AN ABSTRACT OF THE THESIS OF

Lauren Francis Godard for the M.A. in Industrial Education
(Name) (Degree) (Major)

Date thesis is presented May 14, 1952

Title SELECTED PHASES OF ENGLAND'S ARTS AND CRAFTS PROGRAM APPLIED TO INDUSTRIAL ARTS IN THE UNITED STATES

Abstract approved [redacted]
(Major Professor

The purpose of this thesis is to rediscover for industrial-arts teachers in the United States some of the methods and techniques used by England's craftsmen. Teachers of industrial arts can strengthen and enrich their teaching with an understanding of some of the processes and skills practiced by the old craftsmen. Practices commonly applied in the United States have been omitted. A comparison of manual-arts training in the two countries is not intended.

During the school year, 1950-1951, the writer was enrolled in the London County Council Central School of Arts and Crafts, London, England. The information contained in this thesis was selected from lessons learned at this school, as well as from information gathered during visits to similar schools, and from interviews with teachers and tradesmen. Reference books (not commonly available in the United States) in the Central School library offered information which supported and enlarged upon the knowledge secured from other sources.

An insight into the schools of England, particularly London, is given as background. The Central School of Arts and Crafts has been given special attention. This information is found in Chapters II and III. The areas of woodworking, artmetal-working, and design have been selected for discussion in Chapters IV, V, and VI. Appropriate departments of the Central School gave thorough training in these areas.

There is something about the society of England which develops in a school boy the patience and perseverance of an older youth. He can be apprenticed to a tradesman and expected to devote his major attention to the skills of

his trade. During his apprenticeship he may be released part-time to a technical or commercial school sponsored by the county council. If a student is not apprenticed, he may attend one of these schools in lieu of his apprenticeship. The Educational Act of 1944, with subsequent amendments by the British Parliament, prescribes the standards for all schools.

English woodworkers have considerable pride in their craftsmanship. Tools used in the school shops of England are not as modern as those in American shops. The English schoolboy uses his old-fashioned tools skilfully with results comparable with those achieved by students in American schools. Woodworking tools are repaired many times, long after similar equipment in America is discarded. A section of Chapter IV discusses some of the unusual hand tools and their uses. Consideration is given to special techniques related to and a part of woodworking. A section has been devoted to the subject of veneering.

Craftsmanship at its best is displayed by the silversmiths of England. Time has made few changes in the silversmithing techniques. Some of the basic tools and operations are discussed in Chapter V.

Craftsmanship alone has not been enough to sell the products of Britain. British industry is becoming more and more design conscious. In the technical schools, design training is of major importance.

Consideration of the processes as exemplified in England's arts and crafts schools should enable the industrial-arts teacher to improve his program.

SELECTED PHASES OF ENGLAND'S
ARTS AND CRAFTS PROGRAM APPLIED
TO INDUSTRIAL ARTS IN THE UNITED STATES

by

LAUREN FRANCIS GODARD

A THESIS

submitted to

OREGON STATE COLLEGE

in partial fulfillment of
the requirements for the
degree of

MASTER OF ARTS

June 1952

APPROVED:

[redacted]

Head of Department of Industrial Education

In Charge of Major

[redacted]

Chairman of School Graduate Committee

[redacted]

Dean of Graduate School

Date thesis is presented May 14, 1952

Typed by Clara Homyer

TABLE OF CONTENTS

LIST OF FIGURES

Figure No.		Page

Figure No. Page

SELECTED PHASES OF ENGLAND'S
ARTS AND CRAFTS PROGRAM APPLIED
TO INDUSTRIAL ARTS IN THE UNITED STATES

CHAPTER I

INTRODUCTION

The Problem

Industrial-arts teachers are being pressured by their students and the tempo of the machine age. The result is that more and more reliance is placed on machines to do the work that hand tools once did. The "old country" craftsmen who came to this country in earlier years are passing from the scene and taking with them much of the stress that was once put on hand-tool operations. Some of the personal qualities necessary to produce fine hand work are also thought of less and less. Patience and perseverance are difficult traits to develop when a modern school boy sees that a machine can do a job much better than his untrained hand.

There seems to be a need to keep alive some of the processes and skills of the old craftsmen who excelled in hand work. The beginning student in industrial arts will be far richer if he acquires skills in the hand processes. As he develops these skills he will also acquire those personal traits essential to good citizenship and daily living. It becomes the problem therefore to rediscover some of the methods and techniques used by the old craftsmen. If a situation could be found where these craftsmen were still at work and training a younger generation, perhaps one could profit by their training methods. To present these values in an organized form would be of benefit to industrial-arts teachers over the United States.

Source of Information

A country from which many of our craftsmen came, seemed to be a logical source of information. The Central School of Arts and Crafts in London, England, offered an ideal location from which to seek the answers to the problem. The staff of the various departments of the school were of apparent high quality and trained in trades not yet highly industrialized. Selected phases of the arts and crafts program of this school proved to be most interesting and of certain value if applied to the industrial-arts program of United States schools. Nine months in this London situation offered an opportunity to study the craft problems and the programs of schools on the secondary level. Interviews with school handicraft instructors and tradesmen brought to light many interesting facts. Some of these instructors and tradesmen attended part-time day classes and evening classes at the Central School of Arts and Crafts. Through these contacts, it was possible to make several visits to schools and trade establishments in London. The facts learned were correlated with and supplemented by data gathered from numerous books and articles on file in the reference library of the Central School of Arts and Crafts. These sources of information proved to be most rewarding.

Purpose of the Problem

It is hoped that the information as assembled in this paper will suggest methods of solving some of the technical problems often encountered in the workshops by industrial-arts teachers. If some of the solutions seem outdated and not applicable, they could certainly make an interesting basis for historical comment. No teacher who fully understands the possibilities of tools used in years long gone, will fail to appreciate the tools of the modern craftsman. The planning, organization, and shop layout for England's arts and crafts program may suggest some facts of value to industrial-arts teachers in the United States. Although several comparisons have been made, it is not the general intent of this paper to compare the arts and crafts program of England with its most closely allied subject -- industrial arts -- in the United States.

Limitations of the Problem

Three phases of the arts and crafts program were selected for this paper. Special attention is given to the area of woodworking because it is a major area in the industrial-arts program. The artmetal and design phases of the program are also included. To limit the paper, the other phases of England's arts and crafts program have been omitted. The data have been gathered primarily for the industrial-arts teacher.

The paper is based on the assumption that industrial-arts students in secondary schools should begin their workshop experiences with hand-powered tools. Skills with the hands should be the major route toward the realization of accepted industrial-arts objectives. It is further assumed that the arts and crafts program as taught in London's Central School of Arts and Crafts is a reliable source of hand methods for industrial arts in the United States. No attempt has been made to generalize on the statements in this paper. What may be the case in one situation may not be the case in another. It should be assumed that teaching methods, materials, and facilities vary as much in England as they do in the United States.

Related Studies

The amount of literature published concerning the arts and crafts program in England has been slight compared to that printed in the United States for the many industrial-arts areas. Several valuable publications have been referred to throughout this paper and can be noted in the bibliography. It is not the intent to duplicate material given in these publications. The purpose has been to verify and supplement the information gathered from classroom contacts and other sources of information. Nikolaus Pevsner's book, "Industrial Art in England", published in the United States by the MacMillan Company, New York, 1937, is related to certain phases of the problem discussed in this thesis.

Definitions

Throughout this thesis, reference is made to "craftsmen," "artist-craftsmen," "handicrafts," and "arts and crafts." A paragraph of background information may clarify these terms.

England likes to look back a thousand years or more at the accomplishments of English craftsmen. The partnership of foresters, shipwrights, and builders meant progress for the craftsman. The standards attained by craftsmen in the fourteenth and fifteenth centuries had a peculiar excellence. This excellence was a result of a great pride in craftsmanship as well as a close supervision by the guilds of training and the proper use of materials. With the development of industry and specialized mechanics, the rewards of the hand craftsmen or "handicraftsmen" and their place in local economy diminished. The specialized mechanics were required to make their abilities profitable for the commercial enterprise with which they were associated. The handicraftsmen could not compete. Their existence lay chiefly in the rural districts where they were engaged in the building arts and crafts, in the making of farm vehicles and implements, in saddlery, and blacksmith's work. Even today many of these craftsmen use methods that have remained unchanged for four- or five-hundred years. In some industries there is a demand for the skills of the old handicraftsman. Such industries as pottery, glass making, iron founding, and furniture making have absorbed many of the modern craftsmen. Scattered throughout England are a few highly individualistic craftsmen, skilled in tools and art, who are deliberate isolationists so far as the commercial machine age is concerned. Their living is dependent on the sale of their products to the wealthy. The apparent dead end of these who failed to recognize machine production resulted in the support of independent artist-craftsmen and the maintenance of the trade in antique furniture and other articles culled from the past (7:117-128).

The "craftsman" works at his craft with his hands and with the machines of modern industry. Modern industry has made him a specialist. "Handicraft" is his trade. Often it is thought of as his hand work. The "artist-craftsman" has chosen to ignore the progress of industry and concentrates his efforts on the art of his crafts. He hopes in his day to be the guiding light of contemporary design in or out of industry. The term "arts and crafts" refers to the field of work for both the true craftsman and the artist-craftsman.

CHAPTER II

PHASES OF ENGLAND'S EDUCATION SYSTEM

Schools of England

Schools must serve the society of which they are a part. The subject matter taught and the methods of teaching are in part controlled by the society of the area. The way of life in Britain is the great reason for the differences in educational techniques as compared with the United States. Most industrial-arts teachers in the United States would not attempt to hold fourteen year old boys at work benches for three to five hours a day as they developed skills in wood joinery. Most young industrial-arts students in the United States would rebel at spending six to nine months of class time to produce one article made with such skill as to meet the approval of an English designer and craftsman. The qualities of patience and perseverance, however acquired, are quite different in the English boy. These qualities may be acquired by family insistence or by self-determination guided by a different sense of time value. The English way of life places fourteen-year-old boys as apprentice carpenters and expects them to approach the pace of the master carpenter. Such a way of life with all its implications is without doubt a big influence on arts and crafts teaching in

England.

The diagram in Fig. 1 makes an understanding of England's educational system easier. Technical students may leave their formal education to become apprentices at the age of fourteen. Occasionally as a part of their apprenticeship training these students will attend part-time classes at higher technical schools (14:98).

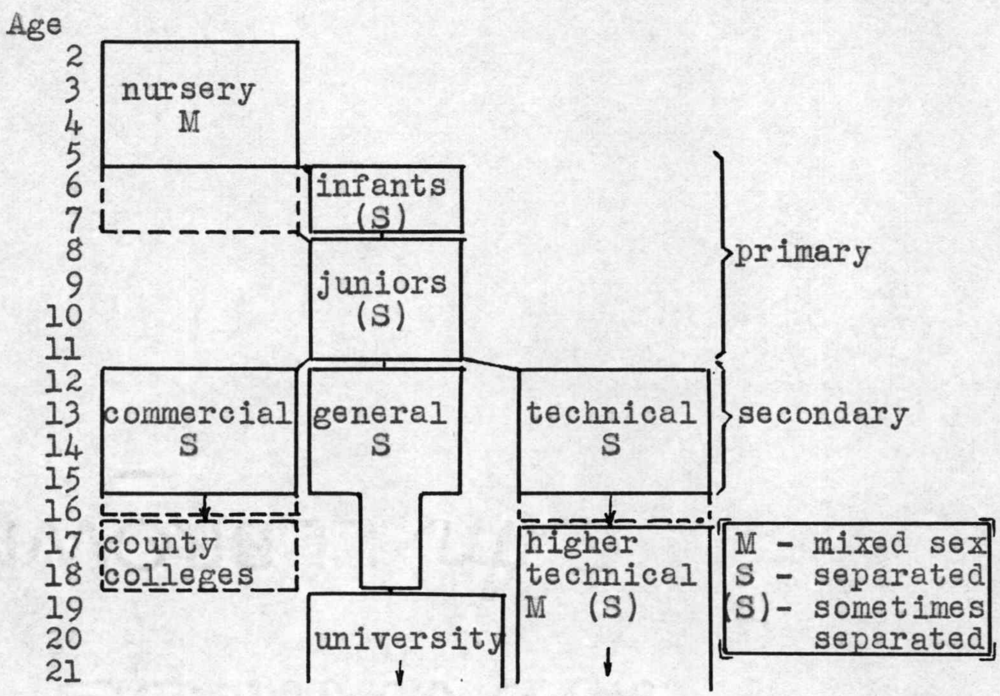


Fig. 1. Progression chart of schools in England (14:99).

The curriculum of the art schools is divided into four parts. The full-time courses are for those who have left schools of general education to make a career of art. The "day release" classes are for those released from trade employment and who are enrolled in classes as part of their trade training. The day part-time art courses are for those who wish to study art as a part of another course. Evening classes are given for these and many other reasons (3:10). The curriculum at London County Council's Central School of Arts and Crafts met these conditions.

Quite popular among parents are the Independent Schools which are owned and operated by private bodies. These schools are open to public attendance and are commonly called "public schools". The County and Voluntary Schools are governed by the county councils or other public organizations and are open to public attendance (14:98).

Schools of London

The county schools of London are under the administration of London County Council. The Education Act of 1944 imposes the provisions of administration. The British Parliament is constantly revising this Act. If a student lives in London County and is under eighteen years old, he can attend full-time courses free. In some cases this is true for part-time students under twenty-one.

Vocational and non-vocational courses are offered at these county schools. Vocational courses are offered at several types of schools. Students over seventeen years old can obtain technical training at the <u>technical colleges</u> and <u>polytechnical institutes</u>. Painting, sculpturing, craftsmanship, design, advertising art, textile printing, and furniture manufacturing are some of the courses that can be arranged at the <u>schools of art</u> and <u>institutes</u> with art departments. Banking, exporting, shipping, insurance, and other commercial trades are studied at the <u>colleges of commerce</u>. Separate classes or separate schools are provided for students under eighteen years old. <u>Junior technical</u> and <u>commercial institutes</u> offer training which prepares students for courses at senior schools. <u>Day colleges</u> are provided for junior students who are released from their work to further their commercial or technical education. <u>National colleges</u> are being set up to meet the needs of small but important industries. Training in heating, ventilation, refrigeration, horology, instrument technology, and rubber technology can be had at the national colleges.

Non-vocational classes are provided by schools of the London County Council. Courses in political theory, history, current affairs, sociology, economics, philosophy, psychology, dramatics, and speaking are held at the literary institutes. Hobby classes in physical training, craft work, and domestic arts are held at the men's or women's institutes. Recreational institutes provide recreation and game rooms (12:7).

In all, about five hundred subjects can be studied at schools under the supervision of the London County Council (12:9). Courses which are normally considered industrial-arts subjects are a part of the technical colleges and art colleges. A teacher of industrial arts would be most interested in subjects taught at the art schools. Industrial administrators and engineers would find more of interest at the technical institutes.

The Central School of Arts and Crafts is one of twelve art schools administered by London County Council. The top students from the other eleven schools have the opportunity to further their specialties at a centralized school.

Planning for Industrial Arts

The crafts and hand work of England distinctly have history written on them. The products of the years show much about the period in which they were produced. To appreciate this language deciphered from the crafts, students must understand the crafts. Just as an appreciation of music or paintings is taught, so must students be taught an appreciation of the crafts. This will facilitate an understanding of the industrial crafts which is one of the foundations of current society (6:ix). There are numerous operations performed in an industrial-arts class which could be enriched by a little historical background.

The Educational Act of 1944 has prescribed certain standards for school premises. All secondary schools, except those exclusively for girls, require one or more handicraft rooms of at least 850 square feet each. In technical secondary schools, where school rooms become more specialized, the minimum requirement is 1200 square feet. Handicraft rooms usually combine wood and metal work into a type of general shop. It is usual to base accommodations on the needs of half classes. This permits half the class to be engaged in metalwork and half in woodwork. Handicraft classes are overcrowded. It is the plan to reduce all classes in the secondary schools progressively from forty to thirty students. Handicraft rooms are to be considered primarily as workshops and not classrooms (14:99). Below are listed some specifications for handicraft rooms.

1. The most usual arrangement of handicraft rooms is to allocate the center of the room to woodworking benches and the wall areas to metalworking benches.

2. It is desirable to have a classroom grouped with the workshop for the teaching of drawing and other classroom activities. If such a classroom is not possible, the shop size should be sufficient to allow space for tables and chairs.
3. Floors should be covered with wood blocks or boards to avoid tool damage if tools are dropped.
4. Provisions must be made for power tools for advanced classes. Power tools are seldom provided in elementary classes.
5. Lathes, if any, should be located in front of windows.
6. A blackboard is essential in all workshops.
7. Windows should be located on the long side of the room. North side windows are desirable. If possible, workshops should be provided with top lights (skylights).
8. Each shop should have a sink, firefighting equipment, and first aid supplies.
9. It is recommended that the shop have a minimum width of twenty-four feet, or thirty feet if in an independent building. A minimum height of eleven feet is recommended. In an independent building this can be reduced to nine feet.

10. A typical handicraft room for woodworking should have twenty double benches, spaced 3 feet 6 inches apart and 3 feet between ends. The suggested bench size is $2\frac{1}{2}$ feet by 5 feet. With this arrangement, each student would have 24 square feet of floor area for bench work.
11. A demonstration bench should be provided. A recommended size is $3\frac{1}{2}$ feet by 6 feet.
12. A suggested size for a metalworking bench is 3 feet by 12 feet to accommodate six boys.

The specifications listed above are recommended but not obligatory (14:97-102).

The list of equipment and supplies to follow will give an interesting comparison. The suggested items are for a class of twenty woodworking students (10:217). Each student is to have a set of tools. The general tools are to be stored in a cabinet near the teacher's area.

Student set:

20 jackplanes
20 tenon saws
20 firmer chisels, $\frac{1}{2}$ inch
20 firmer chisels, 3/4 inch
20 tri-squares, 6 inch
20 marking gauges
20 mallets, small
20 marking knives
20 steel rules
20 hammers, no. 2

General equipment:

4 trying planes
6 smoothing planes (steel)
3 rebate planes (steel)
1 router plane (steel)
1 plough plane and irons
1 half-rip saw
2 crosscut saws
5 panel saws
4 bow saws, 8 inch, with spare blades
6 ea. firmer chisels, 1/8, 1/4, 3/8, 1 inch
3 ea. beveled chisels, 1/4, 1/2, 3/4 inch
12 ea. firmer gouges, 1/4, 3/8, 1/2, 3/4 inch
6 ea. scribing gouges, 3/8, 1/2, 5/8 inch
2 tri-squares, 12 inch
2 "cabinet" screwdrivers, large
2 "cabinet" screwdrivers, small
6 mortise gauges
2 cutting gauges
2 pair pincers
20 brad awls, assorted
3 sets center bits, 1/4 to 1 1/4 inch
1 set twist bits in canvas roll (auger bits)
6 pin or shell bits, assorted
3 braces
3 rose countersinks
6 nail "punches" (sets) assorted
4 wing compasses
6 bench holdfasts
12 spokeshaves, assorted
3 wood files, 8 inch, half-round
3 wood files, 8 inch, full round
4 steel cramps, 30 inch
6 hand screws
2 oil cans
4 oil stones (2 India, 2 washita)
1 grindstone, complete with trough
1 gluepot and brushes
3 cork rubbers (sandpaper blocks)
3 steel scrapers

Also adequate supply of screws, brass and iron panel pins, oval-headed brads, glue in cakes, glasspaper, linseed and sweet oil.

Some of the items in this list are described in later chapters of this paper. Consideration of these tools give an insight to the handicraft program.

CHAPTER III

LONDON COUNTY COUNCIL CENTRAL SCHOOL OF ARTS AND CRAFTS

The Central School of Arts and Crafts has been the source of much of the information on which this paper is written. It seems advisable therefore to present a general picture of the school. An understanding of some of the facts about the school will aid in understanding the information presented in this paper. The Central School of Arts and Crafts is the London County Council's school for the most advanced instruction for tradesmen, commercial artists, and industrial designers. The school is the last step before entering industry. In some departments artistic ability is subordinated and emphasis falls on the manipulative skills of the craftsman. In most departments however, emphasis is placed on art and design.

Physical Plant

The school is located in the heart of London. All activities are contained in one building. The building faces on three sides of the block and is approximately two-hundred feet wide by three-hundred feet long. The building has a basement and seven floors above the basement. During the war, bomb damage destroyed approximately sixty percent of the building. It is slowly being repaired. At the end of the 1950-1951 school year forty percent still remained unusable. Because of this denied space and because of increased postwar enrollment the school is overcrowded. Reconstruction and redecoration keep some of the classes in constant turmoil. The auditorium, gymnasium, and other more unessential rooms are used as storage or classrooms. Much equipment of some departments was destroyed by bombs. The school is operating under a severe handicap.

Administration

Policies of the school are determined by a board of governors and the county council of London County. This group has employed a principal who directs the activities of the school. He is assisted by a "board of studies" consisting mainly of heads of departments of schools within the school. Salaries of teachers and administrators are controlled by the London County Council.

Unfortunately there is none of the close relationship between students and staff or even staff and principal that is found in many schools. This lack of friendliness results in tension that reflects most noticeably upon the efficiency of the instructors and the achievements of the students. Here is a lesson well taken. The understanding generated by close cooperation between the principal and his staff will result in benefits far greater than superficial benefits caused by aloofness, tension, and poor cooperation.

Departments

Training at the Central School of Arts and Crafts is divided into two sections -- training for juniors and training for seniors. The juniors (under eighteen years old) are training for the national certificate given by all technical schools on the secondary level. Upon completion of their national certificate work and if their work is high quality, they may pursue the senior curriculum. Students may attend full-time day classes or, if employed and released by their employers, part-time day classes in lieu of evening classes. Evening classes are available to all who cannot attend day classes. Evening classes are two and one-half hours duration. Day classes are usually five hours duration or in certain cases the day is broken into a two-hour morning session and a three-hour afternoon session. A student enrolling in a full time day course in pottery, for example, will report to the pottery laboratory for five hours a day five days a week. The variety of training received is determined by the instructor, who sees that the student receives sufficient training during his three-year course to meet the standards of attainment.

The schools in which the student may enroll are listed below (2:9-10).

1. School of Drawing, Painting, Modeling, Etching, and Allied Subjects.
2. School of Book Production and Printing. Training may be received in book illustration, advertisement design, bookbinding, typography and layout, machine printing, lithography, and calligraphy.
3. School of Interior Design, Furniture, Pottery, and Stained Glass. In this school great stress is laid on the contemporary background to design.
4. School of Textiles. Instruction is given in design of furnishing fabrics, dress material, and wall paper. Designs are executed on the loom and by various means of fabric printing.
5. School of Costume. Students can obtain training in modern dress design, historical costume, theatrical design, and fashion drawing.
6. School of Silversmith's Work and Allied Crafts. The object of this school is to train students to enter industry. Some of the areas studied are: silvefsmithing, fashion jewelry, design, modeling, working drawings, goldsmithing, jewelry, diamond mounting and setting, enameling, engraving,

metal seal engraving, die sinking, punch making, chasing, repousse, metal casting in sand, cire perdue, pressure and centrifugal casting, and metal spinning.

7. School of Industrial Design. This department deals with the application of contemporary design to the needs of industry. Time is devoted to prototype production. Students are introduced to some of the problems of the plastics industry.

A school reference library is open to all students. The library consists of some 10,000 volumes and periodicals. The teaching staff for the departments consists of men and women who have been selected for exceptional ability in their special field. Most are selected from the trades. Some are still engaged part time in their trade. Others have been exceptional students selected directly from an art school.

Regulations

Students admitted to the senior section of the school normally must have had two years or its equivalent at a senior technical school. All candidates for admission must be accepted by the principal and are required to give some evidence of ability to profit from instructions. The trade classes are restricted to those engaged in the trade (2:4).

The course for full-time students consists of three years of training. In the third year of the course, students whose standards of attainment have some distinction are selected by the principal. They are asked to prepare their work for final judging. No set examination is given, but students submit along with their work of three years, a thesis indicating their knowledge of the craft in which they have been trained. Their laboratory projects, designs, drawings, and thesis are put on exhibition and appraised by the principal and specialists in the various fields. The specialists are usually leaders in their trade. If the student's training has been judged successful, he is awarded the school's Diploma. Outstanding students may receive a "Diploma with Distinction" (2:5).

Work done in the school is controlled by the school for a period of one year following the session in which it was made. On approval of the principal and upon payment of costs, the student may take possession of his work. The philosophy is that work is done for the training received and not for the "by-products" turned out. In some cases the projects are put on exhibition and sold by the school without consent of the craftsman who made them.

Attendance is required and students are asked to sign the class register each class period. Throughout the year there is considerable laxity on attendance. One or two students sign for several others. On the surface it could seem that without this regulation, a student could produce all his requirements outside of class and report at the end of the three-year course for his diploma exhibition and assessment. This, of course, is not the case.

CHAPTER IV

WOODWORKING

SECTION I

DEPARTMENT ORGANIZATION

Introduction

In early days the cabinetmaker was an authority on all phases of his trade. Modern living has required of the cabinetmaker, skills and resources far greater than his predecessors needed. Because his jobs are varied, he eventually becomes known for his ability in a special field. His other abilities become dormant. Soon the public is supporting several cabinetmakers of specialized abilities. The new generation becomes trained as specialists. In England this degree of specialization has not reached the scale that it has in the United States. Many of the "old-timers" in the English cabinet-making trade still work their trade and are extremely jealous of their abilities and their past. The craft dates from pre-fifteenth century time. Crude furnishings were made of solid wood. As personal property increased it was necessary for a "joyner" to construct "cabins" or "cupboards" so their owners could "cabin" or enclose the articles. Early records of the 15th century speak of a "Guild of Coffers" who constructed chests or "coffers" to serve as cupboards, seats, tables or beds. These were the forerunners of the modern wooden furniture. By adding shelves, the old chest became a "buffet", "court", or a "cheese cupboard". With arms it became a "settle" or a "settee". With drawers it became an "almery", "armoire", or "press" (17:1-4).

