WHITE'S
NEW COURSE IN ART INSTRUCTION

OUTLINE

FOR

SIXTH YEAR GRADE

WITH

SUGGESTIONS TO TEACHERS

NEW YORK · CINCINNATI · CHICAGO
AMERICAN BOOK COMPANY

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INTRODUCTORY.

WHITE'S NEW COURSE IN ART INSTRUCTION is not the result of one person's thought; nor was it, primarily, a commercial venture. It embodies the ideas of many, who, starting at widely separated points and working individually along different lines, arrived almost simultaneously at the same conclusions.

In some respects the course differs from all others. Its chief points of departure are as follows:

I. It is based on an analysis of the entire subject of Art Instruction, from which have been derived the divisions of the work and the outline of each division. These divisions are natural and not artificial, and are such as are justified by established usage.

II. Its method is determined by the laws of the mind, upon which depend all correct principles of teaching.

III. It requires the pupil to do his own thinking, and does not permit mere copying of the examples in the books. Geometrical work is done intelligently and in the most practical manner; the decorative work is based on the best examples extant, while the original designs demanded from the pupils are never beyond their powers, and the pictorial drawing is done from objects and not from copies.

IV. It aims, by presenting an abundance of illustration taken from nature and from the industrial and fine arts, both historic and modern, to lead the pupil to study and love nature, and to acquaint him with all kinds of good art; and it thus endeavors to lay the foundation for a broad art culture.

V. It provides scope for the individuality of teacher and pupils. Members of the same class may achieve widely different results, and yet keep within the lines laid down in the course.

WHITE'S

NEW COURSE IN ART INSTRUCTION

FOR

ELEMENTARY SCHOOLS.

MATERIALS FOR GRAMMAR GRADES.

To secure the best results, each class should be supplied with the following materials:

Models. White's drawing models, sets Nos. 2 and 3, prepared especially for this course.

Objects. As called for in the course. So far as possible, each pupil should furnish his own.

Drawing Books. White's New Course in Art Instruction, one number each year.

No. 4, for fourth year in school.
No. 5, for fifth year in school.
No. 6, for sixth year in school.
No. 7, for seventh year in school.
No. 8, for eighth year in school.
No. 9, for ninth year in school.

Drawing Paper. This should be of good quality and in sheets 9″ x 12″. That supplied by the American Book Company is preferable.

Development Paper. "Oak Tag" of medium weight, in sheets 9" x 12".

Colored Papers. Bradley's educational colored papers, are required to complete the work in color, as outlined in this course.

Package No. 4, for fourth year.
Package No. 5, for fifth year.
Package No. 6, for sixth year.
Package No. 7, seventh, eighth, and ninth years.

Tracing Paper. Tissue paper of good quality will do, although the tracing paper used by designers is preferable. One sheet 9" x 12", will be required by each pupil every year.

Pencils. These should be of good quality and medium hardness.

Erasers. Flexible, elastic erasers are the best.

Rulers or Scales. For the fourth and fifth years, Bradley's industrial drawing scales are recommended. For the sixth, seventh, eighth, and ninth years, Bradley's drawing scales, or architects' triangular scales, will be found most satisfactory.

Compasses. White's patent drawing compasses, with pencil.

Scissors. If possible, each pupil should have a pair of sharp-pointed, five-inch, steel scissors of fair quality.

Glue. Each pupil should have a bottle of liquid glue, for constructing designs and objects from developments.

Each pupil should be held responsible for the condition of his own materials.

THE GRAMMAR COURSE.

In this course, all drawing is representation.

Drawing may be *Geometric, Decorative,* or *Pictorial* in character, according to the class of facts represented. That drawing, in which the actual form and structure of artificial objects are represented, is Geometric. That in which the enrichment, or decoration, of artificial objects is represented, and that which represents units, or motives, of design, whether natural or artificial, is Decorative. That in which the forms of objects are represented as they appear from one point of view, is Pictorial.

A thorough understanding of geometric drawing demands a knowledge of measurement, geometry, projection, and develop-

ment. A just appreciation of decorative drawing requires some knowledge of color, historic ornament, plant form, and design; and, if the pupil is to apply his knowledge of color in design, some facility in paper cutting is necessary. Accurate knowledge of pictorial art, and appreciation of its artistic qualities, are gained by a study of the principles underlying the representation of geometric solids, and the application of these principles in the representation of natural and manufactured objects.

The grammar course, therefore, includes a study of

Measurement,	Color,
Geometry,	Historic Ornament,
Working Drawing,	Botanical Drawing,
Development,	Design,

Paper Cutting,
Model and Object Drawing.

The following outline presents the entire grammar course in its simplest form.

Each vertical column shows the analysis of one of the ten divisions of representation. The Roman numerals at the left indicate the years of school life, and each horizontal line marks the program in drawing for that year. The drawing books are arranged in accordance with this plan.

The teacher should familiarize himself with this outline, and refer to it frequently, so that he may be able to teach better that part of it outlined for any given grade.

OUTLINE OF A LOGICAL COURSE IN ART

GRADE OR YEAR IN SCHOOL.	GEOMETRIC DRAWING.			
	MEASUREMENT.	GEOMETRY.	WORKING DRAWING.	DEVELOPMENT.
IV.....	Use of Rule. $\frac{1}{8}''$	Classification of Rectilinear Figs.	Representation of Curved Surfaces.	Equal Plane Faces at right angles.
V.....	Use of Rule. $\frac{1}{16}''$	Classification of Curvilinear and Mixtilinear Figs. (Instrumental.)	Representation of Curved and Plane Faces.	Unequal Plane Faces at right angles.
VI.....	Drawing to Scale. Half size. Quarter size.	Simple Geometric Problems.	Representation of Invisible Parts, Plane Faces oblique in one view.	Plane and Curved Faces combined.
VII.....	Drawing to Scale. $1\frac{1}{2}'' = 1'$	Construction of Polygons.	Plane Faces oblique in one and two views. Three views.	Plane Faces at oblique angles.
VIII.....	Drawing to Scale. $\frac{3}{4}'' = 1'$	Inscribing and Circumscribing.	Plane Faces oblique in two or more views. Sections—parallel.	Radiating Flats.
IX.....	Drawing to Scale. $\frac{1}{2}'' = 1'$ $\frac{1}{4}'' = 1'$	Advanced Problems. Tangents.	Sections oblique. Intersections.	Truncated Radiating Flats.

INSTRUCTION FOR GRAMMAR SCHOOLS.

DECORATIVE DRAWING.					PICTORIAL DRAWING.
COLOR.	HISTORIC ORNAMENT.	BOTANICAL DRAWING.	DESIGN.	PAPER CUTTING.	MODEL AND OBJECT DRAWING.
Classification by Values. Scales of Color. Dominant Harmony.	Modified Geometric Units.	Drawings of Seeds, Buds, Fruits.	Modification of Regular Geometric Units. Contrast. Unity. Strength.	Mixtilinear Forms.	*Effect of Distance and Level.* Representation of Solidity.
Classification by Values (cont.) Scales of Color. Dominant Harmony.	Modified Bilateral Units.	Leaves—entire margined.	Modification of Bilateral Units. Variety. Rhythm. Repose.	Bilateral Forms.	*Foreshortening.* Effect of Level.
Classification by Composition. Simple and Binary Colors. Complementary Harmony.	Conventional Plant Forms on Radial Main Lines.	Leaves—serrate, notched and lobed. Flowers.	Growth. Strict Conventionalization of Plant Forms.	Radial Forms.	*Foreshortening Reviewed.* Concentric Circles. *Convergence.* *a.* One set of retreating edges bounding a vertical plane. *b.* One set of retreating edges bounding a horizontal plane.
Classification by Composit'n (cont.) Simple and Binary Colors. Analogous Harmony.	Conventional Plant Forms on Bilateral Main Lines.	Compound Leaves.	Growth. Free Conventionalization of Plant Forms.	Radial Forms (cont.) Surface Patterns.	*Convergence (cont.)* Two sets of retreating edges. *a.* At equal angles. *b.* At unequal angles.
Classification by Qualities. Natural and Acquired. Analogous Harmony (cont.)	Conventional Ornament on Bilateral Main Lines.	Sprays.	Growth. Conventionalization of Sprays.	Original Forms.	*Use of Diagonals.* *a.* To test work. *b.* To find centers.
Classification by Qualities (cont.) Effects of Juxtaposition. Perfected Harmony.	Conventional Ornament on Balanced Main Lines.	Whole Plants.	Growth. Conventionalization of Plants.	Original Forms.	*Relation of Axes.* *a.* To entire mass of solid.—Ovoidal. *b.* To one face of solid.—Conical. *c.* To two faces of solid.—Cylindrical. *d.* To all edges of solid.—Pyramidal.

