smaller pieces, and produce the pattern he has in mind. For this reason the manufacturer must have samples to show his customer. All the veneer sheets cut from a single log, or a portion of the log, are kept together in the exact sequence in which they came from the log. From each flitch the manufacturer draws one, two, or more sets of samples. Usually there are three sample sheets to the set, one from near the top, one from the middle, and one from near the bottom of the flitch. If the number of sheets in a flitch is unusually great, or the character of the figure changes rapidly, or serious defects appear and disappear, more than three sheets are sometimes required to give a true sample of the veneer in the flitch. The face veneer manufacturer, therefore, sells his veneers by sample. He must keep a large inventory on hand, so that he will be sure to have samples that will please as many customers as possible. He keeps this large inventory so that he can not only supply large quantities of a single species of wood, but also large quantities of a particular cut (such as quartered, flat cut, etc.). At the same time, he must have on hand a good selection of the various patterns and figures. He sells his veneers just as they come from the log, without cutting them to any particular size. It is up to the customer to select a flitch which is wide enough and long enough for the use to which he will put it.

The United States Department of Commerce, National Bureau of Standards, has approved and issued "Commercial Standard CS 64-37" for walnut veneers, a recorded standard of the walnut industry. This standard provides definite minimum grade specifications for the production, distribution and use of walnut veneers. It is designed to

facilitate purchasing and contribute to higher standards of manufacture and greater uniformity of product, and to provide a basis for grade certification similar to that followed in the grading of numerous species of lumber.

The American Walnut Manufacturers' Association has inaugurated a system of grading walnut veneers (20, pages 12-14). Grading rules have been prepared with specifications for the determination of minimum quality. The producers who are operating under these grading rules have placed themselves under bond to meet these exacting requirements. Their walnut veneer footage is graded in accordance with the specifications by experienced inspectors independent of the producers.

Commercial veneers, often known as "utility" veneers, are sold in an entirely different manner. The customer who buys commercial veneers does not usually care how they look, provided that they are well-manufactured, good, sound veneers, sturdy and reliable. Also, he wants certain sizes. Therefore, the commercial veneer manufacturer ordinarily does not cut his logs into veneer until he receives the order. This order will state definitely the minimum length and the minimum width that will be accepted, and the thickness, or, in some cases, the number of pieces of specified sizes. By designating the "grade" required, the order will automatically indicate to the manufacturer just which defects will be allowed, and which are prohibited. Standard terms, such as "crossbands", "cores", "backs", "sheetstock", "log-run", and "cut-downs" are used throughout the industry, and are defined in published grading rules. (22, page 2, section 1).

The commercial veneer manufacturer sells his veneer by grade and size, instead of by sample. He must have sufficient logs in the yard or

under contract so that he can begin cutting when he receives a definite order. Yet, he must not have too many, or decay may set in. There are certain standard sizes which are ordered again and again, and a few manufacturers carry a perpetual inventory of these sizes, to take care of "rush orders". Other than that, they carry no veneers in inventory.

All face veneers are made into plywood (with the exception of a few "specialty" products, wherein the veneer is attached to some base such as metal, cloth, or paper). Plywood is fabricated from face and commercial veneers, commercial veneers alone, or lumber and veneer, depending upon what its use will be.

Therefore, the face and commercial veneer industries have the same customers, in the main, for the buyer of face veneers also needs commercial veneers to make his plywood.

Customer of the Veneer Industry. Those who make plywood are divided into two main groups:

(1) The furniture, radio, and piano manufacturers who buy veneers, make them into plywood, and then construct furniture; (2) The plywood plants who build either "stock" panels of plywood, or manufacture them to size, upon order. Plywood plants must sell their panels to another industry for further fabrication. Their customers are furniture manufacturers who do not make their own plywood, manufacturers of boats, aircraft, railroad cars, and the like, and architects, contractors, and dealers in the wholesale and retail trade who use the panels for interior decoration, flooring, etc. (15, page 7).

No veneer is sold to the ultimate consumer (except the home craftsman) in its original form, for it cannot be used until it has been fabricated into plywood.

The first group of customers are generally located in or near five or six big furniture manufacturing centers. The second group are more

scattered. Neither group will come to the veneer manufacturer, as a rule, so he must go to the customer.

A limited amount of veneer is sold through "wholesale houses" or "jobbers". They buy the entire flitches outright, and resell at their own prices. Some of them carry an inventory. Others purchase the stocks only when they are almost certain of an order.

There are about two hundred commission salesmen who represent the seventy-five face and commercial veneer companies mentioned previously. These salesmen have set up their headquarters in 26 states of the Union. About 60% of them are located in Illinois, New York, North Carolina, Michigan and Indiana, the five largest furniture manufacturing states. California, Kentucky, Virginia, Pennsylvania, Ohio, Maryland and Oregon account for 25%. The rest are scattered throughout Massachusetts, Minnesota, Wisconsin, Texas, Louisiana, Tennessee, Iowa, New Hampshire, Arkansas, New Jersey, Colorado, Missouri, West Virginia, and Washington. Since each salesman may cover several states, the Veneer Industry can rightfully claim to be a truly national industry. (15, page 10).

Method of Cutting Veneer. Trees which will produce veneers that are strong, sturdy and generally reliable, but not particularly pleasing in appearance, are sent to the commercial veneer plants. The finest logs, those from which very attractive veneers can be cut, are reserved for the face veneer mills.

Logs of poplar, red gum (usually not the figured type), tupelo, basswood, and some maple, magnolia, cottonwood, birch and oak, are piled in the yards of the commercial veneer manufacturer until he receives an order stating the kind of wood required, the amount, grade,

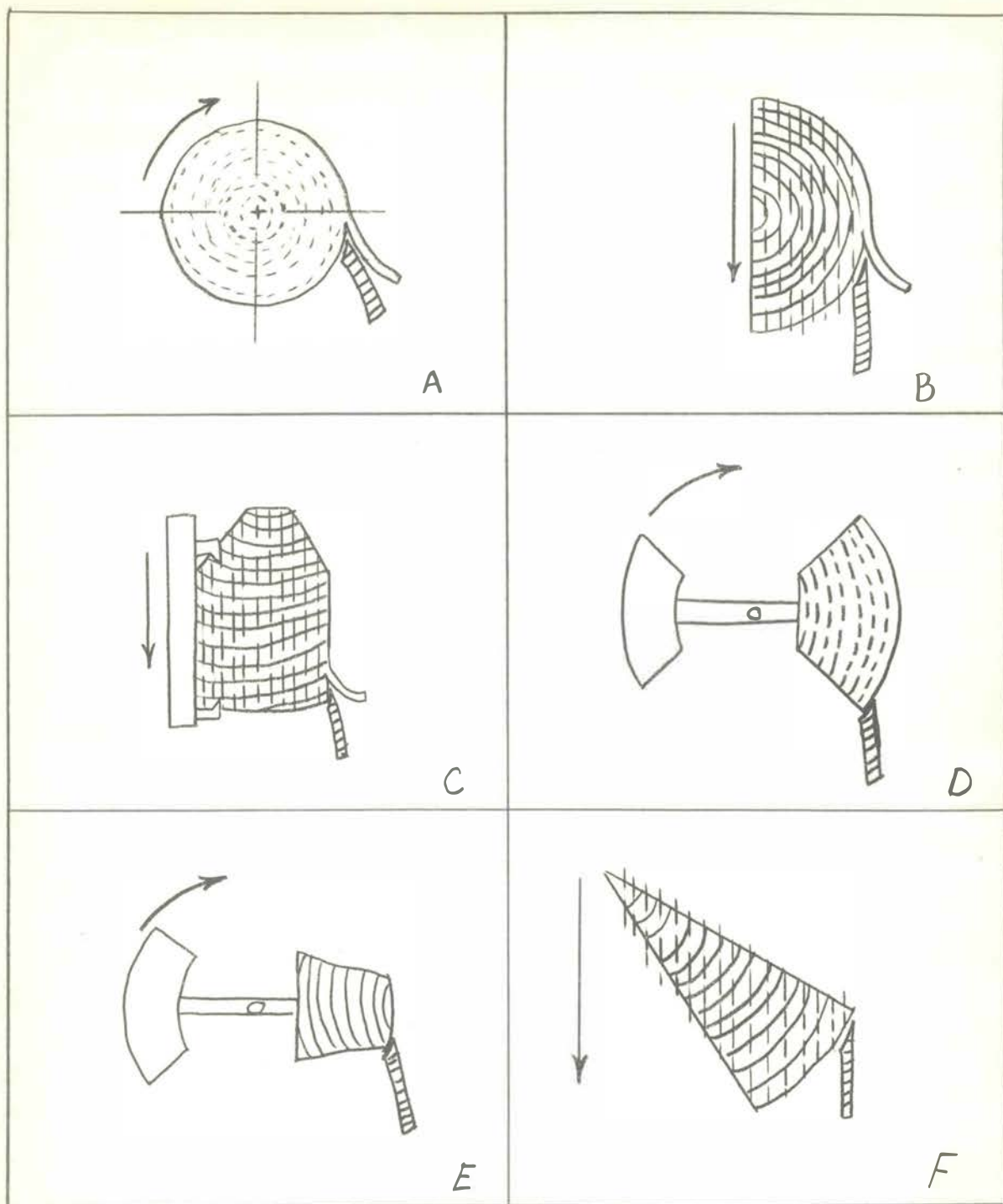
sizes and thickness needed, and other such facts. He then selects the proper logs.

