VISUAL TEACHING AIDS FOR
HAND-TOOL PROCESSES
IN WOODWORKING

by

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VISUAL TEACHING AIDS FOR
HAND-TOOL PROCESSES
IN WOODWORKING

CHAPTER I

INTRODUCTION

Statement of the problem

This study was undertaken in an attempt to apply visual teaching aids to the woodworking learning units. There has been a need for this study for a number of years. The application of specific visual material to a definite learning unit should be easily applied to the learning unit and also be pedagogically sound. The writer has attempted to keep this in mind at all times.

Historical background

Visual instruction had its beginning when the first early cave man, sitting in front of his dwelling, rudely cut a picture of a daring exploit or achievement in the soft stone of his cave. Perhaps he carved a warning in the bark of a nearby tree and warned others away from his retreat. It is said to be the first substitute for the reenactment of the event or pantomime and dates back thousands of years.

Picture writing was then born. The Chinese improved upon our cave man's technique and made pictures convey correct impressions; in fact, the Chinese writing
itself is a form of picture writing. Time has caused these characters to lose their original form.

The Egyptians used the hieroglyphics which form the connecting link between the ancient picture writing and the early alphabets. We are certain that picture language was the forerunner of our modern alphabet.

Time marches on and objects are represented more and more by characters, until today we have a complicated language. Characters or words represent our expressions and bewilder us with their abstractions. When we have a complicated language in which word or words must represent or give an impression of the object, then there is chance of a false impression. Verbalism is a term that represents this situation. Hoban says,

> verbalism may be defined as the generic term applied to the use of words without appreciation of the meaningful content of the words or of the meaningful content of the context in which they are used. (1)

Verbalism may assume any one of many forms. If one sense or meaning is known, and if the words are used in another and different sense, the outcome is

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1. Hoban, C. F. Jr., and Zisman, S. B., Visualizing the Curriculum, p. 3.
verbalism. Words lack meaning unless they are tied up with concrete experiences and understanding.

Attitudes toward visual aids

American educators were startled a few years back by the report of Dr. Henry S. Pritchett, of the Carnegie Foundation for the Advancement of Teaching, which revealed that the average college senior knows but 61 per cent of the words in familiar use by educated people. The prevalence of verbalism has been confirmed by many recent investigations. It is the consensus of well-informed opinion that there is a need for a method of instruction that uses the media of visual aids.

The natural and effective way of having the understanding or experience is through the use of actual materials or other visual aids. These aids form a teaching technique, not a separate subject, and are an effective teaching method, unique only because they use one of the senses, namely, seeing. Hearing, smelling, tasting, and feeling tend to enrich and complete the understanding. Impression and retentiveness are greatly increased in this unity.

In the history of education we find the great thinkers using and advocating the same methods as we
do now. Visitations, observations, and actual experiencing are stressed by each.

The doctrine of Comenius, 1592-1670, forgotten for centuries, has come to life again. "As far as possible men are to be taught to become wise, not by books, but by the heavens, the earth, oaks, and beeches; that is, they must learn to know and examine things themselves and not the testimony and observing of others." Comenius was convinced that the child could not learn through words alone. Words and ideas should be made real through the use of objects themselves or through pictures. His Orbis Pictus was probably the first illustrated picture drawing textbook. Comenius's doctrine states that the child learns through the senses and that the progress of learning should be agreeable to the learner.

Rousseau would have his Emile learn from nature. Pestalozzi taught that a child should be prepared for life only by actually living life and carrying on life activities during the learning period.

Froebel used the ideas of Rousseau and Pestalozzi in his teaching. The part that has stood the test of time is his notion of training the senses of touch and sight.

The John Dewey movement in education stressed
that education must be based upon the nature of the child; must be through experience because all our ideas rise in and through concrete experiences. Visualized instruction is the scientific way to educate a child under this concept.

The modern concept of education, as set forth by such writers as Caswell and Campbell, stresses more than ever before the need of a functional teaching method that will enrich, broaden, and impart information in a natural and effective way. Visualized instruction will meet the need of such a condition.

Modern educators realize the importance of this new procedure. They feel that experience is the fundamental basis of learning. This experiencing can be had only through one or more of the visual aids. The more real the visual aid, the more effective; therefore, the value of a visual aid is measured by its degree of reality.

The values of visual instruction

The values of visual instruction are found in the concrete character of the visual aids. It is the natural and most effective way of gaining understanding or experience. It opens the distant or unknown parts of the earth to the child, brings the past ages in reality
to the pupil's conception and makes a more lasting and accurate impression upon the mind. It develops habits of thought and outside reading in further study, arouses an intense interest in any topic, encourages economy of time and effort and reduces the excess ver-
alism of teaching. It has particular value in the development of the backward and handicapped child. Woodworking instruction, for example, becomes more meaningful when organized into functional activity units, using visual materials to enrich and vary the pupil's concrete experiences. The industrial world and processes should be brought to the pupil, or, better yet, allow him to get first hand information through a field trip. Let him see, feel, smell, taste, and hear woodworking activities, because man's simplest, most effective, and most natural means of gaining in-
formation is through the seeing experience and supple-
mentary senses.

Writers in visual education have been tempted to use figures giving the per-
centages of our knowledge gained through the different senses. Reliable labora-
tory data on such facts have not been reduced to such exact form. (1)

Commercial picture interests made the statement that 87% of our knowledge is gained through the sense

1. Hollis, A. P., *Motion Pictures for Instruction*, p. IX.
of sight. The statement was widely quoted by educators. Hollis says,

by means of a questionnaire, which was answered by eighty-one psychologists and experienced educators in tracing back to their empirical origins fifty words from our daily language, these results were obtained: Visual experiences contribute forty per cent, auditory experiences, twenty-five per cent, and all others together thirty-five per cent. (1)

The most important was the visual, but it was interlinked with the other senses in such a way that it would be difficult to divorce one from the other, or to state with authority, the contribution to learning of each sense.

The term "visual" as used in this thesis means the giving of visualization through any picture, model, object, or device which provides concrete seeing or other sensory experience to the learner for the purpose of introducing, building up, clarifying, or enriching abstract concepts, and stimulating further activity on the part of the learner. It makes use of all means found useable and effective in promoting a more efficient mental imagery, visualization, and understanding of the instruction.

1. Hollis, A. P., Motion Pictures for Instruction, p. 166.
The scope of visual education

The scope of visual education is not confined to the showing of slides or motion pictures in school. It includes many types of concrete and objective instruction, which may be classified into two distinct divisions.

The first of these is the non-projection group, requiring no specific apparatus or screen projection. This group consists of field trips, museum materials, actual objects, flat pictures, graphical and cartographical aids, and dramatic visual aids.

The second division of visual aids to instruction is in the field of projection. All sorts of pictures on film, glass, or paper, either still or motion can be projected upon a screen. The still film, motion picture, sound picture, and the opaque projector are in this group.

Source of woodworking learning units

The high school woodworking units as used in this thesis are those learning units set forth in the report of the American Vocational Association in "Standards of Attainment in Industrial Arts Teaching." 1

The American Vocational Association list of learning units in woodworking is used because it contains the findings of a committee of prominent educators who searched and collaborated their findings of six years, into a workable list of fundamental learning units. These units are basic to the high school woodworking area.

Some writers have criticized the list of learning units. We must use them until a better list is found. Regardless of the terminology used, namely, woodworking shop, wood area, woodworking unit, etc., each is made up of the same units and whenever a particular unit is to be presented, it must be presented in the best technique, at the proper time, and when interest is at its peak.

When learning units are presented in an interesting and visual way, they become functional and make the practical activities of life the center for educational experiencing. The rather simple but exceedingly important practical needs of the pupils are met in the school shop, the hand becomes trained, the arts and crafts are developed, an understanding of industrial life is made in a real sense, but primarily the pupils are meeting some worthwhile practical needs of their lives. Skill of hand, understanding of materials, knowledge of industrial processes, essential items of mathematical and scientific knowledge, directly contribute to subject matter.
CHAPTER II
PURPOSE OF THE STUDY

The main purpose of this study is to furnish woodworking instructors with a scientific plan of visual instruction paralleling the woodworking units. An attempt will be made to guide others in the proper visual materials to use with specific learning units found in woodworking, thus enabling them to carry on an enriched teaching program and make an already functional program "live."

Due somewhat to the necessity of using certain visual materials in the regular teaching routine, shop teachers are aware of the values of visual instruction. They realize that visual instruction is scientifically sound and makes teaching more effective, more interesting and more enjoyable.

Visual materials cannot be utilized successfully by the teacher without careful study and some training. The overburdened teacher has little time to select the proper visual aids most useful in a particular situation.

The school curriculum is continually changing to fit into the changing conditions of life and the new concepts of the educational thinkers. What is current practice today will be passe tomorrow. It is
apparent that much of the time and effort wasted is due to the use of antiquated teaching procedure and the lack of an understanding of curriculum changes.

Curriculum changes are not always retained in their entirety. Those phases which are basically sound are retained, and such is the case with such concepts as "doing," and "seeing." These have stood the test of time and have been interwoven in past educational philosophies.

The child no longer sits at his desk reading black letters printed on white paper, interpreting these letters into words, and the words into thoughts and ideas. The child in the new curriculum sits in his classroom, looks on a silver screen at action, people, and ideas passing in rapid succession; his ears catch any explanations that the screen may not have time to portray. These visual aids have enabled the child actually to learn at a younger age much more than the child once learned in a higher grade at a higher age level.

The General Shop type of organization, popular at the present time, necessitates the handling of large classes in several different "areas." This multiple type of instruction, coupled with the necessity for handling large groups of pupils, intensifies the need for a handy
visual-learning unit reference. The teacher is then able to select the proper visual aid to supplement the learning unit with a minimum of time and effort.

Interest is necessary to effective learning. Interest must be created. The learner must want to learn because learning occurs most effectively when the learner experiences a want or need. Visual aids create this interest and help to motivate the pupil to purposeful activity. Unit experiencing is enlarged according to the interest, the individual's ability, the background, and the total environmental conditions.

Interest creates a desire for more information. Related materials are essential in satisfying this desire. Reference materials become alive, vital and sought after by the learner. The subject matter and methods are definitely adapted to the child.
CHAPTER III
VALIDITY AND IMPLICATIONS
PERTAINING TO VISUAL MATERIALS

Visual instruction is specifically an educational tool of great importance when used as an aid in the learning process. Visual aids are pictorial references and should be used to meet the individual and group problems of the pupil. Dent says,

Very few, if any, of the commonly used visual-sensory aids are instructional in themselves. If we were to show them to groups which had not received earlier preparation and guidance by the teacher, much of the potential educative power would be lost. On the other hand, these same materials properly used by trained teachers, make it possible to teach the child more in a given time, teach him more thoroughly, and enable him to remember the information or instruction much longer. The advantage gained by this procedure, easily measured, has been found to range from a small percentage to 40% or more, depending largely upon the favorable or unfavorable factors involved. The percentage of gain, in carefully controlled classroom situations, has been great enough and consistent enough to cause the majority of the progressive educators to look with favor upon the proper application of visual aids to instruction. (1)

Research in education has brought out a decided advantage of the various forms of visual education as contrasted with regular classroom instruction. (1) Various forms of concrete experience surpass verbal instruction, with regularity. Visual instruction has proved its case. (2)

Visual aids have been put to the test since 1910. A total of thirty-six important research studies had been completed by 1931. Nine of these have been published in book form and the rest as magazine articles. Since 1931 many additional researches on visual instruction have been completed in widely separated localities.

Such educational thinkers as C. J. Judd, Sir James Marchant, C. A. Ruckmick, George Stoddard, Herbert Blumer, Cyril Burt, W. W. Charters, Frank Freeman, Mark J. May, Charles Spearman, L. L. Thurstone, Ben D. Wood, F. D. McClusky, V. C. Arnspiger, Daniel C. Knowlton, and many others have experimented with various groups and have reached definite conclusions in favor of visual aids as educational tools.