GENERAL REVIEW OF THE STUDY OF FORM.

A.—SOLIDS.

1. Curvilinear
   - Sphere.
   - Spheroids.
     - Flat.
     - Long.
   - Ovoid.

2. Mixtilinear
   - Hemisphere.
   - Cylinder.
   - Half-cylinder.
   - Circular Plinth.
   - Cone.

3. Rectilinear
   - Cube.
   - Prisms.....
     - Triangular.
     - Square.
   - Square Plinth.
   - Square Pyramid.

B.—GEOMETRIC FIGURES. *Represent plane faces.*

1. Curvilinear
   - Circle.
   - Ellipse.
   - Oval.

   Circumference.
   Arc.
   Center; foci.
   Diameter.
   Axis.
   Radius.

2. Mixtilinear
   - Semicircle.
   - Quadrant.

3. Rectilinear
   - Triangles,.....
     - Base.
     - Altitude.
     - Apex.

     Scalene (right-angled),
     Isosceles,
     Equilateral.
   - Quadrangles,.....
     - Diagonal.
     - Diameter.

     Square,
     Oblong,
     Rhombus,
     Rhomboid.

C.—LINES. *Represent outlines or edges.*

1. Lines.
   - Curved. ..
     - Circular.
     - Elliptical.
     - Oval.
   - Straight.

2. Direction. { Horizontal. / Vertical. / Oblique.

3. Relation. { Parallel. / At an angle. { Right = perpendicular. / Oblique. { Acute. / Obtuse.

D.—POINTS. *Represent corners; mark positions.*

At the beginning of each year, review the entire subject of Form as here outlined, in order that the pupil may be perfectly familiar with the basis of the year's work.

OUTLINE OF THE SIXTH YEAR'S WORK.

(THIRD GRAMMAR YEAR.)

BOOK VI.

(All the illustrations referred to in the Outline are to be found in Book VI.)

1. GEOMETRIC DRAWING.

I. MEASUREMENT.

Preliminary work (on practice paper):

The ruler and ruling.—The ruler should have a perfect edge and be accurately divided. Great care should be taken in placing the ruler. The points between which the line is to be drawn should not be covered by the ruler, but a little allowance should be made for the space occupied by the pencil-point. The light should always shine upon the edge against which the line is to be ruled. The pencil should be held nearly upright, and the line drawn from left to right.

Drill in use of ruler:

(*a*) Rule lines through two given points.
(*b*) Rule heavy, clearly defined lines.
(*c*) Rule very light lines.
(*d*) Drill in marking off measurements of one inch from left to right without moving the ruler.
(*e*) Drill in marking off parts of an inch and combinations, as $1\frac{1}{2}''$, $2\frac{1}{4}''$, $\frac{7}{8}''$, $\frac{9}{16}''$, etc.

NOTE.—Insist upon accuracy in measuring objects. Give frequent practice in judging distances. A good practice is drawing to scale, making objects half size and quarter size.

NOTE.—All this work is to be taken in connection with other lessons in Geometric Drawing.

II. GEOMETRY. Draw the problems accurately with ruler and compasses. (For illustrations, see page 7.)

Preliminary work:

Practice with compasses:

(*a*) Rule three horizontal lines, $2\frac{1}{2}$ inches apart, across a sheet of practice paper, the first line being drawn $1\frac{1}{2}$ inches from the top margin. Place the needle-point on the first line near the left end, and the pencil-point directly below the needle-point. With radius of one inch describe a circle, moving the pencil-point to the right and upward. (Incline the upper end of the compasses a little in the direction toward which the pencil-point is moving.) Using the same radius, draw another circle, with its center where the circumference of the first circle intersects the horizontal line on the right. Continue this exercise across the page.

(*b*) On the second line draw a similar series of circles, moving the pencil-point toward the left.

(*c*) On the third line draw circles, using alternately the movements described in *a* and *b*. Repeat this exercise many times, in order that the pupils may acquire skill in handling the compasses properly.

(*d*) Draw concentric circles of different radii.

Page 3. *Simple Problems:*

a. Draw margin lines $\frac{1}{2}''$ from the edges of the page.

b. Divide the space into six equal parts (nearly square).

1. Find the center of the upper left space by means of diagonals, drawing only short lines intersecting in the center. Draw concentric circles (see Fig. 49) with the following radii: $1\frac{1}{4}''$, $1''$, $\frac{3}{4}''$, $1\frac{1}{8}''$, $\frac{1}{16}''$, $\frac{3}{8}''$.
2. Find the center of the upper right space. Make this the center of a circle $2\frac{1}{2}''$ in diameter. Draw a horizontal diameter in the circle; mark the left end *a*, and the right end *b*. With centers on the line *ab*, describe circles with the following radii, whose circumferences shall pass through point *a*: $\frac{1}{2}''$, $\frac{1}{16}''$, $\frac{7}{8}''$, $1\frac{1}{16}''$. (See Fig. 50.)
3. Find the center of the remaining upper space. Through this draw a horizontal $2\frac{3}{4}''$ long; mark the line *ab*. With radius of $1''$, and center on line *ab*, describe a circle whose circumference shall pass through *a*. With the same radius, and center on line *ab*, describe another circle whose circumference shall pass through *b*. Mark the points of intersection of these two circumferences *c* and *d*. Connect points *c* and *d* by a vertical line. What relation does this line hold to the horizontal *ab*? How does it divide *ab*? Why?
4. Teach: *To bisect a line or arc.* (See Figs. 52 and 53.) Draw the problem in the lower left space.

5. Teach: *To divide a circle into sectors* of 180°, 90°, 45°, 60°, and 30°. (See Figs. 54, 55, and 56.) Diameter of circle 2¾″. Draw the problem in the lower middle space.
6. Teach: *To erect a perpendicular at the end of a line.* (See Fig. 57.) Draw the problem in the lower right space. Length of horizontal, 2″; position, ¾″ above the lower margin.
7. Teach: *To construct a square.* (See Fig. 58.) Construct the square on the same line as the previous problem.

Page 4. *Geometric Enclosing Forms for Designs.*

a. Draw margin lines as before.

b. Draw a vertical line dividing the space into two equal parts.

c. Find the center of each space.

1. In the left space, draw Fig. 62, 63, 64, or 65, enlarged to fill a space 4″ square.
2. In the right space, draw an original enclosing form for a radial design. (Figs. 60 and 61 will furnish suggestions.)

NOTE.—The last four figures, 62 to 65, may be practically used in the manual training exercises—the girls embroidering them in simple outline stitch on small linen or silk squares for mats, the boys cutting them in wood for reels or trays. They may also be used as patterns for pen-wipers.

SUGGESTIONS.

Materials.

The materials should be distributed, in good condition, before the lesson. Give the pupils directions for handling them carefully. When collected, they should be in as good condition as when distributed. To insure care in the distribution and collection, reliable pupils should be chosen by the teacher for this work. The teacher, however, should also examine instruments at intervals. If the pupils are to be trained to self-reliance, carefulness in work, and the assumption of simple responsibilities, each must be allowed to take care of and keep in working order his own materials, as any good workman keeps his tools.

The pencils.—The drawing pencil should be harder than medium and finely pointed. The compass pencil, also, should be hard, sharpened to a chisel point, and so adjusted that the sharp marking edge is at right angles to a radius of any described arc.

The compasses should be held between the thumb and first finger, at the end above the rivet and hinge. In describing arcs they may be turned either to the left or right, as seems necessary. The needle-point of the compasses should be fine, and can be sharpened with a file. No holes should be visible in the paper after using this instrument; but if any appear, the paper should be smoothed from the back with the thumb-nail.

Lines.

Three kinds of lines are employed in Geometric Drawing. The *working lines* are those drawn in the various processes to obtain the result. They should always be light, but distinct and of uniform thickness. All working lines are retained in the finished problem. The *result lines* are those of the described problem, and should be very clearly defined, rather heavy, and of uniform thickness and color. A *given line* is one of fixed dimensions from which the problem is worked. It should be lighter than the result line and darker than the working line. Intersection of lines to obtain necessary points should be made with short fine lines.

Notation.

All successive steps in the process of solving a problem may be figured from 1 upward, and each result obtained lettered A, B, etc. If this practice is uniformly observed, the various steps in the construction can easily be followed.

Method for a Class Lesson.

The necessary preparation.—The problem forming the subject of each lesson should be previously drawn by the teacher upon the blackboard, or on charts, for reference, for description, and for study before the pupils begin the work upon paper.

How to conduct the lesson.—The teacher should know every step to be taken, and should draw on the blackboard, while developing the exercise. The charts are not to be copied, but used only for reference. By the use of a chart or blackboard representation, the children see the completed work, know what the result is to be, learn to analyze the method of construction, and are enabled to discover the solution for themselves. In this way they understand the whole problem and the use of the lines to obtain it, and work intelligently. In cases where it is possible, the pupils should invent processes to give required results.