If these logs are sufficiently pliable, they may be cut cold. Often, however, they must be conditioned in large vats, with steam or hot water, or both. When they are moist and softened, they are removed, one by one, stripped of their bark, and brought to the rotary lathe. Here a single log is fastened, and revolved like a great spindle against a stationary knife, which peels off a log into a continuous sheet of veneer. This sheet, depending upon the grade required, is clipped at convenient widths, or as undesirable defects appear. Those sections which do not meet specifications, as to size, must be set aside. The veneers are then dried to a specific moisture content, crated, and shipped to the plywood or furniture manufacturer.

Those logs which were sent to the face veneer plant may be kept in the yard for some time, but not necessarily until an order is received, for face veneers are purchased on sample, and are selected because of their attractive figure, pleasing color, good finishing qualities, and other such qualifications. They are cut by one of several methods: slicing, sawing, rotary cutting, etc. (Figure 1, page 26).

Method of cutting is probably most important of all. There is hardly a species which does not have either irregular grain, clearly defined annual rings, variation of pigment coloring or pith rays. Many have a combination of these features. It is the job of the veneer manufacturer to determine which method of cutting and what angle will reveal the finest figure to best advantage.

Veneers cut on the quarter reveal the straight stripe caused by the annual rings in trees of the temperate zone, and the interwoven



A. Rotary cut. Log is revolved against knife which pares off veneer in thin continuous sheets. B. Flat cut, slicing a log directly through the heart of a half section of the log. C. Quartered. Slicing small segments of a log to cut at approximately right angles to the annual growth rings. D. Half-round. Quarter sawed flitch is mounted on rotating arm, with balance log at other end. As flitch turns, the fixed knife peels off sheets of half-round veneer that conform to the shape of annular rings. E. Backcut. Flitch is mounted backward so that the annular rings face out. F. Rift cut. Method used to produce "comb-grained" or "rift" oak. Knife cuts at a 45 degree angle to both rings and medullary rays to produce a striped effect.

FIGURE 1

grain of those of the tropics. The "flake" figure is also revealed by quarter-cutting.

Flat cut veneers show the stripe at the outer edges, and a "leaf figure" in the center. At the outer edges the knife cuts through the annual rings at right angles, and the strips appear. As it nears the heart, however, it gradually cuts more and more parallel to the annual rings, as they diminish in size.

Veneers cut on the rotary lathe very frequently show a "wild" pattern, particularly if there is a marked difference between spring and summer wood. As the log revolves in the lathe, the knife is more or less parallel to the annual rings at all times. No tree grows absolutely symmetrical, and, as a result, spring and summer wood become intermingled on the surface of the veneer that unrolls.

Some fitches lend themselves particularly well to certain types of cutting. Burls, comparatively small in size, are usually cut half-round, to obtain full value of the exceptionally fine figure. Crotches and Swirls may be produced by the flat cut or half-round method, depending upon their size. Stumpwood is ordinarily cut half-round.

Oak, which splinters easily unless handled very carefully when in the slicer, is most frequently sawn, as are exceedingly hard woods such as ebony. (17, pages 8, 9, 10).

An expert decides which of the three methods, namely, slicing, sawing, or rotary cutting will produce the best results from each particular log. A number of factors enter into his decision, including size and shape of the log, amount of wavy grain or coloring matter in the wood, type of figure desired in the finished veneers, texture of the wood, and thickness required.

Logs that are to be sliced are split open by a saw, stripped of their bark, and placed in large vats for conditioning. When sufficiently soft and pliable, they are further trimmed and taken to the cutting machine. Here a single fritch (an entire log or portion of a log prepared for veneer; the strips of veneer are sometimes referred to by the same name) is fixed horizontally in a heavy movable frame. The frame brings the fritch down against the cutting edge of a log stationary knife which shaves off veneers of the desired thickness, anywhere from 1/100" to 1/28", the standard American thickness for face veneers being 1/28". (Commercial veneers are generally 1/20" and thicker, although they may be thinner for certain types of work.) (16, page 6).

Sliced veneers may be either flat-cut or quarter-sliced. Flat-cut veneers are produced by cutting straight through the heart of a half section of a log. This gives a combination of straight grain and heart figure. After the fitches have been steamed it is taken out and carried on to the slicing machine, which has a large knife 7 ft. to 10 ft. long bolted on diagonally. The fritch is mounted upon a bed and the knife moves across the grain with a slicing movement, the bed moving upwards after each cut so that the next leaf can be cut. As before, the leaves are piled in the order in which they are cut, to enable them to be matched. Each fritch can be cut until there is only about 3/4 in. thickness left. To dry the veneers they are either passed into a special machine fitted with steam-heated rollers or are placed in racks kept at a high temperature. The thickness of the veneers may vary from about 1/60 in. to 1/30 in., and the best thickness is a matter of dispute. If cut too thick the grain is liable to be upset as it is raised by the knife, whilst a thin veneer will allow the glue to

soak through it, which is bad for polishing. A thickness of $1/30$ in. is generally considered to be the best, though the rarer and more expensive woods are cut as thin as $1/60$ in.

Sawed veneers are usually produced with a band or circular segment saw that goes through the log from end to end. This is the oldest method of manufacturing veneers. It is necessarily expensive because the sawing process wastes as much timber in sawdust as it produces in veneer form. It is easy to tell a saw-cut veneer by the marks of the circular saw on both sides. The log is first opened up by a single cut down the middle in order that the quality of the figuring may be examined. It is then either cut into veneers as it is or it is reduced into small squared-up pieces known as flitches. These are mounted upon a sort of carriage which moves along a track towards the saw. As each successive cut is made the flitch is moved inward towards the saw by an amount equal to the thickness of the veneer, usually some $1/20$ in. or a little more plus the width of the saw kerf. The veneers are stacked in piles in the same order as cutting, so that when matched panels are required two adjacent leaves can be used, these having almost identical figuring. This method is used mainly when veneers are to be comparatively thick or the logs are unusually hard or otherwise difficult to manufacture properly when cut with the knife. Sawing produces very much the same figure as slicing.

Quarter-sliced veneers are obtained by placing a smaller section of a log in the machine in such a way that the knife will cut through at right angles to the annual rings. This produces a striped effect.

In producing rotary-cut veneers the log is not cut up into flitches, but after steaming is fitted upon a machine rather like a huge lathe.

A long knife is fitted at one side and the log is revolved against it so that the veneer is produced in a practically unlimited width, since the knife travels inwards at each revolution by an amount equal to the thickness of the veneer. As it is peeled off it is passed to another machine which clips it off to convenient sizes. It will be realized that the direction of the cut is practically that of the annual rings of the log, and the resulting grain is generally of a wild, uninteresting character, so that such veneers are suitable only for cross-veneering, a face veneer being applied over it. Generally it is inferior to flat-sliced veneers. Its main commercial use is in the manufacture of plywood. The exception is bird's eye maple, which is cut rotary fashion. Rotary veneers can be from $1/80$ in. up to $3/8$ in. thickness.

Now a good deal of face veneer is manufactured on the rotary lathe, exactly like commercial veneers. This method is most economical and is satisfactory when the wood does not have too much contrasting coloring matter, or when a more prominent or wild figure is desired. Some mills have an electric saw with which they groove the log before it is mounted in the lathe. This eliminates tearing or clipping the veneer as it unrolls. Consecutive sheets are more uniform in size and are easier to match well.