2. Ibid. chap. II.
The Freeman-Commonwealth study has evidence that pictures are an invaluable means of getting certain kinds of experience of a concrete nature. It was found that pictures did not take the place of language but that pictures did have a definite function to perform.

Dr. J. J. Weber found that the efficiency of a lesson after showing a film was due to individual differences and to the variable difficulty of the subject matter. Visual aids used with verbal instruction enabled the retarded pupil to keep up with the class because the objectively illustrated subject matter is interesting and comprehensible. Interest is created more quickly and retained longer, the lesson is made more vital and more meaningful, and pupils contribute more to the topic when film-aided lessons are used.

A. S. Lawerenz of the Psychology and Educational Research Division of the Los Angeles Schools compared oral with film instruction and found 15% advantage for the film group.

Knowlton and Tilton in their Yale experiments found that films increased the pupil's learning by about 19%, that the average pupils with the help of visual aids learned as much as bright children did without them, that pupil participation increased 10%, that 40% more reading was done, and that voluntary reading increased
in all cases.

The Wood and Freeman-Eastman experiment proved that film groups excelled the non-film groups by 33%-85% of the standard deviation of all scores, depending upon the subject used for the experiment. This indicates that when the tests measured the knowledge which the pupils had obtained of concrete phases of the topics, the film groups were decidedly superior in attainment even when they suffered an initial intelligence handicap.

A questionnaire was sent to the teachers taking part in the above experiment. The teachers were under the impression that films contributed to the teaching technique, interest was enhanced, energetic activity and participation were noted, and outside reading was greatly increased.

The Fox experiment showed that sound films contributed a gain of 38% in knowledge made by the children taught by sound films.

The Freeman-Commonwealth study of inter-comparisons of various visual aids shows moving pictures are superior within a restricted range of subjects, and outside this range of subjects the other devices, namely, slides, stereographs, still pictures, etc., are as effective or more effective than motion pictures.
Motion pictures were found to be superior teaching devices in two instances. When an understanding of the action of an object requires that it be shown in motion, and when that motion makes objects attractive, motion pictures are superior. Even though it is not necessary to have an understanding of the subject, motion pictures attract close attention and promote better learning. Films are much better as an introduction to a subject than any other method, oral or otherwise, due to the ability of the motion pictures to give a background of experience which illuminates the subsequent lesson.

Motion pictures are outside their field when they show still objects or when they enter the field of abstract verbal discussion. It is uneconomical to put into motion pictures, actions which the teacher can readily demonstrate. It is desirable to have motion picture films in small units.

Dr. J. J. Weber summed up the final results of over thirty experiments conducted in leading city schools and universities in these words,

In closing .... it should be pointed out that the usefulness of visual aids --films, slides, stereographs, and other reliable aids is specific: that is, the usefulness of any one visual aid varies with every topic or project. Visual aids are supplementary to actual experience, and both are fundamental to verbal instruction. Visual aids thus provide perceptual foundations where actual experience is lacking and enable instruction to transmute these into con-
ceptual products through the processes of interpretation, integration, and generalization. This truth being self-evident, there is no further need for experimentation of the kind (performed by these educators) .... Future research must progress into areas of specification and application. (1)

The outcomes of investigations by Marchant, Consitt, the National Union of teachers in Middlesex, England, Clarke, Arnsperger, Erpi Picture Consultants, the Pittsburgh study, and others demonstrate that the proper use of visual materials:

1. Increases initial learning.
2. Effects an economy of time in learning.
3. Increases permanence of learning.
5. Motivates learning by increasing:
   a. Interest.
   b. Attention.
   c. Self-activity.
   d. Voluntary reading.
   e. Classroom participation. (2)

Intensive research in visual instruction for nearly twenty years has demonstrated that it has a great value in the educative process; that the acid test of classroom

2. Koon, Cline M., Motion Pictures in Education in the United States, p. 57.
experience has substantiated this claim; and that the experience of museums, libraries, newspapers, and advertisers has clearly demonstrated the potential power of visual approach to the development of human intelligence. Foreign countries have for a long time recognized the values of visual aids. Upon such conclusive evidence as found in the preceding experiments, the validity of this thesis is based.

The experiments have brought to light numerous facts of great value. These facts and implications are important in carrying out a visual program and will be discussed at this time.

The study atmosphere of the classroom should be maintained during all visual instruction. The practice of taking pupils to another room, and perhaps of bringing in part of the rest of the school, has a tendency to destroy the study atmosphere. Visual instruction should be used in the classroom, the same as any other aids to learning. Specific needs and interest in intimate informal contact are impossible when in a strange room or when others are present. In a classroom situation, the interest is keen, readiness prevails, questions and discussions follow, important points are emphasized, problems are solved or given a new emphasis for more study and research. A review is
possible without a loss of interest due to interruption.

Teaching with visual aids calls for a well-organized plan of instruction. The proper aid should be available at the precise moment and provision should be made for pupil activity. The more pupil activity, the more interest and learning. Let the pupils contribute to the exhibits, help make the slides, operate the projector, and carry on the program. Student-made aids create more pupil activity than the more imposing commercial ones. If pupil activity is lacking, visual materials lose their value as a teaching device.

A visual aid should be used only when there is a felt need. Select the one that will clarify the problem. No one type or class of visual aid should be used to the exclusion of others. Each has its own use and value. The use of the proper visual aid will save time and be more pertinent to the problem.

When the purpose or need is past, the visual material is stored away. The tendency to litter up the bulletin board and classroom walls with pictures and other devices that have long ago served their purpose, tends to cut down the efficiency of the visual aids employed.

Visual materials are not for entertainment pur-
poses. They must be used with a definite purpose in mind. Each aid has particular values. The field trip contributes to actual experiences; stereography is valuable as an individual study experience, and the stereopticon slide forms an excellent basis for the socialized recitation. The motion picture is an effective summarization device and gives action when action is needed, and the chart or diagram is effective in presenting abstractions and in assisting analysis.

Most visual aids bring the world to the child. The child should be taken out into the world to see, examine, and experience as much of the phenomena as can be opened up to him. When this has been accomplished, bring the world to the classroom. The idea that all teaching and learning are to be done in the classroom has passed on. The pupil is now able to experience concrete situations through visual aids.

Each educational film should be analyzed carefully for content and relationship to the objectives. This teacher analysis determines the content of the film which relates to the objectives of the unit, the organization of this content, the important points that should be studied by the pupils, and the relationship of the film to other related teaching aids and reading assignments. The analysis forces the teacher to study
thoroughly the film and its relationship to textual material available. From this study by the teacher a definite idea of procedure in the use of the film should be developed.

The teacher should evaluate the film to see if it is related to that unit under discussion. Subject matter, titles, scenes, accuracy, quality of photography, and probable effect of a film upon attitudes should be considered. If the film does not contribute to the lesson or if another visual aid will be as effective, do not use the motion picture for that particular lesson.

Pupils should be motivated in such a way as to cause them to contribute and take part in the preparation for the film. An approach of curiosity, of interest, of a desire to learn must replace the usual entertainment aspect of motion pictures. Questions may be raised in the minds of the pupils which will prompt the class to prepare a study guide or outline in advance. The class may participate in developing other visual aids which will contribute to the climax of the unit as portrayed by the sound film. Pupils must know what to look for, be eager to know the content of the film, and have a knowledge of the film's organization and content previous to the film's showing. The greater value of a
sound film is found in the preparation and activity preparing the pupils for the significant observation.

In leaving the topic of motion pictures, the writer wishes to emphasize the importance and values to be found in teacher or class-made motion pictures. It is possible to show motion pictures of a particular situation. Local color and activity contribute to a local teaching situation. The planning of the scenario, the photographing of scenes for particular purposes, and the editing and titling of the film are valuable experiences for the pupils. The classroom is vitalized by the class-made film, and difficult teaching situations are no longer a bugbear of the pupil and teacher alike.
Man has expressed his ideas with pictures since he first carved them in tree trunks or in stone. Civilization has developed and made use of myriads of flat pictures. Today we depend upon them more than ever to give true impressions of important news and world events.

Text-books are profusely illustrated with pictures, newspapers give whole sections to pictures in the news, and advertising depends a great deal upon suggestive pictures. In practically every form that instruction takes, pictures play an important part. This great popularity of pictures gives an idea of their effectiveness and use.

Flat pictures, being abundant and cheap, are available to all. They may be used in a teaching situation by either the pupil or the teacher. Pupils make use of them in their presentations to the class. The teacher will save many minutes of discussion with the help of proper pictures.
Photographs, prints, and drawings are referred to as flat pictures, in order to differentiate them from the stereograph. Flat pictures create interest in the class, but an effort must be made to use them as an effective visual aid. They should pertain to the problem under discussion and then be used only in such quantities that will clarify and bring out the lesson. The showing of too many pictures causes confusion and a decrease in effectiveness.

**Flat pictures with museum exhibits**

Flat pictures used in the background or with museum specimens tend to clarify and to bring out other connections and related fields.

When using flat pictures in connection with models, the models may be numbered and a list of the pictures made to be used with each model. These pictures may be placed on a sheet along with the method to be used for presenting the object with the pictures. Pictures having color, action, and those in series showing progress are essential in displaying objects.

Flat pictures should have statements or commands on them, leading the pupil to discover and learn about the points in a process that might be otherwise overlooked.
This serves to stimulate and direct student activity.

**Teaching with flat pictures**

Flat pictures should be organized into an orderly system of grouping and cataloging. They should be arranged in series under related topics. These topics should be classified under more general headings. A catalogue of the picture series should then be made following the order of the course of study. With the pictures filed in the same order as the course of study, it is not hard to find the pictures when needed.

The written or printed material to be placed beneath the pictures would vary in nature and quantity to meet requirements of the lesson to be taught.

In a lesson on some specific problem the teacher should consult the index to see which pictures are available for use. These pictures should be placed on a table near the window and ample time given during the supervised study period for looking at them.

The recitation would call for a brief test over the textual material and data found on the pictures. The class could exchange papers and hold a discussion to bring out the desirable points, correct papers and return to owners. The interest shown by the class serves as a stimulus for the next day's lesson.
Pictures should be selected with care, care being used to include features pertaining to a specific topic. A picture might contain a wealth of detail, much of which may be irrelevant to the topic under discussion.

Enlarged pictures make it possible to have group study and class concentration of attention upon the same feature of the lesson at one time. It would be well to remember that profusion causes confusion, therefore as few pictures as possible should be used to gain a point.

Advantages of flat pictures

Flat pictures are cheap and abundant, and may readily be found covering every phase of life and industry. The child has a chance to participate in collecting, arranging, and presenting the flat pictures. More student activity is possible with the use of flat pictures than with any other visual aid.

Background material is easily presented through the use of flat pictures. Flat pictures bring in concrete concepts to individuals engaged in preparing assigned work.

The opaque projector makes it possible to project pictures on a screen thus enabling the teacher to obtain effective group work with selected topics.
Disadvantages of flat pictures

Flat pictures lack depth, often causing wrong concepts and giving distorted ideas to the child. Color is not authentic in most flat pictures. True imagery is lost.

Changes in processes or activities must be left to the imagination when using flat pictures. They do not bring a complete, satisfying experience to pupils. Since they are the most popular and easiest visual aid to secure and use, flat pictures are greatly abused.

Graphic and pictorial charts

The business world recognizes the value of graphic materials and uses them profusely in most advertising and commercial work. Educators are following in the footsteps of business and industry and are making use of this exceptional visual aid. Dry and uninteresting subject matter may be made real and vital through the use of a chart or graph.

Graphic materials include the illustration, map, chart, graph, diagram, cartoon, poster, blackboard drawing, dimensioned drawing, sketch, and many others.

Graphic aids may be usefully integrated with other visual aids for the purpose of increasing their effectiveness. The graph or chart is a drawing which presents
a fact, a group of facts, or an idea. It is a means of objectively clarifying our thinking with reference to facts.

Using graphic material

Charts and graphs should rarely present more than two or three relationships, facts, or comparisons in one drawing. Pupils may make different types of graphs portraying a topic. Student participation creates pupil activity.