How to secure a certain degree of excellence.—Exact the closest attention from the pupils when giving a direction, and allow no one to work when an explanation is made. Give the pupils sufficient time for work ; in Geometric Drawing no new step can be taken unless the previous one has been finished correctly. By proceeding slowly, excellent and uniform class work can be procured, and all discouraging errors avoided. Give each direction slowly and distinctly ; make sure that it has been understood, and avoid unnecessary repetition.

NOTE.—Before attempting the work in the books, draw each exercise upon practice paper, in order to avoid mistakes and corrections, and insure nicety of execution in the final drawing.

Solutions of Problems.

PROBLEM 5.—*Bisection of lines.* Draw a horizontal line $2\frac{1}{2}''$ in length. With the end of the line as center, and a radius greater than half the length of the line, draw an arc to intersect the line. With the other end of the line as center, and the same radius, intersect the arc above and below the line. Draw a straight line through the two intersections. This will bisect the line first drawn.

Follow the same process for bisecting arcs.

NOTE.—*To bisect an angle.* (To be drawn on practice paper.) Draw an angle, A. With A, the vertex of the angle, as center, and a short radius, draw an arc intersecting the sides at points 1 and 2. With 1 and 2 as centers, and a radius greater than half 1, 2, draw arcs intersecting each other at point 3. Draw 3 A, which will bisect angle A.

PROBLEM 6.—*Division of a circle into sectors, marking upon them the number of degrees.* Draw a circle with $1\frac{1}{4}''$ radius. The circumference of every circle may be considered as containing 360°, or equal parts. Mark the circumference of the circle thus: 360°. Draw the diameter of the circle, dividing it into semicircles, each of which contains 180°. Mark one of these semicircles thus: 180°.

By bisecting the arc forming one of the semicircles, and drawing a radius from the point of bisection to the center of the circle, a sector of 90° is obtained. Bisect the arc of the sector just found to obtain a sector of 45°.

With the radius of the circle as radius, and one end of the diameter as center, draw a short arc cutting the circumference of the circle. Draw a radius from this point to the center of the circle. Mark the small division of the circle 60°, and the large division 120°. The radius of any circle may be applied six times to its circumference. Test this with compasses.

Bisect the arc of 60° to obtain sector of 30°.

PROBLEM 7.—*To erect a perpendicular at the end of a line.*—Draw a horizontal line, A B. With B as center, and a short radius, draw an indefinite arc, cutting the line A B at 1. With 1 as center, and the same radius, intersect the arc at point 2. With 2 as center, and the same radius, intersect the arc once more at point 3. With 2 and 3 as centers, and the same radius, draw arcs intersecting each other over B at point 4. Draw 4 B, which will be the required perpendicular.

PROBLEM 8.—*To construct a square.*—(Base given,—horizontal line A B. See previous problem.) Take the length of the line A B as radius, and mark it off upon the perpendicular at point C, forming two sides of the square. With A and C respectively as centers, and the length of the line A B as radius, describe arcs intersecting each other, to find the position of the fourth angle in the square. Call this point D. Draw lines from D to A and C respectively, completing the square.

III. WORKING DRAWINGS. Completed drawings to be instrumental. (For illustrations, see pages 8 and 9.)

Preliminary work:

Review the representation of visible outlines and edges; plan and elevation; kinds of lines used, viz., *full lines* representing visible outlines and edges, *dotted lines* representing connecting or working lines, *dot-and-dash lines* representing center lines, or axes.

Teach *use of dash lines*, to represent invisible parts.

Make freehand sketches on practice paper, or blackboard, of two views of objects like a hollow cylinder (Fig. 24), or the square plinth placed on a cylinder (Fig. 33), or similar objects. When the principles are understood, draw accurately with instruments in the book.

Teach term *foreshortened*, as used in working drawing. Make freehand sketches of models, so placed that their faces are foreshortened in one view (Figs. 30 and 32); or of the half-cube (Fig. 31).

Teach the use of *light lines* with *arrow-points* to indicate dimensions. (See Figs. 28 and 34.)

NOTE.—In Fig. 28, between the two arrow-points at the top, is indicated the width of the spool at the ends thus, ⟵ 4″ ⟶, (four inches); the height of the spool from top to base end, thus, ⟵ 8″ ⟶ (eight inches). The arrow-point should be placed carefully, to indicate the exact extent of the dimension.

Page 5. *The representation of invisible outlines and edges.*

a. Draw margin lines.

b. Draw a vertical dividing the space into two equal parts.

1. Draw two views of a hollow cylinder.
2. Draw two views of some object having invisible outlines; *e.g.*, a washer, a section of drain-pipe, or a glass inkwell.

Page 6.

a. Draw margin lines.

b. Draw a vertical dividing the space into two equal parts.

1. Make a freehand sketch of some object having invisible parts; *e.g.*, a spool, or a square-headed bolt. Mark dimensions.
2. Make an accurate drawing of the same on the other half-page.

NOTE.—In drawing the cube to represent two faces equally foreshortened, as in Fig. 30, *first* draw the base (an oblique square); *second*, draw the dotted lines to indicate location of edges in the foreshortened view.

Page 11.

a. Draw margin lines.

1. Draw two views of a square prism turned at an angle (Fig. 36), or of some object similar in form, or draw two views of the house-model (Fig. 39). Draw two views of the tap-bolt (Fig. 41), or of some object having parts foreshortened in one view.

IV. DEVELOPMENT. Drawing to be instrumental. (For illustrations, see page 10.)

Preliminary work:

Make freehand sketches of the flats of all type solids which illustrate the conditions.

NOTE.—During this and succeeding years, the pupils should work out all problems in Development from *working drawings* of the objects, and not from the objects themselves. In this way, only, will Development have an educational value of its own, not found in Geometry and Projection.

Page 12. *Plane and curved faces, combined.*

a. Draw margin lines.

b. $1\frac{7}{8}''$ from the left margin line and $1\frac{5}{8}''$ from the lower, place a point. This point is the center for describing the arc of a semicircle *below* the point. Radius of arc, 1″. This semicircle is the plan of a half-cylinder $2'' \times 4''$. Draw the elevation $\frac{1}{2}''$ above the plan.

1. Draw accurately the flat of this half-cylinder. Place the center for the lower semicircular end $1\frac{7}{8}''$ from the right margin and $1\frac{3}{8}''$ from the lower margin. Draw a semicircle of 1″ radius, having its straight side uppermost. On this side as a base, draw an oblong $2'' \times 4''$ and complete the development.
2. Construct the object, using development paper.

Page 13. *Application.*

a. On a sheet of practice paper make a working drawing of one object shown on page 10 (Fig. 10, 11, or 12), enlarged to twice the size of the drawing in the book.

b. Draw margin lines.

c. Plan the placing of the drawing so that the page will look well when finished.

1. Draw the flat of the selected object.
2. Construct, using development paper.

NOTE.—Call the attention of the pupils to the construction of stove-pipes, tin pails and boxes, and other similar household articles. The principles involved in their construction are the same as those underlying this work in Development.

SUGGESTIONS.

Method of Developing the Surface of the Half-Cylinder.

Draw an oblong $2'' \times 4''$. With 1″ radius describe a semicircle on each short end as a base. The plane oblong face and the two semicircular faces are now drawn. Divide the circumference of one semicircular base into any number of equal parts, say eight. Extend the short sides of the oblong indefinitely toward the left, and mark off on each as many equal and similar parts as there are in the circumference of the semicircle representing the base.

The length of the circumference is thus set off on the straight lines. A vertical line connecting the last points at the left will complete the oblong representing the curved face of the half-cylinder. Draw the laps on the upper, lower, and left edges of the extended oblong. (See illustration in drawing book.) This completes the drawing of the flat. Cut out the flat *in one piece.*

Before folding, mark with a pin on all lines for folding. These marks on the outside of the fold prevent the paper from breaking irregularly.

To construct the half-cylinder from the flat, fold on the bases of the semicircles, on the line dividing the two oblongs, and on the outlines of the second oblong and laps; glue the lap at the straight edge of the half-cylinder, then the laps at the bases.

NOTE.—A similar method should be followed in developing the surface of any cylindrical or semi-cylindrical object. If the bases are complete circles, at least twelve divisions should be set off on the circumferences; sixteen divisions will insure still more accurate work. Even with sixteen divisions some allowance should be made when setting off similar divisions on a straight line; for the distances so set off correspond in length with sixteen equal chords, not with the sixteen equal arcs which they subtend.

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2. DECORATIVE DRAWING.

V. COLOR.

Preliminary work:

Review the previous work in color, especially the spectrum standard colors.