Half round and back-cut are variations of rotary cutting. The same lathe is used, but the flitch is placed off center, so that as it rotates it comes into contact only as the projecting portion reaches the knife. The logs are usually halved first. Burls, stumpwood, and crotches are frequently cut half-round, as are also some types of longwood.

Most face veneers are purchased either by a furniture, radio, or

piano manufacturer, or by a plywood plant. In the Furniture Industry, there is one important final step (matching veneers) before the face veneers are finally fabricated into plywood.

Matching Veneers. The art of matching veneers has been developed to such a high degree of perfection that the well-informed designer may obtain almost any desired effect and utilize the full value of every wood. Because face veneers are cut thin, adjacent sheets contain similar grain and figure markings. By utilizing this duplication of pattern, large sheets may be developed by following a definite pattern of matching.

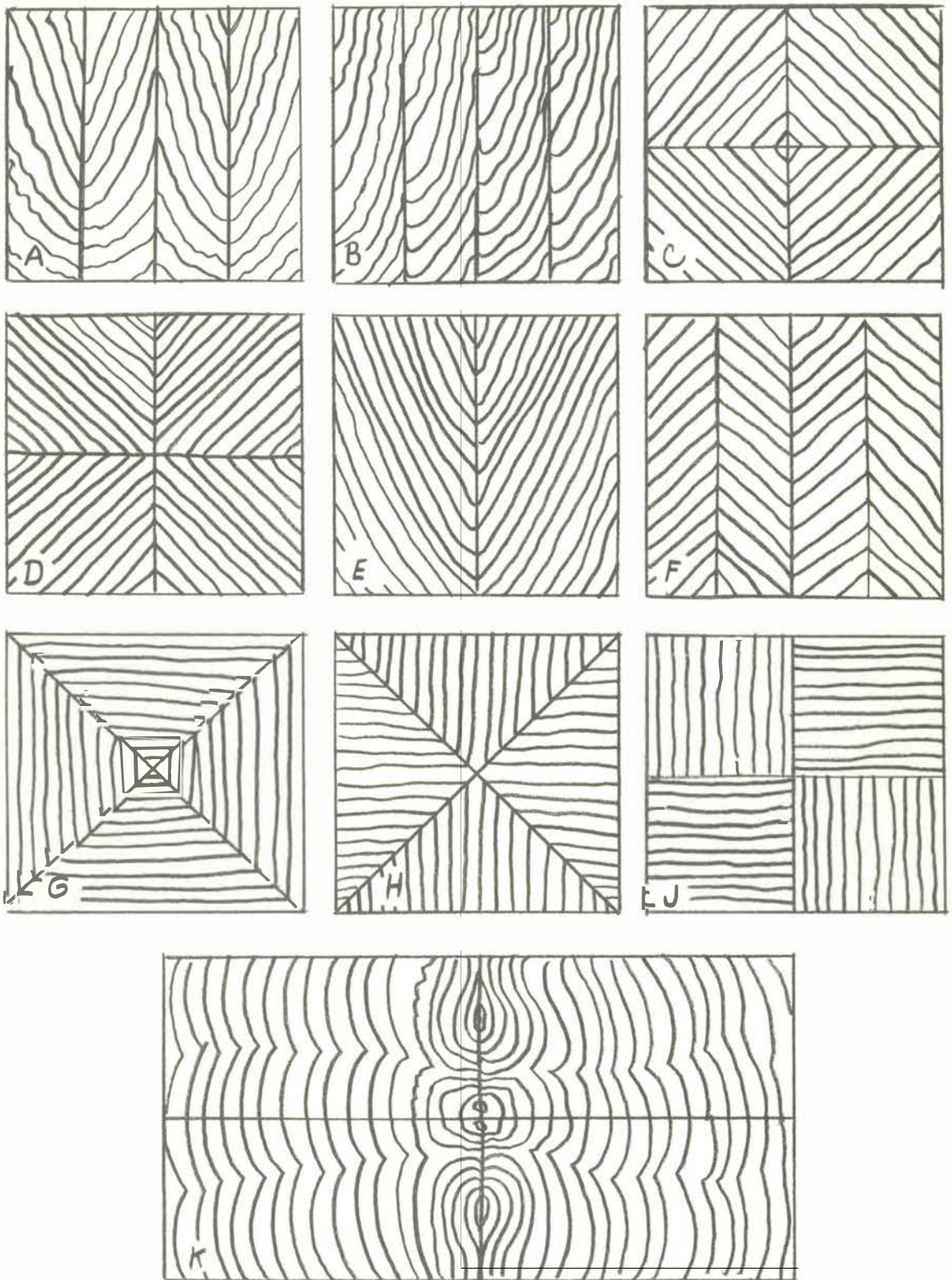
After the face veneers that have been selected by the furniture manufacturer are received from the veneer mill, they are carefully re-dried and kept in the same order as when they were cut. The importance of this step is evident when the matcher begins his work. Depending upon the design, veneers are matched in one of several ways:

1. Book Match: Two adjacent sheets of veneer are opened up like a book and then taped together side to side.

2. End Match: Similar to book match except that the ends, instead of the sides, of the two sheets of veneer are used as a hinge, and they are taped end to end.

3. Miscellaneous: Includes slide match, diamond match, reverse diamond, herringbone, and other effects conceived by the designer. (See Figure 2, page 32).

In the process of matching, the veneers have to be squared, clipped at an angle, cut into a number of small segments, or treated in some other manner, depending upon the result desired. The clipping machine, or "clipper", is invaluable at this point, for it will cut cleanly and quickly through many individual sheets of veneer at one time. Sometimes a third, a half, or in rare cases even three-fourths of each sheet of



A, Book; B, Slip; C, Diamond; D, Reverse Diamond; E, "V"; F, Herringbone; G, Box; H, Reverse Box; J, Checkerboard; K, 4-way Center & Butt.

FIGURE 2

STANDARD VENEER MATCHING PATTERNS

veneer is laid aside, either to be utilized for some other suite, or to be thrown away entirely, merely because only a small portion of its pattern would help form the perfect design needed for a beautifully matched table top or cabinet. (16, pages 9, 10).

Sometimes the veneers are matches in a separate department of the veneer mill itself. They are then sold as "matched and taped faces" direct to the furniture or plywood manufacturer.

From here on the furniture manufacturer, plywood manufacturer or cabinet maker takes over the job. But, the veneer manufacturer must continue his endless search for new woods to offer the public. He must be certain that his latest "discovery" will be available in sufficient quantities to meet the demand. He must make sure that the next consignment of logs will be similar to the first one, for it is often fatal to trust to native names of trees, and botanical identification is frequently not even established. In addition to filling the constant desire for "something new", which may or may not prove popular over an extended period of time, the veneer manufacturer must see that his supply of the favorite cabinet woods is adequate, with a well diversified line of "figures". Here again the public taste varies. One year straight stripes are in vogue, and "quartered" stock moves swiftly. The next year the demand may sway to "flat cut", or perhaps a more elaborate figure, such as "stumpwood", "burl", or "crotch". If one of the 175 different species of veneer, each with its many variations, does not please everyone, perhaps the 176th will!

Figures and Patterns. The question is often asked, "How can two pieces of veneer, both the same species of tree, look so utterly

different?"

Fundamentally, there are two primary causes: (1) variations in the actual physical structure of the wood itself, (2) the ingenuity of man in revealing these variations to the best of advantage. (17, page 3)

The author will make no attempt to determine why one tree is straight grained, and another, nearby, twisted and curly, why the wood of one is tan, another chocolate brown, and a third almost black, with vivid markings, or why one species frequently produces beautifully figured burls, while burls are unheard of on another species. These are for the wood technologists to explain. It is an accepted fact that these peculiarities exist.

Figure is determined largely by the part of the tree from which the veneer is cut. There are four major sections used for veneers: (See Figure 3, page 35).

1. First, there is the trunk of the tree, which is known as Longwood. Most veneers are cut from longwood. All trees, of course, have trunks, and in most cases if any portion of the tree is used for veneers, the longwood is also utilized.

2. Next, is Stumpwood. Sometimes the wood at the base of the tree is twisted and irregular. When cut, it reveals a pattern that is most attractive, and distinctly different from that of any other portion of the tree. Only certain species produce stumpwood suitable for veneers.

3. The third is Crotch, that section of the tree just below the point where it forks. Here the fibers of the wood have been crushed and twisted between the two limbs. Veneers from the very center of this section are called "feather crotch", "flame crotch", or "moon crotch", depending upon which they resemble.