Pupils can write out names of parts corresponding to numbers on charts. Wall charts give the teacher and class something in common as a focal point of attention.

Charts and graphs present definite ideas and information in a small space. The advantages and disadvantages found in flat pictures would also apply to graphic materials.

The designing of posters brings out originality and develops initiative in the pupil. Posters which are cleverly designed will make a vivid impression and may be used quite effectively to clinch a point.

Methods of teaching with large charts

The following methods of teaching with charts are recommended: Charts should be displayed in a place
visible to all, then one of the following methods used. (1) Distribute question sheets to each pupil. Have individuals answer, the rest of the class checking the answers. (2) Have a student act as teacher, asking questions of other students. (3) Exhibit individual pictures of the individual parts shown in the chart. Supplement this with models, exhibits, and pictures. Have these individual pictures and the models available at a table for further reference later. (4) Disassemble a model of the object shown in the chart, having the students name the parts by referring to the labeled chart.

A variation in method of teaching with charts is to draw the chart in pencil before the class arrives. Fill in the chart with charcoal or black crayon while the class is watching. Require the students to name and label the parts as they are drawn in.

The opaque projector (balopticon)

Flat pictures, diagrams, charts, graphs, and all other flat or near-flat surfaces or objects may be enlarged and projected on a screen for group consideration. The instrument which reflects the enlarged illustration on the screen is known as the opaque projector. The materials are reflected as images on a
screen by means of mirrors in the projector. This system causes a loss of intensity of illumination, but new improvements and proper lenses will allow good projection under practically daylight conditions.

Advantages of opaque projection

The opaque projector will project almost anything upon the screen for group study. Pictures or projects are enlarged and reproduced true to color. Enlarged pictures offer opportunities for concentration of the group upon the same feature of the lesson.

The class can participate in collecting, preparing, and projecting the materials. This general class activity is usually not so well provided for by the other methods.

Disadvantages of opaque projection

The room must be partially darkened for projection purposes. The degree of darkening depends upon the type of machine and lens used.

A loss of intensity of illumination is due to the reflection by means of mirrors.

Old type projectors do not protect materials from the heat. Much material can be ruined unless a cooling system is used.
Darkening of the room causes some confusion and might interfere with the use of other visual aids.

The stereograph and stereoscope

The stereograph is a three-dimension picture, produced by the use of two cameras or a double camera, arranged at slightly different angles. These pictures must be taken simultaneously if the object is moving. It is essential that both pictures be focused and centered on the same object or scene and given the same exposure.

One camera stereographs can be made by the following method. Select the object for the center of the picture; take the picture and then move the camera horizontally a distance from four inches to ten feet. Again center the camera on the same object and take the second picture, using the same shutter speed and iris diaphragm opening. Other objects in the foreground and the degree of depth wanted will determine the distance between pictures. The nearer an object is to the camera the shorter the horizontal distance the camera should be moved.

The pictures should be mounted on a stiff card in the same order as taken. If the camera was moved to the right for the second picture, then the picture must
be mounted to the right.

The stereograph is most valuable as a means of carrying vivid experiences and accurate mental concepts to the pupil. It gives an illusion of reality. Hoban says,

Most realistic of all still pictorial material is the stereograph. It is most realistic in that it is the only mechanical pictorial aid which supplies three spatial dimensions. It is particularly adapted to instruction in the school subjects in which a high degree of third-dimensional concreteness in instruction is desired. (1)

The stereoscope is an optical instrument in which two pairs of lenses are mounted in a frame. A partition separates the lenses and forms an avenue through which each eye must look. Light and other distractions are shut out within a hood which fits around the eyes. When the stereograph is placed in the stereoscope, the child seems to be actually in the picture situation. Pictures seem to live and become actualities.

Teaching with the stereograph

The stereographs should be related to the assignment and should illustrate only the activities with which the pupils are unfamiliar. It is desirable for each individual to have a stereoscope, or, if the supply

is limited, divide the class into the smallest groups possible.

The proper time to use stereographs is during the study period or when preparing the assignment. As few pictures as possible should be used. It is the part of wisdom to teach fewer things and teach them well.

Each individual may be asked to turn his back to the source of light so that the full rays of light will fall directly on the face of the picture. This is unnecessary when using the telebinocular.

The stereograph should not be used during recitations because it is so all-absorbing that the discussion will be lost. This will eliminate divided attention and superficial learning.

The individual use of the stereograph should be followed with the group use of the lantern slide. The individual should be guided into seeing the points to be found in the picture.

Advantages of the stereograph

The stereograph is the most realistic of all still pictorial material. It is the only mechanical pictorial aid which supplies three spacial dimensions. Because of the fact that the stereograph may be used at any time, the slower student is given an opportunity to individually
solve his difficulties.

There are stereographic pictures that contribute to instruction and learning in practically every subject. The very cheapness of the stereoscope and pictures is in their favor. The units are easily secured. The intense interest leads to further reading and lively discussion.

Medical authorities say that the use of the stereoscope and stereograph aids the eyes in helping them to work together and thus obtain normal fusion. (1)

Disadvantages of the stereograph

The stereograph is an individual rather than a group instrument. It is a photograph of a momentary situation and lacks all power to show changes in processes and activities. If not properly used by the teacher, divided attention and superficial learning take place.

The stereograph is so commonplace that it is apt to be old fashioned. Its use requires that interest must be regained. The pupil should be guided into seeing the points of interest pertaining to the lesson.

The stereoptican or lantern slide

The "magic lantern" has made it possible to project illuminated pictures upon the wall or screen since the seventeenth century. The lantern slide is one of our best educational visual aids. The projector is easy to operate, illumination is excellent, and the selection of pictures and possibilities is practically unlimited.

The stereograph gave us a vivid depth picture for the individual. The lantern slide is for group instruction. Duplicate lantern slides, corresponding to the stereographs, are effective in fully clinching impressions and in bringing out the implications of the knowledge secured by the individual from the stereograph.

There are two types of glass slides in general use in schools. The first type is the photographic slide made by commercial picture concerns. These slides are made from original negatives of scenes, operations, and situations connected with curriculum subjects. This type of slide gives authentic reproduction of the material.

The second type of glass slide is the pupil-teacher-made slide. Perfection is lost, but greater value is
derived from the activity and preparation necessary for making the slide. Pupil-made slides are excellent and effective teaching aids. Participation and interest more than offset the quality of the slide. It has wonderful possibilities as an educational visual aid.

**Teaching with the lantern slide**

When using the lantern slide it is not necessary to completely darken the room. Any bright light, such as the sun or electric lights, should be eliminated.

Just enough slides should be shown to gain the point, develop the correct idea, or give amplification for better instruction. The slides must be shown in sequence so there will be a continuity of thought.

It is desirable to have a set of flat pictures exactly like each slide. The pupils can refer to the flat pictures for clarification and clinching of facts. Additional written material is given with the flat picture or on a mimeographed sheet, thus adding information on the subject which could not be given on the slide.

The use of slides should be justified by their instructional rather than entertainment value. They should be shown at the psychological moment to clinch a fact, clarify instruction, present the correct initial
impression, or perform the function the teacher has in mind.

Slides may be used effectively as a preview of a lesson, to introduce a lesson, at the close of a lesson, as a review, and for examination purposes.

Outlines or picture forms may be projected on the blackboard and the outlines sketched with chalk and later filled in by the class.

**Advantages of lantern slides**

Lantern slides may be used in a room that is not totally dark. Good results can be had in a fairly light room. Wide variety of slides and slide materials are available. The image remains steady on the screen and may be left on the screen for any desired length of time. Maximum brilliance in the projected image is obtained; lantern slides are easily made; the stereoptican is easily operated by students; student interest and activity are stimulated; storage space is negligible; and it is very economical to make up slides.

The detail can be so enlarged as to be better illustrated. The sequence of operations or processes can be better worked out. Slides are not damaged as easily as large flat pictures or charts, and when they are broken or damaged, they can be replaced easily.
They are a quick and easy reference, and they displace tedious blackboard drawing.

The lantern slide focuses the attention of a group of pupils and lends itself admirably to socialized activity.

**Disadvantages of lantern slides**

Lantern slides must be handled with care in order to avoid breakage. The slides are heavy, therefore shipping costs run high. The emulsion side of the glass must have a cover-plate to prevent it from being scratched.

The room should be partially darkened for best results. Changes in processes or activities must be left to the imagination when using slides. When slides are used in the woodworking shop, special precautions should be taken for storing them in order to prevent damage from dust.

**Care and storage of lantern slides**

Proper handling of slides requires that they be kept free of finger-marks. This may be done by holding the slide by the edges. The face of the slides should be cleaned occasionally. Broken cover glasses should be replaced and slides kept in a case free from dust. All
slides should be properly labeled, indexed, and filed. Keep lantern slides accessible so they will be available at any time. Proper filing will do this.

**Types and construction of slides**

Ground glass, etched glass, or clear glass sanded with #220 finishing sandpaper, makes a type of slide which a pupil can make. Pencil drawings and letterings show up well on these slides, and when their usefulness has ended they may be washed with soap and water and used over again. If color is desired, Keystone, Onward, Anadel, Mongul, Venus, or Aquarella crayons may be used. India ink or Keystone colored inks work well and produce very fine lines. Large areas of black ink on the slide should be avoided, as they are liable to crack the glass when used in the projector. Use a soft pencil (HB) for long lines, a harder pencil (2H) for letters, and then coat the slide with shellac or lacquer. This will prevent smudging.

Clear glass coated with one of the following preparations makes an excellent type of slide: Gelatin or jello, using one part gelatin to thirty parts of water; a thin shellac, lacquer, or fingernail polish; a solution of orange or lemon juice; talc powder or chalk dust; a very thin cooked corn starch. India ink
Keystone inks or Ditto inks are recommended for this type of slide. Attractive slides can be made by using these inks in colors. Clear, uncoated glass is satisfactory if it is cleaned with alcohol or Bon Ami.

Cellophane slides are made by inserting the cellophane between two cover-plates and binding the edges. It is possible to typewrite on cellophane by placing the cellophane between soft folded carbon paper. When this is done, the typewriter ribbon is disengaged as when cutting a stencil. The print is thus made on both sides of the cellophane. Cellophane can also be coated in the same manner as the glass slide. Paper cut-outs (opaque) may be used for silhouettes, or cellophane on cellophane makes a pleasing effect.

Glassine, a paper used to wrap candy and fruits, Jiffy Seal, used in canning fruits, or non-moisture-proof cellophane may be used in the same manner as cellophane.

Lumarith, a new commercial product made of cellulose acetate, makes a reasonable, fire-resisting slide having the appearance of ground glass. The methods used in making the cellophane slide will apply here.

Photographic slides may be made by transferring the image to a sensitized plate. The making of these
slides requires some knowledge of photography. The "Leica Manual" covers every phase of photographic slide making and is recommended for this unit.

The film slide and stillfilm

The commercial world has responded to the demands voiced by educators and has developed a light, compact, and non-breakable film slide which has found much favor and many users in the educational field. The film slide is comparatively new, having been developed and introduced by the Society for Visual Education in 1920.

To avoid confusion we wish to call attention to the fact that the following terms denote the same meaning: Film strip, strip film, slide film, film roll, stereoptican film, and picturerol.

Film strip, or film slide is a roll of standard 35 mm motion picture film that carries images which are projected on a screen. The images are in a fixed series, but a slight adjustment of the projector makes it possible to show the slides in any desired order.

There are two sizes of film roll made on the 35 mm film. The single frame picture is run through the projector vertically. The top of each picture is at the top of the frame. Each frame is approximately 3/4 by 1 inch in size.
The double frame picture is printed so that the width of the picture runs lengthwise of the film and is usually used in a projector that will carry the film horizontally. The double frame slide is about 1½ by 1 inch.

Still another type of commercial film slide is called "Stillfilm." It is arranged in continuous strips of non-inflammable film, 2¼ inches wide. It gives clearer projection with less light and is comparable to the projection qualities of the glass slide.

Teaching with film slides is the same as with glass slides. This technique has been covered under glass slides and will not be repeated here.

