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INDUSTRIAL COURSES

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AN OUTLINE OF COURSES IN INDUSTRIAL ARTS

HENRY GIESE
C. E. PARTCH



Adapted for use in the Public Schools of Iowa. Given in
the Summer Session Iowa State College 1918

DEPARTMENT OF ENGINEERING EXTENSION
IOWA STATE COLLEGE
AMES, IOWA

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PURPOSE OF THE OUTLINE

The following pages contain a brief outline of the course in industrial arts given in the Iowa State College Summer Session (1918).

The purposes of such an outline are several fold. It is felt desirable that a record be kept of the class work offered and the ground covered, not that the course makes any claims to being the ideal, but that it might at least serve as a tangible basis for future criticism or if it has any merit a foundation for future development.

A considerable number of inquiries are constantly coming to us asking for a course of study in manual training. While a manuscript of this size could not be more than a very brief outline, it may be of some help in outlining a course of study for public school work and organizing the material to be taught in such a course. If it does fill this purpose we feel that the effort spent in the writing will not be in vain.

References given at various places throughout the manuscript will help to direct the reader to sources of valuable material.

The time allotted being short, the courses are brief and necessarily do not cover the entire field, but the attempt has been to apply the material as much as possible to the needs of the students taking the course. These, with few exceptions, have been manual training teachers and hence the work is based very largely upon the organization and application of a course of study for manual training in the public schools.

The work has been organized so as to begin with the simple and lead step by step to the more complex, the attitude being taken that an isolated problem has little or no place in industrial education and hence the work has been so correlated that the mind work and hand work have been combined. The course has not gone to the extreme of the abstract Russian joint system, making the work almost purely mechanical, nor to the extreme of the so called individual project method, sacrificing what value there was in maintaining a high standard of skill, but has rather combined the two. The grades have been classified according to definite underlying principles rather than by specific projects. The selection of the projects is left to suit the needs of the community so long as it falls within the proper group and has the necessary educational value.

The exact grade in which each group falls must necessarily be determined by the grades in which the work is offered. Group I is suitable to boys of the 6th grade, but at the same time makes a logical beginning if the work does not commence until the 7th grade. Due allowance must be made, however, for the mental growth of the boy and the work shortened accordingly. In the

same way the exact amount of work falling in groups II and III will vary according to the amount of work given in the grades or if the work is not given until in the high school.

Two classes of projects are shown in each grade to show that this course can be applied to farm woodwork as well as to cabinet making.

This outline is, in general, divided into three parts as follows: (1) A brief description of the courses offered, telling the scope of each; (2) programs of courses giving lecture titles and type of shop work given; (3) a complete outline of the courses, giving an outline of all lectures given, an outline of the shop work for each group showing the underlying principles and suggested projects for emphasizing the same, and an account of further work done by members of the class, including research work on topics of particular interest to the individual or suggested methods of making the work more vital to the life of the boy.

The writers wish to express their appreciation of the kindly suggestions and criticisms offered by members of the class and others who were interested in the welfare of the course. Credit for the work is largely due to their efforts.

With the foregoing in mind, this outline of the industrial arts courses is respectfully submitted.

DESCRIPTION OF COURSES

I. Rural and Grade Teachers' Courses.

A. General Manual Training S-6.

This introductory course of six weeks in general manual training deals with the rougher and more practical farm problems and includes such exercises as saw horse, bench hook, nail box, corn tray, bird house, hog trough, milking stool, bench vise, seed sample case, chicken brooder, etc. Because of the bulky nature of the models undertaken in this course, materials are furnished without a fee and at the close of the course students will be given an opportunity to purchase the models at actual cost of material. Double period daily.

B. General Manual Training S-7.

This is a continuation of General Manual Training S-6, but deals more particularly with farm home problems. The exercises require more refined work and higher degree of finish and include the necessary facts in making mechanical drawings and reading of the same. The following are some of the exercises which are undertaken: Book rack, plant stand, waste basket, medicine case, hall tree, porch swing,

bulletin case, screen, small stepladder, sleeve board, fly trap, etc. Students will pay for lumber actually used and the completed work will become the property of the student. Double period daily.

II. College Credit Courses.

A. M. E. 140—Manual Training.

Organization and methods of application of a course of study for the 6th, 7th, and 8th grades making of projects suitable as type models for the same. Wood carving, care and use of hand tools, simple construction work, wood finishing as needed for these grades. For students in industrial science and home economics who desire to teach manual training; first or second semester; prerequisite must be accompanied by 148; lab. 2, two hours; credit 1 1-3; fee \$2.00.

B. M. E. 141—Vocational Drawing.

Use of drawing instruments; orthographic projection; isometric and working drawings. For teachers of manual training in public schools; lab. 2, three hours; credit 2.

C. M. E. 148—Studies in Manual Training.

Organization of a course of study for public school manual training (grades 6, 7, 8, 9 and 10). Aims and ideals of manual training and their relation to local conditions; woodworking tools and the care of the same; text books and their use; wood finishing. A general informational subject for students in agriculture and manual training and elective for students in Industrial Science and Home Economics who desire to teach manual training. First or second semester; prerequisite must be accompanied by 140. Lectures and recitations 2; credit 2.

D. M. E. 245—Manual Training.

Continuation of M. E. 140. Organization and application of a course of study for the 9th and 10th grades making of projects suitable for type models for the same; detailed study of hand tools; care and use of wood working machinery; wood turning, cabinet making, wood finishing. First or second semester; prerequisite 140, 141 and 148; lab. 2, two hours; credit 1 1-3; fee \$2.00.

E. M. E. 150—Studies in Manual Training.

Continuation of 148. Planning of manual training shop, shop system, selection and location of equipment and estimating cost; study of home and community interests; method of arousing and maintaining pupils' interest; composition of varnishes, paints, glues, and wood finishes and proper methods of their application, furniture design. Second semester; prerequisite 148, and preceded or accompanied by 245; lectures and recitations two; credit 2.

PART II

PROGRAM OF COURSES

S-6 and S-7

These courses were designed for rural and grade teachers who would not be in a school where the work could be given much emphasis or be very highly organized. The people who take this work also represent, as a class, those who have had but little preparation or skill in this work. Largely for these reasons the tendency is to the rougher and simpler models and the emphasis has been placed to a larger extent upon the acquiring of skill than upon the organization of a course of study. The work follows the general trend of the No. 140 course with the exceptions as noted above and a few others noted below.

The course as provided gives no recitation work, but all laboratory work. The work is then largely individual and the demonstrations and talks informal as the needs of the class demand. The shop work begins with small, simple projects and works through larger, more difficult ones as fast as the ability of the student will permit. The S-7 course is given as a continuation of the S-6 and the work is somewhat of the same character except as noted in the catalogue, more difficult projects suitable for the home, have been included. See M. E. 140 and 245 for detailed account of shop work and shop demonstrations.

M. E. 140—PROGRAM

- I. Subjects for class discussion and demonstration.
 1. Chip carving.
 2. Sanding, staining and waxing.
 3. Laying out tools (Rule, try square, pencil, gauge and knife).
 4. Planes (smoothing, jack and jointer).
 5. Saws (cross-cut and rip).
 6. Boring tools.
 7. Demonstration of squaring stock.
 8. Wood fastenings (nails, screws, glue, etc.).
 9. Mechanical Drawing.
 10. Methods of presenting Mech. Dr. to grade pupils.
 11. Sharpening scraper.
 12. Board measure.
 13. Problems of holding material.
 14. Shop discipline.
 15. Upholstering.
 16. Problems due to warping, shrinking and swelling.

17. Assembling problems.
18. Choice of materials.
- II. Shop Work.
 1. 6th grade type models.
 2. 7th grade type models.
 3. 8th grade type models.
 4. Shop drawing for 6th grades.
 5. Shop drawing for 7th grades.
 6. Shop drawing for 8th grades.
 7. Making of lesson plans for each model and analysis of material necessary for presenting to the pupils.
- III. Additional work covered in correlation with M. E. 148.
 1. Organization of course of study for student's particular case.
 2. Special reports and reading assignments.

M. E. 148—LECTURE PROGRAM

- 1—General explanations and scope of the course.
- 2—Aims and ideals of manual training and their relation to local conditions.
- 3—Aims and ideals of manual training and their relation to local conditions.
- 4—Organization of teaching material, group I (grade 6).
- 5—Organization of teaching material, group I (grade 6).
- 6—Organization of teaching material, group II (grade 7).
- 7—Organization of teaching material, group II (grade 7).
- 8—Organization of teaching material, group II (grade 7).
- 9—(Recitation.)
- 10—Classification and care of tools.
- 11—Classification and care of tools.
- 12—Organization of teaching material, group III (grade 8).
- 13—Organization of teaching material, group III (grade 8).
- 14—Mechanical drawing in the grades.
- 15—Recitation and Review.
- 16—Examination.
- 17—Recitation (Comments on Exam.).
- 18—Progress reports on semester papers.
- 19—Progress reports on semester papers.
- 20—Books, bulletins and available material.
- 21—Organization of teaching material, group IV (grade 9).
- 22—Organization of teaching material, group IV (grade 9).
- 23—Organization of teaching material, group V (grade 10).
- 24—Organization of teaching material, group V (grade 10).
- 25—Industrial film (Disston).
- 26—Examination.

- 27—Recitation and review.
- 28—Mechanical Drawing in the high school.
- 29—Manual training and forestry (illustrated).
- 30—Reading of reports.
- 31—Reading of reports.
- 32—Reading of reports.
- 33—Examination.

STUDENT WORK

- I.—Examinations
- II.—Assignments
- III.—Reports
- IV.—Outline Course of Study

M. E. 245—PROGRAM

- I. Subjects for class discussion and demonstration.
 - 1.—Squaring up stock.
 - 2. Finishing (sanding, staining, shellacing, varnishing and waxing).
 - 3. Fuming and special finishes.
 - 4. Planes (sharpening and care).
 - 5. Saws (sharpening and care).
 - 6. Mitre box, try-square and framing square.
 - 7. Special tools.
 - 8. Shop mathematics.
 - 9. Mechanical drawing for 9th and 10th grades.
 - 10. Method of presenting mechanical drawing to 9th and 10th grades.
 - 11. Methods of charging for shop material.
 - 12. Factors to be considered in grading.
 - 13. Shop discipline.
 - 14. Methods of presenting 9th and 10th grade shop work.
 - 15. Wood turning.
 - 16. Upholstering.
 - 17. Carving.
 - 18. Inlaying.
 - 19. Discussion of examinations.
- II. Shop Work.
 - 1. 9th grade type models.
 - 2. 10th grade type models.
 - 3. Wood turning projects.
 - 4. Shop drawing for 9th and 10th grades.
 - 5. Organization of teaching material and analysis of each model.
- III. Additional work covered in correlation with M. E. 148.
 - 1. Organization of course of study for student's particular case.

- 2. Experimental or investigational work for Vitalizing course.
- 3. Assigned readings and reports.

M. E. 250—LECTURE SUBJECTS

- 1—General explanations and scope of the course.
- 2—A course in wood turning.
- 3—Concrete and its possibilities in the school shop.
- 4—A manual training course in concrete.
- 5—A manual training course in concrete.
- 6—A manual training course in concrete.
- 7—Character of wood structure.
- 8—Character of wood structure.
- 9—Effect of wood structure on constructive details.
- 10—Wood finishes, needs, kinds, etc.
- 11-12—Wood finishes, needs, kinds, etc.
- 13—Manufacture of white lead (illustrated).
- 14—Manufacture of wood finishes (illustrated).
- 15—Demonstration on comparison of various finishes.
- 16—Recitation and review.
- 17—Examination.
- 18—Comments on examinations.
- 19—Importance and use of jigs.
- 20—The Smith-Hughes Law.
- 21—Smith-Hughes Courses.
- 22—Equipping and planning the shop (tools, etc.).
- 23—Equipping and planning the shop (tools, etc.).
- 24—Equipping and planning the shop (supplies and supply houses).
- 25—Recitation and review.
- 26—Furniture Design I.
- 27—Furniture Design II.
- 28—Furniture Design III.
- 29—Reading of reports.
- 30—Reading of reports.
- 31—Reading of reports.
- 32—Recitation and review.
- 33—Examination.

PART III

M. E. 140—OUTLINE (SHOP DEMONSTRATIONS)

The aim and object of the shop work in course M. E. 140 is to give as much practical experience in the care and use of the tools as the limited time will permit and at the same time, following a graded course of projects that may be used as models for the 6th, 7th and 8th grade work.

The work of the first three weeks will be projects that will embody the use of the laying out tools, saws, planes, and chisels, in general, the work will cover the fundamental tool processes. The last three weeks of the course the student will be permitted to select his own project within the limits of the grade work covered.

The demonstrations and discussions of the shop work are intended to be a help and a guide to the student in mastering the work for himself and in learning to present it to others.

I.—Carving.

1. Flat patterns made by outlining with a knife or small gouge; space around the design is usually stamped.
2. Cavo cutting or hollow carving usually made with a V shaped tool. This consists of flat patterns, the designs leaving hollows, grooves, lines and small spaces cut out or lowered.
3. Chip carving, which consists of making V shaped hollowed out cuts generally in geometrical designs.
4. Flat patterns with cut out or lowered backgrounds.
5. Relief carving with rounded or moulded figures and a sunk or cut out background.
6. Applique consisting of a flat surface for a background with pieces glued on to form the design.
7. Intaglio or sunk carving, where figures are hollowed out instead of raised in relief.
8. Carving in the round, where figures are finished on every side as statuary.

No. 3 is particularly applicable for the beginner, as the designs are of such a nature that he can lay them out on his work with little or no difficulty. No. 4 can be used for the making of monograms or conventional designs on the ends of book racks, blotter pads, etc. This method of carving is no more difficult of execution, but requires more care in laying out the design.

References:

Wood Carving.—Paul Hasluck.

Problems in Woodwork.—E. F. Worst.

II.—Sanding, staining and waxing.

This demonstration is to show the student the necessity

of using sand paper, when and how to use it, and the grade to be used; also the use of one or two good types of stain and the use of wax for finishing. It is the purpose of this course to limit the kinds of finish to those that can be readily used in the 6th, 7th and 8th grades. (See outline on wood finishing.)

References:

Woodwork for Secondary Schools.—Griffith.

Fundamental Tool Processes.—Laughlin.

III.—Laying out tools.

See outline on classification of tools.

Laying out problems are, in reality, problems in mechanical drawing and can be executed with a rule, pencil and compass. The square and gauge are special devices or tools used to facilitate the laying out of work.

Laying out work resolves itself into one of the following problems:

1. To locate a point at a given distance from a given point. Rule, pencil or knife.
2. To draw a line parallel to given line at given distance. Rule, pencil or knife.
3. To draw line perpendicular to edge or face. Square, pencil or knife.
4. To draw line parallel to edge or face at given distance.
 - (a) Rule, gauge.
 - (b) Rule, pencil, knife.
5. To draw line at any desired angle to edge or face. Rule, bevel, pencil or knife.
6. To draw circular curves. Rule, pencil, compasses or dividers.
7. To draw irregular curves. Pencil, freehand or with patterns.
8. To draw simultaneously two lines parallel to an edge. Mortise, gauge.

References:

Fundamental Tool Processes.—Laughlin.

Essentials of Woodworking.—Griffith.

Woodwork for Secondary Schools.—Griffith.

IV, V & VI.—Planes, Saws and Boring Tools.

1. Function of tool.
2. Form and size of tool.
3. Form, size and relation of parts.
4. Office of parts.
5. Relation of form, size, etc., to function.
6. Size and shape of cutting edges.
7. Care of tools.

8. Adjustment of tools.
(See outline on classification of tools.)

References:

Fundamental Tool Processes.—Laughlin.
Essentials of Woodworking.—Griffith.
Woodwork for Secondary Schools.—Griffith.

VII. Demonstration of squaring stock.

This is a demonstration and explanation of each step necessary in squaring stock to definite dimensions, pointing out that the first two steps in all rules for squaring stock must be the same, but may differ in the rest of the operations.

A demonstration of the methods of laying out and making two or three of the simple joints showing the methods of procedure and advisability of using a knife line to work to rather than a pencil line.

Rules for squaring up stock.

1. Plane face side and put on reference mark.
2. Plane joint edge and put on reference mark.
3. Gauge and cut to width.
4. Gauge and cut to thickness.
5. Square one end.
6. Measure to length.
7. Square around with knife and try-square.
8. Saw to knife line and plane the last end.

References:

Fundamental Tool Processes.—Laughlin.
Essentials of Woodworking.—Griffith.
Woodwork for Secondary Schools.—Griffith.

VIII.—Wood Fastenings.

1. Problems in fastenings.
 - (a) To fasten with nails, brads, tacks, corrugated fasteners, etc.
 - (b) To fasten with screws.
 - (c) To fasten with glue.
 - (d) To fasten with pins or dowels.
 - (e) To fasten with wedges.
 - (f) To fasten with bolts.
2. Problems in fastening involve the following questions:
 - (a) Strength.
 - (b) Appearance.
 - (c) Economy.
 - (d) Permanency.
 - (e) Adjustability.
3. See classification of wood fastenings.