Teach: *Classification by composition.*

By means of the color wheel, show that the *six standard colors*, R., O., Y., G., B., V., are *simple* or *primary* colors; that while an orange color may be produced by mingling rays of light from red and yellow disks, the *standard orange* of the spectrum cannot be thus obtained. (The same is true if pigments are mixed to produce orange.) Show that the mingling of blue and yellow light produces *gray*, not green; and of red and blue light, *purple*, not violet.

By further use of the wheel, show that the intermediate hues may be imitated by mingling rays of light from the primary colors, and that these hues are the true *binary*, or *secondary*, colors.

Show that when a *primary* color is mingled with a certain *binary*, *gray* is produced. The pairs are R. and B.G., O. and G.B., Y. and V.B., G. and V.R., B. and O.Y., V. and G.Y. Two colors which, when mingled, produce gray are *complementary colors.*

Study nature to discover complementary colors.

Learn the six pairs of complementary colors.

Pages 20 *and* 34.

Make arrangements on these pages with colored paper figures,—squares, oblongs, circles,—illustrating complementary colors. For example, select the six pairs of complementary color tablets and arrange them in six squares, properly spaced, on page 20. Or, on page 34, arrange six oblongs of color, each of which shall contain a pair of complementary colors and a harmonizing neutral.

NOTE.—An exercise like the last will reveal the fact that no tone is truly neutral, and that even tones of gray exert some influence on adjacent colors. But such tones are more easily influenced than the spectrum colors, and are therefore *relatively* passive or neutral.

Apply Color in Historic Ornament and Design.

VI. HISTORIC ORNAMENT. Drawing to be either instrumental or free-hand, as convenient. (For illustrations, see page 15.)

Preliminary work :

Study the illustrations given on pages 15 and 16 in the drawing book. Discover that these forms suggest leaves and flowers. What leaves and flowers ? (In Fig. 26, a pond lily partly open—the lotus; Fig. 29, the wild red lily; Fig. 31, leaves of box; Fig. 32, the rudbeckia; Fig. 35, loosestrife; Fig. 38B, leaves of bedstraw; Fig. 43, wild rose, etc.)

What changes have been made in the natural forms? Teach, from the illustrations on page 16, what is meant by *Conventionalization.* Take, for example, the violet leaf (Fig. 66). Have a specimen of the violet leaf in class, and from this specimen and the unconventionalized drawing, make the following observations: The margin is serrated, the midrib and stem are curving, the left and right halves are not of the same shape and size, and the leaf has many veins. The conventional drawing of the same has an entire or unbroken margin, the midrib and stem are straight, the left and right halves are of the same size and shape, and the venation is almost entirely omitted. In the same manner, study the difference between the leaves and the conventional drawing of the red-top sorrel (Fig. 69), or any other leaves and drawings familiarly known, before making any generalization as to what constitutes conventionalization. (See "Illustrated Definitions.")

Page 14. *Strictly conventionalized plant forms.*

a. Draw margin lines.

b. Find a point $3\frac{3}{8}''$ from both the upper and right margin line, and with this point as center, and radius of $2\frac{1}{2}''$, describe a circle.

c. At the left of this circle, draw an oblong $2\frac{1}{4}'' \times 5\frac{1}{2}''$, properly placed between the circle and the left margin.

1. Enlarge Fig. 26, 28, 30, or 31, to fill the oblong.
2. Enlarge Fig. 32, 33, 35, 36, 37, or 43, to fill the circle.

Page 17.

a. Select an historic border to be enlarged.

b. Lay out the drawing; *i.e.*, determine how many times a given unit can be repeated, how wide the border shall be, and where on the page the drawing will appear best. For example, the two alternated units in Fig. 41, enlarged to eight times their present size, will fill an oblong 5″ wide. Two and one half units of each kind will give a length of $8\frac{7}{8}$″; while three of each would require too much space to look well on the page. An oblong 5″ × $8\frac{7}{8}$″, placed centrally on the page without margin lines, will look well, and the drawing should, therefore, be laid out in this manner.

1. Select a border (38A, 38B, 39, 40, 41, or 42), and enlarge it to properly fill a page ; draw it upon practice paper, and, when well studied, draw it upon page 17.

Suggestions.

Lessons.

Make these lessons on Historic Ornament interesting by comparing similar units from different sources, and by reference to the history of the countries where the styles of ornament originated, and to the men who helped develop the style. Such books as Warnum's "Analysis of Ornament," Jones's "Grammar of Ornament," Goodyear's "History of Art," and others will be of great assistance in such study.

Illustrations of Historic Ornament.

Fig. 25. This is an Egyptian border from the wall of a tomb, Gourna. The conventional form of the lotus flower, front view, side view, and bud, are here used.

Fig. 26. A border of lotus flowers, from a mummy case in the British Museum.

Fig. 27. This illustration is a ground decoration, or surface pattern, from the ceiling of a tomb at Thebes. Each circle is formed of four lotus flowers and four buds, and the intermediate figure is probably intended to suggest four sprouting lotus leaves.

Fig. 28. This is a Greek border, taken from a vase decoration in the British Museum, the Greek rosette constituting the unit in the design. The design when placed in a horizontal position illustrates repose in a high degree. The small circles alternating with the rosette give variety, and relieve the design from monotony.

Fig. 29. This is the Greek Anthemion border. The forms of leafage and flower are so freely conventionalized, that it is difficult to recognize any resemblance to the natural forms. Some authorities think the forms are derived from the honeysuckle and lily, others from the palmetto

and lotus; while others believe that the units are simply combinations of brush marks illustrating the three general laws reigning in plant life —radiation from the parent stem, proportionate distribution of areas, and tangential union of lines.

Fig. 30. This illustration is a Greek border, taken from a vase in the British Museum. Repose is obtained by the apposition of the outer curves in opposite leaves. They form an almost complete ellipse.

Fig. 31. This is a Greek border, taken from a vase in the Louvre. The stems, supporting berries, grow out of the parent stem in tangential curves. It is called by some the Laurel border.

Fig. 32. This is a Greek form of rosette. It is found in Greek borders surrounded by a square, a part of an imperfect fret—that is, one not forming a continuous meander.

Fig. 33. This is a Roman rosette. It is a conventional drawing of a six-petaled flower form, which often occurs in Roman friezes, at ends of scrolls, or encircled by them.

Fig. 34. This is a Roman border, representing a blocked-out treatment of the soft acanthus, a leaf constantly used by Roman artists for the enrichment of various scrolls, employed in their designs.

Figs. 35, 36, and 37. These are simple rosettes, found in borders, consisting of a fret form alternated with a rosette.

Fig. 38A. This border is Byzantine, and is taken from the mosaics from St. Sophia, Constantinople, sixth century.

Fig. 38B. This illustration is also Byzantine.

Figs. 39 and 40. Moorish ornaments from the Alhambra. A principal feature of Moorish design is the repetition of a few simple elements, by means of which beautiful and complicated effects are produced.

Fig. 41. This is a Moorish sculptured ornament in low relief.

Fig. 42. This is a Gothic border composed of flat ornamental units derived from the English dog-tooth; a conventional sculptured ornament having the form of a very short pyramid with an indented base.

Fig. 43. This is a Gothic rosette—the Tudor Rose.

VII. BOTANICAL DRAWING. (For illustrations, see page 16.)

Preliminary work:

Make collections of serrate, notched, and lobed leaves, and regular flowers. Make close observation of their chief characteristics; sketch on practice paper and blackboard. Study the drawings on page 16, to learn the essential parts to be represented and how to draw them.

Page 18. *Natural forms of leaves and flowers.*

a. Draw margin lines.

b. Plan the page to receive drawings of two leaves, a serrate and a lobed; or two leaves and a flower; or a lobed leaf and a flower.

1. Make the drawings *from the natural forms.*

Page 19. *Conventional forms of leaves and flowers.*

a. Review conventionalization. (See "Historic Ornament.")

b. Conventionalize the natural forms drawn on page 18. For suggestions, see pages 16 and 21 of drawing book. Draw on practice paper. Repeat until the conventional forms are satisfactory.

1. Draw the conventional forms on page 19.

SUGGESTIONS.

Leaf Drawing.

In drawing a leaf, first determine the entire width and length of the leaf, and indicate them on the page. Then indicate the position and general curve of the midrib and sketch the outline of the leaf. Study the curvature and radiation of the veins, and sketch the principal veins only. Erase incorrect lines, and reduce the others until they are almost invisible. Line in with a line expressive of leaf character, adding such delicate veins and other details as may be required. The *ideal* drawing is perfect in form, delicate in handling, untouched by an eraser.

Illustrations of Leaves.

Fig. 36. Pepperbush. The leaves are wedge-shaped, sharply serrate, and prominently straight-veined. Found in wet copses, Maine to Virginia, near the coast.