Advantages of film slide

A record of a field trip may be made on strip film and used later in the classroom. Film strip is usually economical to purchase, costing from two to five cents per frame. Projection equipment for film slide is inexpensive and compact. Any length or sequence may be printed. It can be utilized where continuous action, development contrast, or comparison is needed for teaching purposes.

Two pictures may be shown on one screen at the same time. Graphic and pictorial materials may be
combined easily. The film strip is considerably smaller in size than any corresponding pictorial means. The average strip will not weigh over an ounce and will fit in a metal can about 1\(\frac{1}{4}\) inches high and 1 inch in diameter.

Film slides do not break like glass slides and may be sent economically to other schools. True imagery is possible when the film strip is made in color. Pupil-teacher participation is unlimited in the making of film rolls. Interest is maintained, not only in the making of the film strip, but in the projection and factual data presented. A phonograph record may be synchronized with a film strip. Commercially made pictures are easily and cheaply obtained.

**Disadvantages of film strip**

The film strip, due to its small size, limits the amount of light which may be projected through the film. This is not true in regards to the "Stillfilm." The classroom should have the direct light eliminated.

The pictures are in fixed sequence. If the order must be changed, it necessitates a screen "flicker" when passing over a scene.

Film strip may be damaged easily if not threaded through the projector correctly. Some skill and equip-
ment are necessary in making titles and printed material on the roll.

Prearranged fixed pictures tend to induce the students to show all the pictures while a fewer number might sometimes be better.

The motion picture

Excursions have made it possible to take a class from a conventional classroom and place the pupils in direct contact with life situations as found in industry and work-a-day business. Motion pictures will serve the same purpose by bringing these activities to the classroom.

Flat pictures, objects, examples, film slides, and other visual aids have been given a prominent place in the teaching process. The one great teaching aid that has been neglected is the motion picture.

Motion pictures have been kept out of the schools partly because they came from the world of entertainment, and also because there was an inadequate supply of good educational films. The cost of the equipment was prohibitive in most schools, and the knowledge of teaching with films was insufficient. These objections are being rapidly overcome.

The motion picture is one of the greatest communicative systems in existence today. Hoban says,
No single communicative medium in the world's history has so universally influenced human behavior as has the motion picture. Through the ages religion has had its great preachers, its beautiful cathedrals, its dramatizations, its stained glass windows, its ceremonies, and its dogmas. But here the influence on emotions and other patterns of behavior has been a combination of experimental media. Today patterns of children's play, patterns of dress, patterns of attitudes, patterns of speech, patterns of morality, patterns of life conduct are all influenced to some extent by the motion picture. So influential, in fact, is the motion picture in shaping the habits of thinking and acting of the masses of people that in countries ruled by dictators the motion picture is strictly regulated and controlled by the state. (1)

The motion picture, as we know it, is less than forty years old. In this short period of time it has achieved a great place for itself, but as yet the full potentialities and effective uses of motion pictures in the educative process lie in the future. The past has given us the raw material; it is up to the educators to develop a psychologically sound technique of teaching with motion and sound pictures.

Lest we become unstable in judging the values of the different visual teaching aids, the writer wishes to state that each visual aid has its advantages and dis-

advantages. Certain situations and circumstances will
naturally call for different types of visual aids.

Freeman says,

The comparison of motion picture films
with other visual aids - slides, stereographs, still pictures - as a means of
informational instruction, indicates that
the motion picture is superior within
a restricted range of subjects, and that
outside this range of subjects, the older
devices are as effective or more effective
than motion pictures. (1)

Such an important device as the motion picture
necessitates some historical knowledge of the device.
Although thought of as comparatively new, the basic
principle of the process is very old. The Chinese for
three or four thousands of years had a device which
produced the effect of motion perceptible to the eye.
Dent says,

It was a far cry from those early
types of attempts to produce the illusion of
motion to the development of the motion
picture film which is used so extensively
for education and entertainment today. However, the ancient and the new
depend upon the same psychological
phenomena for illusion. (2)

The motion picture is an illusion of motion. Psycholo-

1. Freeman, Frank N., Visual Education, A Comparative
   Study of Motion Pictures and other Methods of
   Instruction, p. 72.
2. Dent, Ellsworth C., A Handbook of Visual
   Instruction, p. 60.
remains there approximately 1/12 of a second after the object itself is removed. This is known as the "persistence of vision." By arranging so that the pictures move and replace each other within this period, an illusion of continuity is created. This principle of "persistence of vision" is applied by "moving" the pictures or changing them on the screen at the rate of sixteen times per second for silent films and at the rate of twenty-four times per second for sound pictures.

Motion pictures derive their film power from three fundamentals: (1) The individual is projected into the situation in a darkened room. (2) The continuousness and selectivity of the portrayal on the screen. (3) Dramatization of life situations and conditions upon a screen.

The individual is placed in a darkened room. The situation rapidly shifts, vivid lighted images appear, scenes and action predominate. The spectator becomes a part of the movie situation and blends unconsciously into the scene.

The pupils are taken into a new situation and seemingly take part in the activity portrayed upon the screen. The experience is amplified by the condensation of time, by the careful selection of situations and
minute detail, and by the avoidance of those details, elements, moods, or other effects which distract from the main theme. It is possible to portray only those social phenomena, situations, and activities that are desirable in a given lesson.

Educational films should dramatize more than they do at the present time. Dramatization in movies means the arrangement of events in progression toward a climax with the inclusion of rhythmical movement and unusual photography, taken from many angles, in a natural setting. Too many educational films are as dead pictorially as text-books have been verbally.

The motion picture is the best visual aid available to depict action, slow motion, time-lapse, microphotography, and for speeding up slow phenomena so that it can be observed in a short period of time. The limitations of space, vision, sound, time, and conception are overcome when films are presented in a well organized teaching plan.

Educational films should be classified in order that the inexperienced teacher might select the proper type. Hoban says,

Films used in instruction fall into seven overlapping classifications: (A) those demonstrating a process, (B) those demonstrating a skill, (C) those dramatizing
some event, (D) those produced to explain some industrial product, (E) those having emotional emphasis, (F) those documenting some social situation, and (G) those intended primarily to furnish background. These classifications are not mutually exclusive; they are intended to bring logical order into an assortment of instructional films available to the schools of the nation, and to clarify broad objectives of instruction which may be attained by such films. (1)

Motion pictures in the classroom

The motion picture is probably the most misused visual aid in our schools. Being new, it must pass through an experimental period. This period is passing at the present time. It is possible to profit from past mistakes and to develop a teaching technique which will make moving pictures essential to the learning process.

The general technique for using visual teaching aids applies to all visual materials, including motion pictures. Films should be pertinent to the problem under discussion, shown in the classroom, and provide for pupil activity.

The educational film, in the past, has been too long, causing the class to look upon it as entertainment.

The best length technical film for high school shop classes should vary in length from fifty feet to one hundred feet. A teaching film of a non-technical nature should not be over two hundred feet in length. In some types of background films it is permissible to show from four hundred to twelve hundred feet. As a general rule no visual aid should be used over fifteen minutes in a sixty minute class period.

Motion pictures have three distinct educational functions. (1) They serve as trail blazers and present background materials; (2) as a teaching device in actual teaching routine; and (3) for review purposes.

When used as a background for a topic, the film must be shown at the beginning of the unit. The teacher should preview the film and prepare a list of questions to bring out the points the students are likely to miss. The problem of booking the film in advance is very important.

A film used as a teaching device in actual teaching routine requires that the projector and film be set up and ready to show at the precise time. The film must be on a specific subject and pertinent to the situation or problem at hand. Show the film first with sound, then show it over the second time with the teacher or a student doing the talking. Any part of the film may
be re-shown until all points are cleared up, then the projector turned off and class work resumed. It must be kept in mind that the pictures are a part of the class work and not a show.

Motion pictures are at their best when used for review purposes. Past experiences, gained either by actual participation or by study, are relived by the pupil. Information previously gained is brought out and re-emphasized. Weak points or things previously missed and uncovered in later study are pointed out and given their proper value.

Each educational film should be carefully analyzed for content and relationship to the objectives. This teacher-analysis determines the content of the film which relates to the objectives of the unit, the organization of this content, the important points that should be studied by the pupils, and the relationship of the film to other related teaching aids and reading assignments. The analysis forces the teacher to thoroughly study the film and relationship of textual material available, and, from this study by the teacher, a definite idea of procedures of the film should be developed.

The teacher should now evaluate the film to see if it is related to the unit under discussion. Subject matter, titles, scenes, accuracy, quality of photography,
and possible effect of a film upon attitudes should be considered. If the film does not contribute to the lesson, or if another visual aid will be as effective, do not use the motion picture for that particular lesson.

Pupils should be motivated in such a way as to cause them to contribute and take part in the preparation of the film. An approach of curiosity, of interest, of a desire to learn must replace the usual entertainment aspect of motion pictures. Questions may be raised in the minds of the pupils and a study guide or outline prepared by the class in advance. The class may participate in developing other visual aids which will contribute to the climax of the unit as portrayed by the sound film. Pupils must know what to look for, be eager to know the content of the film, and have a knowledge of the film's organization and content previous to the film's showing. The greater value of a sound film is found in the preparation and activity preparing the pupils for the significant observation.

In leaving the topic of motion pictures, the writer wishes to emphasize the importance and values to be found in teacher or class-made motion pictures. It is possible to show motion pictures which have particular bearing on the teaching of particular subject matter in a particular situation. Local color and activity contribute to a
local teaching situation. The planning of the scenario, the photographing of scenes for particular purposes, the editing and titling of the film are valuable experiences for the pupils.

Advantages of motion pictures (silent)

The silent motion picture supplies all the functions of continuity and action at less cost than the sound film. Silent projectors can be stopped at any place and the picture framed for class discussion. A personal touch is possible when the teacher or a student brings up important points during the scene. Silent films permit the reversing of the film which is necessary in some kinds of projection tunnels.

Student interest and activity are created by making scenes of local industries and field trips. Silent films are well-adapted to this type of activity.

Advantages of motion pictures (sound)

Sound motion pictures add oral explanations of the visual content of the film, thus saving the teacher time and effort. Sound, inherent in the content of the film, makes for reality and greater effectiveness. Sound in motion pictures provides the auditory element essential and necessary in a great number of subjects. Other
visual aids do not supply this.

Leading authorities can be presented on a subject which is of great value in some cases. The sound picture is especially adapted to any low ability group in which reading or a great amount of explaining is necessary.

The sound film relieves the teacher of much lecture work. The slow student or a student that has a limited study time is enabled to secure the desired information.

The oral explanation on sound films is produced by subject matter specialists. There is a high degree of uniformity and teaching technique used by these experts. This degree of uniformity is not ordinarily obtained by the average classroom teacher.

Direction of pupil attention and learning to important aspects of film content is a constituent part of the film presentation. The direction of learning and attention is a very important function of teaching.

Sound films arouse interest in a so-called dead subject. Attention is held and it is possible to get a mental and emotional reaction impossible in any other way.

Disadvantages of motion pictures

Pupils look upon motion pictures as entertainment. It is an easy and enjoyable way of learning. Some critics
call it the lazy way to knowledge.

There has been a lack of proper educational films. Educational films have been too long for effective teaching. Motion pictures are the most expensive visual aid. Pupil participation is limited in a motion film.

It is necessary to be careful in handling and operating projectors and films. A ruined film is expensive. Films must be secured in advance for preview purposes. Teachers are not as familiar with them as they can be with other visual aids. Motion pictures as an educational tool have been over-emphasized. Special training for the teacher is necessary if motion pictures are to be used effectively.

Museum materials

Exhibits of objects, specimens, and models are classed as museum materials. The most impressive and ideal situation is the personal contact with conditions, processes, and things in their natural environment. If this is not possible, then one may sometimes bring in the object, specimen, or model as an exhibit. The child may handle and feel it, see the coloring, and study closely from many angles the object under discussion. Much time and effort are lost in reading and describing an object when a sample will give a more definite knowledge about a thing in less time.
An object is the thing itself, presented in the classroom to supply and enrich the type of experience needed for meaningful instruction. A Queen Anne stool or a Louis XIV chair will serve as an incentive. The specimen is a sample, a part intended to show quality. A piece of wood or a set of sandpaper samples will make the lesson more meaningful.