References:

Woodwork for Secondary Schools.—Griffith.
Trade Catalogs.
King's Woodworking Series.—King.

IX & X.—Mechanical Drawing.

1. Purpose of Mechanical Drawing.
2. Kinds of Mechanical Drawing.
 - (a) Orthographic projection.
 - (b) Isometric drawings.
 - (c) Cabinet projection.
 - (d) Perspective drawing.
3. Methods of presenting drawing.
 - (a) Group method.
 - (b) Individual project method.
 - (c) By teaching the fundamental principle by means of a set of models. (Bennett's Method.)

References:

Correlated Courses.—Griffith.
Constructive drawing.—Atkinson, Mentzer & Co., Vol. I & II.

XI.—Sharpening Scraper.

1. Function and use of scraper.
2. Form of edges.
 - (a) Beveled edge.
 - (b) Square edge.
3. Method of sharpening.
 - (a) Draw file edge of scraper.
 - (b) Whet edge to remove file marks.
 - (c) Turn edge with burnisher.

References:

King's Woodworking Series.—King.
Essentials of Woodworking.—Griffith.

XII.—Board Measure.

1. Definition.
 - (a) Board foot—Unit of measure which is one inch thick and 12 inches square.
2. Method of figuring.
 - (a) Length in feet times width in feet times thickness in inches.

References:

King's Woodworking Series.—King.

XIII.—Problems of holding material.

1. To hold a piece for planing.
Vise, bench hook, bench stop, clamps.
2. To hold a piece for sawing.
Horses, vise, bench hook, clamps.

3. To hold a piece for chiseling.
Vise, bench hook, clamp.
4. To hold material for nailing.
Vise, clamps.

References:

Fundamental Tool Processes.—Laughlin.
Woodwork for Secondary Schools.—Griffith.

XIV.—Shop discipline.

1. Necessity for discipline.
2. Amount of freedom allowable.
3. Control of discipline through shop organization.

References:

Fundamental Tool Processes.—Laughlin.
Correlated Courses.—Griffith.

XV.—Upholstering.

1. Kinds of material.
Leather, imitation leather, tapestry, gimp, nails and tacks.
 2. Slip seats.
 3. Solid seats trimmed with gimp and tacks.
- References—Manual Training Magazine, December, 1915.

XVI.—Problems due to warping, shrinking and swelling.

1. Choice of woods.
2. Quarter sawed or plain sawed lumber.
3. Improving properties of lumber.
 - (a) Seasoning.
 - (b) Building up stock.
Square stock.
Flat stock, edge to edge.
Flat stock, face to face (ply work).
4. To lessen effects of warping, shrinking and swelling through proper arrangement of parts of structure.
Paneling, drawer construction.
5. Fastenings to allow for warping, shrinking and swelling.

References:

King's Woodworking Series.—King.
Woodwork for Secondary Schools.—Griffith.

XVII.—Assembling problems.

1. Method of assembling.
2. Order of assembling.
3. Stage at which to assemble.
4. Methods of holding and squaring.
5. Method of applying fastenings.

References:

King's Woodworking Series.—King.
Woodwork for Secondary Schools.—Griffith.

XVIII.—Choice of Materials.

1. Cost.
2. Ease of working.
3. Durability.
4. Strength.
5. Color.
6. Texture.
7. Hardness.
8. Adaptability to staining and polishing.
9. Quality.

References:

King's Woodworking Series.—King.
Woodwork for Secondary Schools.—Griffith.

CLASSIFICATION OF WOOD FASTENINGS

I. Nails.

1. Classified as to material.
Steel, iron, copper and brass.
2. Classified as to method of manufacture.
 - (a) Cut from plate.
 - (b) Shaped from hot metal.
 - (c) Shaped from drawn wire.
3. Classified as to shape of heads.
 - (a) Common or flathead.
 - (b) Finish or brad.
 - (c) Casing.
4. Classified as to size.
Number prefixed to word penny, as 8 penny, commonly written 8d.
5. Classified as to special names.
Shingle, box, lath, horseshoe, etc.
6. Advantages of nails.
 - (a) Inexpensive.
 - (b) Require little time to drive.
7. Disadvantages of nails.
 - (a) Do not hold well.
 - (b) Unsightly.

II. Tacks.

1. Flathead.
2. Gimp.
3. Roundhead.
4. Double pointed.

III.—Corrugated Fasteners.

1. Kinds—straight and tapered.
Size indicated by length and number of corrugations.

IV.—Screws.

1. Classified as to material.
 - (a) Steel—bright, blue, bronzed.
 - (b) Brass—nickel.
2. Classified as to shape.
 - (a) Flat head.
 - (b) Round head.
 - (c) Oval head.
 - (d) Square head.
3. Classified as to size.
 - (a) Length in inches ($\frac{1}{4}$ " to 6").
 - (b) Diameter of wire from which they are made. No. 0 is less than 1-16". No. 30 is larger than 7-16".
4. Advantages of screws.
 - (a) Strong.
 - (b) Easily taken apart.
 - (c) Can be retightened.
5. Disadvantages of screws.
 - (a) Expensive.
 - (b) Require time to insert.
 - (c) Unsightly.
 - (d) Do not hold well in end grain.

V.—Bolts.

1. Stove bolts.
2. Carriage bolts.
3. Machine bolts.
4. Machine screws—flat and round head.
5. Plates, angle irons, countersinks, etc.
6. Dowel rods.

VI.—Glue.

1. Inferior grade of gelatin.
2. Made from bones, hides, etc.
3. Kinds.
 - (a) Animal or fish.
 - (b) Hot or cold.
 - (c) Waterproof.

VII.—Hinges.

1. Butt.
2. Half surface.
3. Surface.
4. T Hinges.
5. Strap.
6. Double acting.

VIII.—Locks.

1. Parts of locks—bolt, selvage, box, strike, escutcheon.
2. Classification.
 - (a) Uses.

1. Drawers, doors, etc.
2. Chest, desk, sliding doors.
- (b) Method of application.
 1. Surface.
 2. Mortise.

CLASSIFICATION AND CARE OF TOOLS

(Purpose, Size or Capacity.)

I. Care.

A. General.

1. Prevention of rust.
2. Protection of edges of edged tools.

B. Specific (each tool taken separately as mentioned below)

II.—Classification.

A. Measuring and testing or laying out tools.

1. Rule.
 - a. material (1) wood, (2) steel.
 - b. structure (1) straight, (2) folding, (3) flexible.
2. Try Square.
 - a. material (1) wood, (2) steel, (3) combination.
 - b. structure (1) solid, (2) adjustable.
3. Sliding T bevel.
4. Marking gauge.
 - a. spur point.
 - b. roller cutter.
5. Dividers.
6. Winding sticks.

B. Cutting tools.

1. Saws.
 - a. Hand.
 - (1) shape of teeth (a) crosscut, (b) rip.
 - (2) size, structure, etc., (a) rip, (b) hand, (c) panel, (d) back, (e) compass, (f) coping, (g) keyhole, (h) pruning, (i) wood or "buck," (j) turning, (k) butcher's, (l) hack.
 - b. Power.
 - (1) shape of teeth (a) crosscut, (b) rip, (c) mitre.
 - (2) size, structure, etc. (a) circular, (b) band, (c) jig.
2. Planes.
 - a. Structure.
 - (1) wood, (2) wood bottom, (3) iron.
 - b. Size.
 - (1) block, (2) smooth, (3) jack, (4) fore, (5) jointer.

- c. Purpose.
 - (1) dado, (2) beading, (3) rabbet, (4) matching, (5) dovetail, (6) router, (7) chamfer, (8) circular.
- 3. Knives.
- 4. Spokeshaves.
- 5. Chisels.
 - a. Length.
 - (1) butt, (2) pocket or cabinet, (3) framing or firmer.
 - b. Structure.
 - (1) socket, (2) tang, (3) square edged, (4) beveled edge.
- 6. Bits.
 - a. Auger.
 - (1) Jennings, (2) Irwin, (3) Ford single twist, (4) Forstner.
 - b. Dowel.
 - c. Drill.
 - d. Wood drill.
 - e. Gimlet.
 - (1) German pattern, (2) double twist, (3) spoon.
 - f. Expansive.
 - g. Reamer.
 - h. Countersink.
- C. Miscellaneous tools.
 - 1. Brace.
 - a. Structure.
 - (1) plain, (2) ratchet, (3) corner.
 - b. Size.
 - 2. Hammer, nail.
 - a. Structure.
 - (1) plain face, (2) bell face, (3) checkered bell face, (4) octagon neck and head, (5) straight claw.
 - b. Size.
 - 3. Mallet.
 - a. Round head.
 - b. Square head.
 - c. Mortised head.
 - 4. Oilstones.
 - a. Structure.
 - (1) natural stone, (2) artificial stone.
 - b. Shape and size.
 - 5. Oil can.
 - 6. Screw driver.

- 7. Nail set.
- 8. Brush.
- 9. Clamps.
- 10. Handserews.
- 11. Scrapers.
- 12. Burnishers.
- 13. Files.
- 14. Pliers.
- 15. Dowel plates.

M. E. 148—LECTURE OUTLINES

I—General Explanations and Scope of the Course.

I. General Explanations and Scope of the Course.

The first lecture period was used in general explanations to get a common understanding as to different things of interest in the course. The material covered was as follows:

- 1—Time and location of work.
- 2—Attendance (regularity to labs. & lectures encouraged).
- 3—Arrange schedule for lecture conflict.
- 4—Equipment, organization, etc.
- 5—General scope of the course.
- 6—Projects to be made in 140 and 245.
- 7—Research work and papers.
 - Outline course of study.
 - Research work.
- 8—Lectures—General idea of material to be given.
- 9—Examinations.
- 10—Fees, etc.—M. E. 140 and 245.
 - \$2.00 to cover exercise material and wear and tear.
- 11—Lumber and finishes (cost).
- 12—Books available.

II—Aims and Ideals in Manual Training and Their Relation to Local Conditions.

I.—Historical.

- A. Abstract jointing system.
- B. Sloyd system.
- C. Evolutionary system.
- D. Individual project system.
- E. Modified system.

II.—General purposes of the work (relevant and irrelevant).

- A. Busy work (compare sewing).
- B. Training of the hands.
- C. Keeps boys at home evenings.

- D. Keeps boys in school.
- E. Motivizes drawing.
- F. Cultivate taste for good design.
- G. Helps make rounded course.
- H. Helps boy to find himself.
- I. Helps boy to do things better.
- J. Increases respect for labor.
- K. Helps to train for the trades.
- L. Tends to make boys self directive.
- M. Ability to adapt self to conditions.

III.—Means of attaining these ends.

- A. Incorporating work that emphasizes these points.
- B. Combining mind work with hand work.
- C. Selecting projects of interest to the boys.

IV.—Selection of a medium.

- A. Possibilities.
 1. Cabinet making, 2. pattern making, 3. sloyd, 4. carving, 5. clay working, 6. stone, 7. concrete, 8. printing, 9. painting, 10. shoe making, 11. sheet metal work, 12. forge, 13. foundry, 14. machine shop, 15. textiles.
- B. Desirable qualities.
 1. Ease of obtaining raw material.
 2. Relative cheapness of raw material.
 3. Wide local use.
 4. Utilitarian value of product.
 5. Demand for artisans.
- C. Discussion of medium selected.

V.—Need for systematic work.

- A. Disorganized work aims nowhere, gets nowhere.
- B. Training for systematic life work.

VI.—Organization of teaching material.

- A. Relation to previous experience.
- B. Problems presented as few at a time as possible.
- C. Work should follow a logical development.
- D. Vitalize work by all means possible.
- E. Projects should be limited in size.

GROUP I—(6th Grade)

The work in this course has been divided into groups corresponding in general to the different grades. Group I refers to the class of work suitable for boys in the sixth grade or rather a beginning of the work, even if it does not begin until the 7th or 8th grades. It is based upon the principles outlined in the lecture on "Aims and Ideals," which are in general as follows:

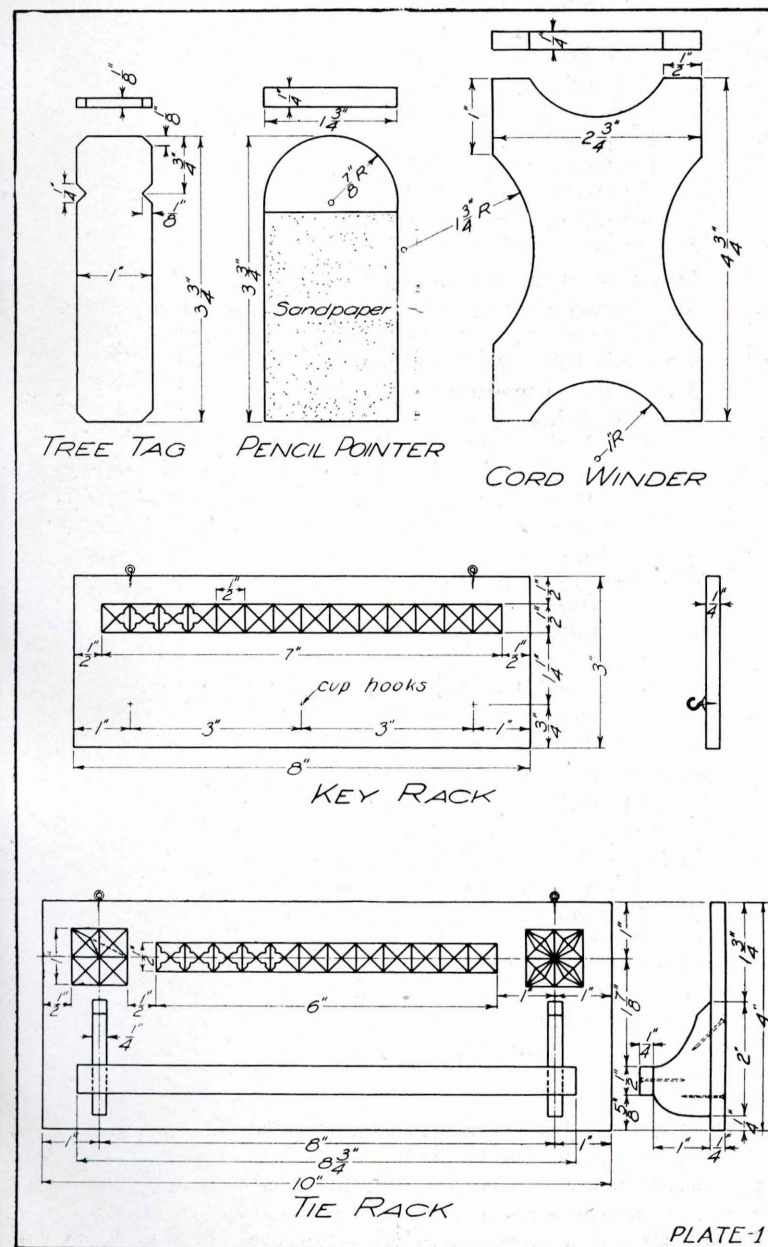


PLATE-1

GROUP I

Class	Reading	Mech. Draw-ings.	Suggested Type Problems	Additional Problems.
I. Fundamental tool process.	1. Measuring.	2. Squaring.	1. Tree tag (with drawing emphasizing principles 1, 2, 3, 4, 5, 6, 7).	Bill file Calendar mount Picture frame Paper knives Pencil sharpeners Blotter pad Key rack Animals Toys
	3. Making full mechanical drawing.	4. Testing.	2. Pencil pointer (Prin. 1, 2, 3, 4, 5, 6, 7, 8).	
	5. Cutting with grain.	6. Cutting across grain.	3. Twine winder (Prin. 1, 2, 3, 4, 5, 6, 7, 9).	
	7. Convex cuts.	8. Concave cuts.		
II. Bearing on the industries.				
			1. Collect pictures of forests and saw mills.	
			2. Talks of methods of manufacturing lumber, stains, oils, varnishes, brushes, etc.	
			4. Exercise on decorative work (Prin. 1, 2, 3, 4, 5, 6, 7, 19).	
			5. Key rack (Prin. 1, 2, 3, 4, 5, 6, 7, 10).	
			6. Tie rack (Prin.).	
			7. Calendar mount (Prin.).	
III. Simple construction work. Principles Involved.				
			10. Chip carving.	
			11. Sandpapering.	
			12. Staining and waxing.	
			13. Making scale drawing.	
			14. Making duplicate parts and pairs.	
			15. Nailing.	

1. The work should be related to the previous experience of the boy.
2. The problems should be presented as few at a time as possible.
3. The work should follow a logical development or sequence.
4. The work should be vitalized by all means possible.
5. Projects should be limited in size.

The boy begins on very simple projects involving as few new principles as possible. Mechanical drawing is correlated with the wood work from the beginning. The boy is required to make a drawing on squared paper of each project before he makes it.