Fig. 37. White birch. The leaves are triangular, tapering to a very sharp point (usually abruptly), and truncate, or nearly so, at the broad base; they have slender petioles, finely serrate notches, and pinnately-netted venation.

Fig. 38. Common white water-crowfoot. The leaves of this plant grow under water; most of them are petioled, the petiole being rather narrowly dilated. The blades are ternately lobed and irregularly notched. The venation is pinnate. Common in slow flowing water.

Fig. 39. Three-leaved goldthread. The leaflets are obovate-wedge-form, sharply toothed, and obscurely three-lobed. The leaf is evergreen and shining, and the roots have long, bright yellow, bitter fibers.

Fig. 39A. Currant. The leaves are heart-shaped at base, three and five-lobed, smooth. The lobes are ovate; the margin is doubly serrate, with acute notches; the venation is palmate.

Fig. 66. Common blue violet. The leaves are roundish-cordate or reniform, with crenate margin; the sides are rolled inward when young; the venation is palmate.

Fig. 67. Climbing false buckwheat. The leaves are heart-shaped, or slightly halberd-shaped, and pointed, with entire margins and pinnate venation. The long, slender, twining stems fit the plant particularly for designs in borders.

Fig. 68. Meadow rue. The leaves are alternate, two and three ternately compound. The divisions and leaflets are stalked; and the petioles dilated at the base. The illustration represents only a leaflet. The leaflet is lobed and palmately veined, and is well adapted for radial designs, but may also be used for borders.

Fig. 69. Sheep sorrel. The leaves have an entire margin and are narrow, lanceolate or linear, halberd-shaped at base, and finely reticulated.

Fig. 70. Lion's foot. The leaves are mostly deltoid, and variously three to seven-lobed.

Fig. 71. Sassafras flower.

Fig. 71A. Sassafras flower conventionalized.

Fig. 72. Stonecrop flower.

Fig. 72A. Stonecrop flower conventionalized.

Observation Lessons.

By the analysis of various plants, teach the children to observe the following common facts of plant life: The *root* is the base of the plant. The *stem* springs from the root, dividing and subdividing, and bearing all the other parts; or, all the other parts spring from a common root-stalk. The stems may spread loosely, turn or bend over on one side, recline on the ground, creep (strike root as they grow), climb (cling to other objects as they grow), and twine, or coil, themselves spirally around other stems for support.

The *arrangement of leaves* on the stem may be *alternate*, when the leaves follow one after another, with but a single leaf from each joint in the stem; *opposite*, when the leaves are in pairs on each joint of the stem, the two leaves being exactly opposite to each other; *whorled*, when three or more leaves are in a circle on one joint of stem; *perfoliate*, when the edges of the base of the leaf are united with each other around the stem. Some leaves have petioles, or stems, and others have none. In some cases, there is a pair of stipules, or small appendages, at the base of the petiole.

In the *position* or *arrangement of the flowers*, notice whether the blossoms terminate a stem or are in the axils of leaves; whether they are single or in clusters; whether the flower clusters are found along the sides of the stem, well removed from each other, or spring apparently from the same point; whether the flowers have pedicels or are sessile, and such other points as will be necessary, without especially going into botanical technicalities, for the future adaptation of the plant for design.

VIII. DESIGN. To be either instrumental or freehand, as convenient. (For illustrations, see pages 21 and 22.)

Preliminary work:

Study pages 21 and 22 of the drawing-book. Notice the three kinds of designs: borders (77, 78, and 79); surfaces (80, 81, 82, 83, 84, and 85—some with main lines only); centers (86, 87, 88, 89, and 90). Notice the different shapes of *fields* or *grounds*, and the different *margins* (plain, Fig. 87; ornamental, Fig. 90). Give special attention to the main lines, which give character to the design. Compare the various main lines given in Fig. 76. Sketch, on practice paper, the main lines of Figs. 78 and 79; also of Fig. 90. Teach thoroughly the method of developing the drawing.

By observation of plant growth, as well as by the study of good examples of design, lead the children to perceive that all good design, with the exception of that purely geometric, is based upon the great law of plant growth,—*Radiation from a parent stem or root-stalk*,—and that the articulation of the branches of the plant must be represented in the design, by means of the tangential curvature of main lines.

The characteristics of leaves and flowers, common to the general type of plant, must also be adhered to in the design.

Page 23.

Draw margin lines. Draw Fig. 85 (omitting the two right-hand units) enlarged to three times its present size; or select one of the radial designs (Figs. 86 to 90) and enlarge it to properly fill the page. If too difficult, the half-tinting in these latter designs may be omitted.

Page 24. *Original design.*

Draw an original design, using the natural forms previously drawn and conventionalized.

SUGGESTIONS.

Order of Steps in Original Design.

a. Decide upon the kind of design to be made—border, surface, or center.

b. Sketch the field for the design on practice paper.

c. Sketch the main lines, remembering that they must have a proper growth, radiation, and tangency.

d. Clothe them with the conventional units, bearing in mind the following points:

(1) A proper arrangement of parts. The *growth* must be orderly. Each part must have an evident and natural source of growth. Leaves should not appear to grow from leaves, nor flowers from leaves or from other flowers.

(2) A proper balance of parts. To secure this, the important masses of the design must be arranged on a symmetrical basis, whether the design is bi-symmetric or otherwise.

(3) A proper distribution of parts. As a rule, good judgment will be a sufficient guide in the disposition of the elements of a design. They should be so distributed as to form a well-balanced whole, constructed and arranged in such a manner as to produce an harmonious effect. To this end, care must be taken that the field of the design shall not be too crowded with decoration in one part, and too open in another, but that a certain decorum and balance shall be preserved throughout.

e. Correct; redraw until satisfactory.

IX. PAPER CUTTING.

Preliminary work:

Practice cutting bilateral units.

Page 25.

Upon this page, construct an original design, using colored papers to illustrate complementary harmony.

NOTE ON COLOR.—As the form of the design is not known, no explicit directions can be given, but the following general rules should be observed: 1. Select the complementary colors with great care. 2. Do not use two full spectrum colors, as tints and shades will give a better effect. 3. Use a neutral color somewhere in the design, either for the background or for some other part.

NOTE ON PAPER CUTTING.—The surest way for inexperienced pupils to obtain good paper units is, first to cut a pattern unit from thick manilla paper. The other units can then be traced from this and cut accurately. If the pupil has good scissors and some facility in cutting, the colored paper may be folded so that four, five, or six units can be cut at once. If the design is radial, the paper may be so folded, that the entire design, with the exception of the margin, can be cut out in one piece.

Cut as many parts as possible at one time; e. g., cut both sides of a bilateral unit; the opposite sides of a central unit; all the sides of the enclosing form in a radial design; the opposite margins in a border, etc.

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3. PICTORIAL DRAWING.

X. MODEL AND OBJECT DRAWING. To be entirely freehand. (For illustrations, see pages 27–30.)

Preliminary work:

Continue practice in observing the characteristics of masses and in making proportional measurements. Review drawing the cylinder.

On practice paper, draw the hollow cylinder. (See Fig. 30 for arrangement of the sheet.) The representation of the concentric circles at the top will require accurate observation and skillful drawing.

Page 26. *Objects with concentric circles.*

a. Draw margin lines.

b. Divide the space, by a vertical line, into two equal parts.

1. Draw, in the left-hand space, the picture of a hollow cylinder, standing upon a plane surface below the level of the eye.
2. Draw, in the right-hand space, the picture of some object, like a wide-mouthed bottle or a vase, standing on a plane surface below the level of the eye.

NOTE.—If preferable, do not divide the space, but draw some object like Fig. 31 or 32, instead of taking the two objects suggested.

Page 31. *Convergence.*

a. Study objects to discover the apparent convergence of retreating parallel edges.

b. Review drawing the cylinder. Make a careful drawing, on practice paper, of an upright cylinder below the level of the eye, representing even the invisible edge of the base; divide the cylinder into two equal parts, as shown in Fig. 34. The straight lines representing the retreating edges will be found to converge.

c. Sketch the cube on practice paper, in the position indicated in Fig. 38.

d. Draw the margin lines on page 31, and divide the space, by a vertical line, into two equal parts.

1. On the left half of the page, draw the picture of a half-cylinder, or similar object, standing upon a plane surface below the level of the eye.
2. On the right half of the page, draw the picture of a cube, or similar object, with one face foreshortened, standing upon a plane surface below the level of the eye.

Page 32.

a. Study the cube in the position indicated in Fig. 42, and sketch on practice paper.

b. Draw the margin lines.

c. Divide the space into two equal parts, by means of a vertical line.

1. Draw the picture of a cube with two faces equally foreshortened, standing upon a plane surface below the eye.
2. Draw the picture of a cubical object under similar conditions.