The model is a replica in miniature of a life-sized object or thing; for example, model houses, model airplanes, and model stage coaches. Attention should be centered upon the comparison of size and reduced dimensions if a true impression of a life situation is to be left with the pupils.

Class collections of museum or exhibit materials are valuable. They furnish self-activity and interest. They place a student on his own resources and encourage reference work.

Where to obtain material

Students may make or collect material as a project, or individuals may make the objects in the school shop. The instructor also may make models and collect samples. Commercial and supply houses will furnish materials and exhibits.

Instructors of different schools in different
parts of the country might agree to exchange materials for a certain period of time. Pupils could write to relatives, supply houses, and other schools for material.

How to use museum materials

Museum materials can be used advantageously just before the class undertakes a new topic, after they start the topic, or when they have just finished the topic. The class should be on some phase of the subject before the museum material is brought forward or collected.

Museum material should be used only when it is the best visual aid available. If simple flat pictures will do as well, it is advisable to use them in place of the museum material.

Museum materials, models, specimens, and objects should be stored away when not in use as a teaching device. The pupils grow immune to objects left on the walls or in show-cases and lose respect for them, thus impairing the teaching value of those objects.

Museum specimens should be supplemented with pictures, graphs, diagrams, explanations, and such notations as will provide for a fuller understanding of the model.
There should be student participation in developing a clear understanding of the operation, function, and application of the device. Pupils should be taught to draw inferences, to develop insights, and to perceive relationships. The teacher should bring these out in the class discussion.

**Storing museum materials**

Every museum piece should have an identification catalogued in a card file, giving information for using the piece, possible examination questions, and page number of the course of study.

Pieces should be stored in special cabinets so they will be available at any time. The flat pictures which accompany specimens should be numbered and the numbers included with the file of the specimens.

**Advantages of museum material**

Museum material offers the best opportunity for student activity during the inspection. A museum piece or actual object gives a three dimension and natural coloring impression which is not always possible with flat pictures. Concreteness and reality are given to the matter being studied.

A museum specimen may portray typical operations
or processes more vividly than many other aids. The student is inclined to be more interested in a collection which he has helped to accumulate.

Parent-teacher relationships are greatly improved through the student's museum-collecting program, because the average parent readily sees a value in this kind of activity and may take part in contributing material.

**Disadvantages of museum material**

Considerable space is necessary to properly store materials. The collecting or procuring of them is difficult and takes much planning and arranging after they are gathered. The time necessary to gather, arrange and label materials, and to conduct class discussions, is sometimes too great to warrant their use.

The cost of a museum or a collection may be high. The large St. Louis school museum has an annual expense per pupil of 27½ cents.

Ordinarily the specimen or model is limited in its ability to portray parts of a process or the component parts of the objects.

The museum should not be allowed to become a collection of curios, but rather a growing collection of pertinent materials.
Preparing for the excursion

The field-trip suggestion should appear to come from the class and be pertinent to the subject-matter under discussion. Permission to make the trip should be arranged with the principal as early as possible. The teacher should find out how much the pupils know about the subject, for if they know about a particular thing, less time can be spent on it. This allows more time to develop unfamiliar points.

The pupils should decide definitely the purpose or reason for making the trip. The trip as a whole should be discussed thoroughly. For example, in visiting an industrial plant, mention should be made of the ownership, type of work, size and physical set-up, and the time necessary to properly make the trip.

Where possible, a student committee should make arrangements with the management for permission to make the excursion. This can be accomplished better in person, although a letter may be used. This committee also arranges for a guide and transportation.

A teacher-company conference should decide upon the points to be explored by the class, after which a speaker from the plant may be brought in to explain the functions to be observed. A complete outline of processes and objects to watch for should be made by the group. This
should be placed on the blackboard for discussion, and a mimeographed copy given to each member for use on the field trip. The pupils should be required to hand in special reports ahead of time, on the general field that is being discussed. This should lead up to a desire to make the trip and furnish a background of knowledge.

Each pupil or group should be assigned something definite to watch for and be required to have writing pads and pencils for taking notes. If pupils know that definite reports are expected, they are more likely to tend to business on the field trip.

The best means of transportation for the trip is by public carrier. The street car or bus is better than the private auto. If private autos are used, make certain that every driver has a proper driver's license.

Pupils should have written permission from their parents before making the trip. Determine the best and most convenient time to make the trip, for both the pupils and the industry to be visited.

Class leaders will help in conducting the trip. If the class is large, the group should be divided into small units, each unit having a bright and active leader, so that there will be someone to ask questions and point out the desired objects.

Discuss the materials used in the industry, sources
of materials, supply and demand for the product and the organization of the factory personnel. Slides, movies, or other visual materials that cover the general field may be shown.

The occupational hazards of the industry should be stressed and particular notice be made to see how safety and accident prevention is carried out.

The movement of the class throughout the trip should be well planned, thus providing for prompt arrival and the best use of the time provided. It should be impressed upon the group that future trips will depend upon the information gained on the present trip and upon their general conduct. "You are judged by your actions."

Take along a first-aid kit and practice safety.

The technique of conducting the excursion

Upon arrival at the plant, the teacher and class should be introduced collectively. The guide is given a list of things to point out and explain. Little difficulty will be found if the pupils have their definite goals set up, arrive on time, are attentive, conduct themselves properly, and have a spirit of alertness to determine, meet, and solve problems.

When the guide is making the explanations, the
teacher should keep in the background and occasionally ask questions to bring out certain points. If the teacher is doing the explaining, he should talk in a clear strong voice, pointing out important features, keep groups moving along at the proper time, act as time keeper and determine when the group must be started to the next project.

The teacher may call the attention of the unobservant pupils to the interesting things and see that all questions are answered and explanations made on the spot.

Pupils should understand that they are guests of the company and behave accordingly. Scuffling should not be permitted under any circumstances. Pupils should follow and listen to the guide, check things that are pointed out to them, make a note of things of special interest, and observe the working conditions, such as heat, light, ventilation, dust, dirt, and safety devices.

Observation should cover the testing and checking operations to maintain standards of production, the packing and storage departments and the office equipment and the force needed to carry on the business.

The time consumed in transportation can be utilized in observation, discussion, and in clarifying thoughts and ideas. Citizenship should be stressed as a real factor while in the plant.
What to do after the trip

At the next meeting of the class after the trip, a class discussion on processes, machines, and plant operations would be worth-while. The pupils may exchange ideas and experiences along with the clearing up of vague points by the instructor. The major points of the trip should be reviewed and organized.

Get pupil opinions such as likes, dislikes, and impressions about the plant. The discussion could be enlarged upon by the use of pictures, models patterned after things the students saw in the plant, stories dealing with the type of plant or processes, and a motion picture on the same subject, when available.

The pupils may give oral reports on interesting discoveries made on the trip. Class enthusiasm is killed if the pupils feel that every trip means a written report. The instructor should make a flow sheet on the blackboard and have pupils check operations and important things that were seen. This will be done during the class discussion and while the oral reports are in progress. The class should prepare a letter of thanks and forward it to the company. The students may be asked to fill out a questionnaire supplied by the teacher, dealing with the things they should have seen on the trip.

A test covering the same material included in the
pre-test may be given to find out what the pupils have learned on the trip. When the students check over the preliminary test, it will show them how the class has improved and it will also give them a chance to make corrections on wrong answers made before the trip.

The enthusiasm in the class should lead to outside reading and formulate new problems to attack. Pupils' questions should be answered by other pupils or by reference reading. The topic should be carried along several days if necessary.

Advantages of the field trip

The main advantage gained by the field trip is that the school atmosphere is dropped. Pupil and teacher join on common ground in a cooperative enterprise. Actual working conditions and phenomena are shown in their natural setting. It gives the pupils a taste of a real life situation, relieving the monotony of school life, and enables them to gain first hand knowledge.

The field trip trains the student in better observation. It develops a better understanding and appreciation of the community in which he lives and develops student leadership and cooperative learning.

The field trip gives knowledge and supplementary information when most needed, much of which cannot be
had from books. The trip makes the topic "live." Machinery in operation gives a more lasting impression than a picture in a book. It affords an excellent opportunity for pupil participation and permits the pupil to see how his own classroom work is related to that in industry. It opens up vocational exploratory opportunities and is an effective example of learning by seeing and doing, rather than by reading.

Disadvantages of the field trip

The field trip requires a great deal of careful organization and planning. Weather conditions and transportation problems sometimes combine to defeat the purpose of the journey. An enormous amount of time is consumed on trips. Some students cannot stand the expense of the trip, if not paid by the school. Some students cannot afford to lose the time from other classes if the trip takes half a day or has to be scheduled outside of their class time.

The instructor is placed under a great deal more responsibility as organization, disciplinary, and accident factors enter.

Students who are already familiar with a particular plant are not greatly interested in the procedure. Considerable "red tape" and loss of time are involved.
when pupils are forced to miss other classes because of a field trip. It may encourage students to develop a play attitude.

Parents might think students are playing rather than working. Students have opportunities to escape from the group and get into mischief.

Reference reading can cover much more material in a given time than a field trip. Undirected students leave a bad impression on the officials of the plant they are visiting. Sometimes an excursion becomes a nuisance to the industry visited because it may interfere with the organization of the plant. Laws and other complications might enter in. An excursion is not always the best visual aid.
CHAPTER V

APPLYING VISUAL AIDS TO THE LEARNING UNITS

1. Read a working drawing

When a pupil experiences woodworking for the first time, he finds that it is necessary to be able to interpret working drawings. It therefore becomes the duty of the instructor to see that every pupil develops the ability to read a working drawing. This unit is essential for good workmanship and should be so developed that every pupil gains a thorough understanding of working drawings and the ability to interpret them.

Visual aids tend to eliminate pupil failure due to large classes, confusion, misinterpretations, and lack of proper visual or hearing ability.

Working drawings should be distributed among the class along with specimens or objects that the drawings portray. Class discussion and comparison will naturally follow.

With the aid of a lantern slide or stillfilm projector, the drawing under discussion may be projected upon the blackboard. This centers attention upon one object. Details thus become greatly enlarged so that everyone can see each detail as someone in the class points out and
explains the drawing. Class participation is developed in the discussion by allowing students to take an active part in operating the projector or in pointing out and explaining the minute details. Before leaving this drawing, a pupil could trace the outline with chalk, thus leaving a sketch for further reference if needed. See p. 75A, Fig. "A".

Other drawings should be projected and handled in much the same manner until a degree of skill in reading working drawings is developed in the group. The pupils will discover the different types of lines. It will then be well to bring out in some detail, the alphabet of lines as used in drawings. See p. 75A, Fig. "B".

After an understanding of lines is assured it would be well to project other drawings and have the class members write in their notebooks answers to the following: scale used, number of parts, thickness of object, width of object, length of object, radius of rounded corners, number of holes, distance of holes from edges and ends.

The projected drawings create a more lasting impression and make for more effective teaching. A focal point for attention is developed and a better illustration is possible than when the drawings are made on the blackboard, hurriedly, and without this aid. The discussion and chalk tracing may go on while in the process of
projection. This method permits socialized activity.

It is not necessary to completely darken the room, but any bright light should be eliminated. The drawing will then be clear enough for ordinary group work. The interest and general participation of all pupils in this type of activity will tend to reduce disciplinary problems to a minimum.

The projected drawings may be made on clear glass, using India ink, or they may be photographed and shown as a film strip. The clear glass type of slide will give the best projection for line work and still permit objects or specimens to be handled and discussed by the class. The objects or specimens used with the drawings should be constructed before the class assembles. If room permits, they may be filed for future use along with other museum specimens.