The scope of this grade is, in general, knife work leading to some use of the saw in the latter part of the course. The following gives the courses outlined by underlying principles and makes suggestions as to the nature of projects that will emphasize that class of work. Plate I gives also a suggestion of the type of projects that fall in the group. No T square or triangle is used in this grade. A good paper is a manilla paper cut to 9x12 sheets and ruled in $\frac{1}{4}$ " squares. Soft wood only to be used.

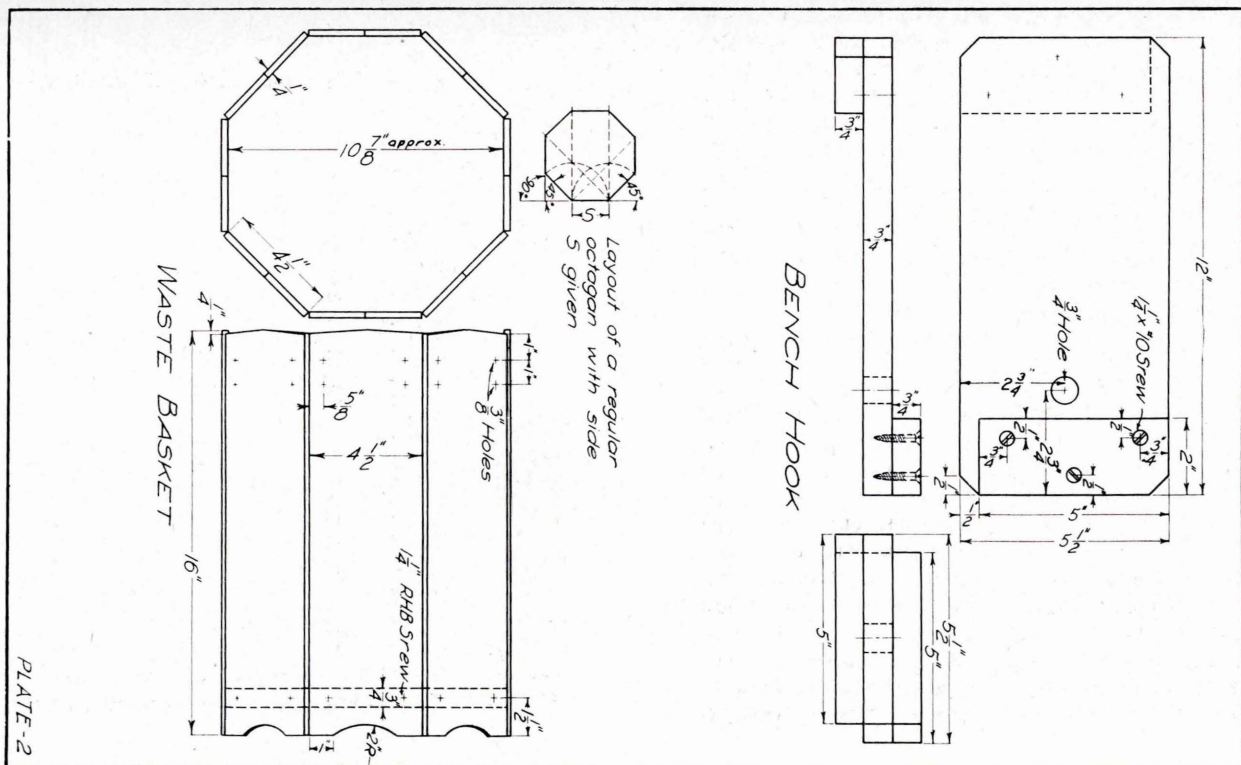
GROUP II—(7th Grade)

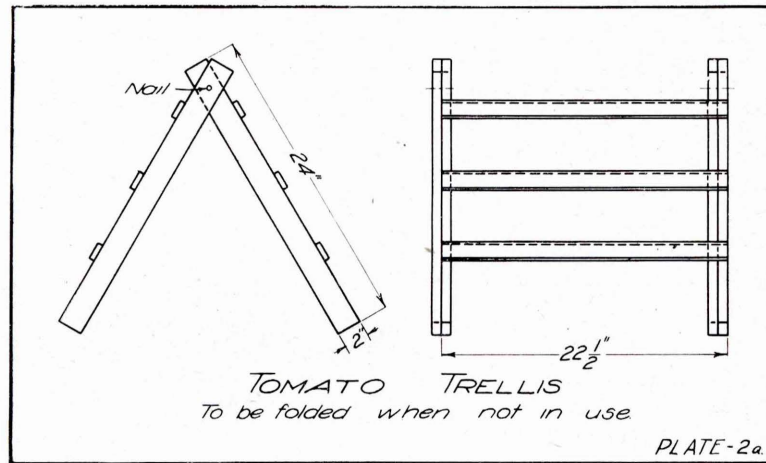
Group II begins with a review of group I to freshen it in the mind of the boy and to bring out the logical connection. The work begins with the simpler bench tools. The principal emphasis in this group is placed upon the squaring of stock properly. The work should be entirely on soft wood. All means possible should be used to keep the boys interested without sacrificing the educational value of the attainment of skill in the use of the plane, saw, and laying out tools. What exercise material is given should be motivized in some way. A good way that is suggested in the following outline is to make each piece used as an exercise, preliminary to and, in some cases, on the same board as a project that is of some definite interest to the boy. As is indicated above, the emphasis is upon squaring of stock and the vitalizing of the course. For this reason, projects are selected involving no joints and also such as would still be good if the dimensions were not strictly adhered to. This gives opportunity for insisting upon flat surfaces, parallel edges, etc., without the discouragement that is bound to follow if the boy is compelled to throw away all undersized material. Emphasis, however, should be put upon working to predetermined dimensions. The outline for this course follows.

Mechanical drawing should go hand in hand with the wood-working, at least to the extent of drawing all projects to be

GROUP II

Class	Principles to be Emphasized.	Suggested Type Problems.	Additional Problems.
IV. Fundamental tool processes and construction.	<p>Review of principles presented in 6th grade.</p> <p>16. Shop system.</p> <p>17. Use of tee square and triangles.</p> <p>18. Adjusting plane.</p> <p>19. Free planing.</p> <p>20. Rules for planing.</p> <p>21. Use of knife, try square and gauge as laying out tools.</p> <p>22. Use of rip saw.</p> <p>23. Use of cross cut saw.</p> <p>24. Chamfering.</p> <p>25. Boring holes.</p> <p>26. Fastening with screws.</p> <p>27. Scraping.</p> <p>28. Staining, filling and waxing.</p> <p>29. Measuring lumber and estimating cost.</p> <p>Study the use of lumber and grading.</p>	<p>1. A lesson in shop system (where to find, how to charge, return and care of tools).</p> <p>2. Exercise on soft wood, emphasizing the use of the plane, saw, marking gauge and try square.</p> <p>3. Piece used in No. 2 made over into some useful article, emphasizing principle of the grade (e. g. a bench hook).</p> <p>4. (Waste basket.) Note—The supervisor will furnish blueprints and detailed notes for the above. These or some other type problems should be worked thru by all the students in the group, being fully explained before the students attempt to use it.</p> <p>5. Selected or original projects approved by the teacher that do not involve any new principles.</p>	<p>Originality of design should be encouraged.</p> <p>Sewing companion.</p> <p>Pencil racks</p> <p>Picture frame</p> <p>Waste basket</p> <p>Broom rack</p> <p>Coat hanger</p> <p>Swing board</p> <p>Foot stool</p> <p>Tabourette</p> <p>Plate rack</p> <p>Tie rack</p> <p>Bench hook</p> <p>Towel holder</p> <p>Nail box</p> <p>Bird house</p> <p>Sleeve board</p> <p>Hall tree</p> <p>Corn tray</p> <p>Bread cutting board</p> <p>Magazine rack</p> <p>1. For floor</p> <p>2. For wall</p> <p>Talks on the building trades</p>
V. Bearing on industries.	<p>6. Visit places where lumber is used.</p> <p>7. Collect specimens of standard defects.</p>		





made. Several excellent mechanical drawing texts are now available. A brief outline for a course will, however, be found elsewhere in this book.

GROUP III—(8th Grade)

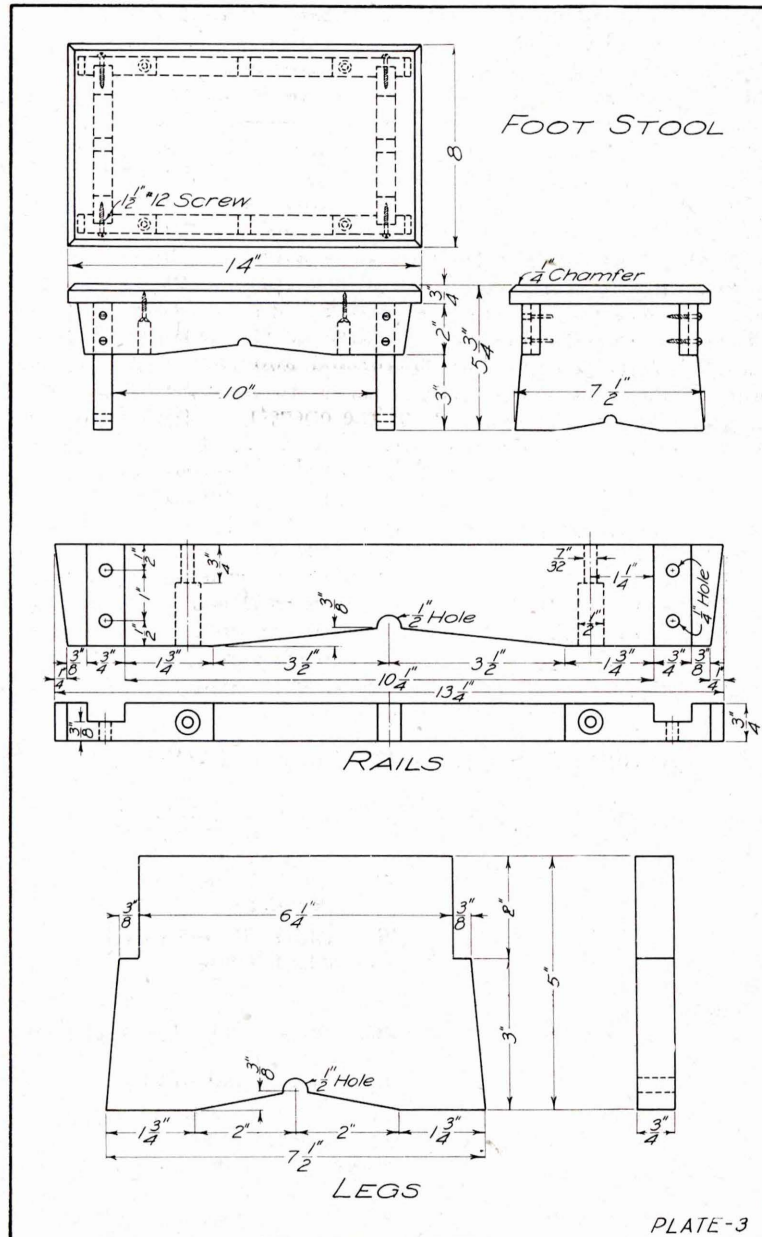
As in the previous case, this grade connects on to group II by means of an exercise in the squaring of stock, greater emphasis is, however, placed upon squaring to definite, predetermined dimensions. This is followed by an exercise piece in the making of the dado joint, the typical joint of the group. This joint, for the purpose of vitalization, should be made the shape and size as it will be used in the type model that follows. This should be made clear to the boys. Work on hard wood may commence here if thought advisable, but in most cases the writers believe it best to leave the use of hard wood for the work in group IV. Greater emphasis should be placed on skill in this grade. Mechanical drawing should be correlated as in group II. A good plan is to require, in addition to the drawing, a stock card and progress record of each piece as suggested in the accompanying foot stool. For the first project, the instructor should furnish an instruction sheet either in the shape of mimeographed notes or by dictation.

The advantages of the stock card and progress record are evident, but a few suggestions on their use may not be out of place.

Shop drawings should be of a uniform size, let us say 9 inches by 12 inches. These, if folded once, make a sheet 6 inches by 9 inches. The following data, which appears on the stock card,

GROUP III

Class	Principles Involved.	Suggested Type Problems.	Additional Problems.
VI. Simple Joinery.	Review of principles of Group II (squaring stock to dimensions, use of laying out tools, etc.) 30. Paring with chisel. 31. Dado joint. 32. Accurate sawing. 33. Form work. 34. Glue work. 35. Clamping.	1. Exercise on soft wood, reviewing squaring of stock to dimensions. 2. Exercise on hard wood (?), making dado joint to be used in this grade. (Foot stool) some project involving work typical of the grade to be made as class exercise. Blueprints and instructions to be furnished by the instructor. 4. Original or selected projects not involving any new principles.	Small bench Round top table Hall tree Towel roller Umbrella rack Tabourette Farm gates Troughs Book racks
VII. Bearing on the industries.	Study shop system. Storage of supplies. Jigs.	Visit shops, collect pictures, have papers written by students describing a shop or time saving jig they have seen.	Talks by other teachers, the supervisor, mechanic, factory men and others on shop system and organization.



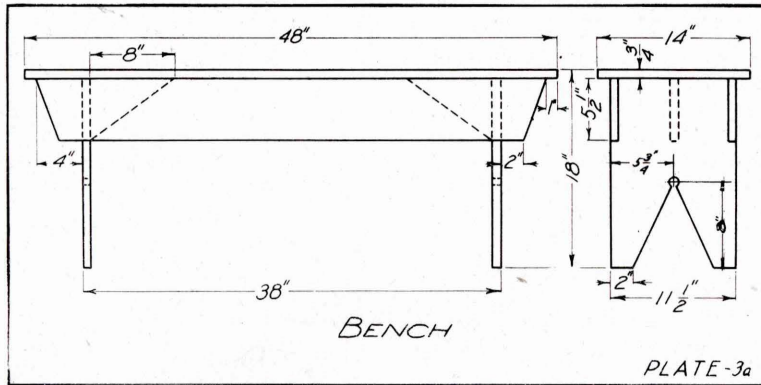
should also appear on the outside of the folded drawing: Name, bench number, name of project and date. The stock card and progress record are fastened by paper clips on the inside of the folded sheet. A good size for a stock card is $5\frac{1}{2}$ inches by $8\frac{1}{2}$ inches. The drawing, etc., are kept on file in the teacher's desk. At the beginning of the period they are passed out and collected again at the close. By referring to his file, the teacher can by means of the data there find immediately (1) what project a boy is working on, (2) whether he has filled out his bill of materials, (3) whether he (the instructor) has approved such bill, and when, (4) whether the boy has obtained his lumber and if so, who cut it (the instructor, a stock keeper, or the pupil himself), (5) whether the boy has paid his bill and when, (6) the different operations necessary in making the project, (7) how many of these the boy has performed and how well. In the column "date due," the teacher places an estimate on the time necessary for the performance of the operation. Naturally, this will not always coincide with the "date O. K.'d," but it gives, at the same time, a very tangible record of the boy's ability or industry. The remarks noted in the last column will be a valuable aid in grading the completed project.

While this grade of work would normally come in the 8th grade, due allowance must be made if the work is not given from the 6th grade up. If the work is not commenced until the high school, it should naturally begin at least at group II and after some work in that group, be carried on through group III.

An outline of the principles to be emphasized in the grade follows:

INSTRUCTION SHEET FOR FOOT STOOL

Order of Work	Principles to be Emphasized
1. Top	22. Use of laying out tools (Review). 20. Rules for planing. 24. Chamfering.
2. Rails.	20. Rules for planing (Review). 14. Laying out duplicate parts. 14. Pairs, or rights and lefts. 25. Boring holes. 22 and 23. Use of cross cut and rip saws. 30. Use of chisel. 25. Boring for screws.



3. Legs.

14. Duplicate parts (Review).
33. Form work.
23. Use of rip saws.

4. Cleaning.

27. Scraping.
11. Sand papering.

5. Assembling.

35. Clamping.
26. Fastening with screws.

6. Finishing.

28. Staining.
28. Filling.
28. Waxing.

Detail Instructions.

1. Top.

Before starting on the top, see that your knife and marking gauge are both sharp and that you can use the marking gauge freely and easily and that you can accurately square knife lines around a piece of stock. This is review work and should surely be mastered before you do anything else.

The rules for planing are to be followed in making this piece. You should already be familiar

DEPARTMENT OF MANUAL ARTS
PUBLIC SCHOOLS
STOCK CARD

NAME *John Jones* BENCH *6*
ARTICLE *Foot stool* DATE *10/22/17*

No. Pieces	Thickness	Width	Length	DESCRIPTION	Material	No. Board Feet	Cost Per Ft.	Total Cost
1	1 3/4"	8 1/2"	14 1/2"	Top	Oak	21.5		
2	1 3/4"	2 1/2"	13 1/2"	Rails		422		
2	1 3/4"	8"	5 1/2"	Legs		584		
						421	18	33
HARDWARE, FINISH, ETC.								
4	1 1/2"	10		Flat head bright screws		2 1/2		92
5	1 1/2"	12		Round head blue screws		2 1/2		02
36				Sa. ft. finish		3 1/2		11
								50

Remarks *One set of rails spoiled cost 08¢*

Approved by *J. L. Mitchell* Date *10/22/17*
Filled by *Will Smith* Date *10/24/17*
Paid to *J. L. Mitchell* Date *11/6/17*

with them. They are, however, of such importance that we restate them.