4. Toward the front and back of the crotch block the distinctive crotch figure gradually fades into a swirly pattern. Veneers from these portions are known as Swirls. There is no definite dividing line between crotches and swirls, for one gradually dissolves into the other. As with stumpwood, only a limited number of trees produce crotches and swirls.

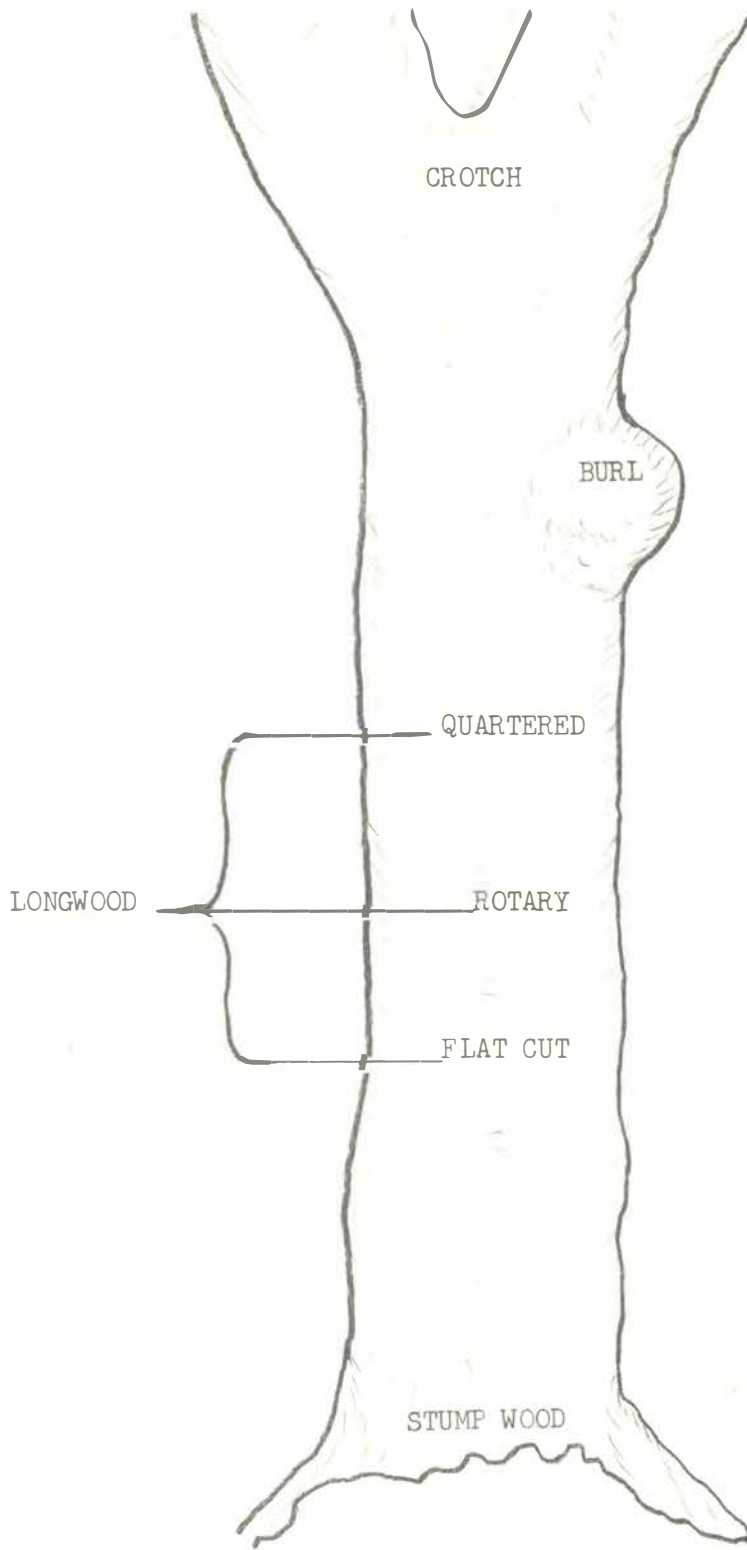


FIGURE 3
LOCATION OF VENEER CUTS

5. The fourth and last, strangely enough, is a wart-like, deformed growth on the side of the tree, believed to have been caused by some injury earlier in its life. Known as a Burl, this growth develops an unusual and exceptionally fine figure that is highly prized. (17, page 3)

The beautiful figures in decorative veneers are determined by several factors, in addition to the part of the tree from which it is cut, such as method of cutting, the pattern formed by the annual growth rings, the pith rays, pigmentation and color distribution, and on such accidents of growth as burls, crotches and irregularity of grain. The following figures, arranged alphabetically for convenience of reference are the most common:

Artificial Fiddleback: Veneers cut from plain logs with knife that has wavy edge.

Bees Wing: When mottle figure appears in wood whose stripes are narrow, it sometimes produces this figure.

Birdseye: Pattern due to buds which could not force their way to surface of the tree (usually in maple).

Blisters: Figures produced when annual rings are irregular as if they had blisters under them.

Broken Stripe: When interwoven grain is quarter cut, the twisted or spiral grain produces stripes broken at irregular intervals.

Burl: Some trees produce a large wart-like growth as a result of injury in tree's early life. When cut, the wood develops unusual figures.

Butt: Same as stump wood.

Conical Cut: Circular figure produced by cutting log like a pencil sharpener cuts a pencil.

Crotch: Where the trunk divides into two large branches the fibers have been twisted into confused and irregular patterns. Produces

a striking pattern when sliced.

Curly: Produced by curly or wavy grain usually found in outside sections of trees.

False Swirls: Half-round cutting of the trunks of certain trees when bent causes the annual rings to appear in swirling lines.

Feather Crotch: Crotch figure cut has characteristic feather or plume figure near the heart of the log.

Fiddleback: Produced when grain has a fine regular wavy figure.

Flake: Enlarged pith rays in some trees, when cut at certain angle, produce the flake figure (Oak, Sycamore, Lacewood).

Knotty: Typical figure on wood near surface caused by branches, buds, knots, burly spots. Usually found in pine or spruce but occasionally in Aspen, Oak, and Red Cedar.

Leaf: Same as shell.

Moon Crotch: Cut from a crotch near the bark, resulting in irregular lines.

Mottle: Straight or broken strip which is broken by short waves or curls. It produces a mottled figure.

Oyster Shell: Pattern produced by angle cutting across sections of limbs and small trees.

Peanut: A mottled figure of distinct character.

Quilted: A large blister figure.

Ribbon Stripe: A wide stripe figure.

Roll: Produced by wide wavy grain.

Rope Figure: Results when stripe breaks only in one direction chiefly found in Mahogany and Avodire.

Shell: When a section of log is cut on bias, the resulting cut

produces shell-like figure due to the face crossing the growth rings at an angle.

Stripe: In some species of trees the annual rings differ in color and structure. When sliced across, these produce a distinct stripe.

Stump Wood: In some trees the grain of the stump is twisted and irregular due to branching off of the roots. When cut, it reveals a distinctive and attractive pattern.

Swirls: Toward front and back of a crotch block the distinctive crotch figure gradually fades into a swirly pattern. Swirl patterns are cut from the swelling on trunks of some trees which usually occurs near the crotch.

Wild: Produced by rotary cutting when there is marked difference between spring and summer growth rings. (10, page 124)

The value of any figure depends primarily upon the use to which the veneers will be put. The burl is rare and expensive. Not for this reason, however, but because of its highly concentrated figure, it is customarily used in combination with plainer types of veneer. A highly figured piece of longwood might be exquisite as a table top, but blinding as the panelling for an entire room. A beautifully figured, brightly colored crotch, might prove striking, but it would be out of place as a table top in a conservatively styled dining room suite.

Now that we have the veneers manufactured, matched and sold according to its uses and patterns, we must discuss how we are going to apply it. There are several methods used. But, to make a broad division, there are two ways in which veneering can be done; by hand methods or by use of presses.

Part B

Method of Veneering

Veneering, the sister art to inlaying, has been known in one form or another throughout the ages, back to the dawn of history, as is shown by the tenth and eleventh verses of the twenty-fifth chapter of Exodus which reads, "And they shall make an ark of acacia wood; two cubits and a half shall be the length thereof, and a cubit and a half the breadth thereof, and a cubit and a half shall be the height thereof. And thou shalt overlay (veneer) it with pure gold, within and without shall thou overlay it . . ." (3, page 119)

At a little later date Phoenician workmen are recorded as making furniture, veneered "with olive wood, with ebony, with silver and with ivory."