Administration

At the London County Council Central School of Arts and Crafts, it has been possible to study under conditions prescribed by the true cabinetmakers craft. The departmental head, Mr. J. H. Brandt, retired in 1951, has been teaching in the classroom some forty years. He is among the craftsmen who made cabinetmaking a pride of the early part of the century. He came not as a teacher but as a tradesman to teach his trade. Such is the training of most of the teachers. The two other instructors are engaged part-time in the cabinetmaking trade. These three instructors offer cabinetmaking training to part-time and full-time students five days and evenings each week. Most of the part-time students are apprentices, securing part of their training in the classroom.

Working with the cabinetmakers is a staff of designers who guide students in the creation of attractive contemporary furniture designs. For the most part it is the policy to consider the cabinetmaking shop as a workshop

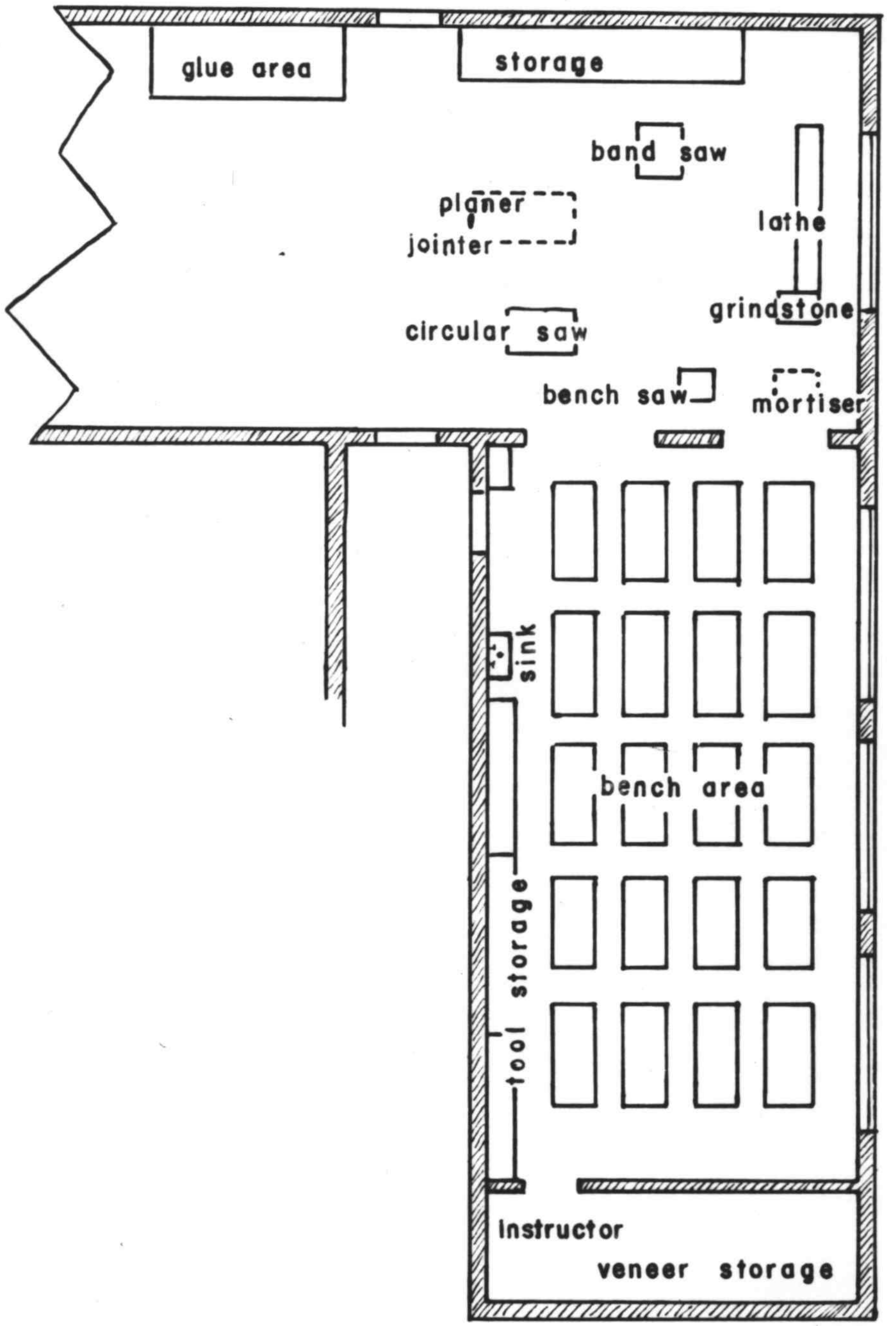


Fig. 2. Woodshop layout.

for designers to carry out, to the finished product, their conceptions on paper. In the process of construction, as much knowledge and understanding of cabinetmaking is passed on to the student as the student is willing to learn. Some of the facilities, materials, and methods that students have at their disposal will be discussed in the paragraphs below.

Physical Plant

The layout of the shop is sketched in Fig. 2. The floor space consisted of approximately 1600 square feet divided into three sections -- the bench section, machine section, and the storage areas. The reconstruction of bomb damage caused during the war created an unsettled condition in the shop throughout the year. Storage facilities and benches were shifted several times during the year. By the end of the year, the situation was becoming more stable. A permanent storage room is constructed across one end of the shop for storage of veneers and more expensive reserve supplies. The instructors also use this room as their office room. Four supply cabinets and a sink are along one inside wall. Windows are four feet from the floor and four feet from the ceiling. The ten-foot windows give adequate light. Two archways separate the bench area from the machine area. Storage cabinets line the wall on the end opposite the veneer storage. A gluing area occupies this same end. This area consists of two gas burners for heating animal glue and a 3 by 5 foot metal-topped veneer table. Under the quarter-inch metal top were gas jets to heat the top when veneering large surfaces (Fig. 62). Woodshop floors are parquetted with 1 by 4 by 10 inch tongue and groove flooring laid in an asphalt type cement over a concrete floor. The woodshop is located on the fourth floor of the school building. The rooms are heated by steam radiators.

SECTION II

GENERAL WOODWORKING PROCEDURES

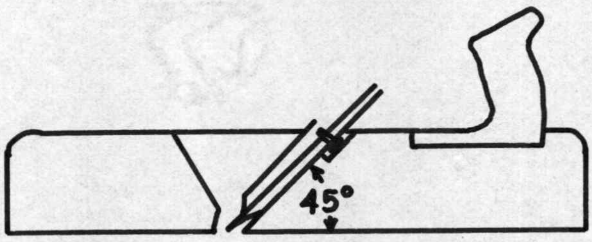
Tools and Their Applications

Within the last thirty years the American tool-making industry has presented the school woodworker and the cabinetmaker with an attractive selection of new tools, with certain variations in design and capabilities. These were put into use for two reasons. They were usable and they were available. The old standby cabinetmaking tools soon passed from the picture. Not so in Britain. The old tools still hold their place among a small selection of tools of new design. The "Record" tool company in Britain, a match to the American "Stanley", is gradually developing its market in Britain. In the descriptions below, will be some of the old standby tools of the past century. A knowledge of them gives a better appreciation of the modern American tools.

The planes. The wooden planes are made of well-seasoned beech wood. "A stock which has been cut from the outside portion of the tree is far better than one cut near the heart, and the sole of the plane should not be on the heart side" (17:5). The plane in Fig. 3A is a sectional view of a wooden jack plane. The letters identify the parts.

A.	Toat or handle	H.	Wedge
B.	Body or stock	I.	Cutting iron
C.	Toe	J.	Cap or back iron
D.	Nose	K.	Sole
E.	Heel	L.	Screw
F.	Escapement	M.	Button
G.	Mouth, one side nearly vertical. The other at 45°		

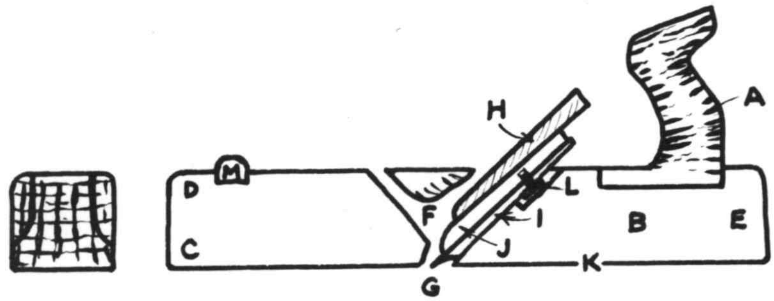
If the cutting space in the mouth of the plane is widened one cannot do as fine work. If a tapered cutting iron has been sharpened considerably, the lessened thickness of the iron will create a larger mouth opening. The angle which the plane iron makes with the sole of the plane varies with the type of plane.



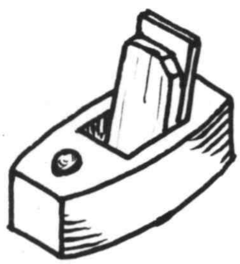
Trying plane	45°
Jack plane	45°
Smoothing plane	50°
Wood rebate plane	50°
Iron rebate plane	30°
Shoulder plane	20°
Bull nose plane	20°
Chariot plane	15°
Toothing plane	80°

Commonly used planes (17:8-9, 5:88-99):

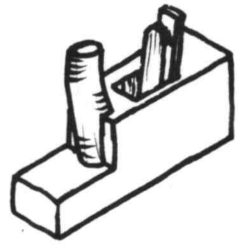
1. Jointer plane: size: 26 inches to 30 inches, 3 inch sole.
2. Trying or Truing-up plane: size: 22 inches, 2½ inch sole.
3. Jack plane: (so-called because it is used in "jacking-up" stock or preparing it roughly for the trying plane) size: 17 inches, 2¼ inch sole (Fig. 3A).
4. Smoothing plane: size: 8 inches, 3 inch sole, 2¼ inch iron. Sometimes the front of the sole is steel (Fig. 3B).
5. Toothing plane: The shape is similar to the smoothing plane. The single iron has a saw



A. Jack plane



B. Smoothing plane



C. Roughing plane

D. Iron smoothing plane

E. Iron shoulder plane

F. Iron rebate plane

G. Router

H. Bullnose plane

I. Miter plane

J. Chariot plane

Fig. 3. Planes

tooth edge. It is used for the preparation of veneers (Fig. 60).

6. Bismark or roughing plane: The size is about the same as the smoothing plane. The cutting edge of the iron is rounded. It is used for taking off dirty or rough surfaces (Fig. 3C).
7. Iron panel or jointer plane: This plane is an early model of the "Stanley-type" jointer plane. Size 13½ to 26½ inches long.
8. Iron smoothing plane. This plane incorporates an iron shell on the older wooden smoothing plane. Size A screw replaces the wooden cap wedge (Fig. 3D).
9. Iron shoulder plane: size: about 8 inches long. 1 or 1½ inches wide for shooting shoulders and short veneer joints. It has either a square or skew mouth. The cutting edge is the same width as the plane bed (Fig. 3E).
10. Iron rebate plane: size: 6 to 9 inches, cutting iron and body ½ to 1½ inches wide (Fig. 3F).
11. Router, or "Old Woman's Tooth": The modern router is an improvement of this wooden model (Fig. 3G).
12. Bullnose plane: This small plane is used for finishing off stopped rebates and angles where

other planes could not work (Fig. 3H).

13. Miter plane: This plane has a low pitch and a single iron for shooting miters (Fig. 3I).

14. Chariot plane: This small plane has the mouth near the front as the bullnose, but the sides are not open. It is sometimes called a block plane (Fig. 3J).

15. Miscellaneous planes:

    a. Plough. A wooden forerunner of the combination plane.

    b. Wooden rebate plane.

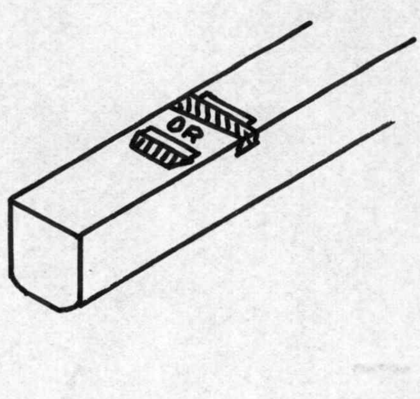
    c. Side rebate plane. Made in left and right pairs with cutting edge on the side for trimming sides of rebates and grooves.

    d. Moulding plane. With cutters for cutting moulds, hollows, rounds, tongue and grooves, and beads.

    e. Side fillister plane. A rebate plane with a depth and width adjustment and a spur cutter.

The planes listed above are a few of those commonly used in Britain. Features of these planes vary according to the maker. Some of the cutting irons are fitted with a cap iron, some have none. The early models made use of a wedge to hold the iron in place. The cutting depth is increased by a hammer tap on the plane iron; it is decreased by a tap on the nose or button. To remove the wedge and iron, the plane is inverted and the nose or button, solidly struck on a bench. To preserve the wood, linseed oil is poured into the escapement of the new wooden planes. If the mouth is plugged and the oil allowed to stand awhile, it will thoroughly penetrate the pores of the wood.

Eventually the mouth of a wooden plane becomes too large, either by continual wear or by planing away the sole to keep it trued-up. Some planes are fitted with an extra wedge which can be driven down to close up the mouth. A new mouthpiece may have to be fitted into the sole.



After sharpening the plane iron, it is further whetted on a leather pad or across the palm of the hand. The iron of the toothing plane is sharpened in the usual manner, except that the wire edge is removed by driving the serrated edge into a softwood block.

The width of the plane iron, 2½ to 3 inches seems to be the maximum for full control of the plane. However the larger the plane the truer the surface can be worked (8:2).

An old plane used to remove the first shavings will save wear on the good plane. Dirty and gritty surfaces are thus avoided.

A cradle as illustrated in Fig. 4 is excellent for planing square stock into rods. The rod is held in the groove against the stop block and rotated as it is planed. This avoids shaved finger tips (5:111-112).

Because machined are not so commonly used in English schools, boards are usually reduced to the proper thickness by the hand planes. Truing-up a surface becomes one of the major problems in the task of squaring up a board to specified dimensions. The procedure is the same but the task is more difficult for the English boy.

Saws in common use. The most commonly used saw for woodworking classes is the back saw. The larger sizes are called tenon saws and the smaller sizes are called dovetail saws. For fine work, saws in lengths of four to six inches are used. These saws usually have turned handles.

A coping saw is referred to as a fret saw or a marquetry saw. These are usually made of steel. A small edition of the turning saw is also in use, called a bow saw.

English hand saws are usually classified as follows (17:10, 5:2):

1. Rip saw. Usually up to four teeth per inch. Some saws are made with fine teeth at the point and coarser teeth at the heel. (Called an increment toothed saw.) This variation in tooth size permits easier starting and quicker cutting after the kerf is commenced. The teeth are filed at right angles to the saw blade.
2. Half rip. Usually 4 to 6 teeth per inch. A happy medium between a coarse rip and a finer crosscut saw. It is filed so that it can be used for crosscutting or ripping.
3. Hand saw. Usually 6 teeth per inch. This saw is filed as a true crosscut saw.
4. Panel saw. Shorter, thinner, and finer for lighter work. It is filed as a crosscut saw.

Some authorities maintain that the rip saws must

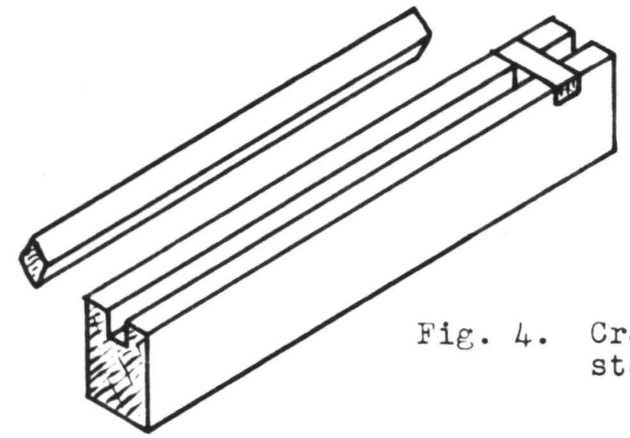


Fig. 4. Cradle for holding stock while planing

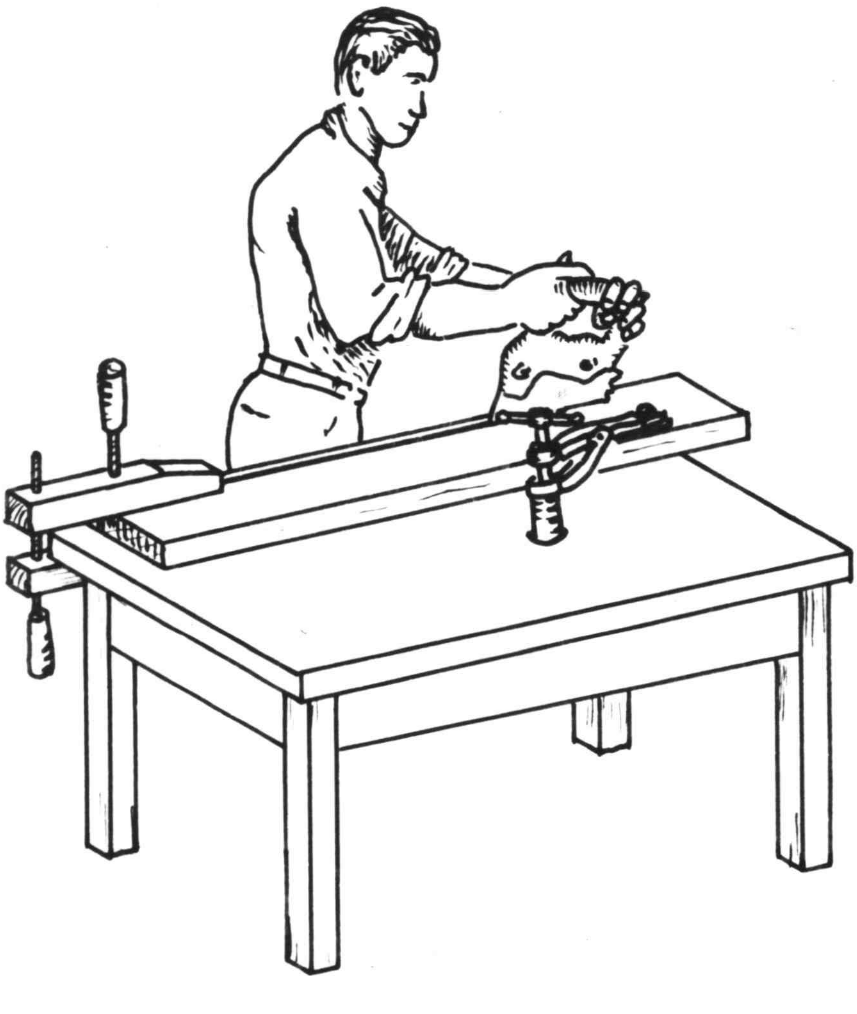


Fig. 5. Overhand ripsawing

have the coarser teeth, according to the scale indicated above. The method of filing is not normally considered as the difference between rip and crosscut saws, although saw filers and manufacturers no doubt accept it as the main difference.

"British-made saws are generally stamped with the number of teeth to the inch, and foreign or American saws are stamped or measured with the number of points to the inch. The present-day tendency, however, is to standardize, and many English saw-makers now quote their saws by points to the inch." (5:6)

A variation in the ripsawing technique which seems to have lost favor in the United States is called "overhand" ripsawing. It is illustrated by the sketch in Fig. 5. The advantage is that it is less fatiguing and quicker. It offers a change of position when considerable ripping has to be done by hand.

Chisels. Firmer chisels usually are shorter and stiffer than paring chisels. The beveled edge of paring chisels allows the chisel to be used in acute-angled corners.

Gouges. Gouges which are ground inside are called "scribing gouges". Those ground on the outside are called "firmer gouges" (17:72).

Boring tools. A bit which is not commonly found in

United States woodworking circles is the <u>center bit</u> (Fig. 6). The center bit comes in sizes up to 2 inches. Since it has no lead screw, it is not used for boring into endgrain. The center bit leaves a nice clean-cut hole. It is useful for removing waste when sinking, or inlaying marquetry work. They leave a flat surface at the bottom of the hole as does a forstner bit.

The shell or pin bit is a type of bit used for making holes for nails or screws. The point of this bit is rounded and ground with an inside bevel.

<u>Screwdrivers</u>. The "cabinet" screwdrivers have a round shaft but the handle is oval. An oval handle offers a strong grip. It also prevents the screwdriver from rolling off a bench. A "London" pattern has a flat shaft and oval handle.

<u>Bradawls</u>. These are used extensively for making holes for nails or screws. They are sharpened to a wedge point and rotated into the wood by hand.

<u>Hammers</u>. Two styles of hammers are used by English cabinetmakers: the "Warrington" and the "London" pattern. Their use is the same but the shape varies slightly. The cross peen or pane replaces the claws and is useful for starting small nails between the fingers. Among other things it is good for riveting. Fig. 7 shows a cross-peen hammer.

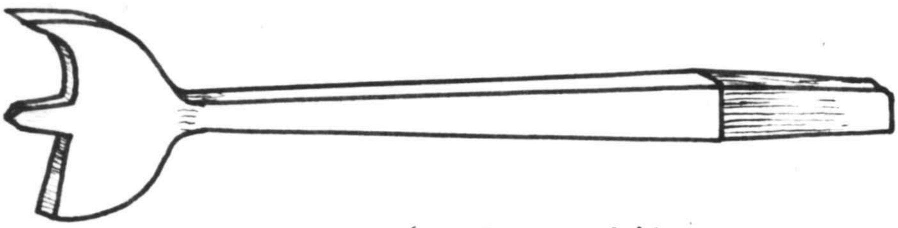


Fig. 6. Center bit

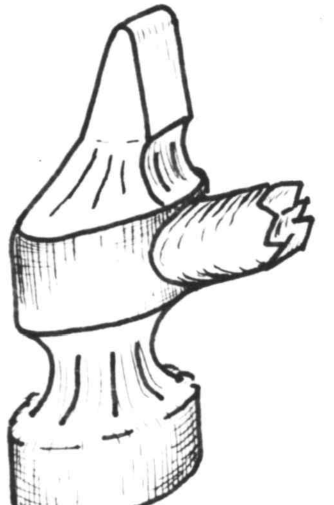


Fig. 7. Cross-peen hammer
(London Pattern)

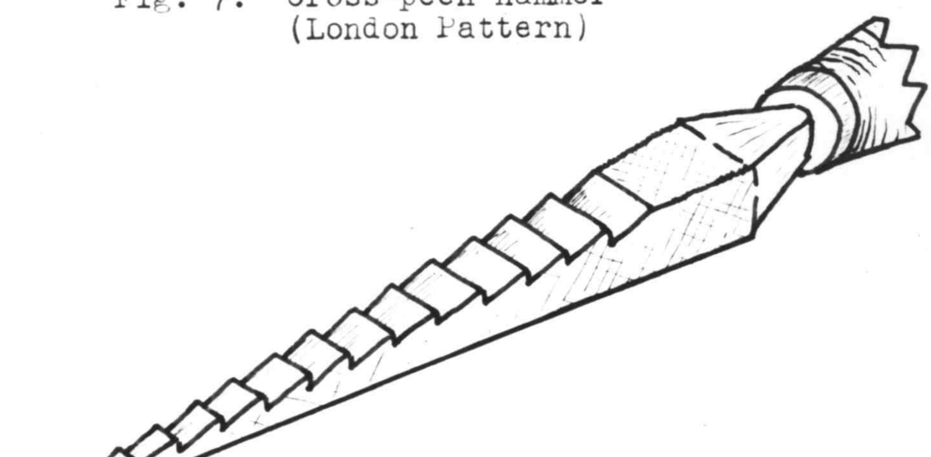


Fig. 8. Cabinetmaker's rake

Marking gauges. The spur of the marking gauge should be filed to a chisel edge with the beveled edge away from the head of the gauge. This assists in keeping the head against the wood to be marked. The tool should be pushed and not pulled (8:1).

Nail "punch". What United States industrial arts teachers insist be called a nail set is happily called a nail "punch" in England.

Scrapers. Scrapers are referred to as cutting tools. A scraping tool which is often used to cut and finish moulded edges is called a "scratch" (Figs. 74 and 75). When used as a moulding tool it might be called the hand shaper -- the predecessor to the power shaper.

Rakes and Floats. If one surface of a three-cornered file were dressed down and teeth filed into it, it would become a cabinetmaker's rake or float (Fig. 8). The difference between a rake and a float is that of the teeth. A rake cuts on the pull stroke and a float cuts on the push stroke. They are commonly used to establish flat surfaces on the inside of mortises or any other place which is difficult to reach with the other surfacing tools.

Holding devices for the bench. The bench stop set into holes in the bench top may be of the spring pattern (Fig. 9). The spring keeps the stop in place.