1. Face side and put on reference mark.
2. Joint edge and put on reference mark.
3. Gauge and plane to width.
4. Gauge and plane to thickness (may be omitted in this case).
5. Square one end.
6. Measure length, square round, cut off and square other end.

In laying out chamfer, use a pencil. Why?

DEPARTMENT OF MANUAL ARTS PUBLIC SCHOOLS PROGRESS RECORD				
NAME <i>John Jones</i>		BENCH <i>6</i>		
ARTICLE <i>Foot stool</i>		DATE <i>10/22/17</i>		
Description of Parts	PROCESS TO BE PERFORMED	Date Due	Date O. K'd	REMARKS
<i>Top</i>	<i>Square to dimensions</i>			
	<i>Plane Chamfer</i>	<i>10-24</i>	<i>10-24</i>	<i>Taper</i>
<i>Rails</i>	<i>Square to dimensions</i>			<i>One set</i>
	<i>Form rails</i>			<i>of rails</i>
	<i>Cut joints</i>			<i>spoiled</i>
	<i>Bore holes for screws</i>	<i>10-28</i>	<i>10-30</i>	
<i>Legs</i>	<i>Square to dimensions</i>			
	<i>Form ends</i>	<i>10-30</i>	<i>11-2</i>	
<i>Cleaning</i>	<i>Scrape and sand</i>			
	<i>paper all parts</i>			
<i>Assembling</i>	<i>Fasten rails to ends</i>			
	<i>Fasten top to rails</i>			
<i>Finish</i>	<i>Stain fill and wax</i>	<i>11-4</i>	<i>11-6</i>	

2. Side Rails.

NOTE—Steps 2 and 3 are always to be taken when laying out duplicate parts. The method saves time and avoids mistakes.

1. Square the stock $\frac{3}{4}$ " x $1\frac{3}{4}$ ". Follow the rules for planing.
2. Lay off all distances from edges of dadoes, centers of holes and other details on the joint edge of the rails.
3. Place the two rails together so that their joint edges and the ends coincide. Then square across the edge of both pieces.

4. With try square, knife and gauge lay out the dados so that they do not come on the face sides of the rails. (Do not cut).
Note—You will notice that the rails are "pairs" (rights and lefts). In such cases, care must be exercised to avoid mistakes.
5. Locate centers for the $\frac{1}{2}$ " holes with try square, pencil and gauge and lay out the other details for the outline. (Do not cut.)
6. Locate centers for screw holes.
7. Show to instructor. Why?
8. Saw and chisel the dados. See that the bottom of the dado is a plane surface.
9. Bore the $\frac{1}{2}$ " hole and cut the outlines of the rails with saw, plane and chisel.
10. Select a body drill for a $1\frac{1}{2}$ " No. 12 round head screw and show it together with the screw to the teacher. Why?
11. Bore for the body of the screw.
12. Find a $1\frac{1}{4}$ " No. 10 flat head screw and select a bit the diameter of its head and another the diameter of its body.
13. Show the screw and the bits to the teacher.
14. Bore holes for the screws that fasten the rails to the top, boring in $1\frac{1}{4}$ " with the larger bit and finishing with the body size.

3. Legs.

1. Square the stock to dimensions.
2. With rule, try square

gauge and knife, lay out the outlines and all details for both legs, observing the method learned for laying out duplicate parts.

3. Show to teacher. *Note*—Making projects of this sort where the joint edge disappears in the finished piece is called form work. In such work, all details must be laid out before cutting away the joint edge.
4. Bore the $\frac{1}{2}$ " holes.
5. With rip and crosscut saws cut to the outline sides of the work and the sawing done first from one side and then the other to keep the saws from running. The teacher will show you how to do this.
6. Pare the surfaces that show with a chisel to make them smooth.

4. Cleaning.

It is impossible to put a good finish on a surface that is not smooth. You should do all you can with the plane, but there are curly places on nearly all pieces of wood that will tear somewhat under the plane. Such places must be made smooth before the stain and other finish is applied. This smoothing can always be done with sand paper alone, but a properly sharpened scraper works faster on hard woods. The teacher will show you how to use the scraper. Do not stop the scraping and sand papering before all the specks disappear. It is also slow work, but something you can surely do, and there is nothing that will give you so good a return for the la-

bor spent as the work put on cleaning your surfaces before putting the parts together.

5. Assembling.

1. Clamp the legs and rails in position.
2. Bore for the core of the screw.
3. Fasten with round head $1\frac{1}{2}$ " No. 12 screws.
4. Clamp the top in position.
5. Bore for the core of the screws.
6. Fasten with $1\frac{1}{4}$ " No. 10 flat head screws.

6. Finishing.

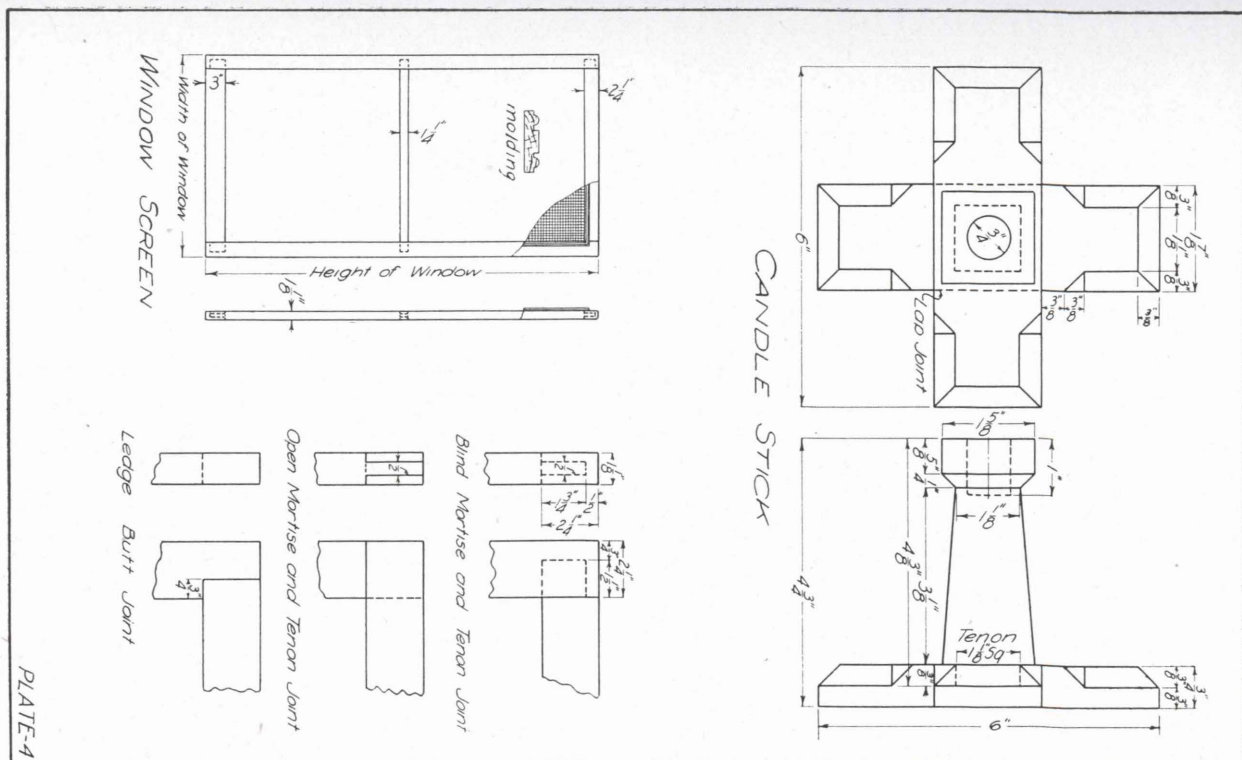
1. Stain with brown or Antwerp oak stain, wiping off the excess of stain at once.
2. After the piece is thoroughly dry, see that no pit marks show, that the surfaces are clean. If they are not, scrape and sand paper until the surfaces are smooth and restain.
3. Fill with a dark filler and wipe off excess of filler with shavings or rag, wiping across the grain.
4. Wax and polish.

GROUP IV

This group is of all perhaps the most difficult to organize properly and apply. So much new work is brought in and the pupils taking it have had such varying preparation that it is difficult to select projects and exercise pieces that will cover the ground properly and still keep the interest and enthusiasm of the boy. The work should begin with a review and be followed by project pieces covering the principles of the grade. As in group III, these should so far as possible be designed as to apply on a class project to be made later. A high standard of tool processes should be maintained. The nature of the joints involved, however, will demand this. While speed is a good thing to work for, quality should be the first aim. A liberal amount of mechan-

GROUP IV

Class.	Principles Involved.	Suggested Type Problems.	Additional Problems.
VIII. Review of tool processes of preceding groups.	2. Measuring. 3. Squaring. 20. Rules for planing. 21. Use of laying out tools. 22. Use of rip saw. 23. Use of cross cut saw. 36. Sharpening chisel. 37. Sharpening plane iron. 38. Gaining. 39. Mortising. 40. Fastening with keys. 41. Fastening with glue. 42. Fastening with glue and dowels. 43. Clamping. 44. Scraping. 45. Sandpapering. 46. Staining. 47. Filling. 48. Shellacing. 49. Varnishing. 50. Waxing and polishing. 51. Duplicate parts. 52. Principles of design.	1. Exercise on soft wood, reviewing these principles. 2. Piece used in (1) worked over or new piece used to emphasize new principles. 3. Lap joints. 4. Slip joints. 5. Mortise and tenons (blind through and keyed). 6. Glue and dowel joints. 7. (Candlestick.) Some project involving work typical of the grade. Design furnished by the instructor. 8. Original or selected projects involving no new principles. 9. Visit hardware stores and classify the small tools. 10. Collect specimens of woods showing kind and character of growth of each. 11. Collect screws and nails.	Tabourette Foot stool Piano bench Small table Cedar chest Telephone stand Morris chair Magazine rack Porch swing Table lamps Hall seat Music cabinet Hay rack Window screens
IX. New tool processes. Methods of fastening, etc.			
X. Old principles given with greater emphasis.			
XI. Simple joinery and design.			
XII. Relation to the industries.	53. Classification of hand tools. 54. Study of wood structure.		



ical drawing should be included in the work. An outline of a mechanical drawing course will be found elsewhere in this general outline. The outline of group IV follows:

While this is work that naturally falls in the 9th grade, due allowance must be made if the boys have not had two or three years previous training and the work modified accordingly. It may be best to begin the 9th grade work with a considerable amount of work in Group III and even some in Group II. Small projects are desirable. The teacher must always be on the watch to see that he does not allow his ambitions and the desire of the boy to make large projects to cause him to lose sight of the underlying principles and the ultimate good to be obtained in his endeavor to make good. Wood butchery is neither conservation nor sound pedagogy.

The outline of the teaching material and a couple of suggestive projects follow:

GROUP V—(10th Grade)

The outline for this group is merely suggestive of a number of types of work that can well be placed in this group, the selection of which should be determined largely by the character and interests of the community and class in question. Farm mechanics, including forge work and other allied interests makes an effective course. A good course in carpentry is well worth while. Wood turning might well occupy at least a portion of the year's work. Concrete is especially applicable.

In any case the most important thing is the standard upheld rather than the subject matter used. A little study of vocational guidance can be introduced here with profit.

MECHANICAL DRAWING

The subject of mechanical drawing is so important that it should be given from the beginning. In order to simplify the work for the immature sixth grade boy, the course has been so outlined as to use paper ruled in $\frac{1}{4}$ " squares and hence not use the tee square and triangles. Projects are chosen small enough that very little scale drawing need be done. In the sixth grade 9x12 paper is recommended. In the seventh grade a 12x18 or 9x12 manilla paper or wrapping paper may be used. No exercise work is given in the grades, but a drawing of each project is required.

MECHANICAL DRAWING IN THE HIGH SCHOOL

The subject of mechanical drawing is rapidly taking its proper place in the manual training course. If a boy merely makes an article from printed instructions and a drawing already given, he is getting only a small portion of the good possible. But if he

GROUP V

Class.	Principles to be Emphasized.	Suggested Type Problems.	Additional Projects.
XIII. Mitre joints.	sized. 55. Plain mitre. 56. Half lap mitre. 57. Rabbeting. 58. Use of plow plane. 59. Rights and lefts, pairs. 60. Hanging door. 61. Laying out and cutting dovetails. Review.	1. Exercise reviewing preceding work. 2. Picture frame using plain or half lap mitre joints. 3. Panel door. 4. Dovetail joints. 5. Original or selected projects, factory methods, etc.	The projects of this grade have little limitation except the ability of the pupil. The selection should be controlled by the teacher so that the pupil does not discourage himself by attempting too difficult things. Some study of vocational guidance can well be worked into this grade. Carpentry can profitably be substituted for cabinet making. Whatever is taken up, however, should be held to a high standard.
XIV. Paneling.	62. Loss of personality of most machine made articles.	6. Visit stores and compare hand and machine made furniture. Visit one shop and make a real study of workman's power to produce.	
XV. Dovetailing.	63. Effect of the machine on the man, his power to produce, his pleasure in his work, his health, his play.	7. Detailed study of jigs.	
XVI. Review.			
XVII. Relation to the industries			

MECHANICAL DRAWING (High School)

Group.	Principles Involved.	Illustrative Problem.	Required Work.
I. Selection and use of tools.	Review of principles emphasized in the grades.	Exercise sheets and projects made in the shop arranged as seems best under the conditions.	1. Plates assigned
II. Orthographic projection.	14. Relationship of views. 15. Auxiliary planes. 16. Intersections.		2. Assignment in texts 3. Discussion in class.
III. Working drawings.	17. Developments. 18. Sketching. 19. Use of coordinate paper.		4. Correlation with wood work.
IV. Pictorial representation.	20. Cutting planes. 21. Cross hatching. 22. Isometric drawing. 23. Cabinet projection. 24. Perspective drawing.		

is taught to design, draw, and then construct, he has gotten a lesson that will be an invaluable aid to him not only in being able to read and follow directions better, but also in being able to think for himself and to carry these ideas into execution.

Mechanical drawing is the natural language of the trades. A language that is becoming more and more commonly used and naturally fits in line with the courses customarily given in manual training work. The following outlines merely suggest types of work that can be given. A large part can and should be given over to making drawings of projects to be constructed in the shop. A few exercise plates are not only valuable, however, but necessary to the proper application of the course.

BOOKS, BULLETINS AND AVAILABLE ADVERTISING MATERIAL

This lecture covers the place of the book in the manual training shop. Manual training publications may be divided into eight general classes, as follows:

1. Text books.
2. Reference books.
3. Books of projects.
4. Professional magazines.
5. Trade magazines.
6. Educational bulletins.
7. Advertising bulletins of educational value.
8. Trade catalogs.

A number of each class were placed in the reading room, so that the students might become familiar with them. Lists of still more material were suggested. Special emphasis was placed upon the importance of the text book and professional magazine in the shop.

BOOKS FOR MANUAL TRAINING TEACHERS

Handwork in Wood—Noyes.
 Wood and Forest—Noyes.
 Design and Construction in Wood—Noyes.
 Problems of the Finishing Room—Schmidt.
 Problems in Farm Woodwork—Blackburn.
 Fundamental Tool Processes—Laughlin.
 Type Models Group 1a—Laughlin.
 Type Models Group 1—Laughlin.
 Type Models Group 2—Laughlin.
 Type Models High School Plates—Laughlin.
 Agricultural Woodworking—Roehl.
 Shop Projects Based on Community Problems—Burton.
 Carpentry—Griffith.
 Woodwork for Beginners—Griffith.
 Essentials for Woodworking—Griffith.

Woodwork for Secondary Schools—Griffith.
 Correlated Courses—Griffith.
 Furniture Making—Advanced Projects in Woodwork—Ira S. Griffith.
 Projects for Beginning Woodwork and Mechanical Drawing—Ira S. Griffith.
 Practical Concrete for the School and Home—Campbell & Beyer.
 Handbook of the Trees of the Northern States—Hough.
 American Woods (11 volumes)—Hough.
 Problems in Furniture Making—Crawshaw.
 Furniture Design for Schools and Shops—Crawshaw.
 Manual Arts for Vocational Ends—Crawshaw.
 Mechanical Drawing for Secondary Schools—Crawshaw & Phillips.
 Notes for Mechanical Drawing—Mathewson.
 Constructive Drawing for Secondary Schools (Vol. 1 & 2)—Atkinson, Mentzer & Co., Publishers.
 Mechanical Drafting—Howe.
 Engineering Drafting—French.
 Problems in Mechanical Drawing—Bennett.
 Principles of Design—Batchelder.
 Classroom Practice in Design—Haney.
 Industrial Arts Design—Varnum.
 Art Metal Work—Payne.
 Handcraft in Wood and Metal—Hooper and Shirley.
 Decorative Design—Chase.
 Kitecraft and Kite Tournaments—Miller.
 Practical Forging and Art Smithing—Googerty.
 Vocational Guidance—Puffer.
 Vocational and Moral Guidance—Davis.
 Demonstrations in Woodwork—Van Deuson.
 Problems in Woodworking—M. W. Murray.
 Studies of Trees—J. J. Levison.
 Painter, Gilder and Varnisher's Companion—W. T. Brannat.
 Expert Wood Finisher—Kelly.
 Woodworking Series—King.
 Handwrought Jewelry—Sorenson & Vaughn.
 The Manual Arts—Chas. A. Bennett.