Today veneer is generally thought of as thin slices of beautifully grained or richly colored woods which are used as a facing for cheaper wood because articles made from these solid boards would be prohibitive in price.

Advantages of Veneering. There is an old illusion that the term veneering is synonymous with woodwork which is cheap and shoddy; that it represents an attempt to hide up cheap materials and poor workmanship; and that it is altogether inferior to solid wood. Nothing could be farther from the truth. Properly carried out, a piece of veneered woodwork is as reliable as a solid job. It is made of the best timber, calls for the highest quality workmanship, and is anything but a cheap process to carry out. That veneering has been made use of to cover a nailed-up carcass must be admitted, but this is merely the abuse of a craft which has its definite uses and advantages.

The chief advantage in veneering is that it enables effects to be obtained which would be impossible or at any rate very unreliable if carried out in solid wood. For instance, there are certain woods, which, although beautiful in figure, are liable to twist and split if used in the solid because of their wild grain. In addition, they seldom have much strength owing to the short grain, which in parts may run practically at right angles through the wood. It is obvious then that veneering provides the only means by which such woods can be used, since by fixing them in thin sheets to a groundwork made of plain, but reliable timber, the necessary strength is provided.

Then again, consider the fine effect produced by built-up patterns and the introduction of various kinds of woods in one panel. A little reflection shows that such work would be out of the question in solid wood. Apart from any lack of strength and constructional difficulty, there would be inevitable trouble due to shrinkage.

In addition there is the question of shaped work. Within certain limits this can be done in solid wood, but if the degree of curvature is great, either the work will lack strength because of the short grain, or the surface will show a number of joints contrived in an endeavour to provide strength. By using veneer the job can be built up in a convenient way which will provide maximum strength, and it will show a fine grain in every part and be free from visible joints.

Another point to be considered is the growing scarcity of finely figured timbers. Cutting them into veneers means that the supply goes much farther, and, since experience has shown that the result is reliable when properly done, it seems an unnecessary waste to use such timber in the solid.

The hammer and the caul are the two main ways of laying veneer by hand. Each has its own special uses and advantages, though they are largely interchangeable. Caul veneering is advisable for built-up patterns and veneers which are liable to cockle. (5, page 1)

Preparation. Most veneer nowadays is knife-cut and is comparatively thin. It can therefore be most conveniently cut with chisel or knife. Lay it on a flat board and put a straight-edge along the place to be cut. Press well down and draw the knife across. When the cut is across the grain take special care at the end not to splinter out the grain. Press down tightly with the straight-edge. If trimming is necessary use a shooting-board, holding the straight-edge near the edge to prevent buckling. The veneer should overhang the edge the merest trifle, not more than $1/8$ in.

Assuming that the veneer has to reach right to the edges of the groundwork, cut it about $1/2$ in. longer and wider than the finished size. Possible jointing may be necessary to make up the width, and in this case the two pieces are cut to allow an overlap of about an inch.

It is imperative that the groundwork is properly prepared because any blemishes in it will inevitably show through the veneer eventually. Any knots must be cut out and the holes filled in with plugs, the grain of which runs the same way as that of the groundwork. Any nail holes (there really ought not to be any) should be filled with plaster of paris mixed with glue. This is allowed to dry out thoroughly and then levelled down.

Plane the surface perfectly true with trying or panel plane and follow with the tooting plane. The purpose of this is to take out marks left by the plane, and to roughen the surface, so providing a key

for the glue. The cutter is scored with fine V-shaped grooves at the back so that the edge has a series of small points which scratch the work. Use the plane diagonally, first in one direction then in the other.

Good-quality plywood and laminated board both make excellent grounds. Remember, however, that the grain of the veneer should be at right angles with the outer layer of the ply as otherwise there may be a tendency for cracks to develop. End grain should be avoided as a groundwork for veneer, but if it cannot be avoided, size it first. (4, page 111).

Hammer Veneering. Apply the glue evenly to both the groundwork and the veneer. Do not use more than is necessary because all surplus has to be squeezed out. Place the veneer in position and press down with the palms of the hands, working from the centre outwards. This will get rid of most air bubbles.

Dip a swab into warm water, wring well out, and lightly damp the surface of the veneer. In the meantime a flat-iron should have been warming up. Do not make it too hot; only just enough heat is wanted to liquefy the glue and enable the surplus to be pressed out. The light damping with the swab prevents the iron from sticking, but use as little water as possible because this is the chief cause of casting. For a similar reason too hot an iron is to be avoided because it causes steam to be generated from the water, and this tends to cause the veneer to become pliable and stretch during the next process when the veneering hammer is used. This naturally means that it has to shrink correspondingly as it dries and so causes casting.

Immediately follow the flat-iron with the veneering hammer, working

with a zig-zag movement from the centre outwards and in line with the grain as far as possible. If you work sideways you tend to stretch the veneer, and this causes casting, as the veneer subsequently contracts as it dries out. You will realize that you can deal with only a comparatively small area at a time because the heat from the iron is soon lost.

You can always tell when the veneer is properly down by tapping with the finger nails. A hollow feeling denotes veneer not in close contact. If after warming and pressing it still tends to rise you can cramp a flat block of wood over the place with a piece of paper beneath to prevent it from sticking.

In hammer veneering the veneers are overlapped and jointed after laying. Lay the first piece as described, then the second so that it overlaps the first by about 1 in. Place a straight-edge along the middle of the overlap and fix down with a couple of thumbscrews. With knife or chisel cut through both thicknesses. The one waste strip can be peeled away immediately, and the other can be removed by raising the veneer. Press down again with the hammer straightway, and stick a length of gummed tape along the joint to prevent it from opening as the glue dries out. (4, page 115)

Caul Veneering. This method should be followed for all tricky veneers which are liable to buckle badly if laid with the hammer, and for built-up patterns, marquetry, and so on. In brief, the groundwork and the veneer are prepared and glued as before, and the one laid in position over the other. A piece of wood known as the caul, slightly larger than the groundwork, is heated thoroughly through, and is cramped down over the veneer so that the latter is pressed tightly down. A sheet of paper placed beneath the caul prevents the latter from

adhering. As the glue must be forced from the centre outwards so that it can escape at the edges, either the caul is made a trifle round, or crossbearers slightly rounded in their length are cramped over it so that the pressure is applied at the centre first.

It will be realized that any jointing that may be required must be done before the veneer is laid, and in the case of a built-up pattern the whole of the veneers are assembled on a design previously drawn out on a sheet of paper. The method necessarily requires the provision of cauls which are generally retained for such purposes, and in this sense requires more apparatus, but for certain jobs it is the only practicable way of doing the work. Marquetry, elaborate built-up panels, and certain pieces of shaped work are examples. (4, page 116)

Inlaying. Nowadays this is generally confined to strings and bandings. These are obtained ready-made in a wide variety of sizes, woods, and designs, and the work consists mostly of cutting the groove or rebate to hold them and of gluing them. The scratch is mostly used for working the groove, the cutter being filed so that inlay makes a finger-tight fit in the groove it forms.

Having filed the cutter to size (its edges are square across so that it cuts in both directions) it is fixed in the scratch so that it works at the required distance from the edge of the work. Its projection should be such that when the inlay is pressed in it stands slightly proud of the general surface of the wood.

Working with the grain presents no difficulties, and if care is taken and the cutter kept sharp a groove can also be taken cleanly across the grain. For a large inlay, however, it is advisable to cut

the sides across the grain with the cutting gauge. The chief points to watch are corners where the groove has to be stopped. The safest plan is to mark the extent of the groove with pencil, and work the scratch as close up to the corner as can be done with safety. A thin chisel can be used to cut right into the corner, the waste being removed with a small brad awl, after which the scratch can be carefully worked into the corner.

In the case of a fairly large inlay line to be fixed right at a corner, the rebate can generally be cut with the cutting gauge. Set the cutter to slightly more than the inlay thickness and cut deeply in each direction. When the rebate is wide and shallow as for a banding, the width can be gauged and the bullnose plane used for the bulk of the waste. The scratch will finish it off and make it of equal depth throughout.

When fitting the inlay, assume that a line is to be inlaid around a panel. Mark one end of the inlay with the miter-square and cut it off at 45 deg. Place it in position and mark the over-all length. Mark in the 45 deg. at this end and cut it with a keen chisel slightly full. Try in position and cut off a little more if necessary. Go around all four sides in the same way.