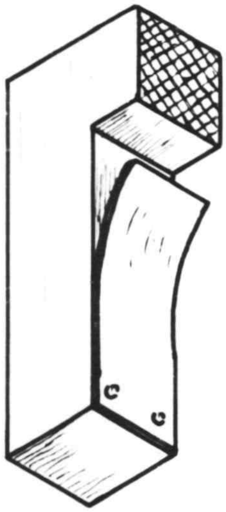


Fig. 9. Spring pattern bench stop

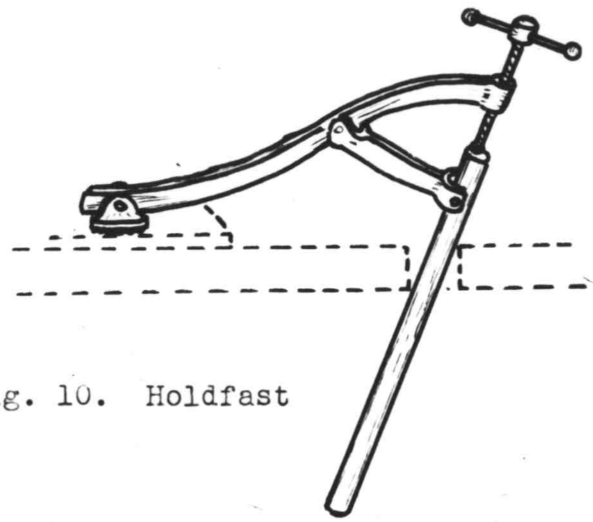


Fig. 10. Holdfast

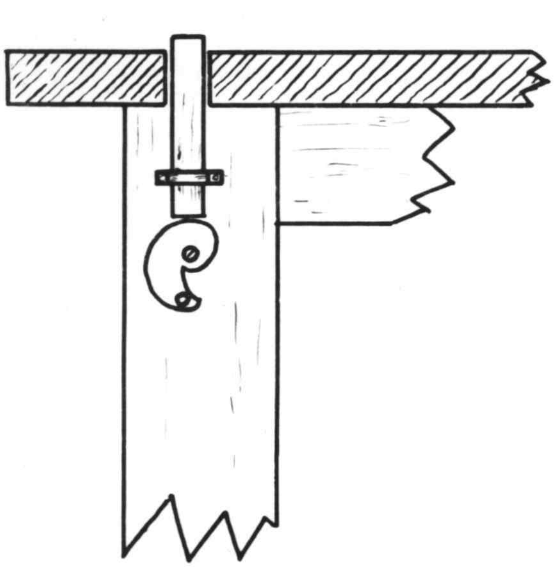


Fig. 11. Bench stop
operated by cam

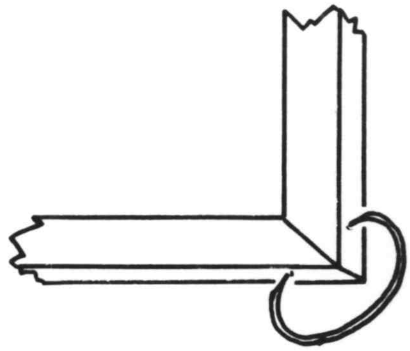


Fig. 12. "Wire dog"
clamp

A bench holdfast is useful (Fig. 10). A hole is made in the bench top near the middle. It is slightly larger than the shaft of the holdfast. By tightening down the thumbscrew pressure is applied to the wood to be held and to the walls of the hole in the bench, thereby securing the holdfast.

Another stationary bench stop can be constructed on the inside of the bench leg and protruding up through a conveniently located hole in the top (Fig. 11). The stop can be lowered or raised by a cam acting from beneath. (See Fig. 55 for method of laying out a cam)

It is sometimes difficult to hold long boards in a bench vise. Holes down the leg of the bench might be bored. A pin in the proper hole will serve as a resting place for the ends of long boards as they are being clamped in the vise.

Clamps. Clamps are referred to as "cramps". "C clamps" are referred to as "G cramps". Either system is used and understood. A "wire dog" or a split chair spring is used to hold mitered corners in place (Fig. 12). The points are sharpened to allow them to dig into wood. They hold satisfactorily but, of course, damage the wood surface.

Holding tools for miter cutting. A miter block attached to a bench hook or a shooting board (Fig. 13)

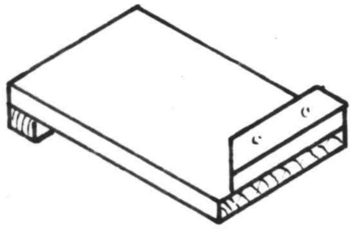


Fig. 13. Miter block

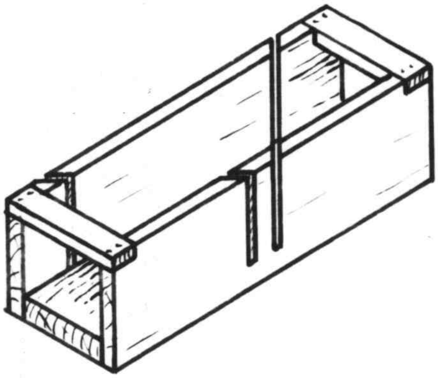


Fig. 14. Miter box

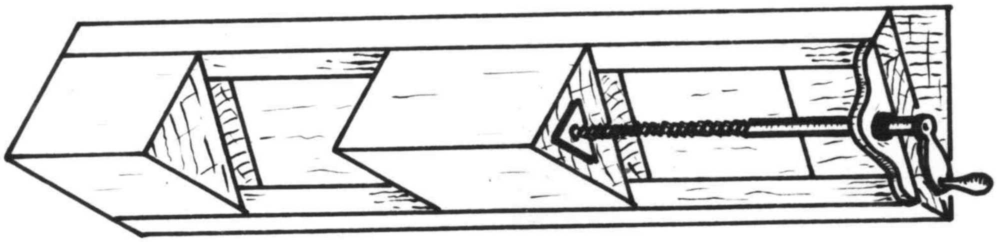


Fig. 15. Miter shooting block

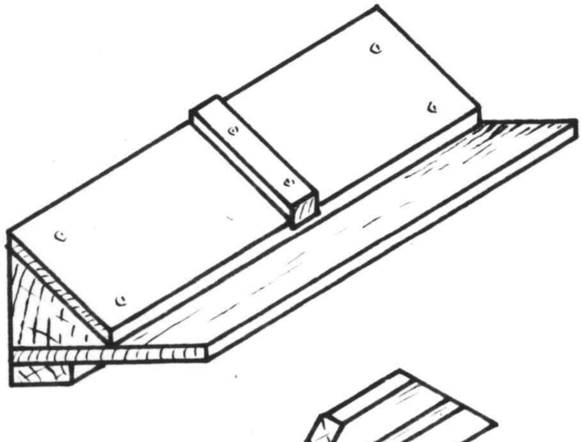


Fig. 16. "Donkey ear" shooting board

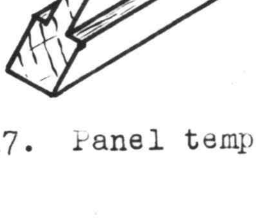


Fig. 17. Panel template

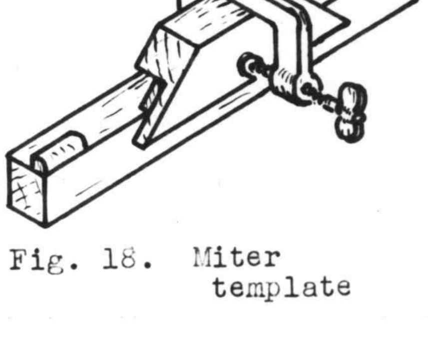


Fig. 18. Miter template

provides a simple method of cutting miters. Special moulding such as cornice moulds are cut in an accurately made miter box which holds the mould at the correct angle (Fig. 14).

A miter shooting block is often used for holding stock to shoot an accurate miter (Fig. 15). This sturdy block is held on the bench between the vise dog and the bench stop. The block is usually made of hardwood so that continued planing does not alter its accuracy. The plane is set at a very fine cut and the stock being mitered is set approximately flush with the block.

A "Donkey's ear" is a type of shooting board which allows the worker to shoot an inside miter on, for example, upright mouldings. It will allow mitering the long edge of a board which couldn't be held in a miter block (Fig. 16).

Miter templates and panel templates are devices used to accurately cut mouldings around a door panel or to cut the inside miter on a moulded panel (Figs. 17 and 18).

Miter clamps are used commonly in picture frame construction. They hold the frame at the proper angle so that a proper miter can be cut with a back saw.

Shooting boards (See Section III, VENEERING). With the aid of a plane with a properly ground and adjusted iron, the shooting board is a handy device for carefully working an edge true. Students will find it handy in squaring up a board when planing both end grain and with the grain. For younger students, the too-heavy jointer planes and even jack planes can be better controlled when working on a shooting board. Wax on the side of the plane allows it to slip easily along the shooting board.

Nails. Cut nails and wrought nails have almost gone out of use. This was probably a decision of the manufacturers and not a decision of the carpenter. Cut and wrought nails are held to have far superior holding power than the "French" wire nails. They were made in several designs (Fig. 19).

The "penny system" for classifying nails is falling into disuse. An instructor in a cabinetmaking class as well as being a foreman in a cabinetmaking shop had not heard of the "penny system". Nails are referenced by their length in inches and the gage of wire from which they are made. The penny system was thought to get its name from old methods of selling -- 10d nails cost ten pence per hundred; others say that one-thousand 10d nails weighed ten pounds. Nails are not used to any great extent in good cabinetwork. Their main use is for fixing the temporary skeleton frame. Screws and especially good joinery make the use of nails unnecessary. Occasionally pins and brads are used. A great number of these are oval in cross-section.

Glue brush. A usable glue brush can be made from a length of cane with its end fibers loosened by hammering. This could be used for small jobs.

Sanding tools. Sandpaper is called glasspaper. The block for holding it is a "rubber" -- often made of cork. A special sanding rubber is made and used to smooth up molding curves after they have been planed or "scratched". The edges of these are curved to fit a particular mold.

Tool Care and Maintenance

English tool steel has long been considered unequaled. Because of and since the war, cabinetmakers and tool maintenance men have not been satisfied with British steel and tools. They are looking to American manufacturers for fine tools. American chisels, planes, auger bits, and numerous cutting tools are in demand. However, because of the availability, more favorable price, and their satisfactory performance, English tools are used almost exclusively in schools.

An object lesson can unmistakably be drawn when one considers the care of woodworking tools at the Central School of Arts and Crafts. The storage of tools isn't what it should be. Chisels are segregated by bins --

fifteen or so to a bin. Screw drivers, hammers, marking gauges, mallets and tri-squares are in their own similar bins. Occasionally tools get mixed. Certainly sharp edges cannot be maintained with such facilities. Planes are set on wooden shelves, cutting edges protruding. Back saws are piled ten or fifteen per bin. Protective racks for these tools would not only save the tools but would save storage space. Orderly racks would permit almost instantaneous checks to detect missing tools. Advantages of proper storage are obvious.

Twice per school year a tool maintenance man makes his rounds of each school in the council. He repairs planes, sharpens saws, and makes necessary repairs to damaged tools and equipment. Chisels, plane irons, and similar tools are ground and whetted as necessary by the students. Tools are ground on a 24 inch natural sandstone grindstone. No emery or carborundum wheels are present in the workshop. Unfortunately, and contrary to most accepted practices chisels and plane irons are whetted so that the length of the cutting edge is parallel to the length of the stone. The obvious result is long deep grooves down the length of the stone and rounded cutting edges. Students should be trained to hold the cutting edges at right angles to the length of the oil stones (Fig. 20).

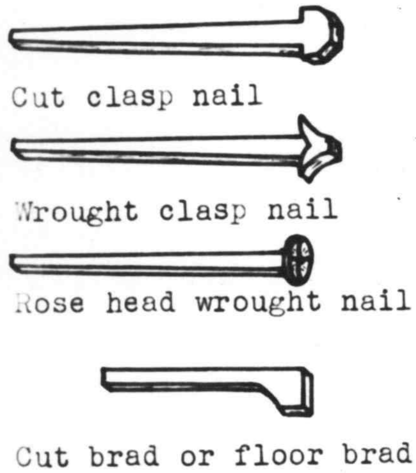


Fig. 19. Nail designs

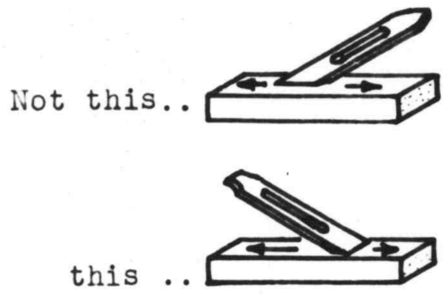


Fig. 20. Whetting a plane iron

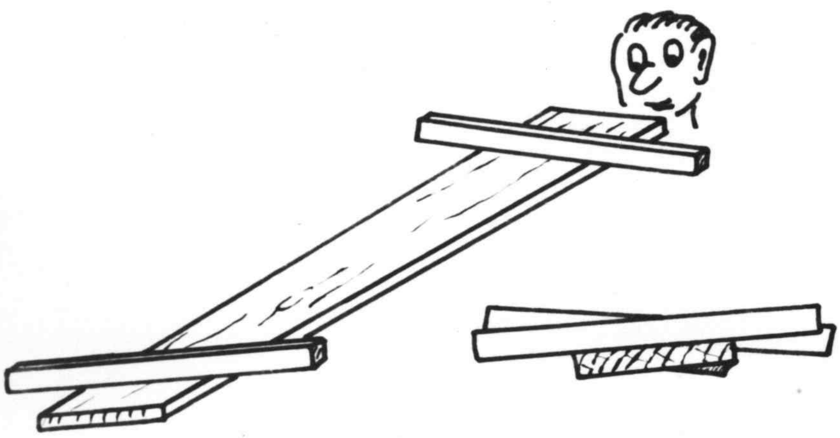


Fig. 21. Using winding sticks

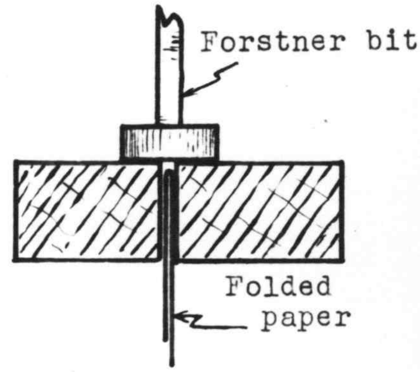


Fig. 23. Boring a square hole in paper

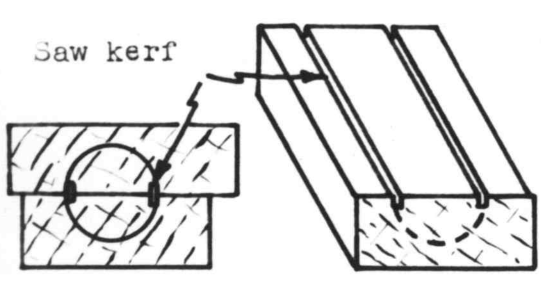


Fig. 22. Boring semi-circular grooves

The type of joinery done by students demands a sharp cutting tool. However when similar cutting tools are used, for example, on the lathe, students often ignore the need for sharp tools.

The scraper blade seems to present the greatest sharpening problems. It is a worthless tool unless sharp. A satisfactory method of sharpening is demonstrated. The scraper edge is filed true and clean. It is rubbed down on a flat oilstone to remove the file marks. The burr is also stoned off the surface to leave a sharp arris free from file or stone scratches. A burnishing tool is rubbed along the flat surfaces to smooth up the arris. The scraper is then held vertically (and at an angle of 85 degrees with the sharpening tool). The angle is reduced as repeated sharp upward strokes are made. This procedure rolls over a satisfactory cutting edge. If carefully done, the scraper can be resharpened several times without filing or stoning.

Artificial oilstones should be lubricated with a light oil. Kerosene or a mixture of kerosene and sweet oil is often used. A natural stone as "washita" should be lubricated with neat's-foot oil.

Furniture students at Central School of Arts and Crafts are required to produce pieces of furniture without sufficient preparatory instruction in tool maintenance or in woodworking basic techniques. With this type of learning, undue burden is forced upon the instructor, materials are wasted, and equipment is improperly treated, all with expected results.

Special procedures

Solutions to problems may be arrived at in a little different manner by most everyone seeking the solutions. A British technique which is different to one American might be familiar to another. The following pages are a discussion of a few woodworking procedures which can be used to solve certain problems.

Layout. Since machines are not commonly used in school shops, boards must be surfaced by hand. The wind of a board offers a much more serious problem. A slight wind can be detected by "winding sticks" which are located at right angles to the board. The winding sticks tend to exaggerate any wind. It is easily dwtected by sighting down the board and along the top of the winding sticks (Fig. 21).

This method is also used to check the length of table legs. If one leg is slightly long it can be detected by using the winding sticks.

Boring. To bore a semicircular groove: the width of the groove is laid out on the stock to be grooved and on a piece of waste stock. Saw kerfs are cut about 1/8 inch deep inside the layout lines. The two pieces are then clamped together kerf to kerf. The kerfs act as a guide as the auger bores the hole. A clean semi-circular groove is the result when the pieces are separated (Fig. 22).

To bore a square hole in a piece of paper: the value of this is only for entertainment -- a good trick to put a little life into a demonstration. Fold a sheet of heavy paper and clamp it between two blocks of wood. With a forstner bit, bore a hole so the paper fold is along the diameter of the bit. Boring to a depth of half the diameter of the bit will result in a square hole in the paper when it is unfolded (Fig. 23).

Wood bending. Two important considerations in wood bending are: 1) woods being bent will fracture much quicker on the side under tension than on the side under compression, 2) woods heated in the presence of moisture become semi-plastic and retain their bend after dry (Fig. 24). The steaming or boiling of wood tends to allow more fibers to go under compression and less under tension. The result is greater strength.

The bending properties of a number of species is given in Table I. The information given is applicable to good quality, one inch material that has been steamed at atmospheric pressure. Wood is at its optimum bending condition if heated up to 212 degrees F. for three-fourths of an hour for each inch of thickness (16:10).

TABLE I

The Approximate Radius of Curvature
In Inches At Which Breakage Should Not Exceed 5%
(16:7, 11:104-106).

Woods	Inches with supporting straps	Inches without supporting straps
Ash (Fraxinus)	2 to 5	12 to 13
Beech (Fagus, sp.)	2 to 4	10 to 15
Birch (Betula, sp.)	3 to 5	15 to 17
Chestnut (Aesculus, sp.)	6	25
Elm (Ulmus, sp.)	½ to 3	10
Oak (Quercus sp.)	1 to 3	10 to 13
Sycamore (Acer platanodus)	4	18
Mahogany (Swietenia mac.)	12	28
Pine (Pinus caribaea)	14	28

A flexible metal strap is used to support the fibers in tension. Table I shows the value of this. After the stock has been cut to approximate dimension and steamed, it can be placed in a variety of bending forms as illustrated in Fig. 25.

After the jigs have been taken off the bent wood, there is a slight straightening. To offset this, the wood must be bent to a slightly smaller radius than desired.

Wood can be bent across grain but to a much less degree than indicated in Table I. However a flat piece

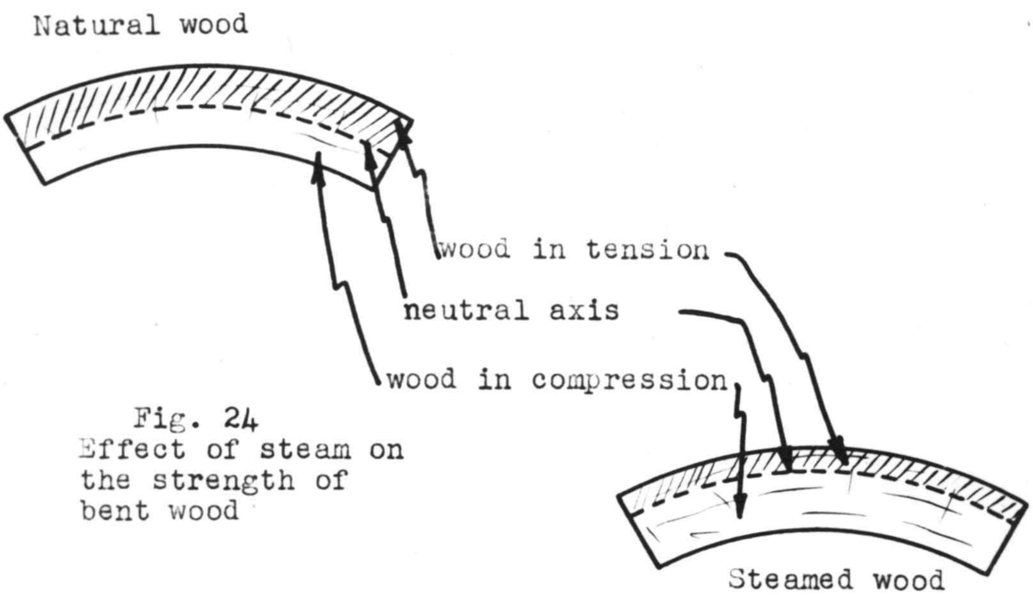


Fig. 24
Effect of steam on the strength of bent wood

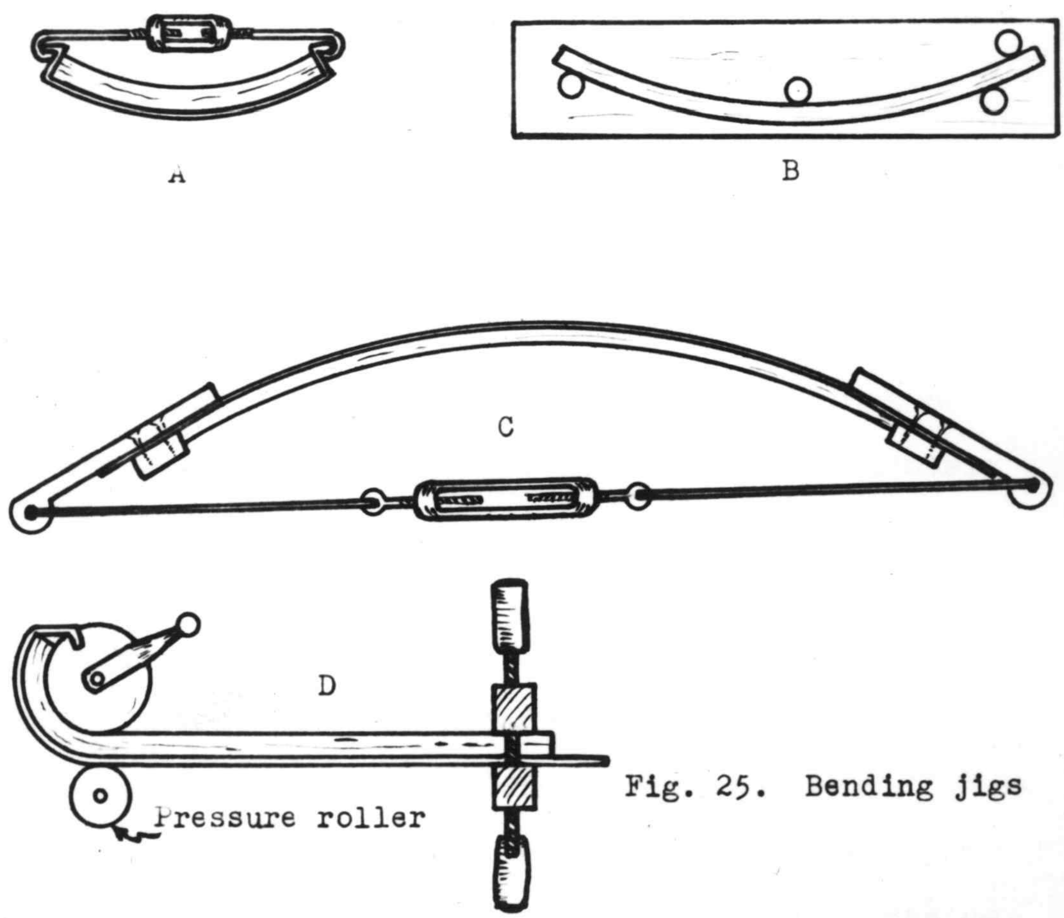


Fig. 25. Bending jigs

of 1/8 inch spruce can be bent into a tubular form with an internal diameter of $3\frac{1}{2}$ inches. One edge is clamped onto a hot steam pipe and the external surface of the wood is steamed. The resultant expansion of the outer fibers causes the wood to curl around the pipe. It is bound around the pipe with strips of canvas and allowed to dry and set (16:26).

A simple steam box can be constructed and used for bending small dimensioned stock. Construct a metal tray about one and one-half inches deep for holding water. Another box fitted snugly over the top of the tray has a door in one end for inserting the wood to be steamed. Bearers are placed in the tray to keep the wood out of the water. Stock to be steamed is rested on edge on the bearers. The entire unit is set on heat and steaming commences.

Laminated bending. Thin strips of wood can be assembled one on top of another and bent simultaneously over a form. If the ends of each layer are not fixed, the bending limitations are those of similar individual thin laminae of wood. When the laminae are glued and therefore fixed, they are not free to slide and practically no change in the bent shape can occur. In this method of bending, thick stock can be built up with bends of small radius (equal to the minimum radius of a single lamina). The inner laminae can be of poorer quality wood, and even spliced with a scarfed joint (16:35). This method was used as early as 1860 in the manufacture of rims of grand pianos. It is considered in most cases to be stronger than similarly bent solid wood (11:92).

TABLE II

The Limiting Radius of Curvature of Various Species of Laminae, at Approximately 13% Moisture Content (16:36).

Species	Thickness in inches	Limiting Radius in inches
Beech (Fagus sylvatica)	0.125	4.4
Elm (Ulmus hollandica)	0.125	3.9
Douglas-fir (Pseudotsuga taxifolia)	0.10	8.5
Hemlock (Tsuga heterophylla)	0.10	5.3
Oak (Quercus robur)	0.125	5.8
Spruce (Picea sitchensis)	0.125	6.0
"	0.104	6.0
"	0.08	3.6

Note: Data refers to bending of good quality material in a cold dry state around unheated forms with the fibers of wood at 90 degrees to the axis of curvature.

If rotary cut veneers are used in laminated bending, the heart side of the veneer should be placed so that it is in compression. This will insure a slightly smaller radius of curvature (16:37).

If the end of a piece of solid stock needs to be bent, a common practice is to saw into the ends the required distance. The saw kerfs are then filled with proper thicknesses of veneer. This combination of solid wood and laminae has the same bending qualities as a full laminate (Fig. 26).

It should be remembered that in all laminated wood, the grain of all pieces runs in the same direction and not alternately at right angles as in plywood.

Plywood bending. A bent piece of plywood can be obtained in several ways. The simplest is to build up the plywood with the desired number of veneers. The veneers are coated with glue and the form achieved by pressing between molds until glue has set.