Page 33. *Group.*

Upon this page, a drawing is to be made of a simple group containing at least one object having facets, or other ornament, affected by foreshortening. (See Figs. 44 and 46.)

a. Teach the representation of a border upon a cylindrical object. Study an object having such a border. Review Development to recall division of cylindrical surfaces. Study Fig. 44.

b. Sketch a simple object like a napkin ring, mug, or collar box. Add an ornamental border. (The object may be constructed by

the pupil from "oak tag," and the drawing made from that object, if preferred.)

1. Arrange a group and make a picture of it on page 33. Select those objects only which are based on some type already drawn. Do not combine incongruous objects. Try to arrange a group that will tell a story.

NOTE.—In sketching a group of objects, determine first the entire width and height of the group, and indicate these upon the page. Notice next the width and height of principal parts, and indicate these. Sketch the general shape of each object *entire*. Study the details, and represent them. Erase guide lines. Finish with a line expressive of the character of the objects composing the group.

SUGGESTIONS.

The Hollow Cylinder.

1. Study the actual size and proportion of the model, and compare with its apparent shape.

2. Determine the size of the drawing.

3. Block out the cylinder, keeping the proportionate dimensions. First draw the left and right vertical lines indefinitely, observing the proper distance between them ; then draw the upper and lower horizontal lines. This oblong will give the general form of the cylinder, and must include the whole representation.

4. Study the apparent shape (an ellipse) of the foreshortened upper circle, comparing its width and length ; then sketch a horizontal line across the oblong, to limit the space it is to occupy.

5. Within this oblong, carefully sketch the ellipse. The curves of the ellipses must not make angles with the straight sides, but must form a tangential union with them.

6. Sketch the inner circle, which gives the cylinder its hollow appearance. Although this inner circle is really equally distant in every part from the outer, it does not appear so, except at the left and right ends. At the front and back, the space between the two circles is foreshortened, and more so at the back than at the front. At the left and right ends, there is no foreshortening.

7. By comparing with the straight horizontal line of the oblong, ascertain the apparent curve of the base of the cylinder, being careful, as before, to make tangential union with the straight sides.

The Cube with one Face Foreshortened.

1. Study the actual size and proportions of the model, and compare them with its apparent shape.

2. Determine the size of the drawing.

3. Represent roughly the width of the whole by two vertical lines, and the height of the whole by two horizontal lines. This oblong should include the drawing of the whole object.

4. Determine the position of the upper edge of the front face.

5. Locate the edge in the drawing. In the position in which the model is studied, the front face should be a square.

6. Study the appearance of the foreshortened upper face ; test its width. Then study the direction of the receding upper edges ; sketch these, giving them the proper degree of convergence.

7. Erase incorrect lines ; finish the drawing.

The Cube with two Faces Foreshortened.

1. Study the actual size and proportions of the model, and compare with its apparent shape.

2. Determine the size of the drawing.

3. Represent roughly the width of the whole by two vertical lines. Determine the highest and lowest points in the object, indicate these, and compare the distance between the highest and lowest points with the greatest distance from side to side. The whole space to be occupied by the drawing has now been determined.

4. Sketch lightly a vertical line to represent the nearest vertical edge and determine accurately its length.

5. Determine and indicate the position of the back corner of the top face ; and determine the apparent level of the left and right corners of the top face, by comparison with the level of the front and back corners. Indicate these corners on the vertical lines.

6. Sketch the top face.

7. Determine the lengths of the left and right edges, by comparison with the front edge.

8. Sketch the lower edges of the cube.

9. Criticise the sketch, first, as to whether the drawing represents the object as seen ; second, as to whether the principles of foreshortening and convergence are truthfully illustrated.

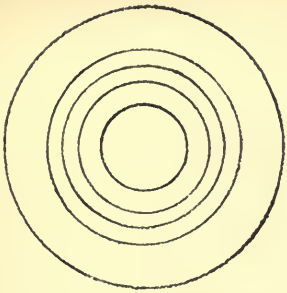
10. Correct errors, or make a second drawing in which the errors are corrected; then finish.

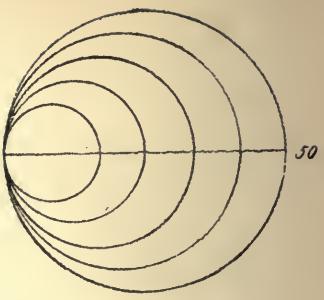
Encourage sketching in connection with work in Language, History, Geography, and Natural Science.

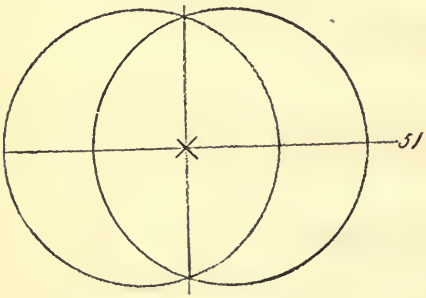
Show the pupils examples of good pictorial art, photographs of historic buildings and their ornament, examples of carved and molded enrichment, vases, and other beautiful forms. If a museum of art is in the vicinity, encourage the pupils to visit it often, and lead them to love and look for the beautiful in all things.

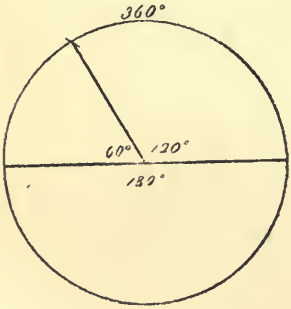
ILLUSTRATIONS.

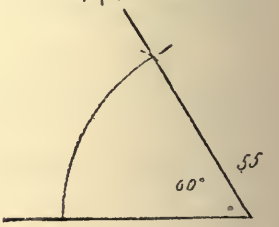
In the following plates are given representative illustrations selected from Book VI., exemplifying the three main divisions of the subject; viz., Geometric Drawing, Decorative Drawing, and Pictorial Drawing.

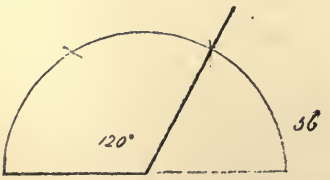


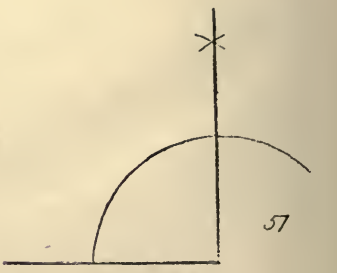




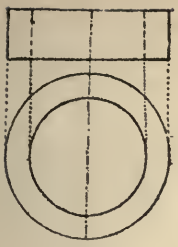


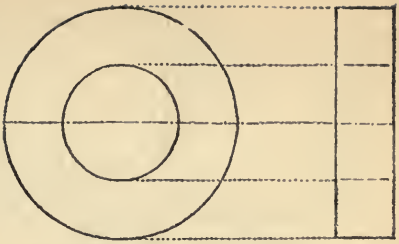


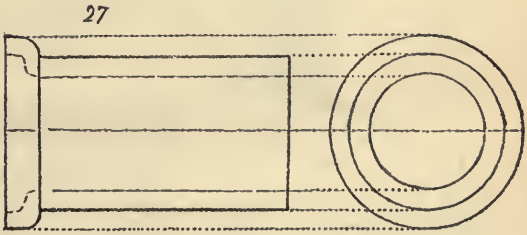


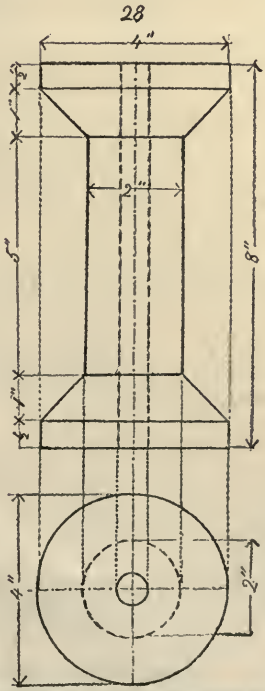


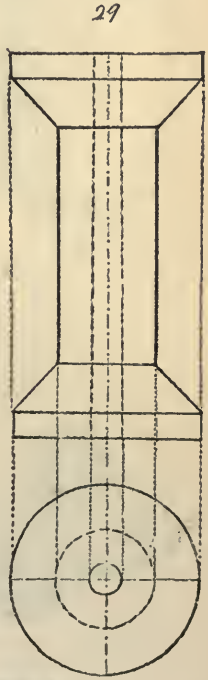
ILLUSTRATIONS OF GEOMETRIC PROBLEMS.