The museum specimens are ideal for supplying personal contact with concrete objects. More lasting impressions are formed by the handling of these exhibits. The pupil may handle and feel the specimens, see the coloring, and study the objects under discussion. Samples give a more definite knowledge about things in less time. Pupil activity is encouraged in the making and filing of the specimens. The making of slides and exhibits furnishes self-activity and encourages reference work.
2. Make out a bill of material

In advance of the presentation of this unit, a large bill of material can be made by a member of the class. He may use heavy white paper or ordinary wrapping paper. A second large filled-in sheet should be made of the same material.

Each pupil is given a bill of material to inspect and fill in as the bill is discussed in class. The large bill of material form previously prepared is used as a focal point of attention while the pupils are discussing and filling in their individual bills of material.

When the bills are completed, pupils check their bills with the filled-in master sheet, thus insuring that their first attempt at filling in material bills is attacked properly.

3. Plan the procedure in doing your work

A good method to use in presenting this unit to the class would be to project the drawing of a specimen on a screen. An India ink drawing on clear glass is best for line projection.

The pupils may point out pieces in the project and such common dimensions as width and thickness. See p. 75A, Fig. "C".

Projection of a drawing with the separate parts
accentuated, would aid in clarifying the procedure of planning the necessary cuts. Another sketch, showing the allowance made in width and length for waste in working stock to size, may be shown on the screen. See p. 75A, Fig. "D".

The class contributes to a discussion of "why" a planning procedure is necessary.

A group of large charts on heavy white paper may be substituted for the slides. The slides or charts offer a focal point of attention and provide the class with an opportunity for participation.

4. Check material when received

A practical visual aid to use in presenting the project of checking material is a museum exhibit made up of specimens of faulty wood. Such faults as sap, bark, knots, pitch and checks may be shown. See p. 75A, Fig. "E".

A pupil may write on the blackboard a list of the things to check on as the class presents them. Over-all dimensions of the projects to be constructed must be taken into consideration when checking in the material to make sure that it is in pieces of ample size.

The museum exhibit of faulty wood specimens may be made up of short pieces of wood having the common faults. These pieces may be labeled with their faults and saved
for use from year to year.

To facilitate storage, a film strip may be made illustrating the faults of wood. This strip can be used in conjunction with the specimens.

5. Measure and divide spaces with a rule

Before the pupils begin the use of a rule for measuring and dividing, they should be given a chart to study on "How to read a rule."

A sketch, showing the proper way to mark off spaces, may be projected on the screen. While the class is looking at this sketch, the pupils may participate in a discussion of the merits of this system.

A Stanley chart on "How to read a rule" is easily obtained. See p. 75A, Fig. "F". A slide made with pencil on ground glass will project clearly enough for this particular unit.

6. Lay out pattern on stock

7. Check the layout

The slide is an excellent medium for illustrating the process of laying out the pattern and checking the layout. A drawing of an object to be constructed by the pupils may be sketched with India ink on a clear glass slide and projected on the screen while pupils suggest ways of laying out. By showing another slide which depicts
both poor and good layouts, the pupils will be given a clear conception of right and wrong methods.

Boards and patterns of the object to be laid out, when placed in the hands of the pupils, will give them a chance to try out various placements of the patterns on the boards to find the most economical placement.

Parts of a dissembled project can be used for patterns in determining the economical layout.

8. Lay out curves with dividers or compass
9. Divide spaces with dividers

Large charts, showing types of dividers and compasses, may be prepared for use as a focal point of attention while studying this unit. The type of dividers the pupils will actually use might be drawn so that it stands out.

Large diagrams showing types of curved work, placement of compass and procedure in dividing spaces with dividers should be included at this time. See p. 75A, Figs. "G" and "H". Dividers should be passed among the group while charts are being studied.

The large charts are easy to prepare, take up little storage space and act as a focal point of attention.

No pupil need miss the points of the demonstration for he can go back later and give further study to the procedures found on the charts.
10. Gauge with a pencil  11. Gauge with a marking gauge

A diagram of methods used in pencil gauging, prepared on clear glass slides, provides a satisfactory means for presenting gauging by projection. The projected diagram may serve as a focal point for group study, and commercial wall charts used for additional study at the pupil's leisure. See p. 85A, Fig. "A".

A drawing showing the proper technique in using a marking gauge should be projected along with the above-mentioned slide. India ink or Keystone inks are most suitable in making these slides.

The display of commercial wall charts should follow the slides to allow slower pupils to clear up doubtful points. Many such charts are available. The Stanley wall chart is excellent. The wall charts may be left on display long enough to allow careful individual study.

12. Test for squareness with the try-square  13. Lay out square cuts with the try-square

These units may be presented in a manner similar to the last. The preferred method of presentation would be to use clear glass slides showing the different testing points and the methods of laying out cuts with the try-square.
A group of charts, paralleling the slides should be presented. Group attention will be centered on the screen and discussion can be carried on during the projection. The wall charts will re-emphasize what has been shown before and will be used by individuals to clear up any point not previously mastered. See p. 85A, Fig. "B".

The clear glass slides give the best illumination, but if too bright, they may be toned down with a covering of colored cellophane.

14. Adjust a jack-plane or a smooth-plane
54. Adjust a block-plane

A demonstration of assembling and adjusting the different types of planes is the recommended approach to this problem.

If the demonstration is supplemented by large wall charts on types of planes and methods of adjusting, the pupils will have a means of later re-checking the processes. Stanley charts are preferred for this purpose. See p. 85A, Fig. "C".

While the instructor demonstrates with a plane, the pupils will actually handle and adjust their planes. Imitation is valuable at this time. Permit the boys to assemble, adjust and practice planing on waste material.

The wall charts can be made on heavy paper, but the commercial charts are easily obtained and are likely to be
superior to those made by the instructor.

15. Plane a surface true 16. Plane an edge square with an adjoining surface 17. Plane end grain 18. Proceed properly in squaring up a board

A demonstration before the class of the actual use of the plane on a piece of scrap lumber will serve as a satisfactory introduction to these units.

Wall charts on "How to plane" placed before the class will provide a center of attention for a group discussion on the topic. See p. 93A, Fig. "A".

Museum specimens showing results of not following instructions should be shown to the class. Examples of such specimens might be a chipped end of a board or a cut from an improperly adjusted plane.

Any available plane and scrap lumber are suitable for the demonstration. While the demonstration progresses, each step as it is completed should be pointed out on the wall chart. Participation must now be directed and close attention given to each individual.

The blackboard may be used as a focal point for attention in giving the steps in squaring up a board.

19. Saw to a line with cross-cut or rip-saw 20. Use a back-saw 21. Saw inside or outside curves with coping-saw 55. Cut curves with a compass-saw 77. Cut curves with a turning-saw

The differences between a rip-saw and a cross-cut saw
may be shown by projecting two sketches on the screen simultaneously. Attention should be called to the same facts on the large charts which have been placed on the bulletin board previously.

The position of the worker with reference to the saw horses may be shown by a drawing flashed on the screen. A large chart paralleling these views should be left on the bulletin board for further study. See p. 93A, Fig. "B".

The differences between saws may be further brought out by having pupils see and handle the various types of saws. From the class discussion, a group might be asked to bring in additional information about saws; historical, kinds, shapes and sizes. See p. 93A, Fig. "C".

To show the process of making the different cuts with the different saws, slides may be used. The "why" of a particular saw should be brought out.

The units on saws would best be made on film slides. The film slide is one of the best means of showing two pictures at the same time, for comparison and contrast, if the projector is a modern double frame machine. Graphic and pictorial materials are easily combined and are necessary in this unit on saws.

Class participation is stimulated in the securing of additional information. Flat pictures and specimens will
bring out historical facts, as well as current trends.

22. Round edges

A large chart is suitable for showing the procedures of rounding edges. The chart is complete enough and easy to prepare for this unit.

A specimen with the steps clearly portrayed should supplement the chart. It would be prepared in advance, labeled and placed with the chart for ready reference.

23. Finish inside curves  24. Finish outside curves

A short demonstration and explanation serve to present these units. A large wall chart may be placed before the pupils showing the methods of finishing curves. This acts as a focal point and a reference.

The demonstration includes the working with actual objects or materials.


Probably the most effective way to introduce drilling, countersinking and boring holes is to give an actual demonstration of these procedures.

The differences between the drill, auger-bit and other boring tools are best shown by large charts. See p. 85A, Fig. "D".
### COMMON WIRE NAILS

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### ESCUTCHEON PINS

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<th>Dia. in Actual</th>
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<td>10 to 20</td>
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### MEANING OF PENNY

The word "penny" is an old trade name used to denote the size of nails. It is indicated by the letter "P" placed after the numeral, so for example, 2d. 16d. 10d., and is read two-penny, three-penny, etc. It also means that thousand two-penny nails weighed two pounds, one thousand three-penny nails weighed three pounds, one thousand four-penny nails weighed four pounds, etc. These terms, however, do not accurately indicate the weight of nails at the time.

<table>
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The demonstration supplies the action needed and the graphic chart gives the related information and centers the attention upon a specific object at the opportune time.

28. Fasten with screws  29. Use brad-awl for making holes for screws or nails

For teaching the use of screws, several mediums for visual teaching may be used profitably.

The film slide may be used to throw on the screen a diagram on how to locate and drill the shank or first hole and the pilot or second hole. The types of screws and where used would also be shown by slides. These slides parallel large wall charts which offer opportunity for extended individual study. The charts show all types of screws, size of holes needed, size of shanks and all comparative information needed.

A demonstration of marking, drilling and driving screws would fit in here. See p. 85A, Figs. "E" and "F". Specimen screws and labels from a few screw-boxes can be profitably passed among the pupils. The encouragement of pupil discussion on screws will bring out desirable points for study. A moving picture on the making of screws will add interest to the study of the unit.

The film slide is recommended in this unit because of its ability to show sequence, comparison, and two pictures.
at the same time. Graphic and pictorial materials are easily combined.

30. Trim or pare with chisel

A short demonstration on the method of paring with a chisel, combined with the display of a chart on the same topic, will suffice to present the unit.

The display of specimens emphasizing mistakes caused by improper paring will be effective in teaching correct methods. The chart on paring, placed where it may be studied easily, will enable pupils to check back and find their mistakes.

31. Smooth a surface with sandpaper

The projector offers a convenient and satisfactory means for showing the proper use of sandpaper. Slides are easily made for showing the use of a sandpaper block for sanding flat surfaces, edges, ends and rounded corners. Means of fastening sandpaper to a round rod for sanding concave surfaces and the folding of sandpaper for holding in the hand to smooth irregular curves may be included in the group.

Specimens of sandpaper, including the grit range as used in the pupils' own shop may be passed through the class. The grit and numbers are at this time discussed.
Museum specimens of sand grits, adhesive and types of sandpaper are placed in the display case. A series of pictures including the mining, preparation and uses should be shown.

The slides used in showing the operations are easily made on cellophane because of the ease of tracing. The projection need not be particularly distinct.

Discussion will bring out the need for additional general information about sandpaper.

The unit, "Concerning sandpaper and steel-wool," is best made on film strip, because any length of film can be made and the manufacturing processes shown in sequence and in natural color.

32. Shape ends, edges, and curves with woodrasps

A quick demonstration on the technique of using a woodraps is an effective introduction to the use of the tool.

A large wall chart showing types of woodrasps or cabinet files and a diagram showing the position of the operator, method of holding the rasp and the board, are desirable for reference by the pupils while learning the proper use of the tools. See p. 85A, Fig. "G".

The demonstration with actual specimens serves as a focal point, while the charts give needed information about
types of rasps and files, and also provide a reference on how to use them.

33. Drive and draw nails  34. Set a nail or brad

The main thing to emphasize in presenting the driving of nails, is the point of contact between hammer and nail head. By projecting a slide showing the hammer contacting the nail head at the proper angle, the most important point of emphasis is clearly presented. A similar sketch may be projected showing the proper method of setting a nail.

The types of nails most commonly used and a table giving penny size, length and other related information can be presented to advantage at this time. A nail chart may be displayed along with a specimen board and flat pictures. See p. 80A.