Plywood which has been cemented with a resin bond can be steamed or boiled as solid wood and bent under heat and pressure.

A system which has been used in the manufacture of plywood boats and aircraft is called the "vacuum" or "rubber bag" process. The cost of the molds and presses makes this a mass production process. In the construction of a plywood boat, the veneer is built up to the required ply and fitted to a mold. The press which holds the veneer in place until the glue has set is a rubber bag. When the air is pumped out of the bag, the rubber presses tightly and uniformly to the veneer. Since

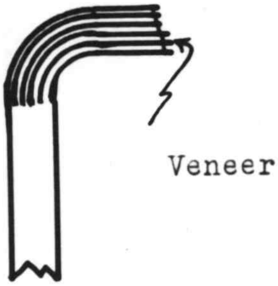
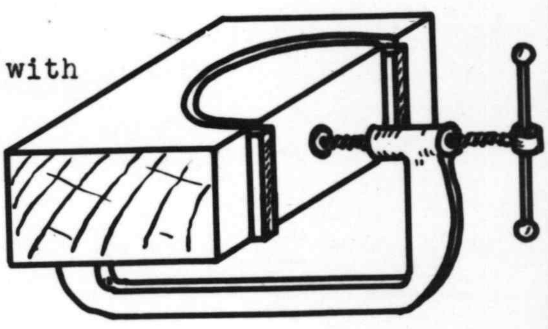
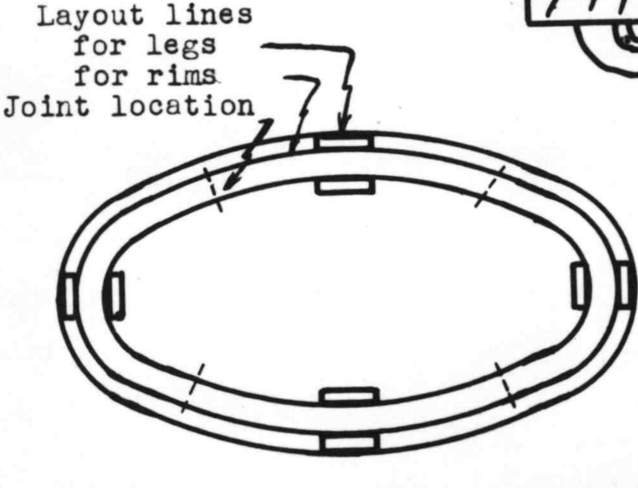


Fig. 26. A laminated end

Fig. 27. Bending plywood around corner posts

Fig. 28. Bending with cauls





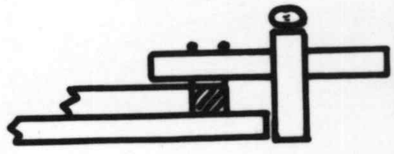


Fig. 29. Layout board for curved table rims.

Method of gauging

atmospheric pressure is not enough, the assembly is rolled into a cylinder at a higher pressure and heat treated until the resin cement has cured (11:90).

Plywood can very simply be bent around cornerposts as sketched in Fig. 27. When saw kerfs are used, there is a possibility that slight corners will be visible from the finished surface.

Curved work. The gluing up of circular case or carcase work has been modernized since the day the following method was used. In making a wooden cylinder, a skeleton frame was first built. The cylinder stock was beveled and fitted around the frame. After all the pieces had been fitted, hot glue was brushed on and the cylinder tightly bound with wet webbing. The inside frame was removed and the entire cylinder was heated over a "shaving blaze". The heat softened the glue and the contracting webbing served to clamp up the stock. The process of wetting and heating was repeated until satisfactory clamping resulted (17:85).

Curved veneered surfaces can be built up on thin stock (e.g. 1/8 inch) by bending between wooden cauls (Fig. 28). The cauls must be cut and surfaced to match the inside and outside curvature of the stock to be curved. The ground and veneer is toothed, steamed, screwed between the cauls, and allowed to remain for two or more hours. This pre-shapes the ground. The cauls should be dry and warm before the glued-up stock is inserted. Clamp the cauls tightly together and allow the glue to dry thoroughly before removing to clean up.

For curved work such as several kidney-shaped, oval, or circular table rims, the layout should be made on a large board. This jig is shaped as desired. The edge serves as a reference from which lines can be gauged accurately (Fig. 29) (17:83).

Glue clean-up. The excess glue that inevitably results can be wiped off with a damp cloth. This saves chipping off glue in awkward places after the glue has set. It will not be possible to completely remove the glue film from the wood. The film that remains seals the wood from any coat of stain. A good policy to follow if staining is to allow excess glue to dry and be chipped off so that it can be completely removed from the wood.

Finishing. The acid in oak will corrode iron screws and cause black stains. Brass screws should be used. Oxalic acid will remove the stain from black iron. The acid crystals can be dissolved in a few drops of spirits of nitre (17:77).

Bruises in wood may be removed by steaming them under a wet rag and a hot iron. This swells the crushed cells until they fill their rightful place.

With the English, French polishing is still the pride of the craftsman. However, "cellulose" (lacquer) finishes are beginning to steal a place in finishing procedures. Cellulose is brushed on most school projects. Some old craftsmen have carried an old twist to a new medium when they apply cellulose with a "rubber" as is done in French polishing. A soft pad about one inch in diameter is made of a wad of cotton bound in muslin. The cotton wad is moistened with cellulose. A few drops of cellulose thinner act as a carrying agent. The cellulose is gently squeezed out and applied in a sweeping motion to the wood surface. This method is generally used to apply finish to a patch being re-lacquered, or to "touch-up" corners or missed areas. As the cellulose in the rubber begins to dry, add a few more drops of thinner.

Contemporary design calls for most projects to be finished "in the natural". The beauty of the natural wood calls for no stains or paints. It was the opinion of one of England's shop instructors that varnish finishes were inferior. Shellac for French polishing and cellulose replace all other clear finishes on the shelves of his finishing room.

Another commonly used and very satisfactory finish is wax. The finishing wax commonly used consists of equal parts of beeswax and paraffin or straight beeswax mixed with an equal part of turpentine. If this mixture was allowed to set overnight the wax would be dissolved into the turpentine forming a thick wax paste. Manufacturers have produced a higher grade wax substituted for beeswax and paraffin. The paste wax can be applied with a stiff-bristled circular brush or a cloth pad. It is rubbed across grain into the pores and then polished with the grain. Several coats may be applied. This wax finish seems ideal for some school projects.

Carving patterns. It is often necessary to duplicate carved areas. A method used by England's craftsmen is the wax mold method. Soft wax is pressed into the carving and then carefully removed. Plaster of Paris is poured into the wax mold to form a plaster of Paris cast. The following is a recipe for the preparation of the wax (17:230-231):

1 part suet
2 parts beeswax
1 part olive oil
1 part turpentine

These ingredients are melted together and can be used upon cooling.

Details of flat relief work can be obtained by placing thin paper over the work and rubbing the paper with heelball (a soapy substance used by shoemakers to rub on heels and to coat the edges of leather).

Joinery. Industries are being forced to

construction which includes joints almost exclusively machine made. "Machine production and mass production have been widely blamed in the past for producing furniture inferior to that made by hand" (11:14). Furniture designers maintain that this is because industry has not been willing to accept their recommendations. They recommend that designs be produced in terms of machine processes and that no attempt should be made to imitate hand craftsmanship (11:14). Industrial arts instructors can afford to straddle the fence on this issue, for they are teaching both machine methods and hand craftsmanship. Some of England's schools are maintaining their custom of teaching hand methods of joinery.

The approach to joinery problems are being affected by several major developments in recent years. The use of machinery has changed the importance of different joints and changed their shape, but basically the kinds of joints are the same. The use of plywood makes unnecessary the grooved-type joints designed to avoid shrinkage cracks in solid wood. Synthetic resin cements and glue curing processes have opened new opportunities for cabinetmakers. Economic conditions in England have restricted the development of high-frequency heating (dialectric) as a means of quickly setting glues.

Joints are classified according to their construction characteristics. Various authorities have classified them differently. Below is a list of nine basic joints. These basic types are further classified by every cabinetmaker that uses a joint for a special need. Local terms have been accepted in certain regions that differ from terms of another region. Except for purely local purposes, it seems unwise, therefore, to stress the teaching of detailed names. A student who learns the basic joints can attach his own name to a joint according to the purpose served. These are considered basic joints (17:36):

1. Edge to edge glued joints such as tongue and groove, dowel, butt, and cooperage joints.
2. Halved and bridle joints.
3. Mortise and tenon joints.
4. Dovetail joints.
5. Mitered joints.
6. Framing joints -- the above type joints especially adapted to framing work.
7. Hinging and shutting joints such as that of a hinging table top.
8. Joints connecting movable parts of furniture.
9. Miscellaneous joints such as cleating, buttoning, handrail joint, slot screwing, and so on.

It seems that the authority who classified these joints must accept some overlapping in the classification.

Common joints and construction techniques. As a preliminary group of exercises, the successful making of the joints described below were required of beginning students at London County Council Central School of Arts and Crafts. The merits of this type of approach to furniture construction will be questioned by industrial arts teachers in the United States. Even though this approach proved satisfactory there is no justification for its use. Other approaches have been practiced and considered superior for many schools.

The joint most depended upon was the dovetail. It was used in many applications. The basic joint is pictured in Fig. 30. The pins and the tails make up the joint. The angle for the dovetails has been accepted as one to six in heavy work and one to eight in light. Where evenly distributed shrinkage is desired, the pins and tails are equally spaced. The craftsmen who made cistern boxes for English homes constructed their boxes with evenly spaced dovetails, then lined the box with a lead lining. In most carcase or case works the pins are made larger than the tails -- three to one space ratio. London craftsmen prided themselves with the technique of joining drawer sides to fronts and backs with a very small pin and large tail. The pins were hardly more than one-eighth inch in width. This was considered as a special design feature. For most work other than drawer construction the pins were cut first. A scratch-awl mark around the pins established the cutting lines for the tails on the opposite board. In drawer construction, the tails on the drawer sides are usually cut first. After the saw kerfs have been made, the drawer side is placed on the front. A scratch through the saw kerf marks the cutting lines for the pins. This scratch is usually made with the point of the saw. If a large number of identical layouts are to be cut, they can be clamped together so that all through dovetails can be cut in one sawing. The construction of common through dovetails such as might be found at the corners of a box, involve simple basic operations. The following steps are involved:

1. Surface and square the stock.
2. Set the marking gauge at the thickness of one piece and gauge a line from the end of the second piece. Gauge the line on the surfaces and edges of the stock. Then set the gauge for thickness of the second piece and gauge lines on the first piece in the manner described.
3. The pins should be laid out first on the end grain of one piece. Two half-pins should be at each edge. The T-bevel should be used to

lay out the proper 1 to 6 ratio.

4. With a back saw, tenon saw, or dovetail saw, cut on the outside of the pin lines. The gauge lines on both surfaces will aid in determining the accurate depth of cut.
5. The spacing of the pins will generally determine the size of chisel to be used. The "ways" for the dovetails are then chiseled out. Chiseling should be done from both surfaces to prevent chipping out the underside and to establish an accurate cut. Since the bevel edge of the chisel tends to force the chisel off line, the first chisel cuts should be made about 1/32 inch away from the final cutting line. Slight undercutting will insure a flat bed for the tails.
6. Stand the pins in their proper position on the other piece of stock. A sharp pencil or a scratch awl can be used to mark around the pins to lay out the cutting lines for the tails.
7. With the saw, cut out the tails. Experience will tell how to cut these lines. Usually cuts are made about 1/64 inch outside the line. This insures a tight fitting dovetail. The saw should cut out the stock at the edges of the board.

Fig. 30. Through dovetail

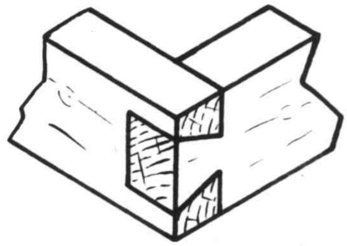
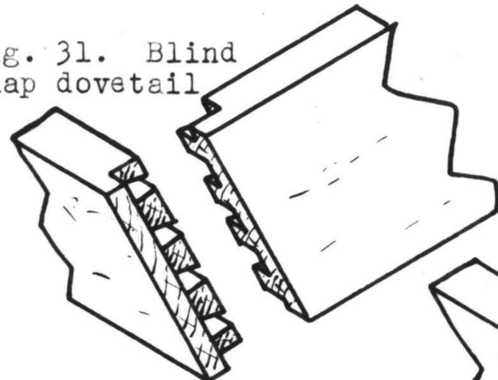


Fig. 31. Blind lap dovetail



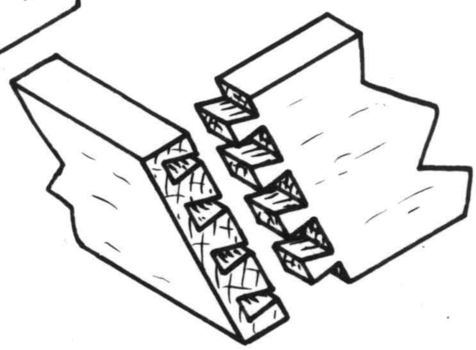


Fig. 32. Lap dovetail

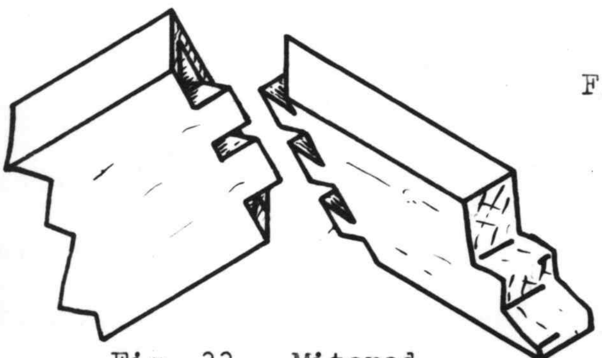
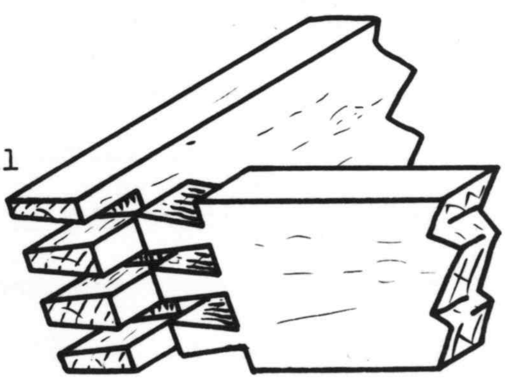


Fig. 33. Mitered dovetail

Fig. 34. Hopper dovetail



8. The remaining "ways" for the pins, should be chiseled out.
9. Fit the joint.

This basic procedure will serve in making most types of dovetails. If the dovetails are to be blind on two surfaces of a carcase (Fig. 31), the saw cuts for the pins can only be made part way. The remaining cuts must be chiseled.

A mitered dovetail (Fig. 33) is more difficult to construct. Before dovetailing can begin, a rebate must be cut in each end. Then after dovetails are made, the tongue, which remains after the rebating, is mitered on the inside. This is done with a rebate plane or a shoulder plane. The fitted joint appears as a mitered joint, but inside is the dovetailing. No trace of dovetailing can be seen if the edges of the stock are also mitered.

The hopper dovetail (Fig. 34) is used in joining the sides of hoppers. The four sides of hoppers usually slope to the center. Since all members slope, the angles of the dovetail become quite complex. It is often used in joining the sloping sides of pieces of furniture.

In making a dovetail carcase where outside measurements are critical, a special technique is suggested. Set the marking gauge at slightly less than the thickness of the stock. If this is done, the ends of the pins and tails will not quite come flush with the surface of the carcase. Therefore any necessary scraping or sanding will not make the carcase smaller than specified dimensions.

Other than dovetail joints, mortise and tenon joints were considered by the London school as most important. Handmade mortises are cut with mortising chisels hit with a heavy wooden mallet. Chisels come in varying widths to meet the needs. The tenons are cut with a backsaw. The cheek cuts are made first. An aid for beginners in cutting a straight cheek is illustrated in Fig. 35. This saw is held at an angle. The cheek is cut from both edges and then down the center. The two angle cuts act as a guide for a straight center cut. Before sawing on the shoulder line, scribe along the line with a knife. Chisel out a small V-cut as shown in Fig. 36. This provides a straight trough for the saw cut. Beginners are apt to "chew-up" the surface shoulder if the cut is started with the saw. This is a handy method of sawing a straight line on any surface. A shoulder plane (Fig. 3E) can be used to dress up the tenon or any surfaces of a rebate. The cutting edges of the shoulder plane are as wide as the bed of the plane. Both sides of the plane are full, thus providing a smooth surface

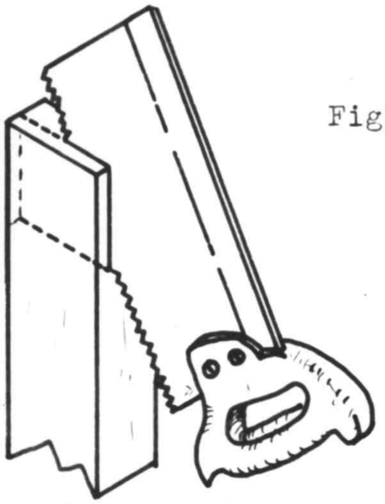


Fig. 35. Cutting a tenon cheek

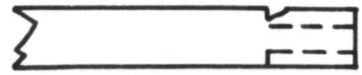


Fig. 36. Starting the shoulder cut

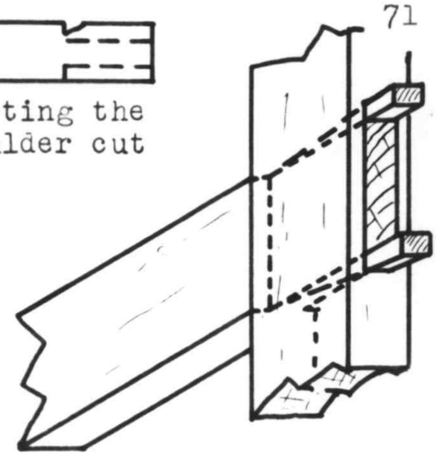
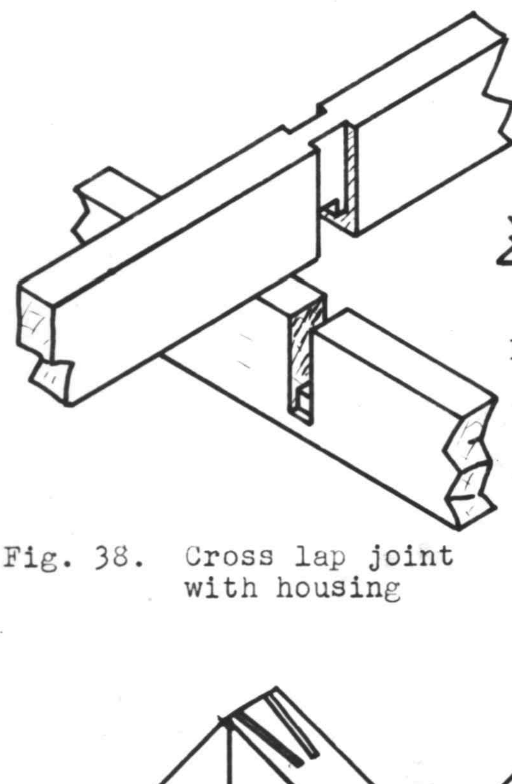
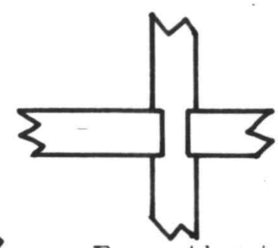
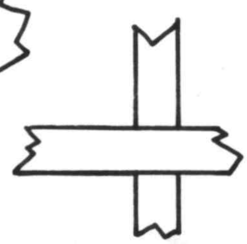


Fig. 37. Wedging a tenon





From the top



From the bottom

Fig. 38. Cross lap joint with housing

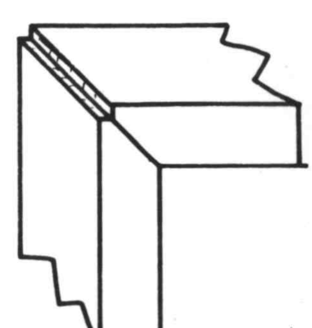


Fig. 42. Shoulders of ends of mitered stock

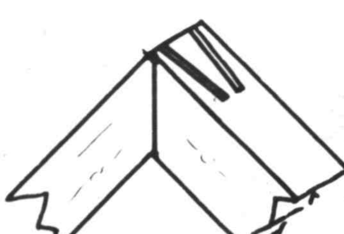


Fig. 39. Keyed miter

Fig. 40. Dovetail keyed miter

Fig. 41. Layout for mitered cuts on long stock

for guiding the plane. The wedging of tenons is a practice common among England's cabinetmakers (Fig. 37). The mortise is slightly fantailed. The tenon fits tightly as it enters the mortise. Glued wedges are then driven along the edges of the tenon if it is a through tenon. This insures a tight tenon. If it is not a through tenon, wedges are fitted before the tenon is inserted into the mortise.

Another well made joint is the cross lap joint with a housing (Fig. 38). Shrinkage will not expose any cracks in the joint.

Several techniques are used to make a strong miter joint. A keyed miter joint (Fig. 39) is very much stronger than a plain miter. Before or after the miter has been glued, saw kerfs are made from the outside corner towards the inside corner. Keys of veneer are glued into the kerf. The grain of the keys should run at right angles to the line of the miter. Additional strength is gained if the two saw kerfs are not made parallel but given the effect of dovetailing. Interesting patterns can be developed if the keys are made of color contrasting to the stock. Occasionally hidden keys are fitted from the inside. In this case the dovetailing effect should be avoided. Dovetail-keyed miters (Fig. 40) are sometimes used.

Occasionally in hand sizing stock for mitering work, the width of the stock may vary slightly. To avoid two widths of pieces at the corner, the pieces should be cut out in sequence from long stock (Fig. 41).

One of the pitfalls of mitering is the danger of cutting the stock slightly short in an attempt to get an accurate fit. After the workman has cut off his layout line he has nothing more to guide him in getting the accurate length. The miter should be cut to leave a slight shoulder (Fig. 42) at the end of the stock. If after fitting and gluing, the shoulder still remains, the outside surfaces can be dressed down to a sharp mitered corner. There are certain drawbacks to this technique which will have to be considered. An excessive shoulder may prohibit a square frame.

Miscellaneous joinery techniques. To cut a stopped rebate with a rebate plane, the workman should chisel out a one to three inch recess at the end of the rebate before planing. This recess permits the plane to ride free at the end of the planing stroke. The same technique may be used in grooving.

Dowels may be toothed with the toothing plane if they fit too tight. If the dowels do not fill their holes completely they may make indentations to appear in the wood especially if the surface is highly polished.

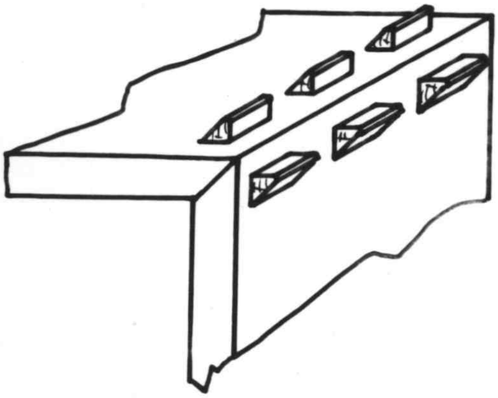
These indentations are caused by the contraction of air and glue in the recess. A special jig can be made to help students hold dowels when cutting (5:28). A V-shaped groove in the end of a board will serve. This board can be held upright in a vise. If such a groove were made in one block on the bench hook it would serve the same purpose.

Draw boring is a technique used for pinning tenons (Fig. 43). Holes are bored through the walls of the mortise with the tenon withdrawn. A hole is then bored through the tenon. This hole is not in line with holes in the walls of the mortise but is located slightly towards the shoulders of the tenon. Glue is applied and the tenon inserted in the usual manner. When the tenon is fully inserted, a steel pin with a tapered point is driven in the holes. The slight offset in the holes allows the pin to draw the tenon shoulders tightly into place. After the glue has set, the steel pin is removed and a wooden pin is glued in its place. This technique makes the use of clamps unnecessary.

Shooting boards are discussed more fully in the section on veneering. Shooting is a joinery technique which is not alone applicable to veneers. It can be used on varying thicknesses of stock as a means of getting a square edge. It offers the younger students a method of supporting a plane that may otherwise be too unwieldy for good joinery. If the edges of several boards are to be glued together, shoot the edges alternately face side up then face side down. This is called the "over and under" method (17:61). If the plane iron projects unequally, a beveled edge will result. The "over and under" method counteracts the inaccuracy caused by the plane iron.

The clamping of glued joints is sometimes a very important process. Success lies in getting the proper pressure in the proper place. There are many common techniques. The English use a technique not so common, for gluing up the corners of carcase work. The joints may be a miter or dovetail, but the joint line is usually quite long -- longer than can be clamped with one clamp (Fig. 44). Beveled blocks are glued firmly to the sides of the carcase. These blocks act as clamping surfaces for any of the standard clamps. After the glue has set, the corner blocks are chipped and the surface dressed down. These blocks aid in pulling the work together at the proper angle.