MANUAL TRAINING AND FORESTRY

The value of visual instruction should not be minimized. This lecture was given with two distinct purposes in mind; (1) to give informational material on the supply and methods of manufacturing lumber, and (2) to show the student some of the possibilities of visual instruction and also to help him to get in touch with persons or bureaus circulating material suitable for school use. This set of slides is circulated by the Bureau of

Forestry, U. S. Department of Agriculture, Washington, D. C., and may be secured for use during a short period of time by responsible persons. More definite information on sets available, conditions upon which they are loaned, etc., may be obtained by writing to the address given above. Other material may be obtained from the Department of Engineering Extension, Iowa State College, Ames, Iowa.

OUTLINE OF LECTURE

- I.—Character and distribution of forests.
 - A. Principal forest regions.
 1. New England forest.
 2. Great Lakes region.
 3. Southern hardwood forest.
 4. Southern pine forest.
 5. Northwest forest of conifers.
 6. Redwood forest of California.
 7. Conifers of Rocky mountains.
 8. Southwest forests.
- II.—Characteristics of good lumber tree.
 - A. Tree grown in dense forest.
 - B. Tree grown in open.
 - C. Knots caused by limbs.
 - D. Twisted grain.
 - E. Fire injury.
 - F. Fungus growth.
- III.—Wood Structure.
 - A. Cross section of black oak.
 - B. Microscopic section of oak.
 - C. Radial section of oak.
- IV.—Timber and Lumbering.
 - A. Rise and fall of industry by regions.
 - B. Whip sawing, primitive lumbering.
 - C. Small portable mill.
 - D. Lumber crew at camp.
 - E. Felling tree with saw.
 - F. Cutting felled log into lengths.
 - G. Scaling a pile of logs.
 - H. Load of logs on sled.
 - I. Steam tractor hauling logs.
 - J. Donkey engine.
 - K. Steam log loader loading on flat cars.
 - L. Lumber flume discharging into river.
 - M. Log jam.
 - N. Logs in sorting boom.
 - O. Logs going from boom to sawmill.
 - P. Log ready for saw.

- Q. Grading of lumber.
- R. Interior of sawmill (live rolls).
- S. Quarter sawing large log.
- T. View of lumber mill and yard.
- U. Lumber at dry kiln.
- V. Loading vessel with lumber.
- V.—Utilization of lumber.
 - A. Building of a frame house.
 - B. Interior of planing mill.
 - C. Interior of room showing fine woodwork.
- VI.—Influence of forestry upon lumbering.
 - A. Logged off lands showing high stumps.
 - B. Unused tops of felled trees left in the woods.
 - C. A turpentine pine tree.
 - D. Waste at sawmills, slabs and sawdust.
 - E. Ties being treated with preservative.
 - F. Conservative lumbering.
 - G. Pine forest with seedling reproduction.

DISSTON SAW FILM

This three reel film was used to give the students some idea of the processes of manufacturing manual training tools. The film in general takes several of the Disston Products and follows them through to the finished product. For example, in the saw, the steps were in general as follows:

1. Mixing and melting steel in crucibles.
2. Casting and "soaking" ingots or billets.
3. Rolling ingots into rods or plates.
4. Trimming of sheets.
5. Sorting by weight.
6. Stamping size.
7. Tothing.
8. Hardening.
9. Tempering.
10. Smithing in the black.
11. Grinding.
12. Hammering.
13. Second grinding.
14. Buffing.
15. Blocking.
16. Polishing.
17. Stiffening.
18. Etching.
19. Setting the teeth.
20. Sharpening.
21. Punching holes for handle.
22. Handling.

23. Inspection.
24. Packing.

This merely shows in a brief way, some of the subjects covered. Files and a few other small tools were shown, as well as different kinds of saws.

This film provided a very interesting as well as educational program.

RESEARCH TOPICS

As a part of the required work, each student prepared a paper or an exhibit on some phase of the work that was of particular interest to him. These were intended not for their informational value alone, but also for developing the students' initiative and also providing suggestions for similar work to be done on a smaller scale in the shop.

In order to give an idea of the work covered, a list of subjects which have been used is included in this pamphlet. A complete paper also follows the list of subjects.

It is hoped that it will prove helpful also in helping manual training teachers to do more toward helping to win the present war.

LIST OF SUBJECTS

Wood Finishing.

Fillers, stains and varnishes.

Effect of stains on different woods.

Composition of paints.

Manufacture of varnishes.

From the viewpoint of the use of sand paper, steel wool, and different stains and varnishes.

A comparison of the permanency of water, oil, and spirit stains.

Glues (kinds, composition, manufacture, tests and uses).

Kinds and sizes of nails and screws.

Exhibit showing different kinds of wood and grain effects.

Defects in lumber; their causes and remedies.

Methods of fastening in wood construction.

Manufacture of Tools.

Manual Training and the War.

Identification of trees.

Correlation of manual training with other subjects.

The selection and use of wood and varnish in airplane construction.

Furniture design.

Manufacture of oil and grindstones.

By-products of lumbering.

The value of a woodworking course in public schools.
 Different kinds of lumber used in our locality, their durability and uses.
 The use of concrete in the high school course of study.
 Cabinet making vs. carpentry in the school.
 Practical applications of the common joints.
 Adapting educational principles to the teaching of manual training.

MANUAL TRAINING AND THE WAR

Harry W. Christy.

In this brief article I have attempted to tell how the war has affected, is affecting and will affect Manual Training in the public schools of Iowa. The manual training shop of the average school of Iowa and in the average community has been kept in mind throughout. It has been very difficult to keep from reaching into the other vocational subjects as they are so closely related to Manual Training. I believe that we, as manual training teachers, should give the matter much serious thought, and at the same time, should not do things rashly or make radical changes in manual training courses in order to attract attention. There is such a good excuse now for a radical to gain popularity on the ground of patriotism that we, as teachers and superintendents, should be on our guard. On the other hand, neither should we allow the old ideas to interfere with "winning the war." I believe that some people still doubt the ability of the pupils to make articles of value. Some fear the educational value of introducing war work into the manual training shop. To these who doubt the ability, we can merely prove that they are wrong and do so very kindly. To those who are forever thinking of the educational value and think little of the Great Struggle for a Free World, we can say it is a blessing in disguise in many schools, as many gain by it instead of lose. We have too much red tape, memorizing of dates as in history, a greater knowledge of foreign countries than of our own, and much on the curriculum that is of no practical value. The girls know more Algebra than Domestic Science and our graduates are often well stocked with knowledge, but know nothing of how to take a part in the world as they should. We need some real motive present in our manual training work. Some teachers still have model joints made in shop and a few articles as coat hanger and other foolish articles of no value educationally and with no motive whatsoever. How much better it would be to instill a lesson of service and patriotism.

Gov. Lowden of Illinois gives us a broad vision in the following extract from one of his recent speeches:

"This is a war in which the children of America have more to lose than anyone else, as the greater part of their lives lies before them. Therefore, if we lose, they will have more years short of all that makes life dear than we of maturer years. God grant that we may leave to these children the freedom and equality of opportunity which we ourselves inherited from our fathers."

I believe we should consider this question from the standpoint of the development of those individuals who will enter the industries whether the school gives consideration to their development along this particular line or not. It is up to the teacher in this subject, as our time in the shop is very limited with the use of text and the predominance of other subjects. Under the Smith-Hughes Act this is the principal object. If the school meets the conditions of this act and receives Federal aid, the school must teach the pupil to enter the industry he chooses. This will be discussed later when we consider the Smith-Hughes Act.

It must follow that everything that the school is able to do to make a more industrious citizen and one who will be a better artisan as the result of his school training is worthy of our time and consideration. At this particular time it is highly important that men be developed both for war and post-war activities.

Giving dignity to labor and creating an interest in the handling of tools must of necessity result in young men entering the industries in greater numbers than they would otherwise.

A Manual Training Association of the East recently said that manual training should do these three things, viz.: 1. Teach thrift and economy and thereby save for bonds, stamps, etc.; 2. increase skill of the nation, and 3. keep pupils in school by showing value of education on the practical side of life and by having part time classes.

The Cosmos Club last December made the following resolutions: 1. We are in a grave situation demanding trained men for army and industries. 2. That we should have special courses for shipbuilders and machinists, etc. 3. We need 200,000 in training now and as it is we have only 50,000. 4. We urge Gen. Crowder to exempt instructors in the industries. 5. We urge the Federal and State Governments to give financial aid to such schools. 6. We urge the Council of Defense to co-operate. 7. We urge that conscripted men be permitted to remain in training until course is completed.

Dr. L. G. Weld, President Pullman Free School of Manual Training, says: "Let us, too, seek to bring our activities fairly within the scope of the broadened definition of culture which

has resulted from wider outlook to which mankind has attained through stress and toil of the centuries."

The lack of co-operation of the manual training shops and war activities are accounted for in three ways: 1. There is no centralized system for inspecting, receiving, and accepting of articles made. 2. Officials of government do not understand value and excellence of work of manual training shops, and 3. The superintendents and principals are sometimes only lukewarm where demands are made. We hope and sincerely believe that the last explanation does not apply to the manual training schools of Iowa.

"If there should be any 'slackers' among the manual training teachers of Iowa, let us as superintendents and loyal teachers hunt them out and expose them to the public. We should make ourselves absolutely indispensable in this work. This is a time to throw away any fine-spun distinctions as to courses, duties, privileges, etc., and to think of the overwhelming needs of the hour and the part each can play in meeting those needs. It seems almost criminal and unpatriotic for a school simply to go on in its accustomed serenity, unaffected in courses, methods and activities by the world crisis into which this country has been swept. The shop teachers must make every possible exertion to facilitate and increase production, to help in every movement for conservation, and to energize by every means at their command, agencies for the subordination of all interests to a common purpose and for the unification of all endeavors in one common endeavor for the welfare and safety of our common country.

James Parton Haney embodies this appeal to us to do our duty here at home in an excellent poem entitled, "A Trumpet Call." The poem is given in full:

A TRUMPET CALL.

A trumpet sings, the other songs are still,
The close-locked ranks fast gather and are gone,
Leaving a myriad stars in casement hung
As symbols of the spirit which doth thrill
A mighty nation, as it bends its will
To aid the cause, which Freedom must see won.
A trumpet sings, it bids the valiant come
Your country calls; the laggard serves her ill.

But what of those who march not in the van,
How shall they serve who yet must bide at home,
Quick to the thousand tasks which must be done;
Each to his post—let each now play the man,
And what for song fit for the trumpet's tone?
Why—raise the battle cry of "Carry On."

While there are conditions necessitated by the war that are injurious to schools's best interests, nevertheless there are numerous ways in which the schools may gain large and lasting profit from the catastrophe of war. The school people are realizing as never before the incalculable service which the schools may render to any cause when once their organized machinery is set in motion in the proper direction by the proper spirit. Perhaps one of the most important gains is the matter of self-discovery, the realization that schools are a powerful instrument even in the grim business of war. The schools that for all these years have been coining such slogans and mottoes as "The Needs of Society are the Problems of the School," should embrace the opportunities now presented and devote themselves to the numerous activities that constitute the needs of the hour.

Directors and instructors of manual training in all parts of the country have expressed a desire to be allowed to organize their shops and students so as to make some tangible and useful contribution in the war emergency. Some great work has been done and we hope to be able to be allowed to have a further hand in this great work. These desires have expressed or manifested themselves in a number of distinctive lines:

First, the manual training departments have tried to produce articles which are of distinct war service. These articles have been (a) Furniture and fittings for Y. M. C. A. cantonments; (b) Games and other articles for the personal use of soldiers; (c) Interior furnishings and hospital equipment for the Red Cross; (d) Miscellaneous articles for the local Red Cross, especially packing boxes, work tables, chairs, folding boards, yarn winders, etc.

A second type of war work has been in the direction of the manufacture of articles for use in schools which cannot be readily obtained in the market. The idea here has been to conserve labor and materials and to reduce the school expenditures, which have grown so enormously through the increased costs.

A third means has been in the direction of manufacturing simple devices that will help in the school and home garden, etc. In some communities the boys have put up sign boards for the War Savings campaigns, for the Liberty Loan campaigns, etc. In one western town the boys made a float for the Liberty Loan campaign. It consisted of a very realistic production of an English war tank. The West High of Des Moines made a huge indicator with representation of Sammy advancing to go "over the top" as the Red Cross funds increased. This was directed by the instructor in manual training, Mr. C. E. Partch.

A fourth way in which the manual training department can do its bit is to make articles for Red Cross sales and for Christmas sales, the profits to be devoted to some form of war work.

Included under this head, schools of many parts of the country have made thousands of puzzles, simple toys, interesting small pieces of furniture, which have been sold at a considerable profit to local people. In some cities the schools have even undertaken jobbing work, including the repair of chairs, recaning of chairs and fixing other pieces of furniture.

A brief list with descriptions will be mentioned to better explain what various schools have done and are doing. Nearly all of these are adapted to wood working classes and more especially to the seventh and eighth grades and high school grades.

A New Jersey school made six different types of fruit and vegetable driers.

A Wisconsin school has made bee-hives.

A Minnesota school has made games.

Oregon schools have made ink wells and penholder stands.

Splints are being made by the Boston schools. Wood splints are made for first aid and sheet iron splints are made for hospitals here.

Kansas schools have made furniture for Y. M. C. A. buildings.

Houston Heights, Texas, Manual Training School has invented a candle winder that will wind eight candles at one time.

New Jersey schools have organized junior industrial army for home project work.

English high school pupils make all needed supplies for Red Cross work in hospitals. They have changed their manual training courses very radically since August, 1914. They make hospital rests, crutches, bed rests, bed trays, bed tables, bed cages and splints.

West Union, Iowa, offers service to citizens to construct feeders, brooders, hog crates and articles of furniture. The department takes orders and charges customers reasonable prices. The proceeds, above cost, go to the Red Cross.

Grand Rapids, Wisconsin, has made many packing boxes for the Red Cross.

Bermidji, Minn., schools are making tables for the Y. M. C. A.

The school board of Cleveland, Ohio, is seriously discussing changes in course to meet war time needs along vocational and military lines.

Manual Training boys of Nampa, Idaho, have made shipping boxes for the Red Cross similar to chests, with handles and castors.

Boys in Cleveland made 6 dozen checker boards for "Y."

Training schools for registrants are being established at 32 vocational schools in Wisconsin.

Phoenix, Ariz., has a remarkable record in industrial work for the war.

Sioux City, under the leadership of Supt. M. G. Clark, is leading in industrial changes in Iowa.

Forty Manual Training teachers of New Jersey are in the service.

At Kearney, N. J., 146 boys are knitting for local Red Cross. Jersey City boys have made knitting machines and folding cots.

West Des Moines high school made high records in Red Cross work. The boys made comfortable easy chairs, card tables, curtains, 100 Red Cross solitaire, 20 sets of drum sticks, miniature bridges, forts and trenches, bulletin boards, morris chairs, rockers and card tables for Red Cross and "Y" in Des Moines and in Camp Dodge.

The state of Pennsylvania reserved \$100,000 to be used in manual training shops for the greatest benefit to the government.

Industrial Arts Department of Oklahoma City made 10 game tables and many individual boxes and packing boxes for the Red Cross. They also made book ends, candle sticks, bowls, door stops, toys, match holders, yarn holders and other articles for Red Cross sale.

Spokane, Washington, made baskets, decorated cans, post stamp albums, flower pots, foot stools, bird sticks, portfolios, vases, pictures and cook books for Red Cross sale.

School in Akron, Ohio, recently made ten checker boards.

Boston school made 200 game tables for Y. M. C. A.

Art Department in Oswego painted name, branch and insignia on tops of officers' trunks for overseas.

Red Cross folding boards are made 10³/₄ by 12 inches and are shellaced twice.

The Southwest Texas Industrial Arts Club declared that the needs of the government took precedence over individual needs and that war activities were not detrimental to the industrial training of pupils. They resolved to aid the government in every way possible and advocated more stress being put on matter of speed in all construction work.

The boys in the manual training shops of Superior, Wisconsin, have made a number of boats and donated them to the Y. M. C. A.