When gluing, place each inlay close to the groove in which it is to fit. Have the glue really hot and apply it to the inlay by drawing it with a single movement across the brush. Without loss of time place one end in position, press in with the cross-peen of the hammer, and rub straight down from end to end. Avoid loss of time because the glue chills rapidly. If the groove is the right width there will be enough friction to overcome any tendency for the inlay to spring upwards.

Generally the glue is tacky enough to hold even a wide banding, but a thumbscrew applied locally will do the trick. In this case put a piece of gummed tape over the inlay and adjoining surface to prevent any tendency for the pressure to cause the inlay to drift outwards. When an inlay has to go around a curve it is bound to spring, and, to hold it in position, two wooden battens with a series of nails in each can be held at each side of the wood with thumbscrews and string threaded around them. After the whole has been tied on the string can be dampened, so tightening it. (3, pages 9-127) (4, page 124)

Hand Presses. These vary from small structures capable of veneering panels of a foot or so square up to large presses operated by hand. The principle is much the same, however, and is similar to that of the old-fashioned wooden press for papers in which pressure is obtained by means of a larger wooden screw. As a matter of fact, such a press can be used for small work, though presses made for the purpose are always of metal. The device may be a press pure and simple, or it may have means of heating the plate or caul. The process is much the same as that of caul veneering by hand, the work being prepared beforehand and taken to the press for laying. (5, page 83)

Machine Presses. There are many types of these, and all of them are capable of being controlled thermostatically to enable them to deal with the many special glues now on the market, some of which require an exact degree and control of heat. Those intended for flat work are of the multiplate type so that many panels can be pressed in one operation. Pressure is usually hydraulic, and heating by means of hot water or steam which can be circulated through the plates and chilled as required.

In other presses the heat is electrical.

For shaped work the vacuum press is often used, the special advantage of which is that no specially shaped caul is needed. Briefly, the groundwork with the veneer glued and laid in position is placed upon a bed, and a stout rubber sheet drawn over the whole. An air pump withdraws the air from beneath so that atmospheric pressure forces down the rubber sheet, thus pressing the veneer down on to the groundwork. In other presses air is pumped in from above and thus work by direct pressure rather than by vacuum. (5, page 88)

Part C

Important Facts and Uses of Veneer

Because in the early part of this century, inferior glues and workmanship caused surface veneers to come loose from core stock, some folks still have a prejudice against veneer. This can be overcome if the advantages of veneering—economy, strength and beauty, has been explained, as has already been mentioned in Part B of this chapter. As in the case of solid furniture, the value and quality depend on the workmanship and the materials used. In cheaper furniture, second-rate woods sometimes are used for legs and posts. In the better qualities, straight grain solid wood of the same species as the face veneer usually is employed.

Beauty, too, has kept pace with utility. Skilled designers have combined their talents with those of the production experts. Today veneer is used for furniture, pianos, radios, aircraft, watercraft, railway streamliners, trailers, store equipment, elevator cabs, and air conditioning units.

Important Facts About Veneer. Prior to World War II, new glues were developed along with new machinery for producing panels. During the war period, other added improvements were made. Here are some of the war-born developments:

Precision Cutting. Veneer is cut today by both the rotary and the slicing method in thicknesses of from 11 to 95 thousandths of an inch with tolerances which were considered impossible before the war.

The Tapeless Splicer. This machine edge-glues pieces of veneer without tape, enabling the mills to make large sheets of unlimited sizes in one piece, and in which the glue joint is stronger than the wood itself.

Hot Plate Presses. Hot Plate Presses have been perfected which make possible production of single, flat panels up to 200 inches long by 60 inches wide. A precise scarfing machine produces scarf joints as strong as the plywood itself. Such panels 84 ft. long and 8 ft. wide were used in P-T Boats.

Synthetic Resins. Synthetic resins--phenol and urea--adhesives which produce a waterproof bond essential to aircraft and marine construction, were just coming into use when the war opened. Now such quantities have been used that the cost of these adhesives has reached an all-time low which probably means the end of cheap and inefficient adhesives used in the construction of cheap furniture, which gave veneer a bad name in some quarters. These synthetic bonds are also resistant to fungus, heat and cold, salt water, etc.

Bag Molding. Bag molding is a process that enables industry to make panels or objects of any degree of curvature. Expandable gasoline reserve tanks carried by aircraft, were one of the war uses.

Impregnated and Compregnated Plywood. These processes mean the impregnation of thin sheets of veneer with phenol resins to any degree that may be required. Heat and pressure are applied and the resultant product is stronger than steel; it machines like metal; it is non-corrosive, a non-conductor of electricity, is impervious to moisture; it is acid resistant and is not affected by heat. "Impreg" is the name for less impregnation and "compreg" is when the veneers are soaked to the point of refusal. (10, page 122)

Veneer and Its Uses. Many of our domestic trees, as well as

foreign ones have beautiful burls, or highly figured portions where the grain is so wavy and irregular that if lumber were cut from these parts of the tree it could not be handled without breaking. The veneer manufacturer gives these exquisite figures to the furniture and plywood manufacturer in a form which can be readily utilized. When glued to several layers of sturdy wood, the veneers are as strong or stronger than the most practical of woods. A single tree will produce enough veneer for several suites of furniture.

Perfect matching to produce symmetrical patterns is obtained only through the use of veneers. Since they are cut thin enough to insure almost identical patterns on consecutive sheets, they are readily matched.

Curved effects such as found on radios, grand pianos, and the round corners of modern furniture are made possible through the use of veneer, which can be bent around corners. In this way the beauty of a long flowing design need not be marred by joints and other necessary structural features.

Is it any wonder, then, that to list the products made of veneer is an almost endless task? Here are but a few:

In the home: china cabinets, dressers and chests, beds, tables, buffets, radio cabinets, phonographs, pianos, book-cases, sewing machines, magazine racks, telephone stands, wardrobes, kitchen cabinets, ironing boards, bread boards, serving trays, chairs, ping pong tables and paddles, toys such as carts and wagons, tool boxes and trunks.

To build the home: wall panels, flooring, door panels, shelving, partitions, and prefabricated units for entire houses of plywood.

In office buildings: desks, chairs, tables, filing cabinets, wall panels, elevator cabs.

In shops and stores: counter tops, boxes, showcases,

window displays, bulletin boards, store fronts, wall panels, furniture.

In the transportation field: all types of water craft, from launches and small boats to steamers; aircraft, railway cars, automobile-"station wagons", buses, trailers. (18, page 9).

We could go on and on. Each day adds new and different uses for a truly superior product - veneer and plywood. (18, page 9)

Solid vs. Veneer. Taking Mahogany as an example probably the most frequent question we are asked is this one. "Is solid Mahogany better than veneered Mahogany Furniture?" This is a question that cannot be answered by "yes" or "no". The furniture manufacturer has two forms of Mahogany available for use in furniture construction, solid Mahogany lumber and Mahogany plywood panels.

Both are quality products. The excellence of Mahogany lumber is proverbial. Mahogany plywood made with resin glues under heat and pressure is equally good.

As a matter of fact, neither term is any criterion of either age of quality. Most Mahogany chairs are made of solid lumber today just as they were during the 18th century. Modern pieces, as well as many famous and valued antiques, are supreme examples of the skillful use of veneer.

The difference is, in most cases, merely a practical one. Small carved pieces are more effectively made of solid lumber than of plywood. Large and highly figured panels are more easily produced by veneering than from solid lumber. For the rest, it's a matter of taste. Solid Mahogany is usually conservative in design and figure, depending on line and turning or carving for ornament. Veneered furniture is usually of a lighter type, more brilliantly figured. Much furniture

is a combination, using solid lumber for structural parts, plywood for surfaces between the framing. Dining room and bedroom furniture, in both traditional and contemporary design, are typical of this type of construction. (7, page 22)

Woods for Veneer. The following list gives the veneers chiefly used in furniture making, and their characteristics. The sizes in which they are normally available are also given, but it should be realized that the supply of many of them is uncertain, while some may be entirely unobtainable. It is clearly impossible to give any indication pertaining to cost, as prices are liable to fluctuate not only with supply, but also according to the financial position generally. It can only be said that the price may vary widely in accordance with the quality of the figure, the soundness, and thickness. The size, too, in the richer woods such as burrs affect the price, a large burr costing more per foot than a small one.