To clamp stock together to form a circular frame such as a chair seat, a special band is needed (Fig. 45). Curved horns fixed to the end of a steel band of the proper length serve as the holding devices for the



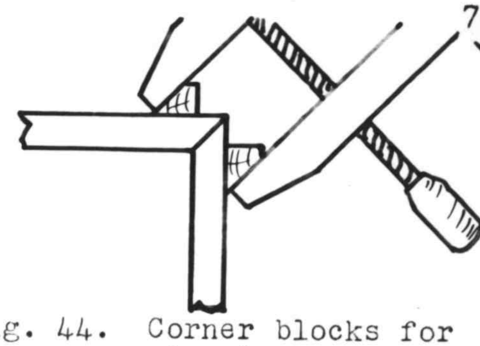


Fig. 44. Corner blocks for clamping

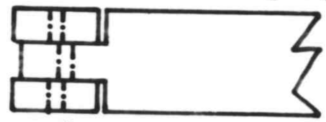
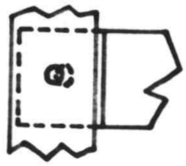


Fig. 43



Hole location for draw boring

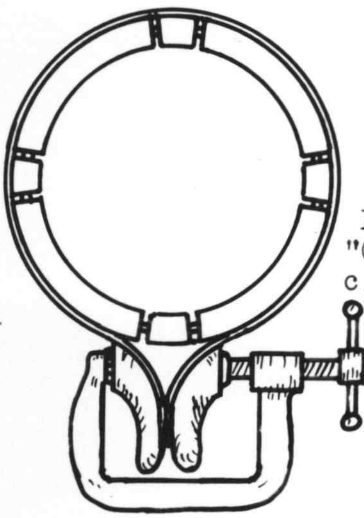


Fig. 45. "Cramping" a circular frame

Slip

Slip with rebated drawer bottom

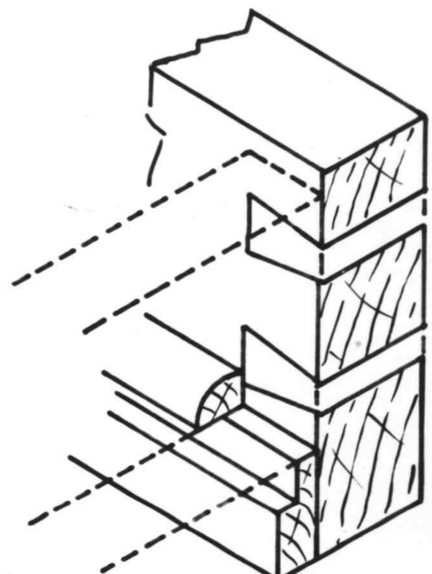
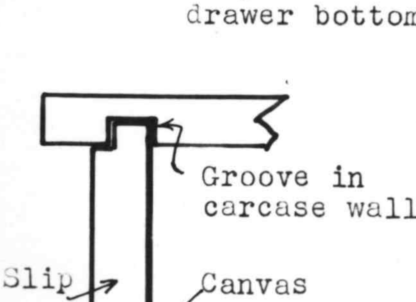


Fig. 46. Placement of slip in drawer



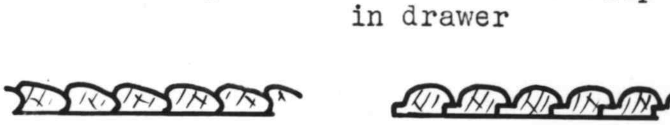


Fig. 47. Tambour designs

Fig. 48. Groove for the tambour

"cramps".

The construction of joints for the sake of joints is not the accepted method of teaching industrial arts. In earlier days this was done. However the student should have some knowledge of proper joinery. To make good joints quickly one has to master certain basic principles of woodwork -- cutting straight lines, chiseling, planing, squaring, laying out, and others. These techniques are probably where the stress should be placed in the school shop. These, along with certain general approach procedures and knacks of tool manipulation, should result in proper joinery practices.

Drawer construction. Drawer sides which are made of thin stock usually cannot be grooved to receive the drawer bottom. England's cabinetmakers often insert small grooved strips called "slips" (Fig. 46). The slip provides added bearing surface on which the drawer can slide and increases the strength of the drawer. The slips may have a quarter-round surface protruding inside the drawer or they may be made flush. In the latter case the two side edges of the bottom are rebated so that the drawer bottom is flush with the top of the slip. On the front edge of the bottom the rebate shoulder is placed on the bottom. This makes a nicer looking joint at the front.

If drawers are made slightly wider at the back then at the front they will tighten slightly when withdrawn. This is a good practice.

Tambours. Tambours at one time were quite common -- being the roll top on the roll-top desks. After a period of disuse, they seem to becoming more and more popular on recent furniture design. The roll effect is given by many strips of wood, called slips, hinged together with wire, hinges, or canvas. The narrower the slips, the sharper the bend around which they can slide. The slips can be of many shapes some of which are pictured in Fig. 47. Occasionally old masterpieces can be found with slips, the face surface of which have been decorated with an intricate marquetry pattern. This would be a task to tax the ambition of many a master craftsman.

The ends of the slips are rebated. They fit into a groove which acts as their guide. The shoulder of the rebate is made on the face side of the slip (Fig. 48). The slips must be of uniform length and thickness. A helpful technique used to get them the same length is based on the principle that it is easier to rebate one wide board than it is many very narrow boards. Select sufficient stock of uniform thickness and glue it up into one large board. This board is carefully squared and rebated so that the shoulder lines of the rebate are parallel. The board is then cut into slips of the desired width and shaped as designed. Since glue joints are not necessarily carefully made, they are cut out as waste stock. After the slips are shaped they should be wedged tightly together on a flat surface. Canvas is then glued on the back surface. Glue should not be allowed to get between the edges of the slips. Homemade jigs can be devised to hold the many slips in position for gluing the canvas.

Related Information

Mathematics and drawing. The cost of bulk lumber is figured by its "price per standard". A "standard" of lumber is 120 pieces, 12 feet long, $1\frac{1}{2}$ inches thick and 11 inches wide. For convenience it is figured as 60 pieces of the same length and width which are 3 inches thick. To figure the cost of a shipment of random size lumber, multiply the number of pieces of a given size by the length in feet, width and thickness in inches. Do the same for all other groups of a given size. Add the totals and divide successively by 3, 11, 12, and 60. The final quotient will be the number of standards of lumber. This multiplied by the cost per standard equals the total cost (15:20).

Example:

Cost per standard = 17 pounds

Pieces	Length Feet	Thickness Inches	Width Inches
60	12	3	9
30	6	3	9
30	9	3	6
60	12	$1\frac{1}{2}$	6

To calculate number of standards:

$$
\begin{array}{lr}
60 \times 12 \times 3 \times 9 = & 19,440 \\
30 \times 6 \times 3 \times 9 = & 4,860 \\
30 \times 9 \times 3 \times 9 = & 4,860 \\
60 \times 12 \times 1\frac{1}{2} \times 6 = & \underline{6,480} \\
 & 35,640
\end{array}
$$

$35640 \div 3 = 11880 \div 11 = 1080 \div 12 = 90$

$90 \div 60 = 1\frac{1}{2}$ standards of lumber.

$1\frac{1}{2}$ standards @ 17 pounds per standard equals 25 pounds 10 shillings.

A standard is equivalent to 1980 board feet of lumber or 163 1/3 cubic feet.

Cabinetmakers have often found a need for constructing various geometric figures. The polygons and ovals are figures which are often used in designing furniture.

To construct an oval of a desired length and breadth, the following method is used (Fig. 49):

AB equals the desired oval length. CD equals the desired oval breadth. E is the center of the oval. Join B and D with a line. Line DG is equal to AE minus DE. Bisect line BG establishing point "a". Extend line DC if necessary. At "a" erect line "ab" perpendicular to BG. Line "ab" intersects EC-extended at "b" and EB at "f". Points "f" and "b" are centers of the arcs forming two sides of the oval. To obtain the axis for opposite sides locate arc centers at "o" and "p" so that A_o equals fB and Dp equals Cb.

The oval can also be constructed making use of a string, pencil, and nails (Fig. 50).

AB equals the length of the oval. BD equals the width of the oval. G is the oval center. EC and CF equal AG. E and F are on the long axis of the oval. Locate nails at E, F, and C and connect the nails with a string. Replace nail at C with a pencil. Keep the string taut and strike the arcs of the oval (15:32).

Cabinetmakers who must construct ovals of a variety of shapes at various times may use a device called a trammel (Fig. 53). Two tracks are constructed at right angles to each other. Two heads are fitted to slide in these tracks. The heads are connected by an adjustable beam which is fixed with a pencil at one end. To set the trammel for making an oval of known width and length, one head is fixed at a distance from the pencil equal to one-half the short axis of the oval. The distance from the pencil to the other head is equal to one-half the long axis of the oval. The tracks should

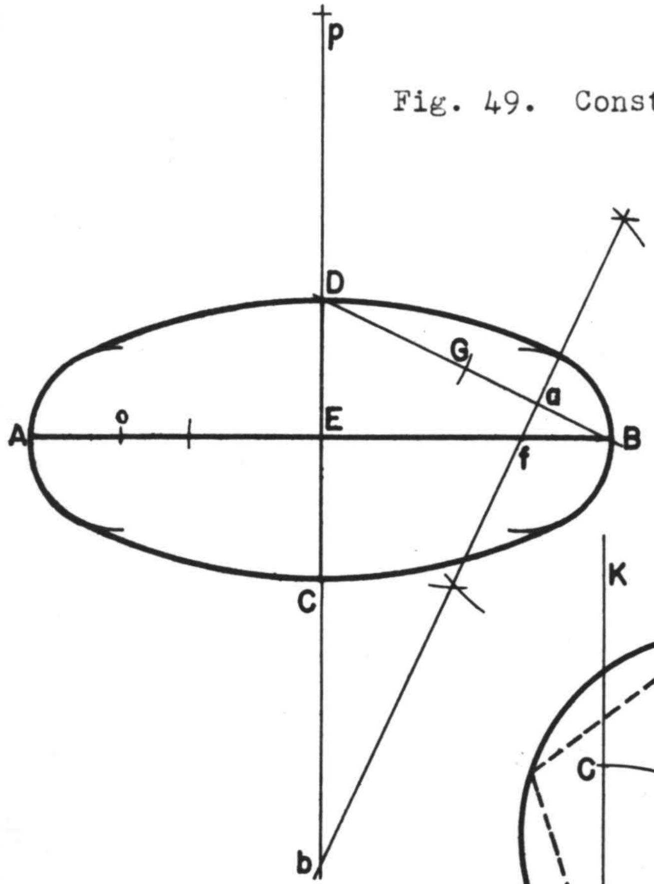


Fig. 49. Constructing an oval

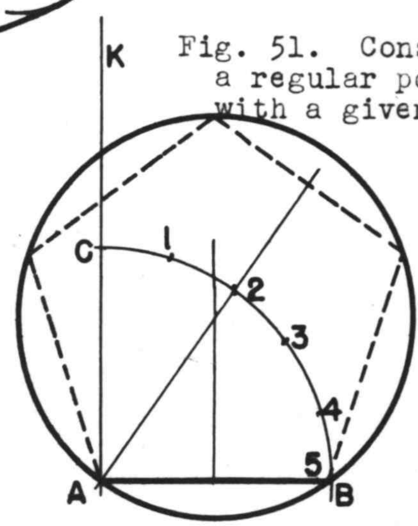


Fig. 51. Constructing a regular polygon with a given side

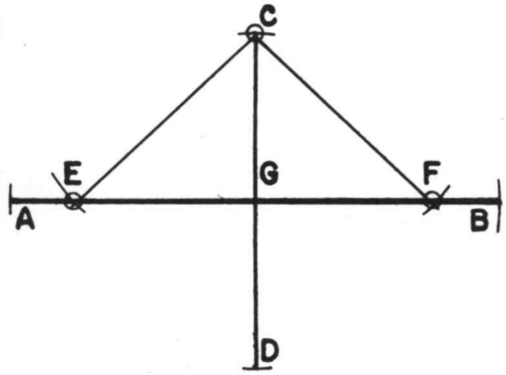


Fig. 50. Constructing an oval with string

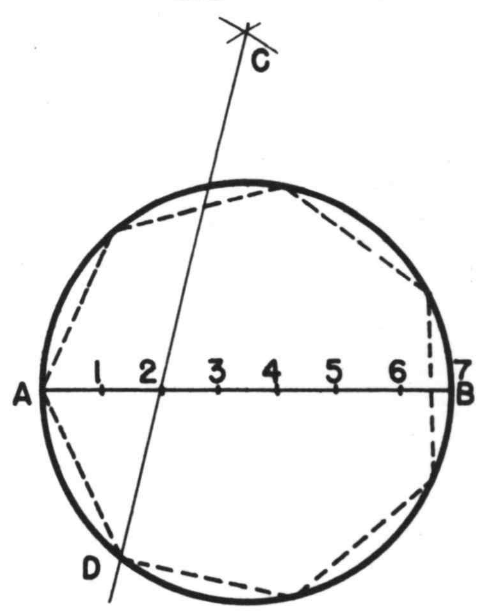


Fig. 52. Constructing a polygon within a given circle

then be fixed over the desired surface and the oval scribed (17:49).

Sometimes it is necessary to construct a polygon on a given length side (Fig. 51). The method is as follows:

AB is the predetermined side of the polygon. Erect a perpendicular AK at A. With AB as a radius and A as a center strike an arc BC to establish C on line AK. Decide how many sides are to be in the polygon (e.g. 5). Divide the arc BC into equal parts. The number of parts depends on the number of sides in the polygon. From A, draw a line through the second division from C. Erect a perpendicular at the mid-point of AB. Allow the line to intersect the line from A which passes through the second division from C. This establishes a point D at the intersection. D is the center of the circle whose radius is DA. Length AB can then be struck off on the circumference of the circle to form the polygon (17:27).

To construct a polygon within a given circle, the following method is used (Fig. 52): Draw the given circle. AB equals the diameter. Divide AB into as many parts as there are to be sides in the polygon. With A and B as centers and AB as the radius, scribe arcs which intersect above the circle at C. From C, draw a line through the second division from A and cutting the circle

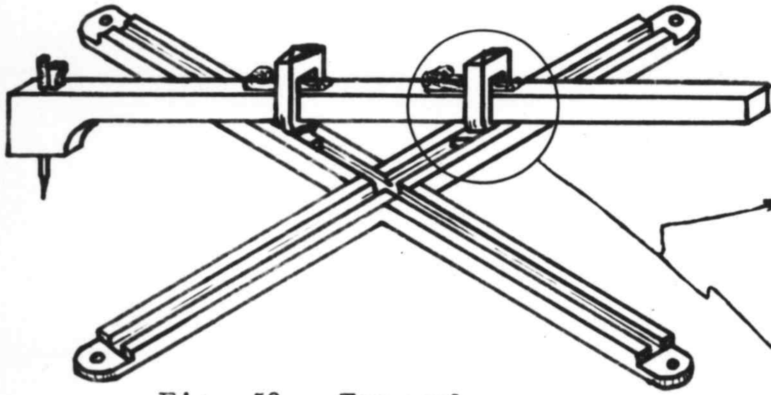
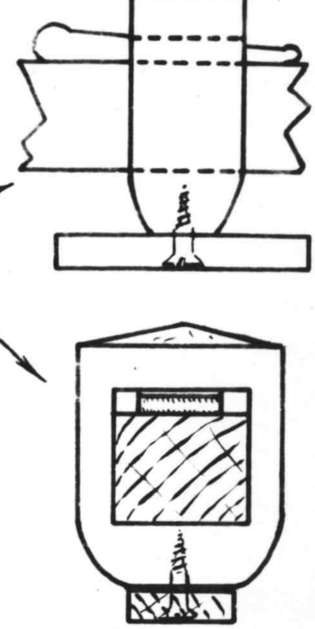
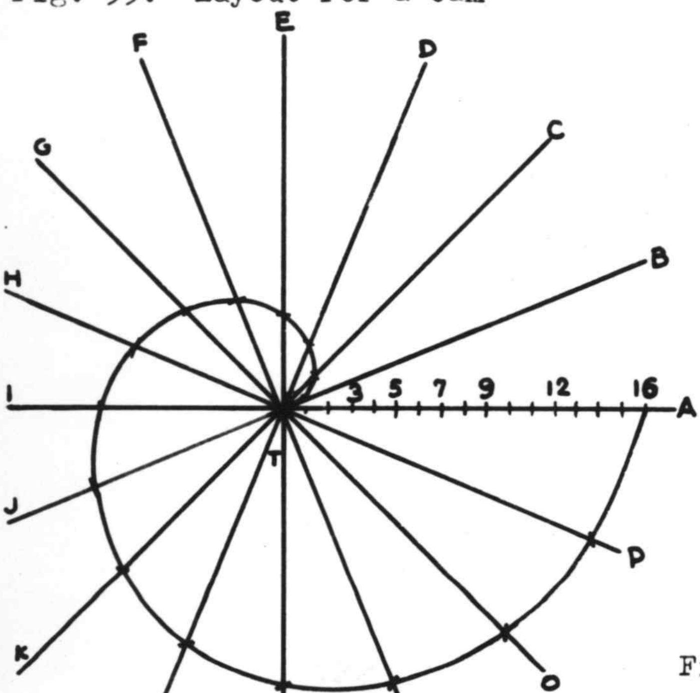


Fig. 53. Trammel



Heads

Fig. 55. Layout for a cam



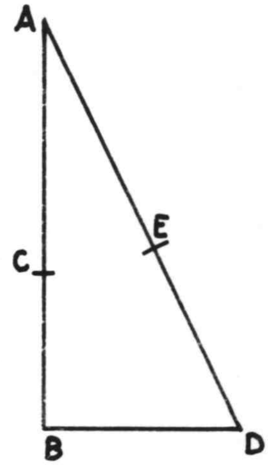


Fig. 54. The Golden Rule of proportion

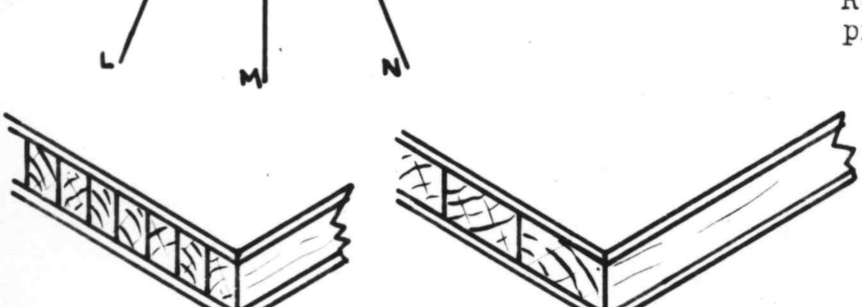


Fig. 56. Laminate board and block board

at D. The distance AD becomes the side of the polygon (17:27).

The proper proportions for a rectangle are those determined in what is called the "Golden Rule of Proportion" (15:48). The length of the rectangle is laid out as in Fig. 54. To determine the proper width proceed as follows: AB equals length of rectangle. A perpendicular BD, is raised at B equal to ½ AB. Point E is established on line DA so that DE equals BD. Point C is located on line AB so that AC equals AE. AC becomes the ideal width of a rectangle whose length is AB.

Cams are sometimes needed by cabinetmakers. Fig. 11 shows a cam being used to raise or lower a bench stop. One method of laying out such a cam is illustrated in Fig. 55, and constructed as follows: Establish a point with sixteen radiating lines equally spaced. Letter the lines A through P. T is the point of radiation. Along line AT lay off sixteen equally spaced divisions. These are numbered from the center. On line B scribe distance 1, on C distance 2, on D distance 3, on E distance 4 and so on until distance 16 falls on line AT. The line connecting these points will form a cam (8:79).

Draughting. English drafting tools are mainly the same as those used in the United States. The plastic triangles are called "set squares". The method adapted in all drawings and designs for orthographic projections places the elevation view on a ground line usually in the upper left corner of the drawing paper. The plan or top view then, is drawn directly beneath the elevation. Other views are extended to the right of the elevation. A pictorial drawing of the project fills the lower right corner (17:30).

Designing is discussed in another part of this paper.

Glues. An attempt has been made to distinguish the more modern synthetic adhesives from the standard glues derived from natural products. The synthetic adhesives have been called cements. The cements have a chemical set produced by heat and pressure. The chemical reaction cannot be reversed. These cements are usually water resistant. True glues have a mechanical set. The strength of these glues can be weakened by moisture. The glue will absorb water (11:83). Britain's economic situation has retarded the development of her synthetic resin industries. School shops use primarily hot animal glue. If this is not practical, they use one of the few available cold-setting resin glues, usually a urea-formaldehyde compound mixed with a catalyst on use.

Cabinetmakers have successfully applied an old technique to a new medium. The hot iron that is used to lay veneer with hot animal glue is used to speed the setting time of the urea-formaldehyde resin to about a minute. The technique is recommended when applying small pieces or narrow strips of veneer. The surface can be worked in a matter of a few minutes whereas without the hot iron application the normal setting time would be four or more hours. The iron should not be so hot as to burn the wood. Exuding resin will bubble and set hard. This procedure has been tried only with the one variety of resin. Other resins may have characteristics which will not respond to this procedure. Preliminary tests should be conducted to determine what reactions result from other synthetic adhesives. The strength of the bond may be affected by the heat.

Plywoods. Several types of plywoods have been developed in Britain and are commonly used. Plywood as known in the United States is in use, but is expensive. A "sandwich plywood" or a "stressed skin" plywood is a light weight synthetic sponge rubber core faced with thin sheets of plywood. This is used in airplane construction and is many times stiffer than the facing sheets. Rubber can be replaced with balsa wood (11:78). Laminated board is made up of thin and narrow strips placed on edge, then faced with veneer. These core strips are generally about 3/8 inch thick and their width plus the thickness of the facing veneer determines the thickness of the laminated board. Block board is similar to laminated board except for the strips which make up the core. The block-board core is made of strips up to an inch wide. Their thickness plus the facing veneer determines the thickness of the block board.

Manufacturers of laminate and block board can utilize many small pieces of low grade wood to make up the cores. These boards are very useful even though they may not have all the strength qualities of standard plywood (Fig. 56).

Woodworking machines. Trade specialization, the decline of the apprenticeship system, and the introduction of machinery has left the craftsman and cabinetmaker in a somewhat inferior position (15:v). The demands of the people are being filled by specialists doing the job in a machine production shop. Apprentices are no longer being trained by the craftsman. This is the tale of woe expressed by some craftsmen. The actual result has been that a new type of cabinetmaker has been produced who, instead of using hand tools, uses machines to do the job. Machines have caused a change in joinery techniques. Hand sanding is replaced by power sanders.

In spite of these and many other changes that machines have made, the schools of England or any other schools will continue to teach hand methods until they can afford to equip school shops with machines. Companies which produce woodworking machinery have yet to find a market vast enough to convince them that they should produce small-size machines for school or home workshops. Most machines on the English market are heavy industrial machines.

The average secondary school industrial-arts shop in England has no woodworking machinery. The most they might have would be a bench saw or perhaps a lathe. These are the opinions expressed by several London shop teachers, The machinery used by the woodworking department of the Central School of Arts and Crafts was: a six-inch bench saw, a ten-inch wood lathe, and a twenty-four inch grindstone powered by belts driven from a common shaft; a twelve-inch tilting-table circular saw, and a thirty-inch band saw. At the end of the school year 1950-51, the school was installing a new twelve-inch wood lathe with an optional compound tool rest, a mortiser, and a combination jointer and planer. The jointer table was built so as to be above and make use of the cutter head of the planer. All machines except the six-inch bench saw are heavy industrial machines.

Trade terms. Trade terms are established as a result of continued usage in a certain locality. The terms vary with the localities. An attempt has been made to standardize them. However the efforts of various authors are not in unison. Individuals of different localities accept different authors as their authority. The result is confusion as to the true meaning of various trade terms. Industrial-arts teachers feel obliged to settle for certain definitions and teach these. It becomes a mistake to teach some of these definitions as the one and only meaning. The definitions should be used to establish a common understanding within the classroom and within the locality.

In some woodshop circles it seems a disgrace to call a nail set a "nail punch". "Nail punch" seems to be accepted nomenclature in schools and books of England (4:449). "Nail set" is also accepted. One author speaks of a router plane being used to rout out grooves <u>across</u> the grain (17:9). Another speaks of an extension bit as "a center bit with a movable cutter for making various sized holes" (4:441).

Below are listed some of the trade terms which might be of interest:

Market forms of lumber (15:16):

LOG: a trunk felled and lopped.

BALK: a log squared by an axe or saw.

PLANK: hardwood, any cut stock up to 9 inches wide and 1 3/4 inches thick. Softwood, up to 10 inches wide and 2 inches thick.

DEAL: stock over $2\frac{1}{4}$ inches thick and less than 10 inches wide.

HUNDRED: 120 deals.

BATTEN: stock between $1\frac{1}{2}$ and 2 inches thick and less than 9 inches wide.

BOARD: stock which is less than 2 inches thick and over 5 inches wide.

DIE SQUARE STUFF: stock between a 5 by 5 inch and a 9 by 9 inch. Less than a balk and larger than a quartering.

WHOLE TIMBER: uncut balks.

FLITCH: one-half a balk, cut in two, lengthwise.

QUARTERING: stock between a 3 by 3 inch and $4\frac{1}{2}$ by 4 inch.

SQUARE of flooring and matching: 100 square feet or called 100 feet super. "Super" is short for superficial.

SCANTLINGS: miscellaneous cut stock.

LOAD OF TIMBER: 50 cubic feet.

FLOAT OF TIMBER: 18 loads.

ENDS: pieces of deals, planks, and battens cut off to convert them to standard length.

STANDARD: a measure of lumber. 120 pieces of $1\frac{1}{2}$ inches by 11 inches by 12 feet long or more, commonly 60 pieces of 3 inches by 11 inches by 12 feet.

Standard measurements for flooring or matching (15:18): (A match board is a board which has a groove on one edge and a tongue on the other (4:446).)

Rough thickness	Finish thickness
$1\frac{1}{4}$ inches	1 1/16 inches
1	7/8
7/8	11/16
3/4	9/16
5/8	7/16
$\frac{1}{2}$	5/16

Other trade terms (17:355) (4:433):

ARRIS: The edge corner formed by the meeting of two surfaces.

BAREFACED TENON: One with a shoulder on one side. A barefaced tongue is similar.