The boys of the Junior High School of Parkersburg, W. Va., made Red Cross banners and flags, lumber rack, tool racks and benches, and other articles of furniture for the school.

The boys in the schools of Johnstown, Pa., made tables and benches for use in farm camps of the Boys' Working Reserve.

The High School manual training shop at Iowa City made several Red Cross packing boxes, checker and crokinole boards.

The Vocational Educational Association of the Middle West met recently and gave the following cautions and statements: Don't spend money to make things until you are assured they

are all wanted. Don't send things that have been made until you have reason to know they will be gladly received. Don't expect the Red Cross to pay for articles made or for material unless given official assurance. Pupils and teachers want to render aid to the government. It is necessary for schools to prove that they can do things before getting much encouragement from headquarters.

The following list was submitted as suitable for grammar grades and high school children to make: Packing cases, 24 in by 24 in by 36 in.; reel for winding yarn, stocking knitting frame, pin balls, map and picture puzzles, checker boards, puzzles chess board and men, solitaire boards, cribbage score boards, ring-toss games, bean bag games, ping pong sets, box ball sets, case or box for above games, splints, crutches, hospital trays, stretchers, canes, canvas chairs, back rests, 32 in. by 18 in., bed trays bed cages, baseball bats, bird cages and flower boxes.

Ira S. Griffith of the University of Missouri says that we have found a way to be of service and that the Red Cross and Y. M. C. A. offer great chances to help the cause. He says that there are 32 army cantonments with a total of 500 Y's, that each building uses 8 to 10 tables, or a total of 5,000 tables. Very few of these buildings are entirely equipped with tables and other articles of furniture.

A high school in Iowa calls for volunteers to work after school for the Red Cross, making articles for use and sale.

The National Society for the Promotion of Vocational Education met in Philadelphia recently and emphasized the importance of hospital supplies needed in the near future. They stated that there are 20,000 men injured in industries in the U. S. each year. They advocated preparing for a large number of wounded men by making hospital articles in manual training shops.

England has proposed raising the age of compulsory education in the industries to 18 years.

The Council of the Western Drawing and Manual Training Association decided to postpone their proposed meeting in St. Paul this spring in order to help transportation congestion.

The Northeastern Teachers' Association of Iowa discussed the Smith-Hughes Act and one of the speakers made the following conclusions: Law makes possible nationalization of vocations. The requirements are: 1. State and school must have definite acceptable plan. 2. Emphasis must be put on, (a) Fitting pupil for useful occupation; (b) Provision must be made for a specialized teacher; (c) Education of each state or school must show improvement. High school pupils must be over 14 years of age. It reaches the boy outside of high school. Difficult to obtain teachers qualified under the act. The Act appropriates a total

of \$1,860,000 in the U. S., and Iowa's share this year was \$34,829.39.

The manual training boys of Franklin, Pa., under J. G. Morgan, made Y. M. C. A. game tables according to the following: Ten tables is greatest number one school can make. Yellow pine that is well dried and clear. Three pieces are in top with tongue groove, corner braces, dovetailed and glued in place. Lag screws used to hold legs in place. Legs are tapered on two sides from 9 in. of top. Painted checker boards on table top and boards are 9"x9" with squares 1 1/8"x1 1/8". Red and black shellac is used to color and polish board. One coat white shellac and two coats flat varnish. Specifications: 36"x24"x28" high. Rail 3 3/4" and top 1 3-16" thick.

A pen holder has been designed by Frank H. Shepherd for 7th and 8th grades. It is used in Y buildings and is made of oak, walnut or maple, 3/8" thick. Half inch bit use to make grooves and are fastened with brads. Stain and wax. Size is 10"x10" with 5 grooves on side.

Cigarette stub receptacle is made of 30 gauge galvanized iron and is 9 1/2" at bottom, 10" top and is 6"x5 1/2" at end.

The Northern Normal School of Aberdeen, S. D., after making knitting needles and Red Cross articles, made 1,000 checker boards and 2,400 men for use in Y. M. C. A. buildings at a cost of 11c each. They used 10 pieces of 3-ply gum, 30"x7'-0", and sawed into 14" squares. Stenciled with lampblack and boiled oil and thinned with Japan drier. They used two coats shellac and printed name of school on back. Men were made from 120 feet 1 1/4" dowel maple or birch 5-16" long. Men were dyed, 1,200 red and 1,200 black. Mahogany powder stain and hot water made the red, and blackened gunmetal and powder stain made the black. Then men were put in a large rattler with orange shellac and raw linseed oil for 20 minutes at a time for four times. One hundred boxes were made to hold the men. They were of pulp board and gummed tape.

The list of accomplishments could be much extended, but these few show the possibilities we have as manual training teachers to do our share here at home. For the benefit of those who are interested in this work, I shall close this article by giving the sources of outlines, descriptions, etc., of articles that may be made in manual training shop.

The Industrial Arts Magazine, The Bruce Pub. Co., Milwaukee.

Manual Training Magazine, The Manual Arts Press, Peoria, Ill.

Bureau of Education, Dept. of Interior, Washington, D. C.
Department of Public Instruction, Des Moines, Iowa.

Proceedings of the 63rd Annual Session of Iowa State Teachers' Association. O. E. Smith, Indianola, Iowa.

Director Vocational Education, W. H. Bender, Des Moines, Iowa.

STUDENTS' OUTLINE FOR COURSE OF STUDY

The outlines given for a course of study in this book assume that the work is given in the 6th, 7th, 8th, 9th and 10th grades. Naturally, some modification must be made if the work is offered in a different combination of grades. Largely for these reasons, each student was required to outline a course of study for his own particular school.

This paper included (1) principles to be emphasized in each grade, (2) projects to be used, and (3) general plans to be followed in preparing for and carrying on school work.

DEMONSTRATION OUTLINES M. E. 245

The aim and object of the shop work in course M. E. 245 is to give as much practical experience in the care and use of the common tools and the use of special tools and jigs as the limited time will permit.

The work of the first two weeks will be on projects of the 7th and 8th grade, reviewing the fundamental tool processes. The last four weeks of the course the student will be given considerable freedom and will be permitted to select more difficult projects for 9th and 10th grade work and will be encouraged to use special tools and jigs in their construction.

The demonstrations and discussions will cover different methods of construction and different methods of presentation and are intended to be a help to the student in mastering his work as well as helping him to present it to others.

I.—Squaring up stock.

A demonstration and explanation of each step necessary in squaring stock to definite dimensions. Analyzing the rule for squaring stock, showing the importance of the first two steps.

The blocks that are used for this demonstration will be used later to demonstrate the method of making some of the common furniture joints.

References:

Fundamental Tool Processes.—Laughlin.
Woodwork for Secondary Schools.—Griffith.
King's Woodworking Series.—King.
Essentials of Woodworking.—Griffith.

II.—Finishing.

This demonstration will cover the common methods of finishing in the manual training shop, including staining, filling, shellacing, varnishing and waxing.

More emphasis will be placed in this course on the preparation of the work for finish than in course M. E. 140, emphasizing the necessity for good workmanship before staining.

References:

Fundamental Tool Processes.—Laughlin.
Woodwork for Secondary Schools.—Griffith.
King's Woodworking Series.—King.
Essentials of Woodworking.—Griffith.

III.—Fuming and Special Finishes.

Method of fuming.

Kinds of wood that can be fumed.

Advantages and disadvantages.

References:

Fundamental Tool Processes.—Laughlin.
Woodwork for Secondary Schools.—Griffith.
King's Woodworking Series.—King.
Essentials of Woodworking.—Griffith.

IV.—Planes.

Demonstration on grinding and whetting the plane, bit, also the adjustment of the plane for use.

Demonstration of use of special planes, i. e., plow, rabbet plane and jointer.

References:

Fundamental Tool Processes.—Laughlin.
Woodwork for Secondary Schools.—Griffith.
King's Woodworking Series.—King.
Essentials of Woodworking.—Griffith.

V.—Saws.

Demonstration of the distinguishing characteristics of the rip and cut off saws and operation of each.

Necessity for, and method of setting and filing saws.

References:

Fundamental Tool Processes.—Laughlin.
Woodwork for Secondary Schools.—Griffith.
King's Woodworking Series.—King.
Essentials of Woodworking.—Griffith.

VI. & VII.—Mitre Box, Try Square, Framing Square and Special Tools.

Demonstration of operation and use of mitre box and special tools, showing that in reality they are some form of a jig.

1. Their importance in the mechanical industry.
2. Framing square.

- Explanation of scales and tables.
3. Try square.
Definition and use.
 4. Combination square.

References:

Fundamental Tool Processes.—Laughlin.
Woodwork for Secondary Schools.—Griffith.
King's Woodworking Series.—King.
Essentials of Woodworking.—Griffith.

VIII.—Shop mathematics.

1. Review of fractions and decimals.
2. Board measure, figuring lumber bills and estimating.

References:

Shop Arithmetic.—Norris & Smith.
Industrial Mathematics.—Marsh.

IX. & X.—Mechanical drawing for 9th and 10th grades.

1. Value of drawing.
2. Methods of presenting.
3. Amount of time devoted to drawing.

References:

Constructive Drawing, Vol. I & II, Atkinson, Mentzer & Co.
Mechanical Drawing for Secondary Schools.—Crawshaw & Phillips.

XI.—Methods of charging for shop material.

Discussion of several methods of keeping shop accounts showing the advisability of keeping accurate accounts for the benefit of the teacher as well as the pupil.

XII.—Factors to be considered in grading.

1. Value of grading.
 - a. To the teacher.
 - b. To the pupil.
2. Accuracy of work.
2. Attitude toward work.

References: School Efficiency.—Bennett.

XIII.—Shop discipline.

1. Necessity for discipline.
2. Amount of freedom allowable.

References: School Efficiency.—Bennett.

XIV.—Methods of presenting 9th and 10th grade shop work.

1. Exercise method.
Advantages and disadvantages.
2. Project method.
 - (a) Productive projects.
 - (b) Experimental projects.
 - (c) Improvement projects.

References: Woodwork for Secondary Schools.—Griffith.

XV.—Wood turning.

1. Value of turning in the industries
2. Value of turning for training.
3. Place for turning in school curriculum.

References:

Problems in Wood-turning.—Crawshaw.
Wood Turning.—Goss.

XVI.—Upholstering.

1. Slip seat with padding.
2. Solid seat with padding and trim.
3. Box seat with springs and padding.

References:

Industrial Arts Magazine.
Manual Training Magazine.

XVII. & XVIII.—Carving and inlaying.

Demonstration of methods of carving and inlaying that would be applicable to shop work where equipment is limited.

References:

Industrial Arts Design.—Varnum.
Woodwork for Secondary Schools.—Griffith.

XIX.—Discussion of examinations.

1. Value of examinations.
 - (a) To the teacher.
 - (b) To the pupil.
2. Necessity for examinations in laboratory course.
3. Teachers examination.

References: School Efficiency.—Bennett.

M. E. 250—LECTURE OUTLINES

I. General Explanations and Scope of the Course.

This period, as in the M. E. 148, was used in straightening classification, making arrangements and giving a general idea of the work to be covered. A general idea may be obtained by referring to the lecture of the same title under the head of M. E. 148.

WOOD TURNING

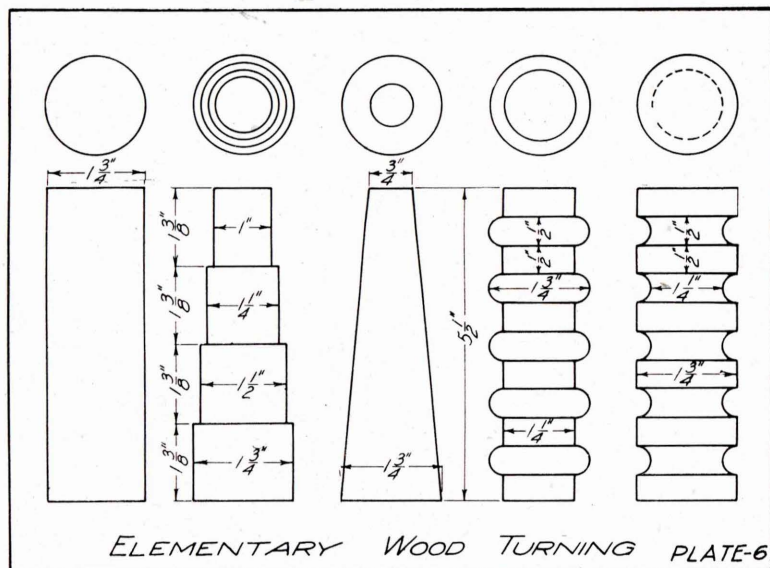
Although there may be some question as to the practical value of a course in wood turning in the public school, the work is too firmly established to disregard. Any course that is given should have a definite purpose and follow a logical development. The following outline and drawing give a suggestion of such a course. By a careful selection of projects, the exercise material may be entirely omitted and more useful material given.

WOOD TURNING

Group	Principles Emphasized.	Type Problem Required.	Suggested Projects.
I. Work between centers.	<ol style="list-style-type: none"> 1. Oiling. 2. Speed of work. 3. Kinds of tools. 4. Sharpening tools 5. Preparing and centering. 6. Placing and driving the work in the lathe. 7. Adjusting the rest. 8. Roughing out with the gouge. 9. Paring with the skew chisel. 10. Cutting off with tool. 11. Facing the ends. 12. Laying out and sizing the work. 13. Use of outside and inside calipers. 14. Inside square corners. 15. Convex cuts. 16. Concave cuts. 17. Templates. 18. Boring in the lathe. 19. Sandpapering. 	Talks and demonstrations illustrating the principles indicated. Exercise pieces to bring out principles involved followed by projects of interest to the boy, but at the same time so designed as to fall in the proper places educationally.	Potato masher. Indian clubs. Dumb bells Darner Ball bats Candle sticks Vases Tea pot stands Jewel boxes Pin trays Nut bowl Napkin ring Collar and button box

	<ol style="list-style-type: none"> 20. Polishing. 21. Use of center screw face plate.
II. Face and Plate and Chuck turning.	<ol style="list-style-type: none"> 22. Round nose and skew chisel in scraping. 23. Surface screw face plate. 24. Cup chuck. 25. Pin chuck. 26. Boring on face plate. 27. Finishing and polishing.
III. Relation to the industries.	<ol style="list-style-type: none"> 28. Evolution and economy of power tools.

1. Visit shops, calculate and compare the cost of doing work by hand and power methods.
2. Draw plans of some shop showing most economical location of machines.
3. Study the comparative amount of work done on lathe to (1) that formerly done, (2) that done by other methods.



CHARACTER OF WOOD STRUCTURE

- I. Timber as a material.
 - A. Relative importance (growing in consumption although largely superseded).
 - B. Number of kinds.
 1. About 500 in U. S.
 2. Few of commercial importance.
(pine, fir, oak, hickory, hemlock, ash, poplar, maple, cypress, spruce, cedar, walnut.)
 - C. Confusion over classification.
 1. Botanical names dependable, but cumbersome.
 2. Ordinary classifications misleading.
 - a. Broad leaves, needle leaves (conifers).
 - b. Hard woods, soft woods.
 - c. Fruit, naked seeds.
 - d. Single seed, two seed.
 - e. Evergreen, deciduous.
- II.—Timber woods, growth and structural characteristics.
 - A. Classes.
 1. Endogens or endogenous.
 2. Exogens or exogenous.
 - B. Endogens.
 1. Class (palms, yuccas, bamboos).
 2. Importance.

- a. Piling and structural material in the orient.
 - b. Practically none in this country.
- C. Exogens.
 1. Classification.
 - a. Conifers.
(Pines: western white, northern white, California sugar, long leaf yellow, short leaf yellow, western yellow, Cuban yellow, loblolly, red); (fir: Douglas, Noble, balsam, lowland); tamarack, hemlock, arborvitae, big trees, cypress, red and white cedar; juniper, Sitka and Engelmann, spruce, red wood, etc.
 - b. Broad leaves.
(Red, white and burr oak; black, white and Oregon ash; shell bark and pignut hickory; poplar; sugar and silver maple; willow, eucalyptus; boxwood; mahogany; black and white walnut; red, white and rock elm; chestnut; birch; beech; cherry; red, water and cotton gum; horse chestnut; laurel; satinwood; locust; basswood; whitewood; sycamore; catalpa, alder, holly.)
 2. Growth.
 - a. Pith.
 - b. Wood.
 - (1) Heart wood.
 - (2) Sap wood.
 - (3) Cambium layer.
 - (4) Primary.
 - (5) Secondary
 - (6) Annular rings (spring and summer wood).
 - (7) Medullary rays.
 - c. Character and properties.
 - (1) Cellular structure (long cells)
 - (a) Kinds (thick walled and thin walled).
 - (2) Moisture content.
 - (a) Where.
 - (1) In all walls.
 - (2) In cavities of and between cells.
 - (b) Amount.
 - (1) About 90% in sapwood.
 - (2) Less in heart wood.
 - (3) Shrinkage.
 - (a) Cause; variation in moisture content.
 - (b) Amount; more in thick walls than in thin.
 - (c) Direction; along annular rings.