Then again, when a log is cut into veneers the total production of the log costs less than when a selection is made of only a few bundles, which are generally chosen from the best part of the log. The difficulty is when people desire to take two or three bundles (representing, say, 600 ft. or 700 ft.) out of a log which has a total of perhaps 25,000 ft. In some woods it does not matter so much when all the veneers are of regular size, but in other cases to take out two or three bundles from the centre of the stock would completely ruin the latter and make it unsaleable. The buyer who wishes to do this must expect to pay a much higher price.

The last point is that it is always advisable to obtain all the veneer required for a single job at the same time, because some logs

have individual color or figure peculiar to themselves. It may be impossible to obtain a similar veneer later. This may not apply to the plainer types of veneer, but it is certainly true of many of the choice fancy woods.

The man who buys only a small quantity of veneer in lesser sizes can often get what he wants by buying small parcels of mixed veneers. Many merchants make a practice of supplying these, and they are cheaper because they contain odd ends which are quite sound, but for which the merchant would have no sale to the trade.

Now let us refer to the list of woods and their characteristics:

Amboyna. A richly mottled veneer of yellowish-gold shade. Mostly small and irregular in shape.

Ash Burr. A creamy-colored wood, from 12 in. and up long, liable to small black bark ingrowths.

Ash, English. A light wood, sometimes with fiddle mottle figure. Obtainable only in narrow widths, as edge is very sappy and nearly all ash has a brown heart.

Ash, Tamo. (Japanese). A rare ash, light in color and with rather large figuring. Sizes range from 4 ft. to 7 ft. in length and from 8 in. to 18 in. in width.

Avodire. A beautiful light yellow wood with mottle striped figure varies from 5 ft. to 8 ft. long by 8 in. to 20 in. wide.

Black Bean. (Australian). Medium brown in color. Expensive as it is difficult to cut, since it tends to become brittle, causing liability for the polish to crack. Sizes are from 4 ft. to 7 ft. long by 6 in. to 14 in. wide.

Birch, Canadian White. A wood with large figure available in two colors, white or dark (the white being the sap wood and the dark the heart wood). The dark is known as betula. Veneers can be obtained in stout thicknesses and large sizes.

Birch, Masur. A light wood with small figure having dark streaks. Obtainable in sizes of about 3 ft. in length by 12 in. to 40 in. wide.

Bubinga. A warm brown veneer with striped straight grain. Sizes 6 ft. to 8 ft. long by 8 in. to 24 in. wide.

Courbaril. This wood varies in figure. It is striped with light and dark brown. It runs about 6 ft. to 8 ft. by 8 in. to 12 in. wide.

Ebony, Macassar. Deep brown in color with almost black streaks. It is generally supplied in widths from, say, 3 in. to 6 in. only. This wood is prone to contain small hair shakes or cracks - hence the narrow widths.

Elm Burr. Varies from reddish-brown to cream. Sometimes the veneers attain a large size, but generally they run from, say, 18 in. square up to as much as 4 ft. long by 12 in. and up wide.

Greywood, Indian Silver. Somewhat similar in color to walnut. When quartered the veneer has straight striped effect, but when cut across the tree the figure and color are more varied. Sizes 5 ft. to 7 ft. and up long by 6 in. to 20 in. wide.

Laurel, Indian. A fine medium-brown wood with light and dark streaks. Every log varies much in color, figure and grain. Mostly the veneers range in size from 4 ft. to 8 ft. long by 8 in. to 18 in. wide.

Mahogany. There are innumerable varieties of this, the two main groups being the swietenia, which includes Cuban, St. Domingo, Belize, Honduras, Tobasco, and the Khaya group, which comes from Africa. The American mahoganies are not so hard as those from the West Indies, and the producing of the finest figure is the Cuban, though it is now becoming scarce. All the Swietenia group, however, produce fine veneers. The African varieties are softer in texture and fade more quickly.

Of the curls the Cuban is the most reliable, followed by the Honduras variety; the African curl is liable to develop cracks after polishing. Other figures include the straight stripe of the Sapele; the irregular stripe broken by a mottle; the rich roe of the Honduras often again broken by a cross figure; the bee's wing of the Cuban variety; the dapple figure; the fiddle back, and so on. Sizes are from 4 ft. 6 in. to 10 ft. long by 8 in. to 18 in. wide when quarter cut, and wider when cut across the tree.

Amboyna, False (Maidu). This, being a burr, is an irregular shape, commencing with small veneers and gradually getting larger as stocks proceed.

Maple, Queensland. A hard, dense wood somewhat like a light mahogany in color. Plain veneers 6 ft. to 10 ft. by 5 in. to 14 in. wide. Finely figured butty veneers vary in size from 1 ft. 6 in. to 3 ft. long by 12 in. to 24 in. wide.

Maple, Bird's Eye. Being rotary cut, this is obtainable in great widths. A thick veneer is advisable, as otherwise the glue is liable to work through and cause discoloration. Sizes are from 3 ft. to 7 ft. long by 10 in. to 40 in. wide.

Burr, Maple. A beautiful burr, but irregular in shape, liable to bark ingrowths. Varies in color from a light biege shade to a pinkish coloration.

Maple, Quilted. A light wood with large figure. A stout gauge should be used, as this wood is liable to glue penetration. The sizes range from 4 ft. to 7 ft. long by 12 in. to 24 in. wide, sometimes of irregular shape.

Oak. There are many varieties of this, of which the English is the finest, producing an extremely fine figure with silver grain. Austrian and Russian oaks also produce fine woods and are milder. Japanese oak is a dense wood of slight, delicate figure, while Australian oak has a full figure. English brown oak and pollard oak are especially fine, being of rich deep brown shade beautifully marked.

Oak, Figured British. Veneers are supplied in various gauges. The classification of figure in oak may be roughly divided into small, medium, and heavy figure.

Oak, English Brown. 4 ft. to 6 ft. long by 6 in. to 12 in. wide.

Oak, Australian Silky. Veneers run from 10 in. to 15 in. wide.

Obeche. A light yellow softwood. Sizes are 6 ft. in length by 10 in. to 24 in. width.

Padouk, Indian. A reddish-brown wood with narrow striped figure.

Peroba. Richly figured, yellowish in color. Sizes 6 ft. and up long by 4 in. to 14 in. and up wide.

Rosewood, Bombay. Deep brown in color tending to purple. Sizes are 6 ft. and up long.

Rosewood, Rio. Lighter in color than the above. Sizes are similar.

Satinwood, East Indian. Finely figured golden yellow wood, 4 ft. to 8 ft. long by 6 in. to 18 in. wide.

Sycamore, English. A fine hard white wood liable to tone down in time. Grey sycamore (harewood) is immersed in a solution which, by chemical action with the acid in the wood, turns

it to a fine silver grey. Weathered sycamore is of a very light brown shade.

Teak. A hard wood of a sombre brown shade. Varies from 6 ft. and up long by 12 in. to 24 in. wide.

Thuja. This produces fine burrs somewhat like amboyna, but lacks the golden color of the latter. The stocks commence with a small veneer anything up to 3 ft. by 2 ft.

Walnut. There are many varieties of this, of which the most usual are the French, Italian, American, Circassian, Australian, and English (though the latter is rare nowadays). The Italian is generally darker than the French. American walnut is straighter in the grain and of a purple-brown shade. The varieties of figuring can be roughly classified as follows:

Walnut, Plain. Obtainable with straight grain suitable for quartering, and with more curly but plain figuring. Varies from 6 ft. 6 in. to 9 ft. in length and from 9 in. to 24 in. in width.

Walnut, Butt. With fine feather-like grain, varying from 2 ft. to 5 ft. long and 12 in. to 24 in. wide. In some cases a leaf is plain for the greater part and has butt figuring at one end.

Walnut, Burr. A choice veneer having small mottled grain.

Walnut, Queensland.

Walnut, Benin.

Zebrano. A strongly marked wood with dark brown stripes on a light background. The veneers are mostly 5 ft. and up long by 6 in. to 12 in. wide. The veneer is somewhat inclined to buckle. (5, page 151)

CHAPTER IV

CONCLUSION AND SUMMARY

Public taste runs in cycles, reflecting the spirit of the times. Fashions swing from demurely modest and coquettish to boldly flippant styles, and then back to gay, light-hearted ones. People move from apartments of many, small dark rooms to well-arranged apartments of a few large light rooms. Public tastes waver from dark woodwork to blond furniture, and then to a conservative middle course. So, too, does the demand for various figures in wood rise and fall. Never before, however, has such a large selection been available. To use a popular, current expression, the veneer manufacturer has "outdone himself" or "bent over backwards" to please everyone.