BASIL: The beveled face of a cutting edge such as a chisel plane iron.

CABINET: Originally this term referred to a small private room for consultations. Now it is a form of enclosed cupboard.

CARCASE WORK: Work of a box-like nature as distinguished from frame work such as tables.

CHECK: A local term for a rebate or a rabbet.

CRAMP: A clamp.

DADO: The wooden framing around a room, more often called wainscot.

DRIFT: The off-line direction of the saw kerf taken when the saw is improperly set.

OLD WOMAN'S TOOTH: a router plane.

STUFF: Wood used in cabinet making; stock.

TAMBOUR: A fall made by gluing narrow strips to a canvas backing. Often used in roll top desks, secretaries or bureaus.

TENONS, DOUBLE: two or more tenons side by side, or twin tenons.

TENONS, PAIR OR SINGLE: Two tenons edge to edge, called a double tenon in the United States.

TRAMMEL: an apparatus for drawing ellipses.

TRENCHING: Grooving.

The cutting lists for lumber quite often have the lumber dimensions listed in this order: length, thickness, width.

It is evident that there is a need for a standardized dictionary of woodworking terms.

Common timbers. The availability of supply determines the chief varieties of woods used in cabinetmaking. Many of the woods used in England come from forests of the British Empire. Others come from Europe and Africa.

Below are listed some of the woods in stock at the Central School of Arts and Crafts:

Abura	Pearwood, American
Amaranthe (Purple heart)	Pearwood, Nigerian (Bosse)
Ash, olive	Rosewood, Bombay
Beech, European	Rosewood, African
Cherry, French	Rosewood, Brazilian (Palisander)
Chestnut, English	Satinwood, East Indian
Ebony, Black	Satinwood, West Indian
Ebony, Macassar	Teak
Holly	Tulipwood
Limba	Walnut, American black
Mahogany, Cuba	Walnut, English
Mahogany, Australian	Walnut, Australian (Orientalwood)
Obechi (Ayous)	
Oak, English	
Oak, Tasmanian	

SECTION III

VENEERING

Introduction

Veneering is one of the most outstanding means of surface decoration on furniture. It is an old art. Museum pieces are to be seen which are thousands of years old. Egyptian and Roman furniture was veneered with rare woods. The veneering done by Dutch and French craftsmen reached a high place in quality furniture. Such English cabinetmakers as Sheraton and Hepplewhite display the art of veneering in their masterpieces (17:210). Contemporary designers in this day are using veneers to achieve the simple beauty in wooden furniture.

Furniture buyers are now realizing that veneered furniture is not a cheap substitute for solid wood. Veneered furniture is not, as some thought, a "wolf in sheep's clothing." Unfortunately some veneered furniture has been poorly constructed but this should not condemn veneering and its place in furniture construction.

Veneers give an enrichment to furniture which surpasses that of solid wood furniture in the same price range. Cabinetmakers can use the "curls" of satinwood and mahogany, and the "burrs" of walnut. If these woods were used in thicker sections, there would be great risk of warping and twisting the furniture out of shape. There would also be greater expense and more difficulty in matching patterns. Patterns can easily be obtained with the use of veneers. Because veneer is cut thin, almost identical patterns can be obtained on several cuts of veneer. Through careful arrangement of grain, figure, or color, a variety of patterns can be developed (10:75). Another advantage is the added strength which extra layers of veneer gives. A layer of veneer may serve to preserve a "ground" or "core" of wood susceptible to decay or insect damage (17:210). More advanced boys in school woodworking shops should be able to do veneering in simple form.

Definitions

The term "veneering" has been used as a general descriptive term and as a term expressing a quite definite cabinetmaking operation. For this paper, veneering will be interpreted as the using of thin sheets of wood or other material, suitable either as an inlay or an overlay, on a piece of furniture. Therefore within this definition will fall marquetry, buhlwork, and intarsia as well as the more general applications of numerous small pieces of veneer in patterns and of relatively few large pieces on broad surfaces. Although veneers are generally thought of as thin pieces of wood, cabinetmakers have occasionally used other materials such as ivory, tortoise shell, pearl, and certain metals as a surface decoration on pieces of furniture. Because these materials, other than wood, are not what most persons accept as veneers, it will be necessary to more definitely specify the type of veneer in all cases except wood. Hence a bare reference to veneer will mean wood veneer.

Production of veneers

Veneers are cut generally in two manners: by the saw and by a knife. Saw-cut veneer is thicker, 1/32 to 1/16 inch thick. In early days when veneers were cut by handsaws, they were as thick as 1/8 inch. These hand-cut veneers permitted planing. Veneer cut by a knife can be made much thinner, usually 1/28 inch thick, but occasionally as thin as 1/100 inch. There are two methods of cutting veneers with a knife (17:211). The more common way is the rotary cut. In this method the log is mounted between two centers and rotated against a knife which peels the log to produce veneer of a desired thickness. The other method of knife-cutting veneers is to slice it from blocks called flitches. With this method a cutter could produce either flat-grained or vertical-grained veneers. The rotary cutter produces only flat-grained veneer.

The grains which can be produced in veneers are most interesting. "Burrs" are especially beautiful in walnut, yew, elm, cherry, ash, and amboyna. "Curls" and "feathers" are usually confined to mahogany and satinwood. Curls and feathers are produced by the separation of the heart in the fork, found at the junction of a branch with the main trunk. Burrs are the warts which grow on the outside of a tree trunk. "Fiddle back" is a grain usually found in maple, satinwood, or mahogany. The figure runs across grain. This wood was often used on the backs of violins (fiddles). Cabinetmakers have given names to numerous other grain characteristics in various woods. Some of them are: "rain mottle," "roe," "broken mottle," "flowered," "stripe," "streaky," "blistered," "silver grain" in oak, "clash" or "felt," "lacy," and so on. Veneers are sold by a single "leaf" or in parcels of several leaves (17:211, 10:76).

Application of veneers

To achieve satisfaction in constructing a veneered piece of furniture, the maker must have a measure of patience and give special attention to certain important details. The materials must be carefully selected and the equipment and tools must be available and in working condition.

Preparation for application. The base onto which the veneer is laid is called the "ground." The ground should be free from blemishes, particularly knots, shakes, and sap. The ground should be of uniform texture and straight grain. Vertical grained stock makes the best ground. All grounds must be dry and well seasoned. Some of the best woods for grounds are Honduras mahogany and yellow pine. Plywood makes an excellent ground. If a doubtful piece of wood must be used, rip it into strips and glue the strips together so that the heart side is up on alternate pieces (Fig. 57). Since wood tends to become rounded (convex) on the heart side, this alternating of the heart sides of the narrow strips, tends to counteract any warping that may develop. It is always the practice to veneer on the heart side when only one side is being veneered. The natural tendency is for a veneered surface to become concave. Therefore to apply the veneer to the heart side of a board, serves to balance any warping of the board (17:212, 10:76-77, 8:318) (Fig. 58). There are other techniques which help prevent shrinkage and warping of veneered stock. It is advisable to veneer both sides of the ground at right angles to the grain of the ground. Select well seasoned grounds. Size the face of the ground with thin glue and dampen the back surface (if hot animal glue is being used). If the veneered board is laid flat while drying it will help to prevent warping. Take care that uniform drying is obtained. Some cabinetmakers shrink the veneer between hot cauls before it is laid. In veneering, the effect of moisture and evaporation is most important (17:212).

Very hard woods should not be glued upon a very soft ground. Since the absorption is not equal, unglued areas may result. Veneering directly onto end grain should be avoided. For the same reason care must be taken in gluing over certain joints such as through dovetails. The end grain of the joint may, through uneven shrinkage, show through later. Avoid joints which produce end grain to be veneered. If it becomes necessary to veneer over end grain or a very soft or open grained wood, size the ground thoroughly before applying the veneer (10:77).

In the past most veneering has been done with hot animal glue. Hot glue seems to be the preferred glue of some London cabinetmakers, although for some jobs synthetic resin glues are being used. Occasionally a glue will soak through the veneers. Select a glue which will not off-color the wood if it soaks through. Unless otherwise noted, all references in this section to glue, refer to hot animal glue.

A few special tools are convenient for most types of veneering. A toothing plane is used to produce a flat surface and a roughened surface. The rough surface provides a better key for the glue. A toothed surface makes a less noticeable joint. A veneer saw is convenient but a small-toothed dovetail saw is satisfactory. The veneer saw (Fig. 59) has a blade about six inches long with fine teeth and very little set (1:87). Some craftsmen use the blade of the toothing plane to replace the veneer saw (8:317) (Fig. 60). Other essential tools are described later.

The preparations made before laying the veneer are important. Once started, the process of veneering must continue until the job is in the presses. The ground must be smooth. Any holes must be filled. The ground is then toothed with the toothing plane. If soft or porous, it is sized with a thin glue and then retoothed (17:212). When veneers are sawcut, the marks left by the saw must be toothed off. A uniform flat surface must be had on the veneer as well as the ground. After the large pieces of veneer have been surfaced, they are cut to the proper sizes. If one large sheet is to be glued to the ground, it is cut over-size to be trimmed after the glue sets. Small pieces of a pattern must be, of course, cut to exact size and treated in the manner described later. With what tool the veneer is cut, is immaterial so long as a good result is achieved. A chisel is recommended for thinner veneers. A saw will be necessary for thicker stock. Instead of a chisel, some craftsmen use an ordinary penknife or a marking knife. Some use a plane iron. In any case the cutting should be done along a secure straightedge (17:212, 8:317). Very dry veneers should be handled very carefully as they split easily. For this reason they should be laid on a firm flat surface for cutting. Some veneers such as burrs are inclined to buckle. It may become necessary to flatten them before laying. If the veneer is dampened and pressed between hot cauls until dry, it will generally flatten. Oily woods such as rosewood and satinwood need not be dampened. Some craftsmen prefer to flatten and shrink all veneers before using. The less water used in this process, the better (17:215). It should be noted that knife cut veneers have two sides -- a face side and a wrong side. The face side can be finished more easily and is recognized by the tiny projections at the pores.

Laying the veneer. The laying of one piece of veneer to cover a ground will be discussed first. The techniques involved in this procedure are usually common to other procedures. Generally, there are two methods of laying veneers: with the veneering hammer and with cauls. The hammer method is usually used with thinner veneers but can be used on small areas of thicker saw cut veneers. The minimum equipment needed for hammer laying is a veneering hammer, a flat iron, and a "swab"

Fig. 57. Glued strips for veneering ground

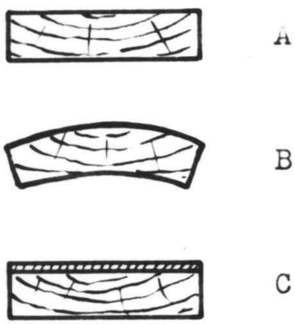
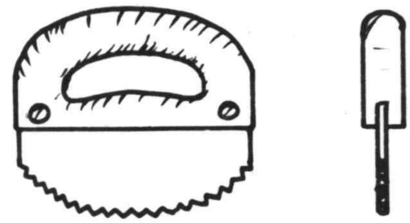


Fig. 58. Veneer on heart side

Fig. 59. A veneer saw



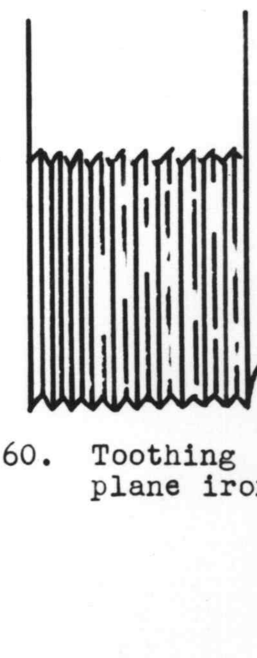


Fig. 60. Toothing plane iron

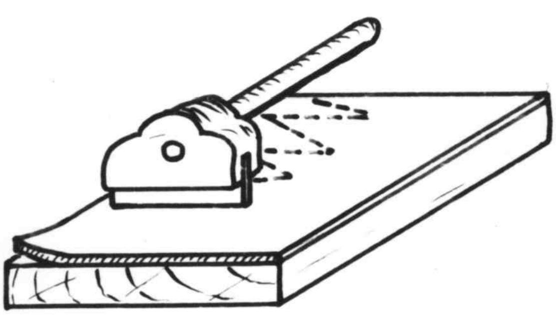


Fig. 61. Veneering with a hammer

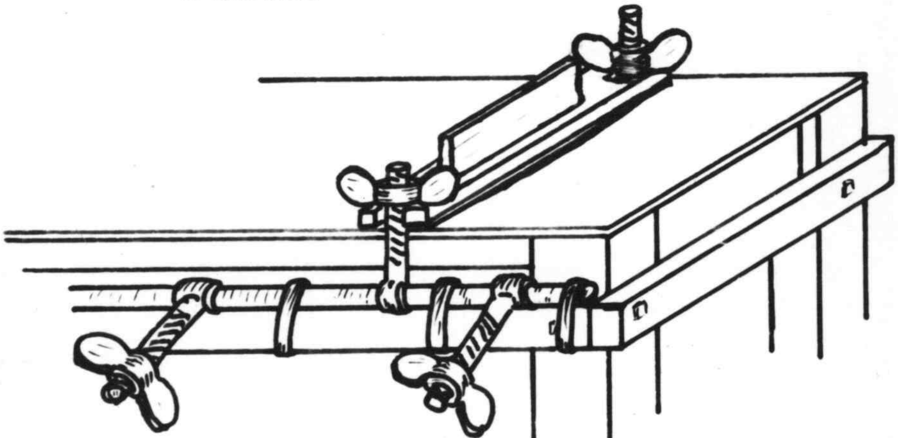


Fig. 62. Clamping device for veneering table

or sponge. The veneering hammer can be easily homemade (Fig. 61). A 1/16 inch metal blade is let into a head. The edge of the blade is rounded so as not to scratch the veneer. The old non-electric flat iron is ideal for veneering. The glue should be hot, fairly thin, and free from grit and dirt. When everything is in order, cover the ground quickly with glue using a large brush. Lay the veneer and flatten it with the hand. Dampen it with hot water and then pass the hot iron over it rapidly without much pressure. It is essential to remove all air bubbles and excess glue, so start with the veneer hammer in the center and zigzag across the veneer. Do this quickly to force out the excess glue and air bubbles. Repeat the zigzag strokes with the hammer until the glue sets and the veneer holds flat. When the veneer is tapped with the fingers or handle, any hollow sound indicates an air space. If air spaces are detected, dampen the locality and use the hot iron sparingly. The hot iron and the hammer should disperse any lumps. Wipe off the excess glue and stand the stock up to dry so that air can circulate on both sides. A clamp across the surface will help to keep it flat while drying. If when dry, blisters are found, slit them or prick them to let out the air. Warm the area with the iron and flatten with the hammer. It may be necessary to insert a little glue (17:213).

The above procedure for laying veneers with a hammer will produce good results. However, craftsmen vary the procedure according to their own likes. It does not seem to matter whether glue is put only on the ground or on both the ground and the veneer. One authority says to put glue only on the ground with an occasional dab on the veneer (8:321). This seems to be a happy compromise. An excessive amount of glue will cause the veneer to slide about as it is being "hammered." It may be necessary to pin or clamp the edges. Authorities agree that veneer must be dampened. Some say to dampen it before any glue is applied, others dampen it just prior to pressure with the hammer and after it is laid to the ground. The point of value seems to be to have damp veneer which aids in the adhering of the glue and promotes more equal expansion and drying conditions. Damp veneer loses its stiffness and tends to lay flatter and more easily. After the veneer has been laid, the outside surface is dampened with clean hot water. This counteracts a tendency for curling. Some authorities say to dampen with a thin glue size to aid in laying on curved work or where blisters persist (8:322). The evaporation of moisture within the veneered stock must be given careful consideration. Careless evaporating conditions will result in unstuck veneer or a twisted ground. The important consideration is to achieve a uniform drying so as not to disturb the tensions of the wood fibers. It may be necessary to expose both surfaces to the atmosphere or it may be of more value to prevent air from circulating upon the veneered surface. A careful study of drying requirements must be made.

To lay veneers with the aid of cauls, one must have the necessary equipment within reach. The hot cauls, the odd paper and the veneer pins, the hammer, and the presses must be onhamd. The cauls are necessary to impart the required heat and to distribute the pressure obtained by whatever clamping method used. They are made of either metal or wood. The metal cauls are usually zinc plate up to 3/16 inches thick. The best wooden cauls are made from one-inch mahogany or pine. The cauls must be hot. The hot caul keeps the glue in a liquid state until final clamping is possible. Care should be taken not to get the cauls too hot. Excess heat may burn the glue. A warm ground makes laying easier, but there is danger of warping the board. It should be warmed slowly and evenly. A ground which is too hot may soak up the moisture from the glue, leaving it too thick to get a good grip on the veneer (15:60).

When everything is ready, cover the ground and the veneer with a thin layer of glue. The wetness of the glued surface should be allowed to disappear before the veneer is placed on the ground. This slight setting prevents the veneer from sliding and swelling too quickly. The veneer may "sieze the ground" and be most difficult to shift into position (17:214, 8:323, 1:89). The hot cauls will remelt the glue properly. If necessary the veneer should be pinned. On waste surfaces the pins may be bent over so they can be removed later. If there is no waste surface, the pins may be driven in flush with the veneer surface and later set beneath the surface so that the hole can be filled or swelled shut. Pins are usually 1/4 inch headless brads.

The cauls should be heated to the point that it is uncomfortable to handle them. If one side is rounded (convex), the convex surface should be placed down. This rounded surface being in the middle, will force excess glue from the center outwards. Odd pieces of paper should be placed between the veneered surface and the caul to prevent the caul from becoming fixed to the veneer. Metal cauls can be rubbed with soap to prevent sticking. A layer of thick flannel or baize between the paper and the caul helps to press out any little irregularities (17:214).

A variety of presses could be used, from the simple hand application of a veneering hammer to an elaborate screw-type press. The important thing is to apply uniform pressure sufficient to create a close joint. It may serve to merely place the stock on the floor and to apply weights. Pressure can also be applied by using wedges (Fig. 63). Other presses can be made using the same wedge principle (8:327). Screws may be used (Fig. 64). A variety of hand clamps may be used. The press used at the Central School of Arts and Crafts (Fig. 62) consists of a 1/4 inch metal top which can be heated by gas jets from beneath. Swinging bolts with winged nuts are spaced about ten inches apart. These bolts are swung up into slots on the ends of heavy T-iron bars. To the bottom of the bars is fixed a wooden facing. Pressure is applied to each end of these bars by the winged nuts. The wooden facing is slightly bellied in the center to allow center pressure to be applied first.

The application of veneers onto a curved surface requires careful work and careful preparation. Only advanced students in school are likely to be doing it. Saddles are made to correspond closely with the concave and convex surface to be veneered. The cauls used must be thin -- about ¼ inch thick. They must be capable of being bent to the curved surface. The saddles serve only to apply uniform pressure on all glued areas (Fig. 65). The cauls as usual are heated (10:80). If wooden cauls are not adaptable, then sandbags are used as a substitute.

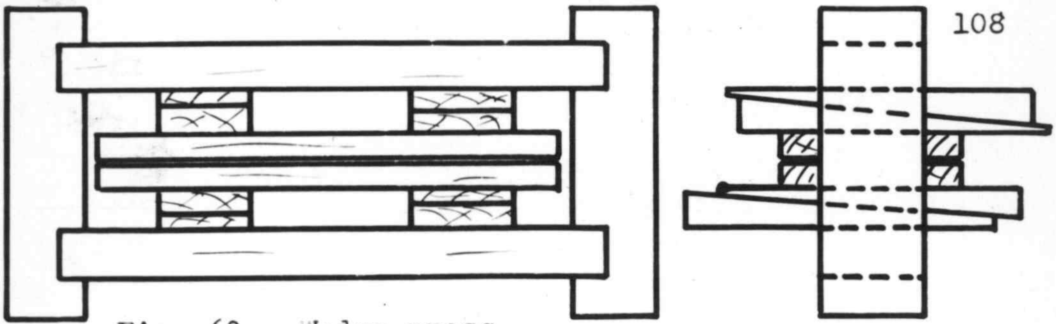


Fig. 63. Wedge press

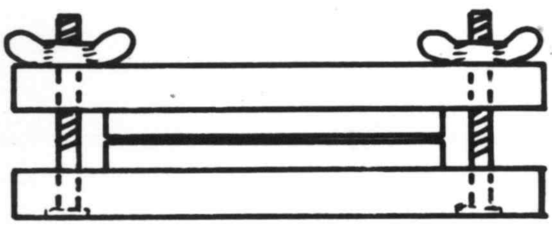


Fig. 64. Screw press

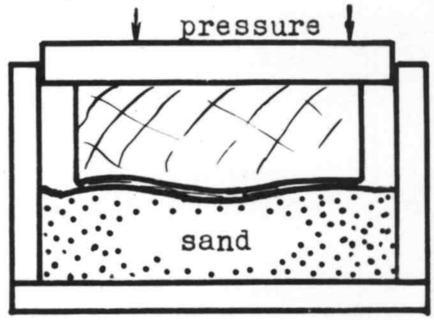


Fig. 66. Sand box press

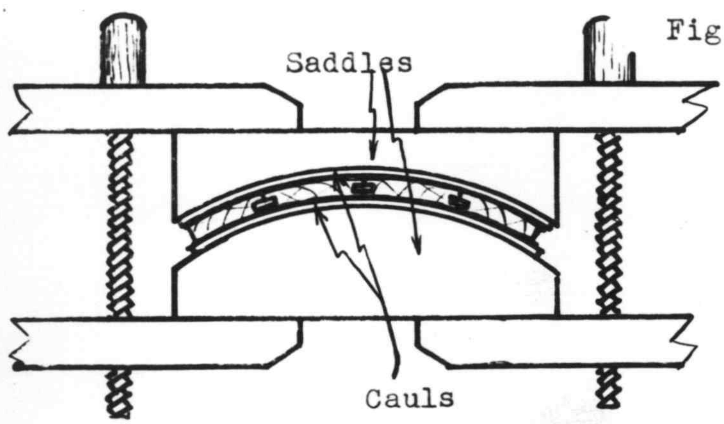


Fig. 65. Saddles for curved work

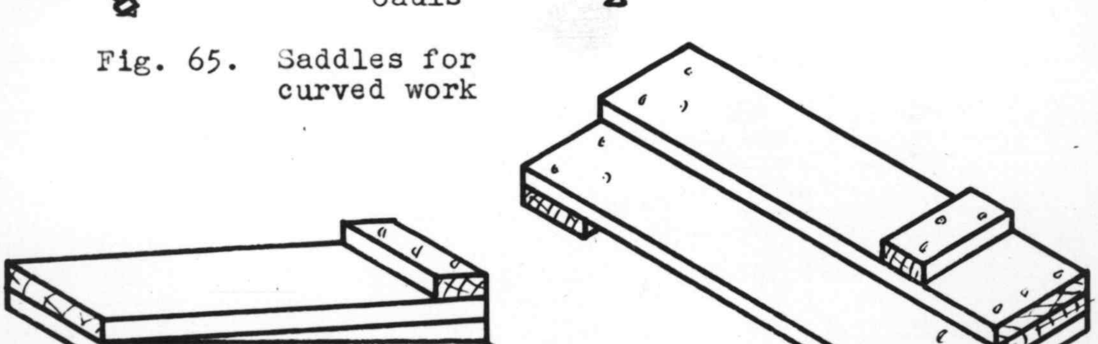


Fig. 67. Shooting boards

Calico bags should be of sufficient size and filled with sufficient sand so that, when the shape is formed there will be at least one inch of sand pressing at all points. By placing the bag in a specially prepared box it is easier to control the sand (Fig. 66). The veneered surface is gently fitted to the sand. The process of veneering is the same whether laid with sandbags or with wooden cauls. The sandbag is heated and laid in the box. Since the sand retains heat much longer than standard cauls, care should be taken not to overheat and hence burn the glue or even the veneer (8:324-325, 17:214-215).

It is usually advisable to use a caul of some type for all curved work -- even for the thinner knife-cut veneers. One exception to this is the process used in hammer-laying veneer on circular pedestals. A slightly curved veneering hammer is used. The procedure used in flat surface veneering with hammer is followed. Joining the edges becomes the important problem in circular work. The veneer is worked around until it overlaps the starting edge. Here it is left until the glue has partially set. This allows a certain amount of shrinkage to be completed and hence tends to produce a tighter joint. A straight edge is then laid along the joint and a chisel or knife is used to cut through both layers of veneer. The glue at the joint is remelted with a warm iron and the veneer pressed into place with the hammer (17:214-215).

Another method of veneering circular work makes use of canvas webbing as a clamping device. The glue is applied to the ground. It is allowed to chill slightly. The veneer is wrapped around with an overlapping joint. Dry webbing is then stretched around the veneer. The job is heated over a fire. The heat remelts the glue. Then if the warm webbing is wetted the resulting contraction will force out the excess glue. The heating and wetting are repeated as necessary. The work is allowed to dry. The joint is then made with a hammer and warm iron as described above (8:327-328).

One of the most enjoyable and satisfying areas of cabinetmaking is that of doing pattern work in veneers. Good work is readily obtained if the worker is patient and careful. Good work cannot be done hurriedly. The order of procedure involved in pattern work varies with the design of the pattern. If workers can combine the procedures of veneering as previously discussed with a few simple suggestions and a bit of good judgment, good results can be obtained. One problem arising in pattern work is how to make close fitting joints. Irregular shaped edges can be joined as described later in the process called "Marquetry". Individual pieces of veneer may be cut, sandwiched between two thin pieces of scrap board, with a coping saw. Irregularities may be removed with a gouge, sandpaper, or knife. A very satisfactory way is to use a fine file. The file is held vertically and worked over the edge of a block or bench. It is possible to remove a smaller amount of wood with the fine file than with a gouge or knife. By working carefully an irregular edge of veneer can be worked quite closely to a matching irregular edge or line. To smooth the straight edges of veneer, a plane used in conjunction with a shooting board is ideal. There are several types of shooting boards all of which can be made in the workshop.