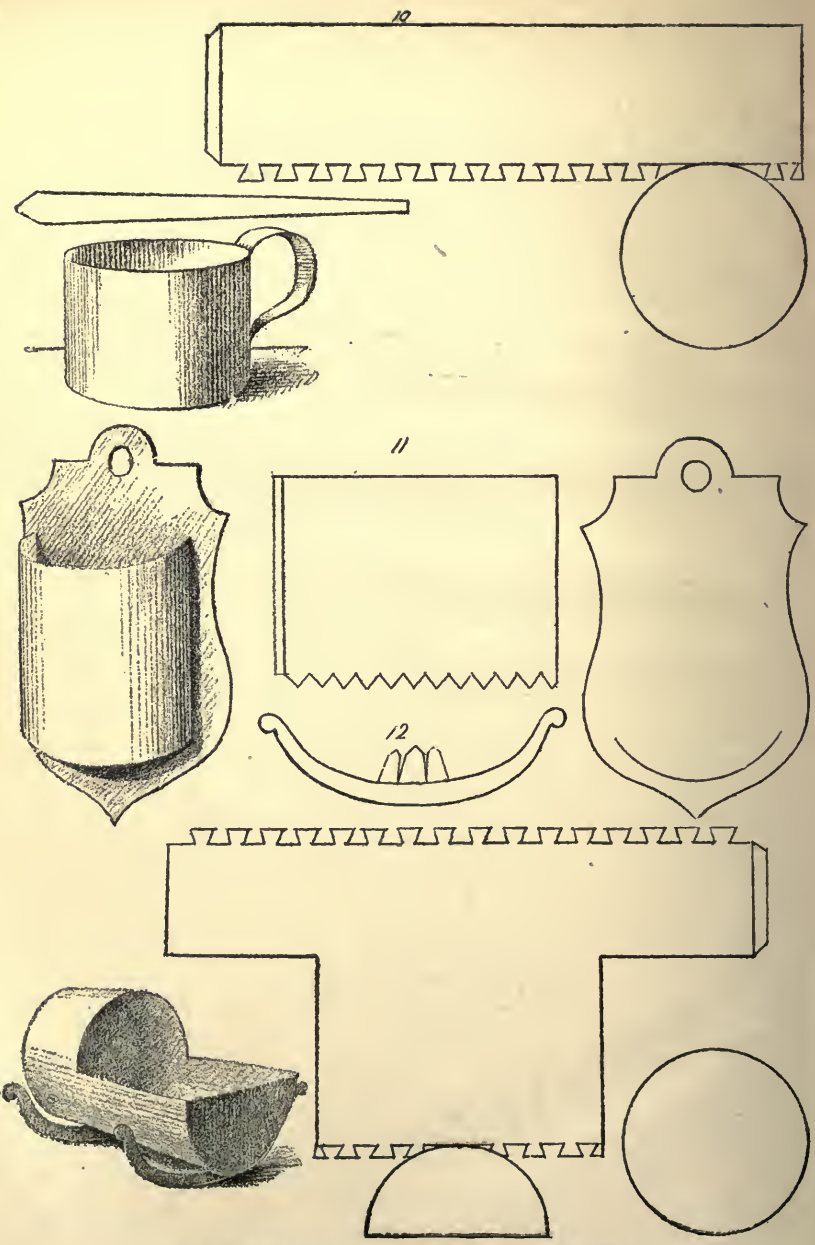




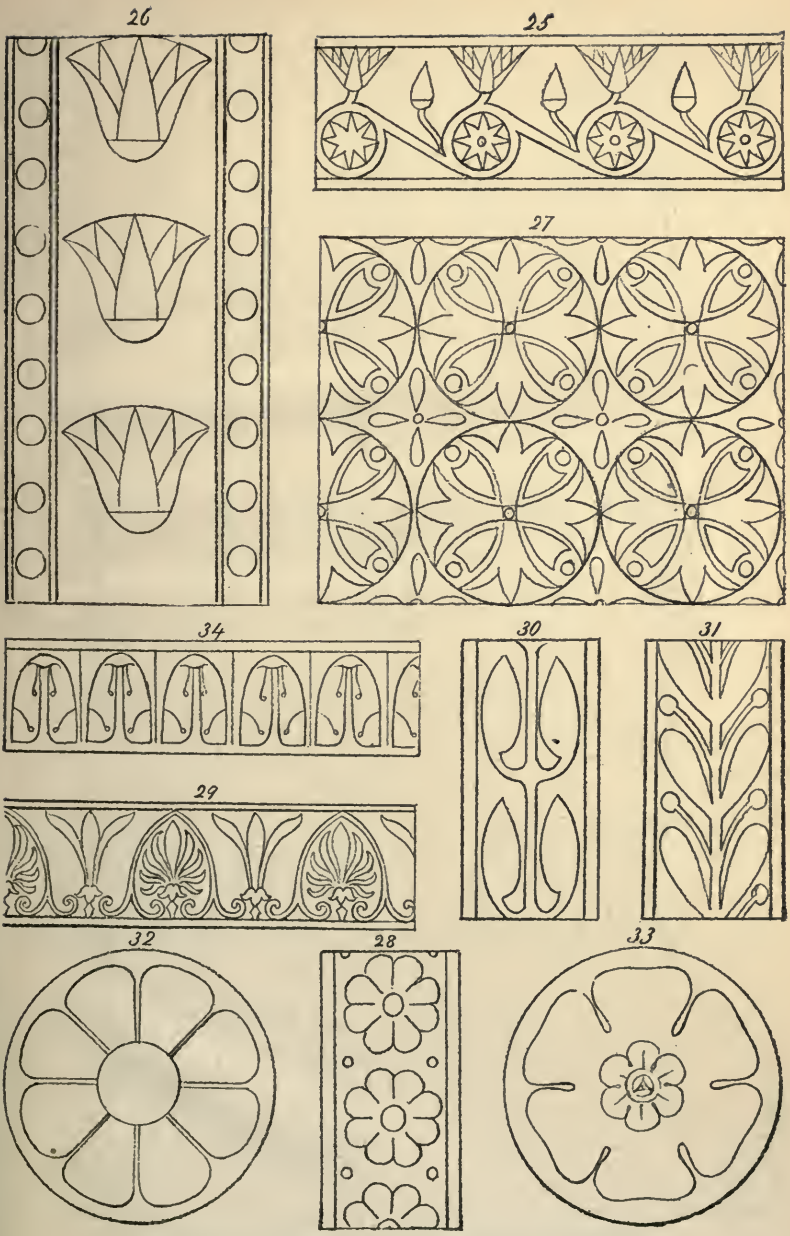




ILLUSTRATIONS OF WORKING DRAWINGS.



ILLUSTRATIONS OF DEVELOPMENTS.



ILLUSTRATIONS OF HISTORIC ORNAMENT.

ILLUSTRATIONS OF BOTANICAL DRAWING.

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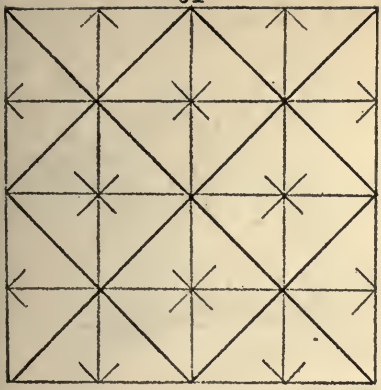

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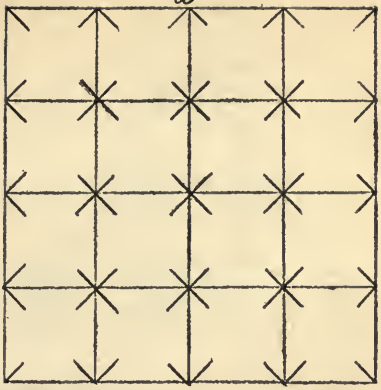

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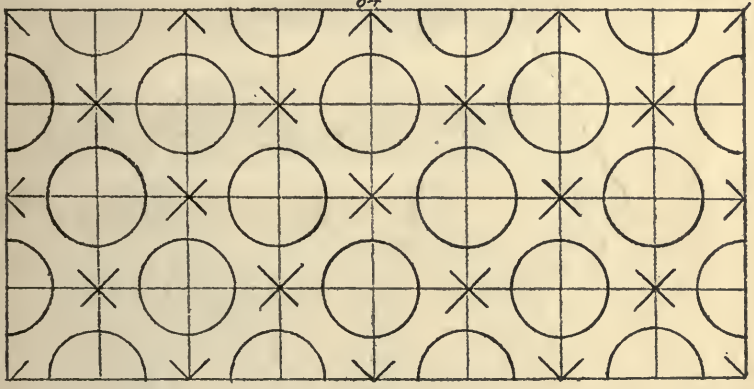