- (d) Effect; warp.
- (4) Character of grain; non, ring and diffuse porous.

References:

American Woods.—R. B. Hough.
 Woods and Forest.—Noyes.
 Materials of Construction.—Mills.

EFFECT OF WOOD STRUCTURE ON CONSTRUCTIVE DETAILS

- I. Methods of sawing.
 - A. Plain.
 - 1. Purpose (cheapness).
 - 2. Restrictions.
 - B. Quartered.
 - a. On oak (beauty of grain and relative freedom from warp).
 - b. On pine (freedom from warp and splintering).
 - C. Rotary cut.
 - 1. Purpose (beauty of grain and saving of material).
- II.—Class of grain.
 - A. Open grain (effects on gauging, cutting and filling).
 - B. Close grain (effects on gauging, cutting and filling).
- III.—Warping.
 - A. Cause.
 - B. Prevention.
 - 1. Cleats.
 - 2. Grooves to break strength.
 - 3. Moisture proof covering.
- IV.—Season checks.
 - A. Cause.
 - B. Prevention.
 - 1. Paint or varnish ends.
 - 2. Cover ends in making furniture.
- V.—Shear.
 - A. With grain.
 - B. Across grain.
- VI.—Methods of fastening.
 - A. Nails.
 - 1. Setting.
 - 2. Toe nailing.
 - 3. Blind nailing.
 - 4. Clinching.
 - B. Screws.
 - 1. Pilot holes.
 - 2. Countersinking.

- 3. Drive screws.
- C. Glue.
 - 1. Comparison of dry and liquid.
 - 2. Cautions and limitations.
 - 3. Use of dowels.
- D. Keys.
- VII.—Grading of lumber.

Defects: knots, knot holes, splits, shake, wane, red heart, pith, rot, rotten streaks, worm holes, pitch, pitch pockets, torn grain, loosened grain, seasoning checks, sap stains, crooks and defects caused by manufacturing.
- References:

American Woods.—R. B. Hough.
 Wood and Forest.—Noyes.
 Materials of Construction.—Mills.

WOOD FINISHES (Need, Kinds, etc.)

- I.—Purpose.
 - A. Furnish protective covering.
 - B. Emphasize beauty of the grain.
 - C. Protect and beautify.
- II.—Kinds.
 - A. Natural.
 - 1. Protects from elements.
 - 2. Emphasizes natural beauty of the grain.
 - B. Stained.
 - 1. Protective covering.
 - 2. Grain contrast.
 - 3. Provides color harmony.
 - C. Painted.
 - 1. Protective covering.
 - 2. Uniformity of color.
- III.—Material.
 - A. Stain.
 - 1. Classified by solvent.
 - a. Water.
 - (1) Made of any coloring matter that will dissolve in water (vegetable, animal or mineral).
 - (2) Comparatively cheap.
 - (3) Penetrate deeply.
 - (4) Raise the grain of the wood.
 - (5) Usually permanent.
 - (6) Easily applied without showing laps.

- b. Oil.
 - (1) Made of oil soluble dyes.
 - (2) More expensive than water stains.
 - (3) Do not penetrate deeply.
 - (4) Do not raise the grain.
 - (5) Fade somewhat (usually).
 - (6) Easily applied without showing laps.
 - (7) Solvents (alcohol, amyl acetate, etc.).
- c. Spirit.
 - (1) Made of spirit soluble dyes.
 - (2) Expensive.
 - (3) Penetrate deeply and quickly.
 - (4) Do not raise the grain.
 - (g) Usually fade easily.
 - (6) Difficult to apply—show laps.
 - (7) Solvents (alcohol, amyl, acetate, etc.).
- 2. Classified by chemical nature.
 - a. Vegetable.
 - (1) Kinds (logwood, japonica, cutch, walnut crystals, etc.).
 - b. Mineral.
 - (1) Kinds (analines, etc.).
 - (2) Dependability (variable in some cases).
 - c. Acid.
 - (1) Kinds (chromic, tannic, acetic, pyrogallie).
 - (2) Dependability (recommended).
 - d. Alkaline.
 - (1) Kinds (ammonia, soda, potash, lime).
 - (2) Dependability (fixed alkalies have a tendency to produce saponification).
 - e. Combination acid and alkaline (fuming).
 - (1) Limited to a few woods.
 - (2) Dependent upon chemical action taking place in the wood.
 - (3) Cheap.
 - (4) Permanent.
- 3. Pigment stains.
 - (Should be called thin paints or graining colors.)
- 4. Classified by colors.
 - (Black, brown, red, green.)
- B. Filler.
 - 1. Purpose.
 - a. Fill pores of wood.
 - b. Give smooth, non-absorbent surface.
 - 2. Kinds.

- a. Liquid for close grained woods.
- b. Paste for coarse grained woods.
- 3. Composition.
 - a. Ground rock crystal.
 - b. Raw linseed oil.
 - c. Turpentine.
 - d. Coloring matter to match stain.
 - e. Varnish.
- 4. Use
 - a. Thinning.
 - b. Applying.
 - c. Surplus removed.
- C. Wax.
 - 1. Purpose.
 - a. Put on surface polish.
 - b. Protection.
 - 2. Kinds.
 - a. Liquid.
 - b. Powder.
 - c. Paste.
 - 3. Composition.
 - a. Beeswax, carnauba, kerosene, paraffine, Japanese.
 - b. Turpentine.
 - 4. Use.
 - a. Apply thin coat.
 - b. Allow to dry.
 - c. Rub briskly with soft cloth.
- D. Varnish.
 - 1. Purpose.
 - a. Non-absorbent surface.
 - b. Beauty.
 - c. Fill pores of wood.
 - 2. Kinds.
 - Linloxyn, spirit, volatile oil, fixed oil, pyroxylin.
 - 3. Linloxyn.
 - a. Composition.
 - (1) Shellac or varnish resin.
 - (2) Spirit used as solvent.
 - b. Use.
 - 5. Volatile oil varnish.
 - a. Composition.
 - (1) Raw linseed oil.
 - (2) Boiled linseed oil.
 - (3) Mixture of boiled oil and turpentine.
 - b. Use.
 - 4. Spirit varnish.

- a. Composition.
 - (1) Varnish resin (Damar, Sandarac, Mastie, Elemi, Rosin).
 - (2) Volatile oil solvent (turpentine or substitute turpentine).
- b. Use.
6. Fixed oil varnish.
 - a. Composition.
 - (1) Varnish resin (fossil gums or copals; white, manila, brown manila, Kauri of various grades, East India dark and light, Congo, Sierra Leone, Pebble Animi, African Pebble, Zanzibar, Asphaltum, etc.).
 - (2) Fixed oil.
(Linseed oil, china wood oil, degreas.)
 - (3) Thinner.
(Turpentine, or substitute turpentine.)
 - (4) Drier.
(Red lead, litharge, manganese borate, manganese dioxide, etc.)
 - b. Use.
 - (1) Apply in thin coats with brush.
 - (2) Sand carefully between coats or rub with steel wool or pumice and water.
 - (3) Repeat until a smooth surface is obtained.
 - (4) Finish by rubbing with pumice and oil or rotten stone and oil.
7. Paint.
 1. Purpose.
 - (a) Protection against weather.
 - (b) Give uniform color effects desired.
 - (c) Cover grain or defects.
 2. Kinds.
 - (a) Water.
 - (b) Oil.
 3. Composition.
 - (a) White lead or zinc oxide.
 - (b) Pigment.
 - (c) Linseed oil (raw or boiled).
 - (d) Turpentine.
 4. Use.

Apply in thin coats, rubbing in well. Repeat until desired surface is obtained.

References:

Problems of the Finishing Room.—Schmidt.
 Technology of Paint and Varnish.—Sabin.
 Woodwork for Secondary Schools.—Griffith.
 Trade Literature.

THE MANUFACTURE OF WHITE LEAD

This set of slides furnished by the National Lead Company and circulated by the Visual Instruction Service of the Iowa State College, illustrates in a very clear way the manufacture of one of the very important materials used in wood finishing. Space will not permit giving more than a mere mention of the slide titles, which are as follows:

1. Pig lead as it comes from the smelter.
2. Furnace for melting pig lead.
3. Casting metallic lead into buckles.
4. Dumping and spreading tan bark.
5. Setting the corroding pots.
6. Putting acetic acid into pots.
7. Putting acetic acid into pots (near view).
8. Placing lead buckles into pots.
9. Placing lead knuckles into pots (near view).
10. Laying boards over filled pots.
11. Awaiting cover layer of tan bark.
12. Finished stack.
13. General view over top of stacks.
14. Stripping or uncovering stack of corroded lead (old style).
15. Stripping or uncovering stack of corroded lead (modern way).
16. Dumping corroded buckles into lead box.
17. Pot broken to show corroded buckles.
18. Dumping corroded buckles into buckle beater.
19. Buckle beater.
20. Crushing roll.
21. Water mills.
22. Drag box.
23. Shaker screen.
24. Revolving screen.
25. Drying pans.
26. Dry white lead storage hopper.
27. Weigh hopper and scales.
28. Interior of chaser.
29. White lead discharging from chaser.
30. Battery of oil mills.
31. Filling white lead kegs.

THE MANUFACTURE OF VARNISH

This lecture was illustrated by a set of slides selected from a group furnished by the Murphy Varnish Co. and Berry Bros. Varnish Co. A general idea of the subject matter may be obtained from the list of subjects, which were along the following line:

1. Classes of varnish.
2. Typical varnish resins.
3. Classes of people engaged in gum digging.
4. Types of fields.
5. Process of obtaining gum.
6. Manufacture of linseed oil.
7. Origin and manufacture of china wood oil.
8. Distillation of turpentine.
9. Selecting gums and manufacturing varnishes.
10. Production of shellac.

TESTS OF STAINS AND VARNISHES

This series of recitations on wood finishing materials was concluded by making a number of tests of commercial stains, shellacs, fillers, waxes, varnishes and lacquers. These were made for permanency, ease of applying, desirability of results, etc.

PURPOSE OF CONCRETE COURSE

The use of concrete as a material of construction is getting to be so large and so much of it so poorly handled that it seems extremely desirable that some means of educating the general public in its use ought to be taken. This is particularly true in the rural community, where the material is used in too small quantities to justify the hiring of expert help. Furthermore, the material furnishes an excellent medium for a manual training course. It offers unlimited possibilities of design, demands carefully made wood work and at the same time adds an interest that comes from the working of plastic materials. The permanence of such products also appeals to the average boy.

Contrary to the general supposition, the additional equipment necessary is small. It was for these reasons that several lecture periods in the course were taken for discussion of a course in concrete construction suitable for public school work.

MANUAL TRAINING COURSE IN CONCRETE

I.—Divisions.

- A. Class or recitation work.
- B. Laboratory work (experimental).
- C. Shop work.

II.—Recitation work.

- A. Manufacture of Portland cement.
 1. Origin.
 - a. Some form of cement or lime in use since the dawn of civilization.
 - b. 1756, John Smeaton, English government employee, discovered hydraulic lime.
 - c. 1796, James Parker of Northfleet, England,

patented "Roman cement," a sort of natural cement.

- d. Natural cements in the United States in 1818.
- e. 1824, Joseph Aspdin patented Portland cement.

2. Composition.

- a. Argillaceous materials.
 - (1) Clay.
 - (2) Shale.
 - (3) Slag.
- b. Calcareous materials.
 - (1) Limestone.
 - (2) Cement rock.
- c. Adulterant.
 - (1) Gypsum to regulate the time of setting.

3. Process of manufacture.

- a. Mining and quarrying of raw materials.
- b. Drying and grinding.
- c. Proportioning and mixing.
- d. Burning the mixed materials to incipient fusion.
- e. Grinding the clinker thus formed to an extremely fine powder, meanwhile adding the proper proportion of gypsum, the resulting powder being known as Portland cement.

B. Concrete aggregates.

1. Impurities.
2. Vegetable matter.
3. Hardness.
4. Weights and voids.
5. Maximum size.
6. Shape of particles.
7. Gradation and effective size.

C. Proportioning, mixing and placing.

1. Proportioning.
 - a. Object.
 - b. Theory.
 - c. Method.
 - d. Sizing or grading materials (screening).
 - e. Proportioning used for floors, walks, posts, etc.
 - f. Amount of water used.
2. Mixing.
 - a. Fundamental principle.
 - b. Shovel.
 - c. Machine.
3. Placing.
 - a. Pressure and tamping.

- b. Agitation.
- c. Depositing wet concrete.

D. Forms.

- 1. Rectangular.
 - a. All lumber.
 - b. Part metal.
 - c. All metal.
- 2. Circular.
 - a. Wood and sheet metal.
 - b. All sheet metal.
- 3. Miscellaneous.
 - a. Ornamental.
 - b. Unit construction.

E. Reinforcing.

- 1. Object.
- 2. Theory.
- 3. Method.

III.—Laboratory work.

A. Equipment required.

- 1. Mixing box, or platform.
- 2. Measuring boxes.
- 3. Trowels.
- 4. Tamper.
- 5. Bins for storing material.
- 6. Water barrel.
- 7. Two or three buckets.
- 8. Wheelbarrow (preferably with a metal body).
- 9. Screen for separating sand and gravel ($\frac{1}{4}$ " mesh screen).
- 10. Two square nosed shovels.
- 11. Curing tubs for exercises (such tubs can be made from oak oil barrels sawed in two).
- 12. Machine for testing small beams.

B. Form making.

- 1. Rectangular.
- 2. Ornamental work.
- 3. Unit Construction.
- 4. Work requiring reinforcing.

C. Suggested projects.

- 1. Building blocks.
- 2. Horse block.
- 3. Bird bath.
- 4. Foundations.
- 5. Hotbed frame.
- 6. Troughs.
- 7. Fence posts.
- 8. Hitching posts.

- 9. Flower box.
- 10. Garden seat.

IV.—Experimental work.

- 1. Percentage of sand and gravel in bank run.
- 2. Size of sand grains.
- 3. Percentage of silt in sand.
- 4. Percentage of voids in sand and gravel.
- 5. Strength of mortar.
- 6. Strength of reinforced beams.

References:

Bulletins.—Iowa State College.

Bulletins.—Portland Cement Association.

Practical Concrete for the School and Home.—Campbell and Beyer.

SHOP ORGANIZATION

A.—Need of system.

- 1. Systematic training.
- 2. Help in shop also.
- 3. Regular classes make it possible.

B.—Lumber racks.

- 1. New lumber.
- 2. Odd lengths.
- 3. Scraps.
- 4. Unfinished exercises.

C.—Other cases.

- 1. Stain bench.
- 2. Glue bench.
- 3. Screw and nail case.
- 4. Tool board or case.
- 5. File for drawings.
- 6. File for drawing boards.
- 7. Hat and coat racks.
- 8. Apron rack.
- 9. Pigeon holes for books.

D.—Management.

- 1. Inspectors.
 - a. Bench.
 - b. Drawing board.
 - c. Tool board or stock room keeper.
 - d. Stain and finish bench.
- 2. General order and discipline.
- 3. Getting supplies and tools.
- 4. Bookkeeping system.
- 5. Grading.

SHOP EQUIPMENT

A.—Kinds of tools and supplies.

1. Intended use.
 - a. Individual.
 - b. Bench.
 - c. General.
 - d. Supplies (in special outline).

B.—Individual.

1. Plane iron.
2. Chisels.
3. Knife.

C.—Bench.

1. Sloyd knife (Ed Zinn Elephant Brand No. A 2½" or equal).
2. Try square (Stanley No. 20 9").
3. 12" steel rule (Lufkin No. 60).
4. 6" marking gauge (Stanley No. 65).
5. ⅜" beveled edge, socket, butt chisel (Buck Bros. or Barton's).
6. Solid back bench brush.
7. 12" 14 pt. back saw (Disston No. 4).
8. 3"x5" round head, mortised head hickory mallet.
9. 14" jack plane (Stanley Bed Rock No. 605).
10. 1"x2"x6" medium India oilstone in iron box.
11. Drawing boards (Springfield industrial kit No. 3).
12. Eagle compasses No. 576.

D.—General Tools.

1. Copperized steel oilers. ¼ pint.
2. Rip saws, 24". 8 joint (Disston's No. D8).
3. Cross cut saws, 22", 10 point (Disston's No. D8).
4. Hammers, 13 oz. bell faced claw (Maydole's).
5. Bit braces, 8" sweep (Stanley No. 921).
6. Framing squares, 2 ft.
7. Gimlet bits (Pratt's) (3-32" to 7-32").
8. Countersink, ⅝" rose.
9. Dowel bits (½" and ⅜") (Russell Jennings).
10. Auger bits (¼" to 1" by 16ths) (Russell Jennings).
11. Expansive bit.
12. Cabinet maker's clamps, 4 ft.
13. Screw drivers (3", 5" and 7") (Stanley Hurwood).
14. Cabinet scrapers.
15. Nail sets (Syracuse) (cup point).
16. Wing dividers.
17. Dowel plates.
18. Knife handle monkey wrench (Coe's).
19. Saw files (5" slim taper).
20. Saw vise.