The proper method for drawing a nail using a block of wood to gain leverage and stop marring, may be pictured by projection.

Before discussing the corrugated fastener, pictures on types of fasteners and methods of using them, should be shown.

A good method to use in making the slides is to cut the objects out of cellophane and glue them to clear glass. A good contrast may be provided by using different colored
cellophane. This method will prevent the glass slide from breaking due to heat.

The nail chart slide is made by typing on cellophane. This makes it possible to present a table of figures. The general information concerning nails is best given on film strip.

The use of the film strip makes it possible to present two pictures at the same time for comparison. Any length or sequence is possible, and pupil-teacher participation creates interest.

The repeating of information previously given is good practice. The interest is maintained in projection and factual data is presented at the opportune time.

35. Lay out and test cuts with the sliding T-bevel

The steps in laying out angles and testing cuts with the sliding T-bevel may be well presented with glass slides. The parts and functions of the parts of the T-bevel may be shown in the same manner.

A wall chart, paralleling the slide information, kept on display will allow for further study. The wall chart should be made on heavy white paper. A commercial chart is also recommended.

The slides for this unit should be made on clear glass with India ink. This type of slide gives the best
Fig. "A"

Fig. "B"

Fig. "C"

Fig. "D"

Fig. "E"

Fig. "F"

Fig. "G"

Fig. "H"
illumination for bringing out the graduation markings.

36. Round or form work with the spokeshave

A chart serves this unit effectively. It should include the types of spokeshaves and the names and functions of the various parts. Drawings on the proper procedure in using the tool are quite useful here. Additional general information would be included on the chart. See p. 85A, Fig. "H".

The chart, either commercial or otherwise, will present all the necessary information and procedures needed in this unit. The handling of spokeshaves by the learner will further impress upon him the use and adjustments of these tools.

37. Lay out an octagon

The steps in laying out an octagon will be presented plainly if a clear glass slide, illustrating the process, is used.

During class discussion, a pupil could be asked to lay out an octagon on the blackboard according to the instructions indicated on the slide and supplemented by class instructions. This diagram should be left on the blackboard long enough to allow pupils to give it careful study. The clear glass slide is recommended because of
its ability to portray lines clearly.

39. Lay out and cut a chamfer

The differences between a jointed edge, a chamfer and a bevel would be shown from ground glass slides. In using the slides, the different types of chamfers and the recommended tools and steps in making and testing them should be covered.

Wall charts and specimens have their place in adding parallel material to this unit.

Ground glass slides are satisfactory for use in presenting this unit, as clear line projection is not necessary. The ground glass slide is easier to construct.

Since unit 10 and unit 11 present a part of the process of laying out a chamfer, these units should be reviewed at this time.

40. Apply stain 41. Clean and care for stain-brushes
42. Apply stain for two-tone effect

By following the proper procedure in applying stain and explaining each step, an effective demonstration may be given the class which will raise many questions and suggest proper answers. The demonstration would show the proper way to apply stain and also proper care for brushes.
Specimens of stained material should be available to the class. These will show the errors as well as the good points. Sample color-boards are easily obtained to use as specimens of stained material.

Samples of well kept and poorly kept stain-brushes should be displayed and handled by each individual.

Large color charts on stains and their uses may be observed and discussed by the group. Flat pictures may be included at this time.

For the demonstration before the class, the actual materials should be used. By adding to the demonstration, a series of projected pictures from a film strip, the right and wrong ways and the results can be shown. Since two pictures may be projected at the same time from film strip, it is possible to show both right and wrong methods at once.

The errors are accentuated somewhat in the sample stain-brushes which are used to illustrate improper care. The large color charts and charts on correct procedures serve to freshen the pupil's mind.

43. Apply fillers

A demonstration and discussion on filling the pores of the wood should precede the other material in this unit. A method chart, containing the proper filling
procedure and related information, may be placed before the class to supplement the demonstration.

Samples of filled woods, some done correctly and some incorrectly, presented to the class will bring the lesson out more clearly than any other method.

The large wall chart, made on white paper, is preferred for extended study, because it will give the necessary method and information and serve as a point for attention in group work and individual study.

44. Apply shellac 45. Clean and care for shellac-brushes

The methods and justifications used in units 40, 41, and 42 apply here and need not be repeated.

An illustrated lecture on the history of shellac should be given. A film slide and specimens will suffice as illustrating matter.

46. Apply wax

A slide which tells what wax is and how it is applied serves to introduce this unit. A wood surface may then be waxed before the group, allowing the pupils to handle the resulting specimen.

A cellophane slide is recommended for giving the general information along with diagrams on correct and incorrect methods of application. Attention is thereby
centered on only one thing, the projection.

47. Apply enamel 48. Clean and care for enamel-brushes

The methods and justifications used in units 40, 41, and 42 apply here and need not be repeated.

49. Transfer a design

The methods used in transferring a design are easily shown from a slide. Such items as making and using a template are discussed while the slide is being shown.

The drawing for the slide, made on cellophane with the large areas made of cut-out cellophane and glued on, makes a satisfactory slide for use in this unit. This method of slide construction permits making the large areas in color, for contrast, without the danger of breakage from heat.

50. Lay out irregular design by means of squares

Presentation of this unit should follow a plan similar to that used in presenting unit 49. Projection on the screen of a drawing on the procedure of laying out irregular designs by means of squares may be followed by projection of the slide used in showing unit 49. This allows the pupils to compare methods.

An India ink drawing on a clear-glass slide provides
51. Make a butt-joint

When there is an interest or a need to present the method of making a butt-joint, the pupil or class should be referred to a large wall chart. This chart includes method of construction and general information. See p. 90A.

The chart is large enough to serve as a focal point for group work. The drawings on the chart are large so that the boy can easily see minute detail. The chart should be available for reference while the pupil is working.

52. Sharpen edge tools, such as a knife, chisel, and plane

Because of the fact that a sequence is needed to properly present the operations of sharpening edge tools, the film slide is recommended for this purpose. The operations are easier to photograph than draw. In the film slide, we have in one compact unit a whole series of pictures on method.

Along with the slides should be presented drawings on wall charts of the same procedures. General information is included on the chart. The wall charts are used to supplement the film strip and serve as check sheets while
the pupil is actually sharpening the tools. Free commercial charts are excellent for this purpose.

53. Keep tools free from rust

The film strip is here again recommended for showing why tools get rusty and how this may be prevented.

Any length sequence may be made on film strip and two pictures shown at the same time for comparison. Pupil participation is recommended in making this strip. The improper care of tools in the home and community provide the best examples for these pictures.

54. Use a gouge for gouge work

The large wall chart presents an opportunity for the introduction to the use of gouges. With the chart in front of the pupils, specimens of gouges may be passed about the class and their use demonstrated.

The chart is easy to make or may be obtained free of charge from advertisers. It serves as a point of attention while discussing the unit. It also serves as a reference and as a reminder.

57. Smooth a surface with a scraper

The film strip is the best medium for presenting this unit, as it is necessary to show a number of pic-
tures to bring out the desired information.

The types of scrapers and why they cut should come first. Included in the illustrations should be the processes of removing the old edge, draw filing, whetting the edge, burnishing, and testing. The method of holding and operating each type of scraper should be included. See p. 93A, Fig. "D".

A chart on scrapers may be used to parallel the film strip. The film strip allows the sequence to be well fixed in the mind of the pupil.

58. Lay out a hexagon

India ink on a clear glass slide makes a clear line projection, ideal for showing the steps in laying out a hexagon.

A pupil may demonstrate the process before the class and at the direction of the class, using a large piece of panel on which to lay out the hexagon. This specimen should be left for further inspection by the pupils.

59. Prepare glue

Again the film strip is a suitable medium for presenting the unit. General glue information may be projected, including the common glues, the uses of each, and their preparation.
Fig. "A"

Fig. "B"

Fig. "C"

Fig. "D"
The actual process of preparing glue may be demonstrated before the class. This includes cleaning the glue pot, measuring the correct proportions of glue and water, soaking the glue preparatory to heating, and the heating of the glue for use.

A large wall chart on these same steps should be made available. Specimens of glue may be placed on display.

The film strip is recommended for use in this unit because it is necessary to present general information and some specific information. Color projection, comparison, and sequence are desirable and are available with the film strip. The chart will re-emphasize the points and serve as a reference.

60. Glue up work  39. Use handscrews and clamps

From a film strip, a sequence of pictures on procedure in gluing up work may first be presented. These will include the preparation of stock, arranging of pieces, arranging of clamps, trial assembly, selecting glue, applying glue, and clamping of stock. These pictures might logically be followed by a demonstration.

The film strip permits a fixed sequence, information, color and comparison. Interest is heightened if the class makes the film.
62. Apply paint with a brush
63. Clean and care for paint-brushes

The methods and justifications used in units 40, 41, and 42, apply here and need not be repeated.

In addition, a moving picture on the manufacturing and uses of paints and enamels may be included.

64. Lay out duplicate parts

Laying out duplicate parts may be shown clearly by projecting a clear glass slide with an India ink sketch. This should be followed by a demonstration.

The line work will show clearer and permit daylight projection if the clear glass slide with India ink is used.

The use of a wall chart will clinch the points covered by other methods. A white paper wall chart is the desirable type to use. It is effective for both group and individual work.

65. Make a notch joint 66. Make a half-lap joint
67. Lay out and cut a dado joint 68. Cut a groove or a rabbet 69. Lay out and cut a cross-lap joint
70. Make an edge-to-edge glue joint

By use of a film strip, the methods and steps in laying out, tools used, and procedure in making the joint may be shown. After a demonstration of the procedure, the slides may be re-shown.

The wall chart is here recommended to re-emphasize
the steps and cautions. See p. 90A and p. 102A.

The film strip is most suitable for the teaching of these units because a right and wrong procedure may be shown at the same time. The unit is made in a fixed sequence and graphic and pictorial materials are combined.

71. Lay out and cut tapers

From a slide the laying out and procedure in cutting a taper may be projected on the screen. A wall chart on the same unit will show the identical steps.

A cellophane slide is best for this unit, as it allows cut-out designs which bring out points peculiar to this unit. The slide is easy to construct and the one will be sufficient.

The chart is used to recall points and for reference purposes.

72. Do upholstering involving simple padding 73. Do simple upholstery involving webbing and rolled edges 74. Do simple upholstery involving use of springs

Methods and justifications for these units are the same as those for unit 65. In addition, an excursion to a cabinet or upholstering shop for observation of cabinet construction and upholstering, adds interest and variety to the teaching of the unit.
75. Dress a screwdriver

The steps and cautions necessary for dressing a screwdriver are well presented by the projection of a cellophane slide. This may be supplemented by a large wall chart on screwdrivers.

A pupil demonstration with corrections from the class is desirable. The class should be shown specimens of each type of screwdriver.

The cellophane slide is easy to make and will bring out comparisons.

76. Set and use an expansive-bit

The first step in presenting this unit should be a demonstration on the use of an expansive-bit. This may be followed by the showing of a slide on setting and checking an expansive-bit.

For clear illumination, an India ink clear glass slide is suggested. It will show the fine graduations clearly.

78. Lay out an ellipse

Portrayal of the steps in laying out an ellipse is well handled by the clear glass slide. India ink is used to give a clear projection of line.
A pupil may be asked to lay out an ellipse on a large piece of panel. The demonstration would be before the class and under its direction. The panel should be held perpendicular so that all may see the procedure. The specimen should be left for further inspection. It serves as a point of attention and also creates pupil activity.

79. Put on locks

This unit may be presented with wall charts. A chart giving types of locks and uses of each type should be used first.

On a second wall chart, the procedure in attaching a cabinet lock is presented. Emphasis is placed on locating the position, boring the hole for the cylinder or keyhole, cutting gain or mortising, attaching the lock with screws, attaching the escutcheon plate and the lock strike.

A commercial lock chart serves as a point of attention and provides general information on locks.

The second wall chart should be made large enough so that the steps in the procedure can be easily seen at a distance. The information with each step in the procedure must be complete.