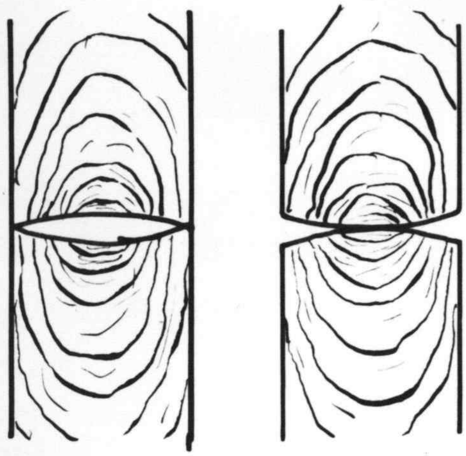
In the type of shooting board pictured in Fig. 67A, the plane moves horizontally. The board is constructed so that the stock is held on the board at an incline. As a result the plane makes a slanting cut which is a cleaner cut and which uses a greater width of the plane iron (8:232). Wax rubbed onto the board allows the plane to slip much easier.

In joining veneers, attention must be given to the characteristics of the veneers. Future shrinkage or expansion may spoil an expected tight joint. For example, the greatest swelling when glued, on a piece of "curl" veneer, as pictured in Fig. 68, is in the center where the grain tends towards the horizontal. The hollow joint is essential. If a tight dry joint is made, the moisture of the glue will swell the center area leaving the edges gapping (15:60).

The procedure for working the pattern in Fig. 69 will be described. The design is set out carefully on a board. A template of each different shape should be made of heavy cardboard or of metal if it is to receive considerable use. The template aids in the selection of the best grain for the design. The veneer is cut to rough size with the saw or knife. The curved edges of an inside piece is finished first with a coping saw and file. The center joint is "shot" on the shooting board. The finished piece should be laid on the prepared board and fixed with veneer pins or paper tape. Other pieces are fitted to this fixed piece to form the "hourglass shape". The outside pieces are fitted last. Paper strips are glued over the joints and all pins are removed. In any light-colored wood like satinwood, pins should not be used, as the resultant hole is difficult to conceal. In such cases, and in the case of easily split wood, pins should be replaced by strips of gummed paper. If a strip (line) is desired around the hourglass shape, place the line up to the shape with a small amount of glue. Hold it in place with pins until the glue sets. Remove the pins when you are ready to continue with the fitting of the outside pieces (17:215-216). Normally the pattern held together by paper is ready to lay onto the ground. Certain circumstances, such as varying thicknesses of the pieces of veneer, will require that the pattern be glued to a sheet of paper, the original paper strips washed off, the surface toothed, and then laid to the ground.

Another quite satisfactory method of building up the pattern is often used. Strong paper is stretched onto a board by dampening the paper and gluing the edges. In drying, the paper shrinks and becomes taut. The pattern is carefully drawn on the paper. Pieces of the pattern are shaped and laid to the paper. A little glue near the edges fixes them securely to the paper. The face side of the veneer is laid onto the paper. With this method the pattern is built up without pins. Various thicknesses of veneers can be used without the extra step of the previously described method. The veneers are brought to a uniform thickness and laid directly onto the ground (17:216). When pattern work is laid onto the ground, paper should be glued over a joint or crack to prevent the joint from opening during drying. The veneer has a tendency to shrink away from a joint (10:81).

Drawer fronts have often been pattern-veneered. The example in Fig. 70 could be done as follows: A roughly shaped piece of veneer (A) is laid. The margins are



Proper fit-up (Exaggerated)

Results of swelling after a tight joint

Fig. 68. Joining a "curl" of veneer

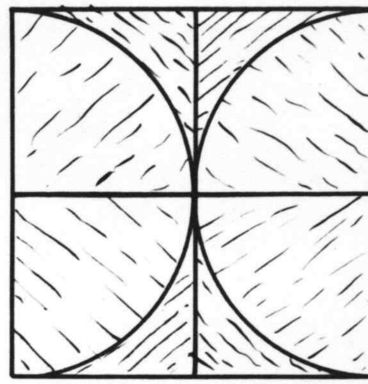


Fig. 69. Example of veneer pattern

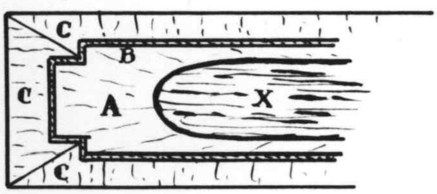


Fig. 70. Veneer pattern on drawer front

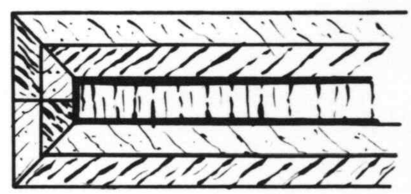


Fig. 71. Herringbone drawer front

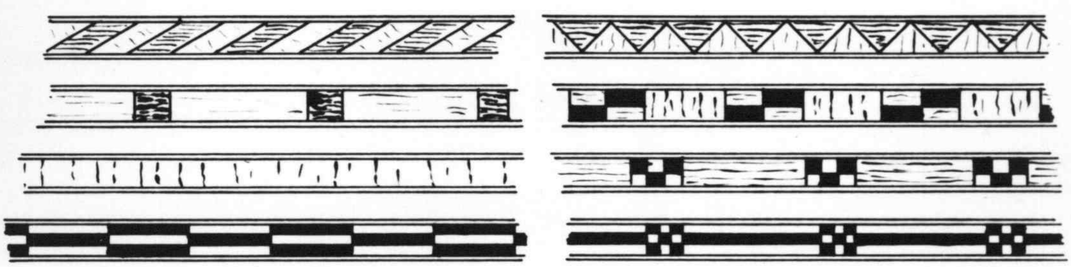


Fig. 72. Bands in various designs

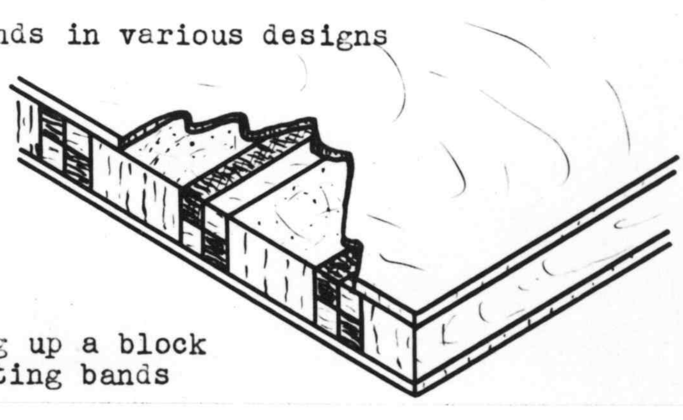


Fig. 73. Building up a block for cutting bands

gauged and the excess veneer is removed to a clean edge. A chisel or knife is used to cut the veneer and a hot file or other heated metal is used to soften the glue so the waste can be lifted. Line B is fitted and laid as described in preceding paragraphs. The exterior cross-banding (C) is then fitted and laid. The center piece (X) is inlaid into the drawer front as the final process (1:86). Inlaying is described in a later section. It will be noted in this process that pieces of the pattern are not fixed together before the veneer is laid as one piece. Instead, each piece is laid with a hammer as it is fitted. Cross-banding and herringbone patterns are often laid in this manner. The pieces must be dampened on top to counteract the tendency for the edges to curl when laid to the glue. The usual strips of paper over the joint prevents air from getting in and holds the pieces up to the joint until the glue is dry. In making a herringbone pattern, the veneer is cut obliquely. It is essential to have plainly striped wood (Fig. 71) (17:216).

Strings and bands add very much to the veneered decoration. Strings (or lines) are solid strips of wood ranging from hair thicknesses to 1/8 inch squares. The widths vary as well as the thicknesses. Bandings are built up of layers of varicolored woods. The grain of these is usually in the same direction. Slices of required thicknesses are made of this layered wood to produce a decorative band (Fig. 72 and Fig. 73). These bands as well as the strings can be purchased pre-made from veneer dealers. The method of laying these bands and strings corresponds to that described in inlaying.

Cleaning-up and finishing. Before cleaning up and finishing a veneered job, the glue must be thoroughly dry. If the glue has not set firmly, the veneer may blister or tear up in the cleaning-up operation. When the glue has set, clean off any paper with warm water and a sponge, or it may be taken off with the toothing plane. If water is used, use as little as possible. A broad chisel or a scraping tool will help to scrape off the paper after it has been dampened. After the paper has been removed, tooth the surface finely to establish as flat a surface as possible. Scrape the veneer with a steel scraper. Work with the grain as nearly as possible, but in the case of burrs or other extremely irregular grain, scrape in a circular motion. Final surfacing should be done with sandpaper (10:90, 17:217). Care should be taken not to cut through the thin veneer in the cleaning-up.

Special Processes

Overlaying. The veneering described in the previous paragraphs has been the application of veneers onto a ground. In one sense this is a form of overlaying. Normally overlaying is the application of thicker materials than veneers onto the surface of the project. The overlay gives a raised pattern to the finished project. As a result, two layers of a finished surface can be seen. In the type of veneering previously described their is, of course, only one layer visible -- the ground being entirely covered.

Inlaying. The process of inlaying described in the following paragraphs, as compared to overlaying, is the setting of pieces of veneer into a surface. Both the surface and the inlaid veneer make up the surface decoration. The basic techniques of inlaying are quite simple. The pieces of veneer are cut to size; the edges are slightly beveled to make a tighter joint; the pieces are laid onto the surface and traced around; the recesses are then cut out to receive the pieces. Knowledge of certain techniques and details makes the results much more satisfactory. Some simple tools make the work much easier. To cut the groove inlaying a straight line, e.g. strings or bands, a number of tools can be used. A bradawl or the sharpened tang of a file can be used along a straight edge to scratch out a groove. A "scratch" is a tool which can be used for the same operation. Cutters can be made in any desired shape. Fig. 74 shows a simple homemade scratch. A more elaborate scratch is pictured in Fig. 75

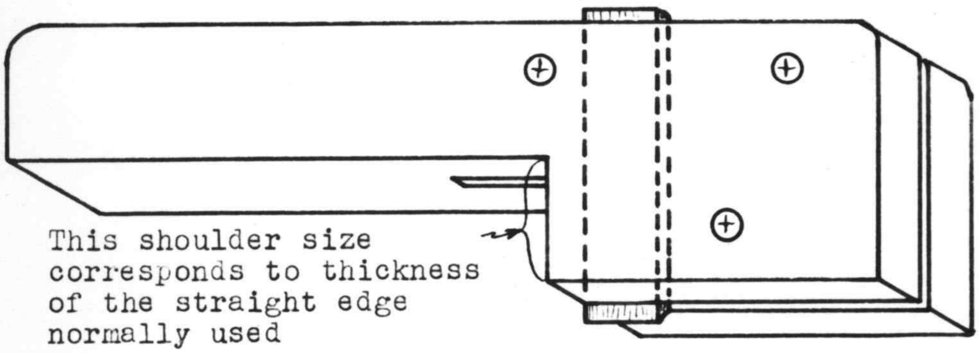


Fig. 74. Homemade scratch

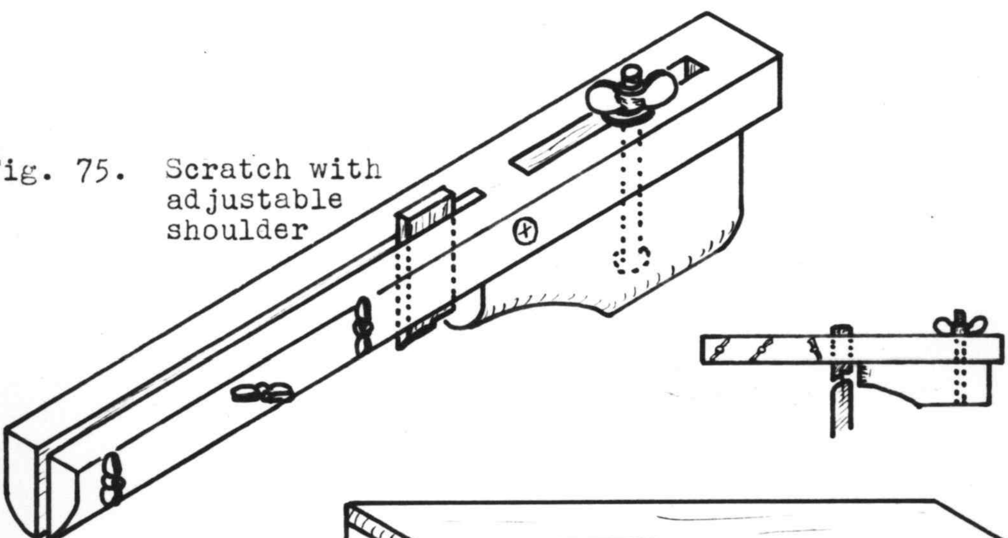


Fig. 75. Scratch with adjustable shoulder

Fig. 76. Jig for inlaying tapered legs

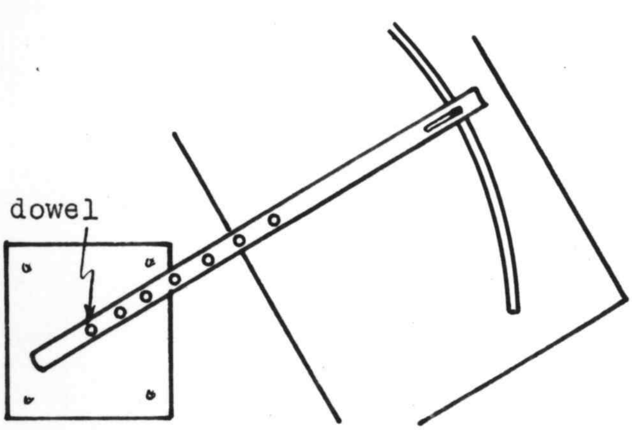


Fig. 77. Jig for cutting circular grooves for inlaying

with a cutter shaped to cut a moulded edge. The curved bottom reduces friction. Before using a scratch, a knife line is cut at the borders of the groove to prevent the edges from being frayed. A cleaner cut groove results. It may be worth while to prepare a cutter with small knife-like edges at each side of the scratch cutter. The action of these would be similar to the spurs of an auger bit. A quickly made scratch used by some craftsmen is the tool made by driving a chisel of desired dimensions through a board. The cutting edge of the chisel acts as the scratch cutter and the board serves as the handle.

It is sometimes necessary to inlay strings in a tapered and round table leg. If the leg is placed into a frame box, as shown in Fig. 76, it can be rotated as desired. The edges of the box as a gauge-shoulder make it quite simple to lay out straight and centered lines (15:62).

A simple device for cutting circular grooves is shown in Fig. 77. A base which holds the dowel pivot is fixed by clamp or other means to the bench. The surface to be grooved is located and fixed. The arm which holds the cutter can be made with additional holes so that the radius of curvature can be altered. A finer adjustment to the proper radius can be made by sliding the cutter along the arm (17:218).

The bottom surface of the groove or recess must be flat. In some hard wood, a better key for the glue is provided if the surface is pricked with an awl or something similar. If the edges of the recess are slightly undercut, a tighter joint will result. Care must be taken to undercut only slightly, otherwise the result will be a loose fit instead of a close joint.

When the groove or recess is properly made, glue the veneer in place and clamp in the usual manner. Allow the glue to dry thoroughly before cleaning up. If the veneer is cleaned off before the glue is completely dry, the continuing glue shrinkage may pull the veneer so that the inlay does not fill the recess. When curved bands or strings are necessary, it may be helpful to prebend the veneer before it is glued. The dampened veneers can be bent around simple forms or a warm pipe and allowed to dry. Prebending makes final laying much easier. Built-up patterns (marquetry patterns) are inlayed as one piece. The individual pieces of the pattern are held together, as described previously and also in the marquetry discussion, by strips of paper and glue which has been worked into the joints.

Certain metals, ivory, tortoise shell, and mother-of-pearl have been used with woods for inlaying. The decorations achieved with their use is quite attractive.

Mother-of-pearl used for inlaying is about 1/16 inch thick. It is cut with a fine saw such as a jeweler's saw. The mother-of-pearl can be backed with stiff paper or veneer glued with paper between, if there is a possibility of breaking it during cutting. The under surface of the mother-of-pearl should be roughened with a file and the ground pricked to provide a better key for the glue. A little plaster of Paris mixed with the glue gives added strength. Very little pressure should be applied to mother-of-pearl as it is brittle and easily cracked. A plane or a flat iron should be sufficient. A scraper or a fine file can be used to clean up. Flour paper, pumice, and rotten stone can be used to rub down the pearl to a final finish. To prevent the pearl powder from penetrating the surrounding wood, give the wood a light coat of shellac or other sealer. A design can be cut into the pearl with nitric acid. A coat of warmed beeswax is brushed onto the pearl. The desired design is scratched through the wax. Nitric acid is poured carefully into the scratches. After the acid is allowed to eat into the pearl for one hour, the surface is washed and cleaned with warm water. A little "mastic" run into the acid lines will complete the design (17:222, 9:83).

Ivory and tortoise shell is laid similar to mother-of-pearl. These two materials are not so brittle and permit laying with cauls. The underside can be toothed. Ivory and tortoise shell are finished with fine sandpaper and pumice. Polishing is best done with rotten stone or dry whiting (9:84). Ivory can be made temporarily flexible by soaking it in pure phosphoric acid until it is no longer opaque. After it has reached the translucent stage, it is washed in cold water and dried with a clean soft cloth. After it becomes hard again, additional softening can be accomplished by soaking it in hot water. Some common ivory substitutes are "ivorine," bone, and celluloid (17:223). White celluloid must not be toothed because the marks show when the celluloid is laid. With thin ivory this danger is also present. Previous to gluing, the celluloid should be covered with a paste made from celluloid dissolved in some solvent such as ether. This permits more satisfactory adherence (17:61).

Metal is occasionally used as an inlay into wood. During the Louis XV period of furniture, a Frenchman named Andre' Boulle, inlaid brass or silver into tortoise shell and later imitations of tortoise shell. His work became known as "Buhl work". The work was not favored by many craftsmen outside of France, however a few English craftsmen worked with the technique. Cutting and forming the pattern is done similar to the marquetry techniques. Plaster of Paris with the glue gives added strength. Emery cloth and files are used to clean off the metal.

Finishing is done with pumice powder and oil (17:221, 9:84). To hold wood and metal together, add a tablespoon of "Venice" turpentine to each pint of glue. It should be stirred well while boiling (15:61).

Intarsia (or tarsia). Intarsia and marquetry are two forms of veneering very closely allied. The difference between the two techniques seems to be small and for the craftsman it is relatively unimportant. In the 14th century some craftsmen in Italy developed a technique of building up a picture out of pieces of veneer and inlaying them piece by piece into a ground. This "pictorial inlaying" was called intarsia. The veneers were carefully selected for their grain and color. They were cut to shape by gouges, chisels, saws, and files, and cleverly arranged to give a three-dimensional effect to a picture. Marquetry cutters achieved the same results by laying several selected sheets of veneer together, with the design on top, and cutting through all the sheets simultaneously to make the individual parts of the design. The pieces were built up on a paper base and the entire pattern inlaid into a ground. The techniques of manufacture seem to be the only difference between intarsia and marquetry. Both processes produce a design or picture in wood (17:223, 363; 10:97).

Marquetry. The French word "marqueterie" means to mark, to impress, or to cut into. It is from this that the word marquetry comes. The process was practiced extensively during the 18th century (Louis XVI period) in France (17:221, 9:84). The French, Dutch, and English produced many skilled marquetry cutters. A careful study of the design and the veneers must be made. The selected sheets of veneers are glued together with thin glue and a sheet of paper between each. The design is glued to a top sheet as a guide for cutting. By gluing the veneer sheets together it is easily possible to keep all the small pieces together in one "block" until they are ready to be separated with a thin bladed knife. Without glue, loose interior pieces may be chewed up by the saw if they slip. If the veneer is satisfactory, as many pictures can be produced as there are sheets of veneer. However if only one picture is desired, it is more economical to replace veneer with cardboard into which selected pieces of veneer have been properly located and fixed. This method permits use of smaller pieces of veneers and veneers more suited to the picture. With this method the sheets of cardboard are sandwiched between two 1/8 inch board and the entire assembly held together by carefully placed brads.

The cutting can be done with any fine-bladed saw.

Jig saws or coping saws fitted with a jeweler's saw blade are satisfactory. In the past marquetry cutters used a "donkey". They became highly skilled. The saw blades were often self-made from clock spring steel. The marquetry cutter's donkey was a frame into which was mounted the saw blade and a clamp for holding the veneers. The saw blade was mounted into a movable and adjustable arm. The pressure applied to the clamp was controlled by the operator's feet as he sat at a fixed seat. The veneer was held vertically and the hand-operated saw moved horizontally. After cutting, the pieces are separated and assembled on a board. Shading (called scorching) of pieces can be done by dipping the pieces into hot sand. After assembling, a piece of paper or linen is glued over the lot and the design is ready for laying. It is laid onto the groundwork in the usual manner with cauls as described previously (17:221, 10:96).

Intarsia and marquetry offer a wide scope of interesting work to students. They offer a chance to apply some art training. Experiments with ideas in color, contrast, and harmony, together with practical drawing design, and composition are all possible. Woods must be selected carefully. Rosewood and lungwood make good tree trunks. Walnut or amboynia burrs make good foliage. Sycamore, greywood, or tulipwood make good sky effects.

"Fiddle back" figured greywood is often used for water effects (10:98). Cuts made transversely on branches of lignum vitae or laburnum wood produce a figure similar to an oystershell. Patterns often incorporate these oysters to a good advantage.

Parquetry. Parquetry is another veneering process. It usually refers to geometric patterns composed of "diapers" of the same wood. The pattern is built up on paper and laid with cauls. Parquetry also refers to the process of building up a pattern of solid wood in floors. A parqueted floor is quite attractive (17:223).

CHAPTER V

ARTMETAL WORK

SECTION I

DEPARTMENT ORGANIZATION

Introduction

Artmetal as known in the industrial-arts program is usually an outgrowth of the silver and coppersmith's trades. One may also include the jewelry and engraving trades and certain phases of metal casting. The artmetal trades of Britain are attempting to work themselves out of a tradition that has restricted their production of fine artmetal work. Manufacturers who have been satisfied with existing conditions are being forced to produce the works of a new class of contemporary designers.

Machines are assuming the task of mass producing artmetal products. In Britain there remains still a group of artist-craftsmen who produce custom-made articles of artmetal. The techniques of these craftsmen seem to remain unchanged through the years. At the school of silversmiths' work at Central School of Arts and Crafts, it is possible to learn many lessons in artmetal work from some of these artist-craftsmen.

Administration

The Silversmith's work is one of several sections making up the Department of Silversmiths' Work and Allied Crafts. Under the direction of a section head are three men who spend half of their time teaching and half at the silversmithing trade. Daytime and evening classes are offered. The same laboratory offers evening classes in metal spinning. The instructor of this course is owner-operator of a metal-spinning firm.

Classes are made up of boys from fourteen to eighteen years old who are students in lieu of or in conjunction with their apprenticeship training. Other class members are adults who are studying for the trade or who are seeking a leisure time activity.

Physical Plant

The silversmithing and metal-spinning workshops consist of approximately 1000 square feet on the second floor of the school. Fig. 78 shows the layout of the shop. Twenty bench-stations are provided. Each station is equipped with a machinists' vise. Excluding the two spinning lathes, the shop contains three polishing-buffing wheels, a power grinder, a drill press, three annealing-soldering stations, and a pickle vat. Ten-foot windows on one side of the shop provide adequate natural light. Artificial light is provided at each bench station.

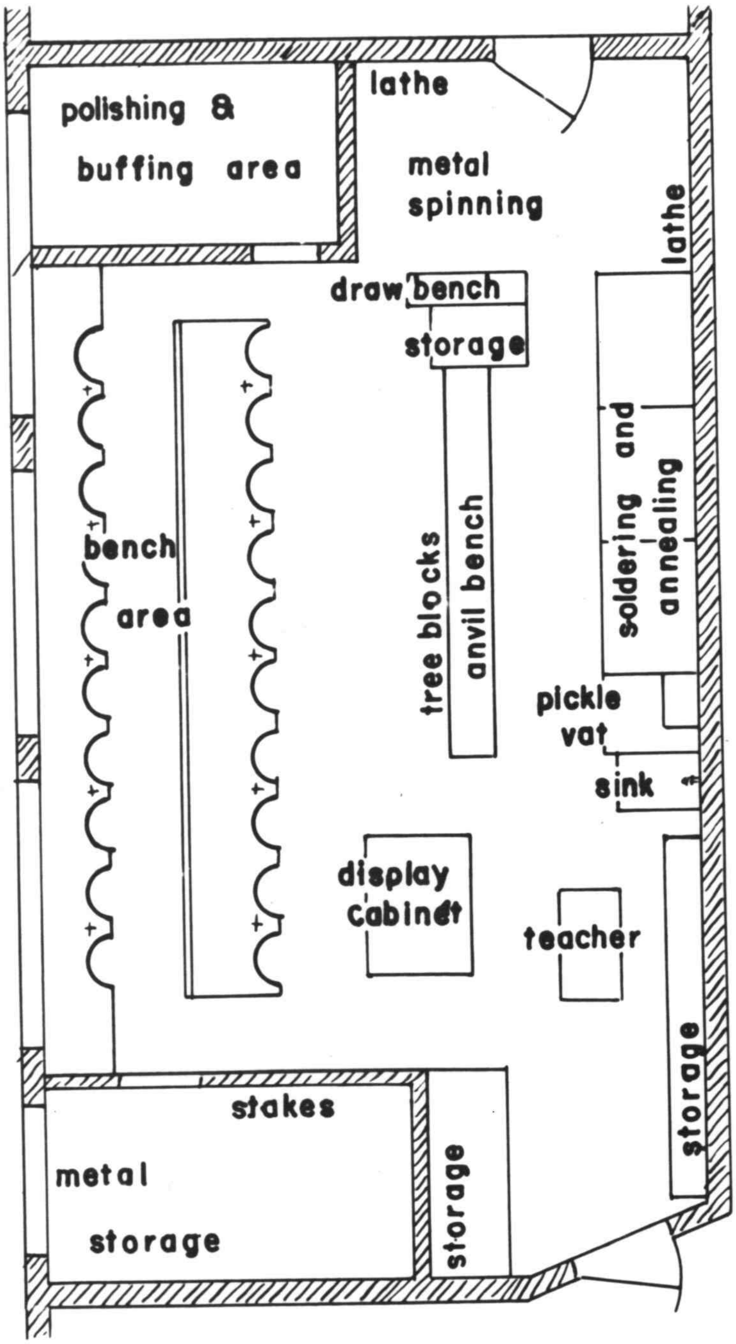


Fig. 78. Silversmiths' shop layout

SECTION II

GENERAL ARTMETAL-WORK PROCEDURES

Tools and Equipment and their Application

The tools of the silversmiths' trade have varied little from those used in the past. The shapes and designs have been altered to comply with modern manufacturing processes. The purposes of each tool remains about the same. The following are some of the tools used in the silversmiths' shop at Central School of Arts and Crafts:

Layout tools. Steel rule; tri-square, sometimes called an "L" square; calipers, inside and out; dividers; surface gauges; and pencil compasses. The metal point leg of the pencil compass was often bent as in Fig. 79 to permit the lining of raised articles. Other layout tools include scratch awls and punches of various types.