21. 14" turning saw with extra blades.
22. Pliers.
23. Sliding T bevel.
24. Half round bastard file (10").
25. Oval burnisher.
26. Mitre box.
27. Nest of saws (keyhole compass and pruning).
28. Peerless Jorgensen clamps (8" and 10").
29. Smooth planes (Bed Rock).
30. Jointer planes (Bed Rock).
31. Block planes (Stanley No. 60).
32. Pike peerless tool grinder (Senior).
33. Chisels (¼", ½", ¾", 1", 1½") (Buck Bros. or Barton).
34. Benches.

SUPPLIES FOR MANUAL TRAINING SHOP

I.—Kinds.

- A. Lumber.
- B. Hardware.
- C. Finishes.
- D. Drawing materials.

II.—Lumber.

- A. Quartered red oak (or white) 1".
- B. Clear cypress (1" and ½").
- C. White pine (Idaho D) (1" and ½").
- D. Basswood, 1".
- E. Poplar.
- F. Mahogany.

III.—Hardware.

A. Screws (flat head, bright and round head blued).

⅝" No. 5	1 " No. 8	1¾" No. 10
¾" No. 6	1¼" No. 9	2 " No. 12
7/8" No. 7	1½" No. 10	
Brass cup hooks, ½"		
Brass screw eyes, ¼"		

B. Nails.

⅜" brads	7/8" brads	6d finish nails
½" brads	1 " brads	9d finish nails
⅝" brads	1¼" brads	10d finish nails
¾" brads	1½" brads	
		3d common nails
		4d common nails
		6d common nails
		8d common nails
		10d common nails

C. Sandpaper, No. 00, No. 0, No. ½, No. 1, No. 1½, No. 2.

IV.—Finishes.

- A. Stain.
- B. Filler.
- C. Wax.
- D. Varnish.
- E. Benzine.
- F. Turpentine.
- G. Denatured alcohol.
- H. Varnish Brushes.

V.—Drawing materials.

- A. Squared paper for 6th grade (9"x12").
- B. Manila paper for 7th and 8th grades (12"x18").
- C. Drawing paper for high school (11"x15").

DESIGN I

Division of Industrial Arts design. The Primary mass and its proportions.

I.—References.

- A. "Industrial Arts Design," Varnum.
- B. "Furniture Design for Schools and Shops," Crawshaw.

II.—Division of industrial arts design.

A. Need.

- 1. Solves complete problems.
- 2. Makes possible the using of one's ideas.
- 3. Develops initiative.
- 4. Develops power to create, select and reject.
- 5. Non-technical criticism.
 - a. Ambiguous terms; good-looking, ugly, squatty, stiff.
- 6. Intelligent analysis.
 - a. Can analyze intelligently (not dependent upon "what he likes").
 - b. Knowledge of principles that have survived hundreds of years.

B. Results of clear criticism.

- 1. Harmony of home surroundings.
- 2. Basis for criticism or appreciation.
- 3. Leads to better forms of construction.

C. Kinds of design.

- 1. Pure.
- 2. Applied.
- 3. Constructive.

D. Requirements of industrial problem.

- 1. Service to community of individual.
- 2. Constructed of durable material.
- 3. Beauty of proportion and color.

E. Divisions of industrial arts design.

- 1. Structural design.
- 2. Contour enrichment.
- 3. Surface enrichment.

III.—The primary mass and its proportions.

A. Architectural methods.

- 1. Masses planned first.
- 2. Details worked out later.

B. Industrial arts method.

- 1. Problem considered as simple mass at first.
- 2. Details disregarded at first.

C. The primary mass.

1. Service.

- a. *Rule 1a.* "A primary mass must be either vertical or horizontal, according to the intended service, unless prohibited by technical requirements."

b. Horizontal and vertical examples.

- (1) Davenport
Chair
- (2) Low bowl for pansies
High bowl for goldenrod.

2. Proportions.

- a. *Rule 1b.* "A primary mass should have the ratio 1:3, 3:4, 3:5, 5:8, 7:10, or some other similar proportion difficult for the eye to detect readily and analyze."

b. Monotonous ratios.

- 1:1 or 1:2 (similar to people speaking in a low, monotonous voice).

c. Weak and indeterminate ratios.

- 2:2 $\frac{1}{8}$ or 3:3 $\frac{1}{4}$ (neither positively square nor frankly rectangular).

3. Preliminary thinking in terms of design.

- a. Thinking out problem.
- b. Drawing one rectangle.
- c. Subsequent procedure determined by technical limitations of tools and materials.
- d. Avoid slipshod methods.

DESIGN II

I.—General considerations.

- 1. Rhythm (movement or flow of parts).
- 2. Balance (equalization of parts to produce real or apparent rest).
- 3. Harmony.

II.—Horizontal major divisions.

1. Divisions of the primary mass.
 - a. Nature or intended service (already discussed).
 - b. Division necessary.
 - (1) Structural requirements.
 - (2) Improvement of appearance.
 - (3) Two simple types.
2. Nature and need of divisions.
 - (1) Appearance.
 - (2) Bind whole together.
3. Architectural horizontal divisions.
 - (1) Compare buildings.
 - (2) Lengthen or shorten by lines.
4. Designing objects with horizontal divisions.
 - a. Height established to suit needs.
 - b. Rectangle formed to enclose whole.
(Rule 1c—Rectangle designed from service and good proportion standpoints.)
 - c. 3 horizontal spaces formed by rail and shelf.
 - d. Several sketches made and best selected. Top may project slightly without affecting proportions.
 - e. Relation of side to front view.
Value of large drawings.
Round object similar.
5. Architectural precedent for horizontal divisions. (Divide complex objects into two or three general divisions.)

Rule 2A. "If the primary mass is divided into two horizontal divisions, the dominance should be either in the upper or lower sections." (Monotonous 1:1 or equal) (same general rule as rectangle) (Pinched or dwarfed proportions) (screen).

Rule 2B. "If the primary mass is divided into three horizontal divisions or sections, the dominance should be placed in the center section with varying widths in the upper and lower thirds."

III.—Vertical major divisions of the primary mass.

- Rule 3A.* "If the primary mass is divided into two vertical divisions, the divisions should be equal in area and similar in form." (Balance.) (Except in cases where structural requirements prohibit.)
- Rule 3B.* "If the primary mass is divided into three vertical divisions, the center division should be the larger, with the remaining divisions of equal size."
- Rule 3C.* In elementary problems, if more than 3 vertical divisions are required, they should be so grouped as to analyze into rules 3A or 3B or be exactly similar.

DESIGN III

I.—Appendages.

A. Rules.

Rule 4A. The appendage should be designed in unity with, and proportionately related to, the vertical or horizontal character of the primary mass, but subordinated to it.

Rule 4B. The appendage should have the appearance of flowing smoothly and, if possible, tangentially from the primary mass.

Rule 4C. The appendage should, if possible, echo or repeat some lines similar in character and direction to those of the primary mass.

B. Use of appendage.

C. Violations of appendage design.

1. Dresser mirrors.
2. Handle.
3. Tall chimney on flat building.

D. Appendages in wood.

E. Unifying the appendage and primary mass.

II.—Enrichment of the contours or outlines of designs in wood.

A. Need and value of enrichment.

(Criticism of average school work.)

B. Contour enrichment.

Rule 5A. Outline enrichment should be subordinated to and support the structure.

Rule 5B. Outline enrichment should add grace, lightness and variety to the design.

C. Purpose.

1. Grace.
2. Lightness.
3. Variety.
4. Unity.

D. Requirements.

1. Should not obscure or destroy structural lines.
2. Should add to apparent strength or beauty of object. (Turned candlestick) (Vines on building).

E. *Rule 5C.* Outline enrichment, by its similarity, should give a sense of oneness or unity to the design, building diverging members together.

THE SMITH-HUGHES VOCATIONAL EDUCATION BILL

Introductory:

- I.—Purpose. To aid the states in the promotion of specified vocations.

II.—Vocations.

- A. Agriculture.
- B. Trades and Industries.
- C. Home Economics or Home Making.

III.—Aid.

- A. Salaries of teachers, supervisors, etc., in each.
- B. Preparation of teachers, supervisors, etc., in each.
- C. Investigations, studies and administration.

Federal Board.

I.—Members.

- A. Secretary of Agriculture.
- B. Secretary of Commerce.
- C. Secretary of Labor.
- D. U. S. Commissioner of Education.
- E. Three citizens of U. S. President's appointive power.
 - 1. One for one year. One for two years. One for three years, after which for three years each.
 - 2. Salary of \$5,000 per annum.

II.—Function.

- A. Advise and control (by approval) courses and plans outlined by states.
- B. Disburse moneys.
 - 1. Ascertain amount for each state and report to Treasurer. Money then paid to state custodian.
 - 2. Withhold moneys if state is not using them according to contract, their plans and courses. State may appeal from such decision to congress.
 - 3. Deduct from subsequent state appropriation any amount which said state has not used.
 - 4. Withhold state appropriation if such state has lost or diminished any federal moneys.
- C. Make annual report to Congress of moneys spent and include state reports.

State Board.

I.—Members.

- A. Three.
 - 1. Constituted state board of public education.
 - 2. Any state board of public education.
 - 3. Any state board of vocational education.
- B. Provided state assembly is not in session, the governor may accept provisions of federal board and start organization until assembly has been in session sixty days.
- C. State treasurer is made custodian of moneys.

II.—Functions.

- A. Appropriations.
 - 1. Appropriations for a particular vocation must be used exclusively for that vocation.

Sec.	From	Amount	to	Amount	Annually Thereafter	Purpose	Basis		
IIa.	1918	Increase	1926	\$3,000,000	\$3,000,000	Salaries of Teachers of agriculture State allotment	Rural Pop.		
IIa.	1918	Decrease	1924	9,000	27,000	Salaries of Teachers of trades, industry and home economics	Urban Pop.		
IIIa.	1918	Increase	1926	3,000,000	3,000,000	Training Teachers State allotment	Total Pop.		
IIIb.	1918	Decrease	1924	19,000	50,000	Office expense, salaries of Federal Board and assistants, studies and investigations			
IVa.	1918	Increase	1921	1,000,000	1,000,000				
IVb.	1918	Decrease	1920	24,000	90,000				
VII.				200,000	200,000				

2. Appropriations for salaries of teachers or for training.
3. To be paid out by custodian requisition of state board, to schools as reimbursement for expenditures already incurred. Such schools must have been approved by state board.
4. No private or religious institution can receive appropriations.

B. Duties.

1. Make plans outlining:
 - a. Kind of schools and equipment.
 - b. Courses of study.
 - c. Qualification of teachers.
 - d. Qualifications of supervisors and directors of agriculture.
 - e. Training of teachers.
2. Make annual report to Federal Board on or before September first each year of plans and expenditures.

III.—Training of teachers.

- A. Must be under state control.
- B. Must be under public supervision.
- C. Person must have had adequate experience or contact in the line of work for which he is preparing or must have such experience as part of his training.
- D. Person must have minimum requirement of experience as established by state board.
- E. Not more than 60% nor less than 20% of appropriation can be expended for:
 1. Teachers of Agriculture.
 2. Teachers of Trade and Industry.
 3. Teachers of Home Economics.
- F. State must expend dollar for dollar of aid received.

Local School or Community:

I.—Requirements of Federal Board through state plans.

- A. Hire teachers who meet qualifications of state.
- B. Provide building and equipment.
- C. Supply dollar for dollar of aid received.
- D. Expenditure to be not less than that required by state as a minimum.
- E. Cost of instruction supplementary to vocational education which is necessary to build a well rounded course, must be borne by the state or local community.
- F.
 1. Vocational education must be under public control.
 2. To fit for useful employment.
 3. Be less than college grade.
 4. To meet needs of persons over 14 years of age.

- a. Those who have entered upon work (short time courses).
- b. Those who are preparing to enter upon work.
5. Special.
 - a. In agriculture, must provide for supervised practice on farm provided by school or other farm, for six months of year.
 - b. Those who have not entered trade or industrial employment must give half of the time of instruction to practice work on useful or productive basis.
 - (1) Such instruction to extend over not less than nine months per year and not less than 30 hours per week.
 - (2) One-third of appropriation must be given to part time classes for those who have entered into such employment. In such classes, subjects may be given to enlarge the civic or vocational intelligence of persons over 14 but less than 18 years of age. Not less than 140 hours of classroom instruction.
 - (3) Evening trade schools shall require minimum age limit of 16 years and instruction must supplement the daily employment.
 - (a) Towns of less than 25,000 population may modify length of course and hours of instruction per week to meet the needs of the community.

References:

- Bulletins—National Society for Vocational Education.—
New York.
Bulletins—State Department of Public Instruction.

VOCATIONAL DRAWING (M. E. 141)

The purpose of this course is to give the teacher in manual training a better knowledge of mechanical drawing and design that will enable him to teach his subject more intelligently and link the work up more definitely with allied subjects.

The first few plates are exercise plates to enable the student to handle the instruments successfully before he is confronted with the theory of drawing. This is followed briefly by a few plates of geometrical drawing, using as projects, forms and constructions that are commonly used in manual training work, but having as their main aim, the teaching of elementary theory of orthographic projection. The third division of the course is

that of furniture design. In order that a boy should get the full value from the making of a project, we feel that he should design, draw, and then construct, rather than merely copy the design or drawing made by another. This section of the course also gives opportunity for the organization of teaching material for a manual training course covering the three upper grades and perhaps one or two years of the high school work.

Sheet 1. Is an explanatory sheet showing the size of paper to use, method of fastening to the board, method of using triangles, tee square, etc., and should be studied carefully before proceeding with the course.

Sheet 2. Is an explanatory sheet showing the quality of lines to use and the proper methods of dimensioning. If a drawing is to be made on a flat surface and in one color, some other method must be used to distinguish between the different lines on the drawing. This is obtained as indicated on this sheet.

Sheet 3. Illustrates the proper relationship of the top, front and side views, as well as an auxiliary view showing the true size and shape of surfaces not parallel to either the top, front or side.

Sheet 4. Shows a method of developing the surface of the pyramid used in sheet three. This is used to emphasize the reading and proper understanding of the preceding.

Plate 1. This is an exercise in the proper use of the instruments in making straight lines. Copy in accordance to dimensions given, using tee square and triangles as indicated in Sheet No. 1. Study French Engineering Drawing, Chapters I, II and III.

Plate 2. This sheet continues the use of the instruments, but involves circles and tangents as well as straight lines. Read Chapter IV in "French." Notice geometrical constructions and order of inking.

Plate 3. Problem.—This plate will be a drawing of a project suitable for the 6th grade (illustration given). This project should be small, made of soft, thin material and such as can be made with a knife.

Plate 4. Lettering plate.—Lettering is one of the most important parts of mechanical drawing. Many otherwise well executed drawings have been disfigured by poor lettering. This sheet is to help the student to become familiar with the structure of the alphabet and to attain some skill in the making of free-hand letters. The subject matter is left largely with the student, but should be selected in keeping with the work involved. Do not fill out this plate until you have practiced a good deal, and do not stop practicing when the plate is filled out, but continue to practice a little every day.

Plate 5. The hexagon and octagon, after the square, are of considerable importance to the manual training teacher. This plate shows several methods of constructing them. In drawing this plate, be sure to follow the methods indicated.

Plate 6. This plate begins the theory of orthographic projection. Complete the views as indicated. Note carefully the relationship between the top, front and side views. Study "French," Chapter VI.

Plate 7. Design problem. Design some piece of furniture such as a waste basket or tabourette made of soft wood and involving no joints except plain or butt. An assembled drawing required.

Plate 8. Complete the drawings as indicated. This plate may be put on two sheets if desired. Study Chapter VII in "French." (Intersections and developments.)

Plate 9. Change the isometric drawings of the dado and cross lap to orthographic projections showing three views in their proper position (use two sheets for this plate, also). Study Chapter VIII on Pictorial Representation.

Plate 10. This problem is similar to Plate 9 and is intended to emphasize the principles of orthographic projection and at the same time to familiarize the student with common joints. Change from isometric to orthographic.

Plate 11. (Change to orthographic projection.)

Plates 12 and 13. Design problem. Design a piece of furniture suitable for the 8th grade. (See example given.) This problem should be rather small, to be made of hard wood and making use of the dado joint only. The design should be preferably an original design worked out by the student. Make two sheets. One assembled drawing and one detailing each part. (Remember the proper relationship of views.)

Plates 14 and 15. Design problem. This is also a problem in designing furniture and applying the principles of orthographic projection. This project should be one suitable for 9th grade manual training work. It should use some or all of the following joints: Half lap on edge or side, slip joint, blind, through, or keyed mortise and tenon joints and glue joint; it should not be too large and suitable for making in hard wood. Make one sheet of assembled drawings, one or two of details as necessary. Tabulate bill of materials necessary, using finished sizes.

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