80. Put on drawer-pulls

A large chart showing the types of drawer-pulls and
their approximate location on the drawer is appropriate for use in introducing this unit.

On a second chart is shown how to determine the location, the number and method of attaching the pull. A commercial chart on drawer-pulls is recommended. Attention need not be called to unnecessary material found on some commercial charts.

A large chart made of heavy paper is used in the second case and should include the other desired information. The charts are easy to make, handle and store. They serve as a point of attention and may be used to enable the slower pupil to gain information that he has previously missed.

81. Fit hinges 82. Put on ball-catches

The same type of visual aid and justification are recommended for these units as used in units 79 and 80.

83. Apply varnish 84. Clean and care for varnish-brushes

A definite procedure should be strictly followed while demonstrating these units. An explanation of the necessity of each step is desirable while the demonstration is in progress.

The method of applying varnish may be projected on the screen. The right and wrong methods and the results
Specimens of the varnished materials, corresponding to the slide, should be handled by the class. The class should have the opportunity to handle samples of well and poorly kept varnish-brushes. A discussion of these brushes and those previously used and handled would fit in well at this point.

This unit may be supplemented with flat pictures and charts. The actual materials should be used for the demonstration. The film slide will give a continuous sequence in color and the right and wrong ways can be shown on the same picture. The specimens of varnish-brushes are kept for the purpose of showing right and wrong care of the brushes.

The large charts on the procedure are for the purpose of freshening the pupils' minds.

85. Apply lacquer 86. Clean and care for lacquer-brushes

The same type of visual material may be used in these units as was recommended in units 83 and 84. The same justifications apply here.

87. Apply finish with a spray-gun

Large wall charts, showing the particular spray-gun under discussion and all of its parts and function of each part, may first be shown to the class to give a
general idea of the principles involved.

Following the study of the charts would come a demonstration of the filling and adjusting of the spray-gun. Water may be used in the gun for demonstration purposes. Adjustments on the spray-gun would be made while the liquid is under pressure.

The pupils may be given an opportunity to demonstrate their ability and knowledge in adjusting and handling of the spray-gun.

A re-emphasis of the functions of the parts, operation, and application of the finish by the use of slides would fit into the instruction after the demonstration by the instructor and the handling of the spray-gun by the pupils.

The large wall chart permits minute study of the details regarding the spray-gun. The demonstration brings out the adjustment of the spray-gun and the application of spray material. The actual use of the spray-gun by the pupil motivates him in learning the proper technique so that he can use this new contrivance.

The general information and points previously mentioned on the charts are reviewed and placed in sequence on a film slide. This type of slide is recommended because of its ability to combine graphic and pictorial materials.

88. Apply inlay

By way of introduction, a set of drawings may be
projected on the screen to bring out these points: general information, directions for forming and fitting, and the finishing of inlays. These slides should be supplemented with wall charts giving the inlaying procedures.

Following these graphic illustrations should be a demonstration of simple inlaying so that the class can observe. A group of sample inlay projects may be placed in the display case.

The projected drawings showing procedure should be made on film slide. The film slide permits projection in color, the combining of graphic and pictorial materials, and the presentation of general information.

89. Lay out and cut a miter joint  92. Lay out and cut a blind mortise-and-tenon joint  93. Lay out and cut a through mortise-and-tenon joint

A set of drawings showing the methods and steps in laying out the joint may be projected on the screen. The particular tools needed for the job are also shown.

A demonstration of the making of the joint should follow the drawings. After the demonstration, a re-showing of the slides combined with class discussion would be desirable.

A re-emphasis of the steps, cautions, and procedures by use of wall charts will serve as a review and sustained reminder. See p. 90A and p. 102A. A specimen joint may
DOVETAIL DADO
THROUGH SINGLE DOVETAIL
THROUGH MULTIPLE DOVETAIL
LAP OR HALF BLIND DOVETAIL
STOPPED LAP DOVETAIL
BLIND MITER OR SECRET DOVETAIL
NOTCHED JOINT
END NOTCHED JOINT
BIRDSMOUTH JOINT

A = TENON MARKED ON STOCK
B = THE RIGHT WAY TO SAW THE TENON, KEEP SAW ON WASTE SIDE OF LINE WHICH LEAVES TENON FULL SIZE
C = THE WRONG WAY - DO NOT SAW ON LINE, MAKES TENON TOO SMALL.
D = DO NOT SAW INSIDE OF LINE.
also be passed among the pupils for their inspection.

The drawings showing technique are presented on film strip. Two pictures may be shown on the one screen at the same time for comparison of right and wrong methods. A fixed sequence is better portrayed and related information made more enjoyable by using the film strip.

94. Lay out and cut a haunched mortise-and-tenon joint
96. Make a splined joint 97. Lay out and cut a housed joint

The same visual material is used in each type of joint and has been given in the preceding units.

90. Make a dowel joint 91. Use a doweling jig

A large Stanley wall chart on doweling jigs is easy to obtain for use in presenting this unit. This chart is well prepared and serves as a satisfactory means for introducing the method of using the doweling jig. See p. 90A.

The chart should be supplemented by specimens of the identical representation on the chart.

The methods and procedure in laying out and making a doweled joint may be demonstrated before the class. A specimen of a properly made doweled joint should be made available for pupils to handle and study.

A set of sample specimens of the materials used and the steps in making the joint are needed and should be
prepared in advance.

95. Construct a panel

While specimens of the types of panels are passed among the members of the class, a drawing may be projected on the screen showing the types and parts of paneling. A class discussion on each type of paneling while the specimens are being examined should bring out the various characteristics of each type.

Wall charts may be used for further study and comparison.

The clear glass slide and India ink drawing will give the best projection for illustrating this unit.

98. Make a drawer-slide

India ink drawings on clear glass slides illustrating drawer-slides should be projected on the screen to remain there while the class examines specimens of the different types of drawer-slides. No darkening of the room is necessary.

A large wall chart showing the same types of drawer-slides as projected should be made. Some general information should be included on the chart.

99. Make and fit a drawer

Drawings of each type of drawer and its construction
may be shown on the screen. The film strip is recommended for this purpose because of its ability to show two pictures at the same time. A fixed sequence for showing the pictures is desirable, but if a re-showing is necessary, the film may be turned back with only a flicker. Graphic and pictorial materials are easily combined on the film strip.

The type of drawer which the class will build may be pointed out and emphasized. A discussion on the selection of type, method of construction, and fitting of a drawer should be held by the class.

A large wall chart paralleling the information shown on the screen may be displayed for summing up the points discussed and clarifying answers to questions.

100. Fasten on a table-top

Drawings on ground glass, using a lead pencil and Keystone crayons, showing the different methods of fastening on a table-top should be projected on the screen. A small amount of information on each slide is desirable. When this type of slide is used, a clear distinction between parts is possible and desirable. A coating of thin oil on the slide will increase the illuminosity.

Questions may be cleared up by using a wall chart for reference and further study.
101. Fasten with lag-screws or bolts

Projection of drawings showing lag-screws or bolts and their uses is a good means for presenting this unit. A chart on sizes may be included on a slide.

A wall chart on lag-bolts could be used to parallel the information on the slides. More general information and pictures of manufacturing may be included on the chart.

102. Sharpen a scraper

What makes a scraper cut and the steps in sharpening it may be projected on the screen from clear glass slides with drawings made with India ink. This is the best type of slide for the purpose, as line work shows up well from a slide of this kind.

A demonstration of the sharpening of a scraper should follow the slides. To re-emphasize the points considered on the screen and in the demonstration, a chart on scrapers may be displayed for further study. The Stanley wall chart on scrapers is highly recommended.

103. Cut an edge mould

A demonstration on the cutting of an edge mould serves as a suitable introduction to this unit. The important points may be emphasized by the use of slides.
The demonstration serves as a focal point and gives an over-view of the process. Ground glass slides with lead pencil drawings will project clear enough for this lesson and are easily and quickly made.

After the demonstration and use of the slides, a pupil may be asked to cut an edge mould by following the directions given by the class.

104. Sharpen auger-bits

Ground glass slides with lead pencil drawings offer an excellent approach to the lesson on auger-bits and the sharpening of them. The parts of the auger-bits can be shaded and made to appear realistic on this type of slide. The slides should present the auger-bit with the parts labeled. They should also include the steps in sharpening an auger-bit.

After the projection of the slides, the instructor may demonstrate the sharpening of an auger-bit.

A wall chart is suitable for use in re-emphasizing the points considered in the sharpening process. The Stanley wall chart on auger-bits is recommended.

105. Sharpen a saw

Because of the large number of processes involved in sharpening a saw, the film slide is recommended for
introducing the unit. The need for presenting a large amount of information in sequence is best taken care of by the film slide.

Comparison, by showing two pictures at the same time, is essential in bringing out the right and wrong methods and the differences between sharpening a rip-saw and a crosscut saw. Graphic and pictorial material may be combined on the film slide.

The drawings, projected on the screen, would include clamping the saw, top-jointing the cutting edge, selection of file, filing of saw teeth, setting of saw teeth, point filing of saw teeth, and side-jointing of saw teeth.

The pupils should be allowed to see and handle a sharp and a dull saw in order to fix in their minds just what needs to be done to a dull saw to put it into working condition.

The instructor should demonstrate before the class the procedure as shown on the slides.

Accentuated specimens of saw teeth, made from panel, may be passed about the class to give the pupils a clearer concept of the construction of the saw. From class discussion, the essential points may be clinched by referring to these wooden specimens.

Wall charts offer an opportunity for the slower pupils to secure information which they have previously
Pupils should be given the opportunity to practice sharpening saws. Practice blanks may be used for this exercise.

106. Use a Forstner bit

A demonstration on the proper use of the Forstner bit serves to introduce the unit and serves as a point of attention while explaining its use.

Information about the Forstner bit is effectively presented on a wall chart. A discussion on when to use particular kinds of bits and the advantages of each type and other useful points of information may be brought out and centered around the study of the chart. The chart will serve later on for a reference.

A review of unit 27 on auger-bits would fit in well with the study of this unit.

107. Clean and care for spray-gun

A demonstration by the instructor on the cleaning and care necessary in keeping a spray-gun in good condition may be used as a means of centering attention and, at the same time, offer an opportunity to stress the importance of proper care.

The demonstration should be supplemented by large
wall charts showing the particular spray-gun under discussion, all of its parts and the function of each part.

A repetition of the demonstration by one of the pupils, as he points out on the chart the various steps, will aid in fixing the procedure in the minds of the pupils.

A check-chart hung permanently in the paintroom will act as a constant reminder for proper use of the spray-gun. The steps for proper use may be shown in red and emphasis placed on the "don'ts."

A moving picture on spray-finishing with power equipment would prove interesting to the class and aid in teaching proper techniques. The picture should give information about spray-finishing, spray equipment, and commercial work.
CHAPTER VI
SUMMARY AND RECOMMENDATIONS

In reviewing the materials in this thesis, emphasis must be placed on the purpose of the study and on the practical application of visual aids to the specific problems. As previously stated, the main purpose of the treatise was to present a plan in which the various visual materials would be utilized to enrich and parallel the hand-tool processes found in the woodworking learning units.

A review of the context of the thesis indicates this has been accomplished. There being no precedent to follow, the writer acknowledges that new facts, inventions, and changing conditions will somewhat alter the content of the study. This condition will keep the plan healthy and up-to-date.

The uniting of visual materials to the specific learning units has been completed. A great deal of study and research were necessary in order to present the essential factors pertinent to the problem. Experts in the field of industrial education and in visual education have contributed much valuable information and many suggestions, thus making it possible to develop a method that is pedagogically sound and of practical value to the teacher on the job.
It will take considerable time and effort to collect and prepare the materials suggested in this thesis. Pupil participation is highly recommended for this work. When the material has once been selected, prepared, indexed, and filed, it should be convenient for the teacher to refer to the thesis and to follow the definite instructions.

In conclusion, it is recommended that future studies, following the same general plan, might include the other groups of learning units listed in "Standards of Attainment in Industrial Arts Teaching."
CHAPTER VII

BIBLIOGRAPHY


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