Summary. This has been a report on the history of wood veneer and a look at its progress, both early, late, and current. The progress made in wood veneer, as a material in the art of woodworking, has been extremely good. While the earliest use of veneer was largely for the purpose of display and ornamentation, and none for the purpose of artistic balance, the industry today, has all this plus mechanical perfection and durability.

Conclusion. Wood veneer has made great contributions to the development of wood furniture and wood products. Man has learned to appreciate beauty, well constructed and durable products. Veneer is so workable that there is hardly a business, trade or industry in which it

can not play an important role. Veneer is used extensively in construction of furniture and decorative trim in office buildings, etc. The invention of better glue and better process in which veneer is applied to the base or core stock has improved veneer tremendously in the last few years. It is now more valuable than ever.

Recommendation for Further Study. Far too little information is available about the history of wood veneer and the application of it. It might be worthwhile for some one to make a deeper study of wood veneer. Since veneer and plywood are used together so much, it is believed by the author that a very worthwhile study could be conducted on "The Amount and to What Extent is Plywood and Veneer used in the School Shop Today".

A SELECTED BIBLIOGRAPHY

A. Books

1. Cour, Robert M., The Plywood Age, Binford and Mort, Portland, Oregon, 1955, 171 pages.
2. Dahl, Alf. A., and Wilson, Douglas J., Cabinetmaking and Millwork, American Technical Society, Chicago, Ill., 1953, 235 pages.
3. Frost, Charles W., and Fullerton, Margaret, Furniture Inlaying, The Bruce Publishing Company, Milwaukee, Wis., 140 Pages.
4. Hayward, Charles H., Cabinet Making for Beginners, J. B. Lippincott Company, New York, New York, 1948, 200 pages.
5. Hayward, Charles H., Practical Veneering, J. B. Lippincott Company, New York, New York, 1950, 166 pages.
6. Knight, Vernon E., and Walpi, Meinrad., Veneers and Plywood, The Ronald Press Company, 1927, pages 143-147.
7. Lamb, George N., The Mahogany Book, Mahogany Association, Inc., Chicago, Illinois, 1851, 72 pages.
8. Meyer, Louis H., Plywood, McGraw-Hill Book Company, Inc., New York and London, 1947, 250 pages.
9. Perry, Thomas D., Modern Plywood, Pitman Publishing Corporation, New York and London, 1948, 458 pages.
10. The Seng Handbook, The Seng Company, Chicago, Ill., 1954, 176 pages.

B. Periodicals

11. Green, B., "Fine Hardwood Veneers for Architectural Woodwork", Architectural Record, January 1956, pages 198-202.
12. Hall, J. A., "Paper and Wood; A New Team", Paper Industries, February 1954, pages 1209-12.

C. Brochure and Pamphlets

13. Brochure, "Questions and Answers about Weldwood Plywood", United States Plywood Corporation, New York 36, N. Y., pages 1-11.

14. Educational Series No. 1., "Veneers", Fine Hardwoods Association, 666 Lake Shore Drive, Chicago 11, Illinois, Pages 2-11.
15. Educational Series No. 2., "Veneers", Fine Hardwoods Association, 666 Lake Shore Drive, Chicago 11, Illinois, Pages 3-10.
16. Educational Series No. 3., "Veneers", Fine Hardwoods Association, 666 Lake Shore Drive, Chicago 11, Illinois, Pages 3-10.
17. Educational Series No. 4., "Veneers", Fine Hardwoods Association, 666 Lake Shore Drive, Chicago 11, Illinois, Pages 1-11.
18. Educational Series No. 5., "Veneers", Fine Hardwoods Association, 666 Lake Shore Drive, Chicago 11, Illinois, Pages 9-11.
19. "Figure Types in Mahogany", Mahogany Association, Inc., 666 Lake Shore Drive, Chicago 11, Illinois, 1956, pages 2-31.
20. Nanrahan, Frank J., "Commercial Lumber Grades", Wood Symposium, Timber Engineering Company, Washington, D. C., September 1952, pages 12-14.
21. Plywood Organization, "First Come Sales", United States Plywood Corporation, 55 West 44th Street, New York 36, New York, 33 pages.
22. Plywood, "Technical Data", Douglas Firplywood Association, Tacoma 2, Washington, 10 sections.

D. Encyclopedia Articles

23. "Inlaying", Encyclopaedia Britannica (20th ed.), XII, 367a-367d.
24. "Veneers", Encyclopaedia Britannica (20th ed.), XXIII, 42d.

APPENDICES

- A. Letter of Inquiry
- B. Respondents to Inquiry

Appendix A

October 2, 1957

Gentlemen:

I am preparing a report on Wood Veneer that will be submitted to the faculty of the Graduate School of Oklahoma State University as partial fulfillment of the requirements for the degree of MASTER OF SCIENCE, December 1957. This report is being directed by L. H. Bengtson, Associate Professor, School of Industrial Arts Education.

The report will include history, processing, uses, and application of WOOD VENEER. I would appreciate any and all written information that you could furnish me pertaining to this subject in order that I may compile this report.

This letter comes to you as a request for information that might aid in this study, including books, catalogues, folders, etc., which you might lend or give to me. These would be very gratefully received and acknowledgments would be included in the report.

Sincerely,

Floyd Leroy Jack
Student, Oklahoma State University

Adviser's approval: _____

Appendix B

RESPONDENTS TO INQUIRY

Allen and Allen
1621 N. Comel St.
San Antonio 1, Texas

American Walnut Manufacturers Association
666 N. Lake Shore Drive
Chicago 11, Illinois

Appalachian Hardwood Manufacturers
414 Walnut St.
Cincinnati, Ohio

Ben Miller Lumber Company
7400 St. John Avenue
Kansas City, Missouri

Douglas Fir Plywood Association
Dept. S.C. 1119 A St.
Tacoma 2, Washington

Frank Paxton Lumber Company
6311 St. John Avenue
Kansas City 23, Missouri

Hardwood Corporation of America
Educational Lumber Division
P.O. Box 1091
Asheville, North Carolina

Hardwood Plywood Inst.
600 S. Michigan Ave.
Chicago 5, Ill.

Kilpatrick Brothers
820 N. W. 4th Street
Oklahoma City, Okla.

Mahogany Association Inc.
75 East Wacker Drive
Chicago, Ill.

Minnesota Woodworkers Supply Co.
1713 Olson Highway
Minneapolis 5, Minn.

National Hardwood Lumber Association
59 & Van Buren St.
Chicago, Ill.

National Plywood Dist. Assoc.
20 N. Wacker Drive
Chicago 6, Ill.

North American Plywood Corporation
120 E. 56th Street
New York, N. Y.

U.S. Dept. of Agriculture and Forestry Service
Forest Product Laboratories
Madison, Wisconsin

United States Plywood Corp.
55 West 44th Street
New York 36, N. Y.

Walnut Export Sales Company
630 N. College Ave.
Indianapolis 2, Indiana

W. P. Stark Lumber Co. Inc.
Fairfax Industrial District
Kansas City 15, Kansas

VITA

Floyd Leroy Jack

Candidate for the Degree of

Master of Science

Report: THE HISTORY, INDUSTRY, PROCESSING, USES AND APPLICATION
OF WOOD VENEER

Major: Industrial Arts Education

Biographical:

Personal data: Born near Ramona, Oklahoma, August 20, 1928, the
son of Edith P. and Norval F. Jack

Education: Attended grade school in Ramona, Oklahoma;
graduated from Ramona High School, Ramona, Oklahoma, in
1948; received the Bachelor of Science degree from Oklahoma
State University in July 1952, with a major in Industrial
Arts Education; completed requirements for the Master of
Science degree at Oklahoma State University in May 1958.

Professional experience: Worked as a teacher for the Board of
Education in Bartlesville, Oklahoma, until 1953; entered
United States Army, in March 1953, spent two years in Fort
Bliss and Fort Hood, Texas, in Radar Operation; returned
to the Board of Education in Bartlesville, Oklahoma, in
1955; teacher of Driver Education and Assistant in football
and track.

REPORT TITLE: THE HISTORY, INDUSTRY, PROCESSING, USES AND
APPLICATION OF WOOD VENEER

AUTHOR: Floyd L. Jack

REPORT ADVISER: Gary L. Hill

The content and form have been checked and approved by the author and report adviser. The Graduate School Office assumes no responsibility for errors either in form or content. The copies are sent to the bindery just as they are approved by the author and the faculty adviser.

TYPIST: Rose Chamberlain