Hammers. Hammers of many types are in use. Most common are the raising hammers, planishing hammers, and neck or collet hammers. The shapes of these forming hammers are varied to fit the form of the article being worked on. Planishing hammers are used for smoothing out other hammer marks. They should be used only for planishing. Boxwood mallets are used by beginners for raising hammers. One surface should be cut and filed to a blunt cross-peen. Rawhide mallets are used for shaping metals without leaving hammer marks.

Forming devices. Stakes and heads are used as the undersupport for metal during hammering processes. Heads have small shanks which fit into special receptacles or into a vise (Fig. 80). Heads and stakes are made in any shape suitable to the workman. They can be cast or ground to the shape desired. Their working surfaces must be perfectly smooth. A "horse" and a "crank" are tools used to hold the heads so that work may be done inside of deep vessels (Fig. 81). Bottom stakes have long shanks which enable them to be used at the bottom of deep vessels. Bottom stakes with various sized circular faces are used to form the bottom of vases and coffee pots. Other stakes are used according to the shape of the work to be hammered. Common types are the "cow's tongue," "throw back," "Beck iron," and "side" stakes (Fig. 82).

Miscellaneous tools. Pliers, tongs, and tweezers are often needed. Non-ferrous tongs are used in the pickle vat. Jewelers' saws and frames are common, as well as hack saws and small bow saws. Needle files and larger files are always on hand. Surplus solder is removed by "scorpers" -- a form of graving tool. Swage blocks and draw plates are necessary for forming wire. Other tools used in the shop included the ring mandrels, large cone mandrels, flat dies with at least one true surface,

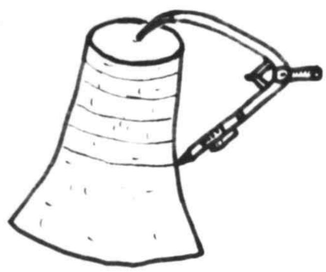
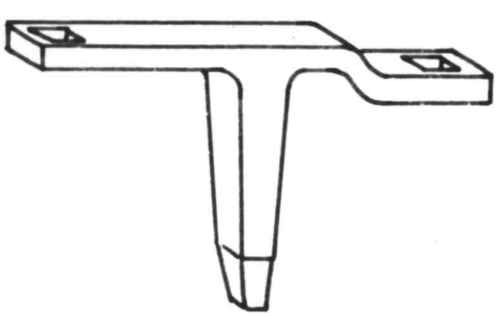


Fig. 79. Compass lines to guide raising

Fig. 80. Three heads



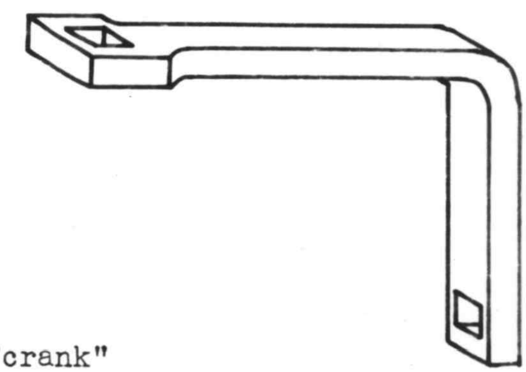


Fig. 81. A "horse" and "crank"

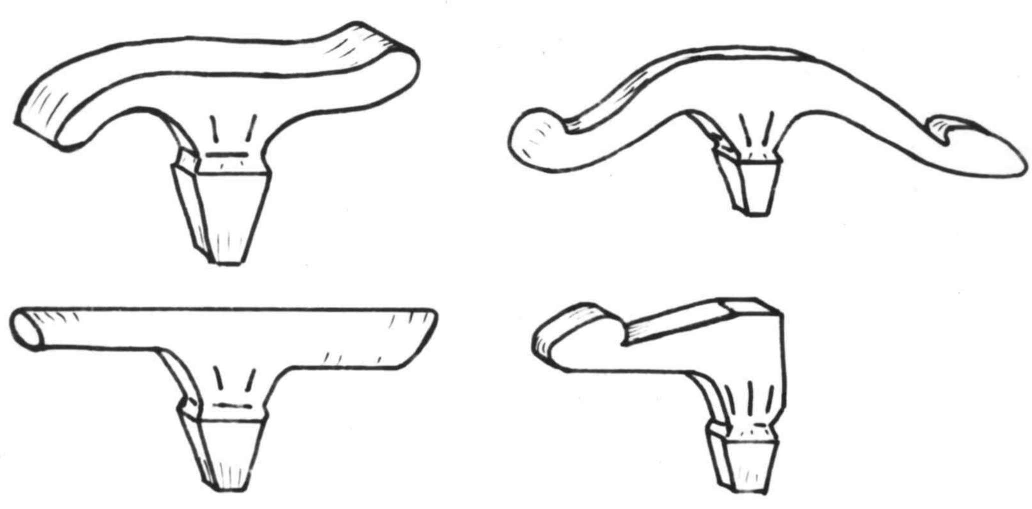


Fig. 82. Stakes

sandbags covered with thick cowhide, tree blocks or steady blocks, pitch bowls with leather rings, and lead blocks.

The heating torches are important pieces of equipment in the silversmiths' shop. It may be an ordinary oil or alcohol lamp, or it may be a bunsen burner. The air jets for the lamp flames are usually supplied by the workman blowing through a tube. Some torches are made, such as the ones at Central School of Arts and Crafts, with built-in mixer valves. These valves allow the amount of air and gas to be regulated from the torch. Air pressure is supplied by air compressed either by electric motor or foot-powered bellows. Foot bellows sometimes are equipped with an air storage compartment to permit a steady air pressure.

Other equipment at Central School of Arts and Crafts seems typical of silversmithing shops. The revolving annealing pans are placed a convenient height above the floor. The three pans are separated by sheetmetal partitions to provide enough darkness for careful annealing. The annealing pan should be filled with crumbled coke. Each pan is supplied with a fire brick slab about two inches thick and a foot square. One side of the slab is smooth and the other corrugated.

Adjacent to the soldering and annealing area is located a two by three foot pickle vat. The vat sets on the floor and is approximately two feet deep. The pickle in this vat cannot be heated. Situated over this large vat is a shelf supporting a gas ring and a small vat six inches deep, ten inches wide and fourteen inches long. Hot pickle is prepared in this vat. A pickle bath is used to remove the glaze of borax flux which results after hard soldering. This glaze is difficult to cut with a file or any other tool. It is glass hard. The acid in the vat eats through this glaze and saves the sharp cutting edges of tools.

The work benches consisted of a long table, three feet and six inches high. Each work station is a semi-circular notch cut out of the side. Every other station is equipped with a vise. Each station is fitted with a swinging bench pin for sawing and filing. A canvas apron or "skin" is fitted from the under side of each station to catch filings and trimmings from precious metals (Fig. 83). Each bench station is provided with a low (chair height) stool. Filing and sawing can be performed better at this height. Bench top work is done in a standing position or from a high stool.

The draw bench (Fig. 84) is used only occasionally at the Central School of Arts and Crafts. It is a most convenient tool when needed. It is used to shape wire into any desired cross-sectional form. After the wire

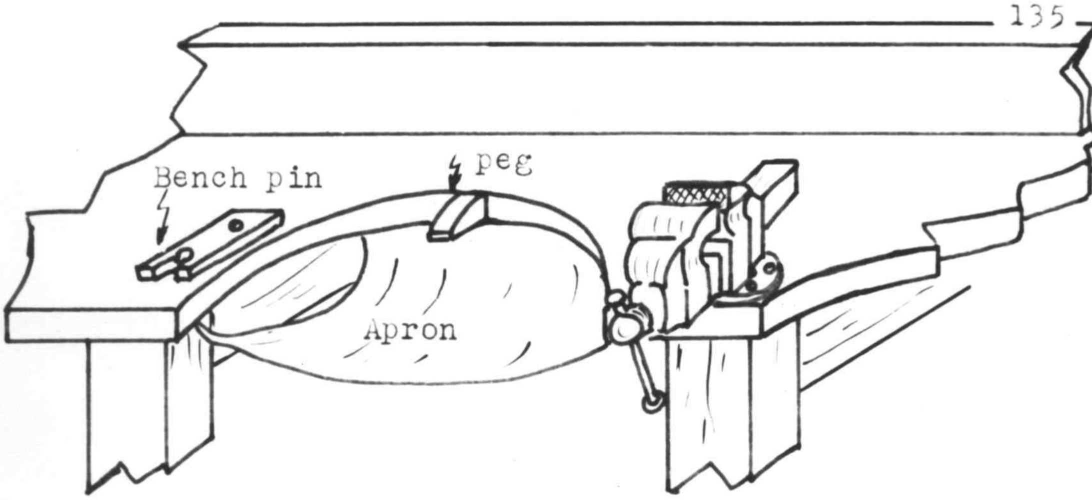


Fig. 83. Silversmith's bench

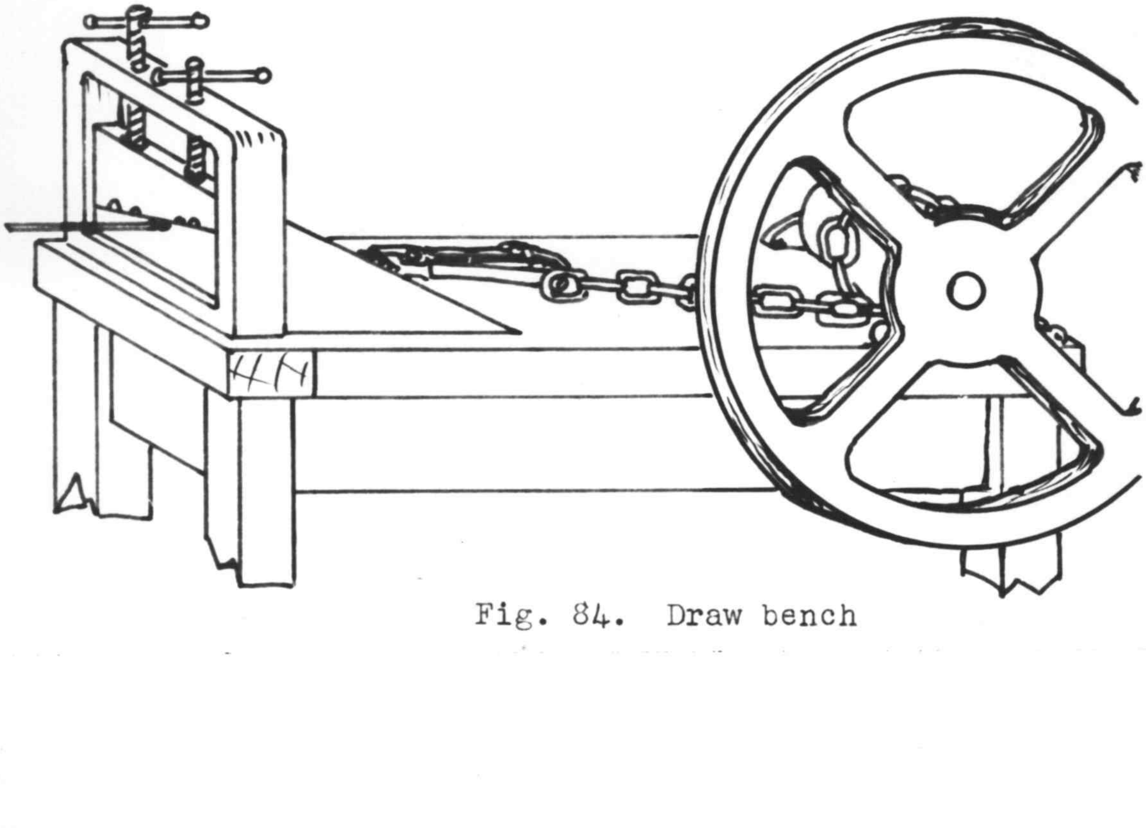


Fig. 84. Draw bench

has been annealed, it is drawn through swage plates with holes of desired shape. A chain and crank assembly permits a stronger pull. A belt may substitute for the chain.

Materials

The beginning students in silversmithing use copper, brass, and gilding metal more than any other metal. As their abilities increase, they begin using silver. These four metals are the major metals used in the silversmiths' shop at Central School of Arts and Crafts. No lead-base solders are permitted in the shop. All soldering is done with three grades of silver solder -- "hard," "easy," and "easy flow." The hard solder melts at the highest temperature. Easy solder melts with less heat, and easy flow requires the least heat. The temperature gradient of these three solders permits soldering several pieces on the same metal at different times. First solderings need not be loosened by temperatures of subsequent soldering. The fluxes are of a borax type supplied by the solder manufacturers in a powder form.

Special Procedures

Occasionally it is necessary to fit a shape to a flat or curved surface, such as a spout to a pot. During the soldering process it is difficult to keep the spout from shifting. "Stitches" are used to prevent the slipping (Fig. 85). Small triangular burrs are rolled up at strategic points with a stitcher -- a pointed graver. Since these stitches prevent only horizontal slippage it may still be necessary to use iron binding wire to hold pieces together for soldering.

To bend a wire against its width, a special tool will be found useful (Fig. 86). The wire has a tendency to bend out of flat. Using this tool the wire can be held more firmly while it is hammered with a mallet. As the wire is bent, it is shifted in the slot. Several slots are provided for different width wires and different type bends.

To form a ring: A ring made of such flat wire as mentioned above should be soldered before any attempt is made to make it a "perfect" circle. Large rings can be formed into a circle on a cone mandrel (Fig. 87). If the ring is horizontally fitted to the cone and hammered, it will develop the taper of the cone on the inner edge. To prevent this the ring should be slightly sloped so that the inner edge bears squarely on the side of the cone. This will provide the proper arc around which the ring can be formed with the mallet. Two cones were in use at the London school. A three-foot high cone set on the floor and a twelve-inch cone set on the bench.

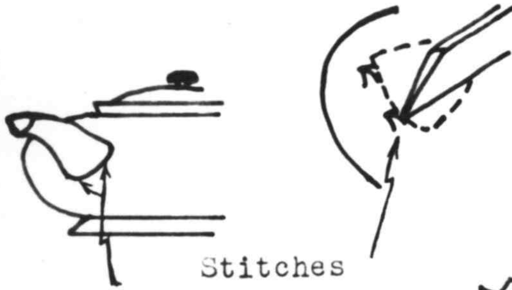


Fig. 85. Stitching

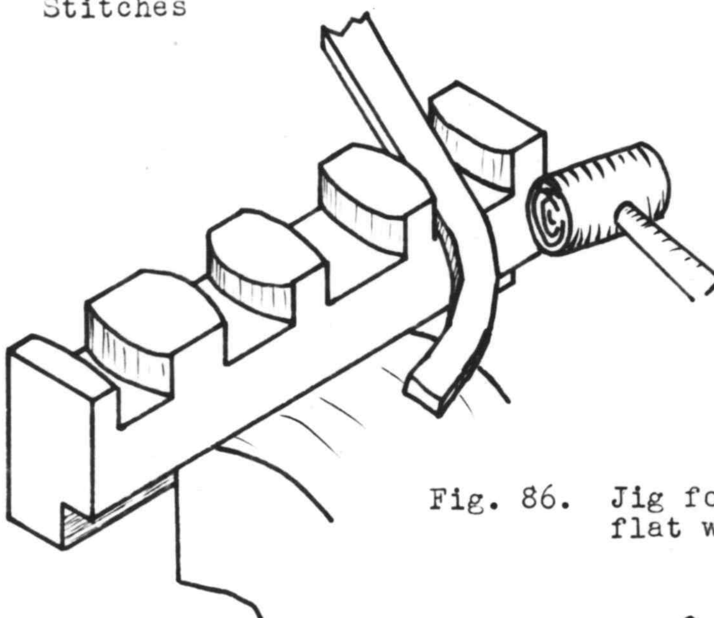


Fig. 86. Jig for bending flat wire

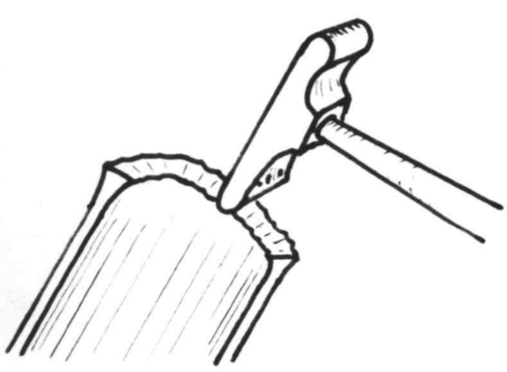


Fig. 87. Forming a ring on a cone

Fig. 88. Thickening an edge

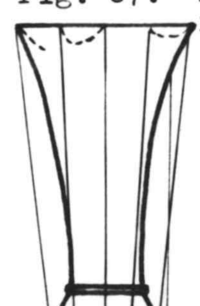


Fig. 89. Applying binding wire to a vase

The top edge of a vessel can be thickened to give added strength and better appearance. After annealing the metal, the edge to be thickened is firmly hammered with a collet hammer. If this is done systemmatically along the edge, a uniform wedged cross-section will be formed (Fig. 88). It may be necessary to anneal the metal several times before the desired thickness is secured. The hammer blows must be made directly onto the edge to avoid rolling the edge. Top edges of vases or cups can be thickened in this manner. The vessel is best supported on a leather cased sandbag. The sandbag absorbs some of the shock thus preventing buckling in the vessel walls.

Binding wire is frequently used to hold parts during assembly and soldering. If it is improperly applied, the expansion of the wire under heat may pull the pieces apart. Many techniques may be used. The circumstances will determine the method used. Fig. 89 illustrates the binding of a foot on a vase. Note that the wire does not cross the vase opening or the foot. It is bent down into the vase and then out. The kinks in the wire hold firmly. Such a method prevents excessive tension on one side of the vase from affecting the other side.

CHAPTER VI

DESIGN DEPARTMENT

A designer is an artist who applies his artistic talents to the products of industry. His is more a technical art. In Britain the designers are concerned truly with industrial art.

Administration

The job of training designers should be the responsibility of the schools of arts and crafts in collaboration with certain technical colleges (3:8). London's Central School of Arts and Crafts is training designers in several fields. In most all departments design is of first importance. All articles made in the workshops should have the approval of one of a staff of designers. The woodworking department has a staff of three designers. All have been selected for their proved ability to produce acceptable contemporary designs. The silversmithing department has one designer. He, too, is outstanding in his field.

It is customary for a student to spend the majority of the first half of his school course developing acceptable designs. As the course progresses and as his file of designs accumulate he is allowed more time in the workshops to develop his design in wood, silver, or whatever medium he selects.

Physical Plant

The designers of the woodworking section have three design rooms equipped with drafting boards, tables, stools, and T-squares. The rooms are adequate to meet the needs of the various classes. The silver designers have two adequate rooms for their designing.

Design Philosophy

The teaching of design is much different than teaching the mechanical steps of drafting. Successful design is so closely allied with the fundamentals of good art that a combination of artist and craftsman is required. Britain too often forgets that a teacher in addition to his ability to produce must have the trained ability to teach. The industrial arts teachers in the United States have often ignored the field of design as an area of the industrial arts program.

John Gloag in his book (7) expresses a fear that Britain has been "spoiled by the dull wits of the Victorian furniture trade." Craftsmen, designers, manufacturers, and buyers were content apparently to rest on the glories of their age. During the last fifty years the artist craftsmen have invigorated and informed many branches of industry. They have begun to realize that a craftsman's manual skills and techniques have not made him a designer. It wasn't until 1939 that original creative design began to interest England. The opportunity to "civilize our commercial machine age" has been realized (7:164). The time has come for British designers to show their faces even into the profusion of better designed products manufactured as a result of foreign designers. They are insisting that future success lies in the acceptance by industry of designers as a part of the industrial process (6:ix).

A curious sidelight of the progressive development of design has been the association of industrial art with left wing politics. Assume that one thousand people in Britain, who appreciate good design, were given a free hand. They would be able to change the whole process of mass production by the type of design they produced. They could change the entire character of physical environment. If all this was done without concern for the reaction of fellow countrymen and industry, revolutionary changes would result. Since this is not desirable, it certainly must be connected with left wing politics. For this reason a great deal of opposition was given to the earlier revival of art or good design in the manufacturing process (7:128). Industry, because of its "capatalistic views," was not willing to change procedures and good profit making styles to accept the wonders of the new designers.

The standards of design at a given time have been likened to a three-tiered cake. The largest or bottom tier represents the commercial tastes of those "who like what they know." The middle and smaller tier represents the more educated tastes of those "who know what they like." The top tier and smallest represents the experimental ideas of the advanced designers "who know what they like so long as it is like nothing that they know." The eccentricities of these experimental designers of one generation have a way of becoming the accepted standards for those with educated tastes in the next generation. These eccentricities become "run of the mill" in the third generation (13:25). So goes the cycle of design.

CHAPTER VII

CONCLUSIONS

It has been the intent of this paper to present some methods and techniques used by teachers and administrators in England's Arts and Crafts program. It was felt that to understand why and how these methods and techniques were used, one should be acquainted with the school organization and policies of England's schools. An effort has been made to give an over-all picture of the school system of England as related to industrial arts, as well as a picture of the Central School of Arts and Crafts at which most training was received. This information has been given in Chapters II and III and Section I of Chapters IV, V, and VI.

Two major types of schools in England are the privately operated schools and those operated by the counties. The secondary schools are classed as general, commercial, and technical. The technical schools begin at the secondary level and end at technical institutes of higher learning. In London, vocational preparation and training is offered at the technical colleges, polytechnical institutes, institutes and schools of art, colleges of commerce, and various National colleges. The Central School of Arts and Crafts in London offers vocational training from seven departments -- the School of Interior Design, Furniture, Pottery, and Stained Glass, and the School of Silversmiths' Work and Allied Crafts. The staff is selected mainly from the related trades.

Selected tool skills and construction procedures from the fields of general woodworking and artmetal work offers information of interest to industrial-arts teachers. The chapter on design points out that good art is essential in the industrial process. It is necessary to have designers with advanced ideas to prevent industrial art from becoming stagnant.

It is recommended that the material given, be used by industrial-arts teachers of the United States to supplement and enliven their informational background for teaching the industrial arts. If American teachers could command the processes and techniques used by the craftsmen of England, they would realize that handwork is basic to industrial-arts training in secondary schools of the United States. Machines are not a necessity to the execution of good projects, but patience and perseverance are necessary prerequisites to real craftsmanship.

BIBLIOGRAPHY

1. Bowers, R. S. and John Bovingdon. Furniture Making. London, Cassel, 1929, 3p.

2. Central School of Arts and Crafts. Syllabus, 1950-1951. London, London County Council, 1950, 4p.

3. Dunnett, H. McG. The Art Schools--Are They Doing A Good Job for Industry? Design 20:8-13. August 1950, 2p.

4. Ellis, George. Modern Practical Joinery. London, B. T. Batsford, 1908, 4p.

5. Fairham, William. Woodwork Tools, London, Evans Brothers, (no date) 17p.

6. Glass, Frederick J. The Industrial Arts. London, University of London Press, 1927, 1p.

7. Gloag, John. Industrial Art Explained. London, Allen and Unwin, 1946, 14p.

8. Jones, Bernard E. The Complete Woodworker. London, Cassel, 1926, 13p.

9. Keeble, Alfred L. Cabinet Making, Theory and Practice. London, Longmans, Green, and Company, 1930, 2p.

10. Keeble, A. L. Handicraft Woodwork. London, Sir Isaac Pitman and Sons, 1935, 10p.

11. Logie, Gordon. Furniture from Machines. London, Allen and Unwin, 1947, 8p.

12. London County Council. Floodlight. London, London County Council, 1950, 2p.

13. "P. R." Design Overseas. Design 20:25. August 1950. 1p.

14. Pierce, S. Rowland, and Patrick Cutbush. Planning, the Architects Handbook. London, Gilbert Wood and Sons, 1949, 6p.

15. Rudd, J. H. Practical Cabinet Making and Draughting. London, Ernest Benn, 1929, 9p.

16. Stevens, W. C. and N. Turner. Solid and Laminated Wood Bending. London, His Majesty's Stationery Office, 1948, 7p.

17. Wells, Percy A. and John Hooper. Modern Cabinet Work, Furniture and Fitments. London, B. T. Batsford, 1909, 34p.