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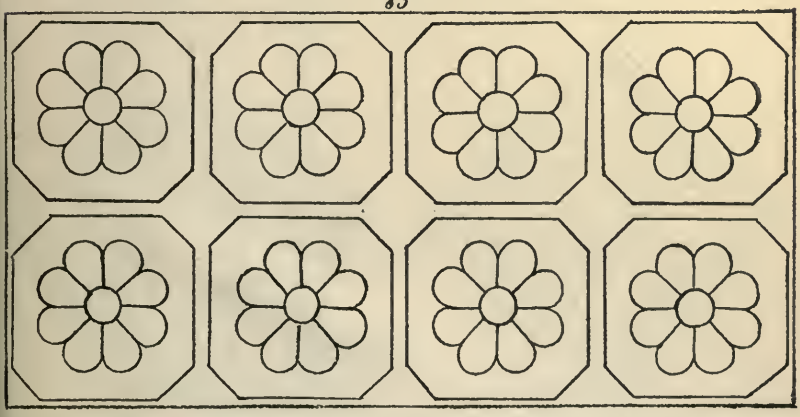
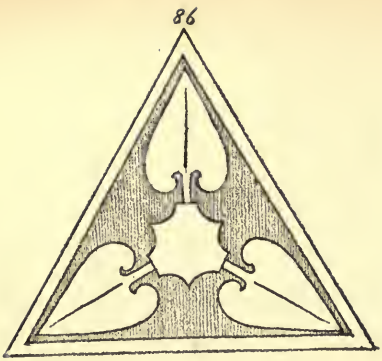
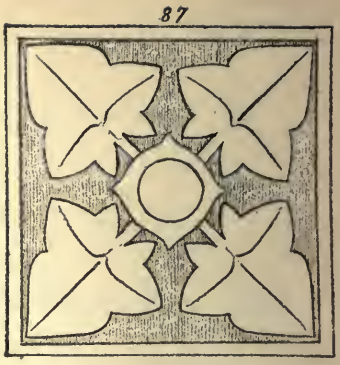
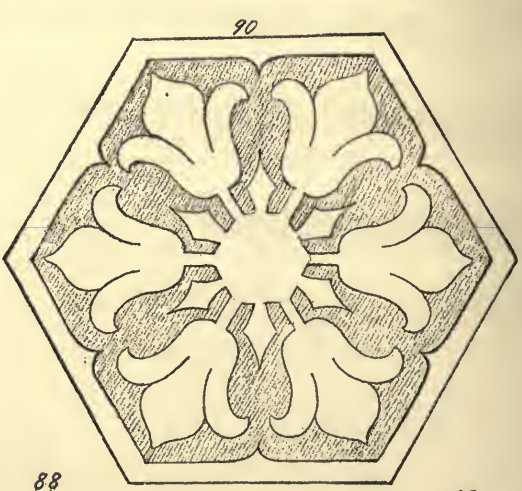


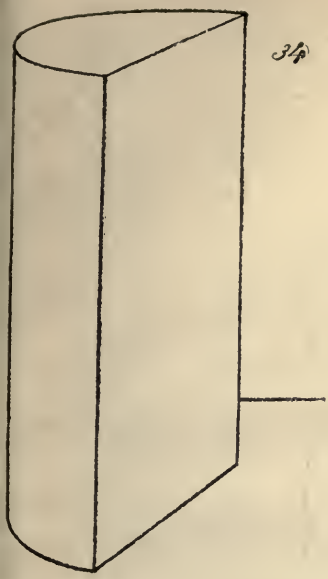
ILLUSTRATIONS OF DESIGN—CONSTRUCTION.

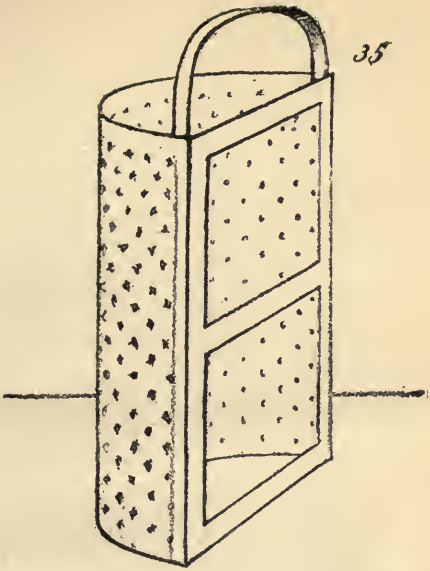


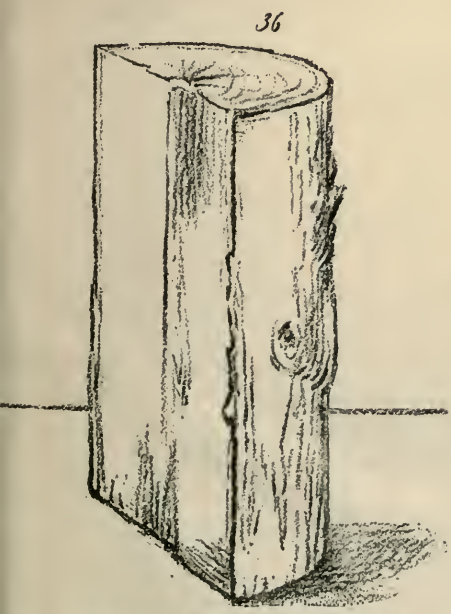


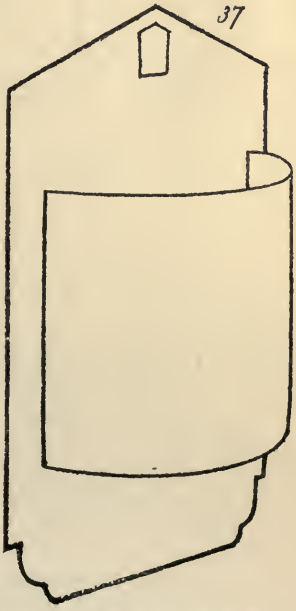


ILLUSTRATIONS OF DESIGN—RADIAL ARRANGEMENT.









ILLUSTRATIONS OF PICTORIAL DRAWING—HALF CYLINDER.

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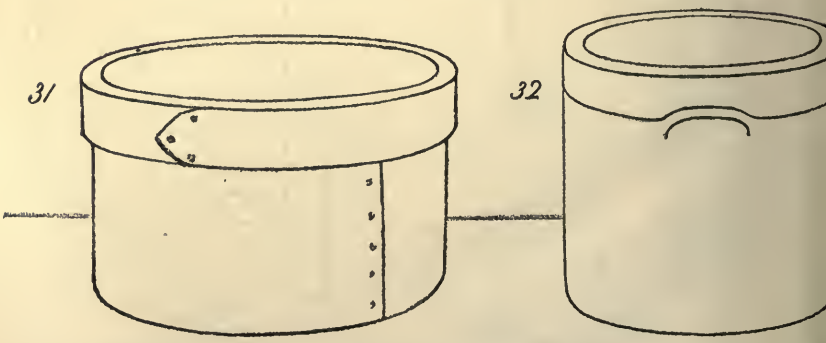

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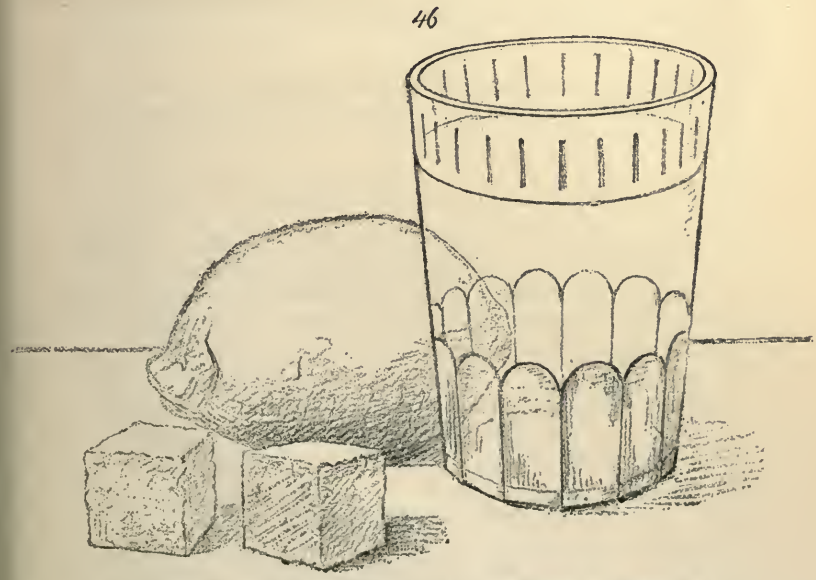
ILLUSTRATIONS OF PICTORIAL DRAWING—CYLINDER.



ILLUSTRATIONS OF PICTORIAL DRAWING—APPLIED DECORATION.

ILLUSTRATED DEFINITIONS

GEOMETRIC SOLIDS.

A Solid is space or magnitude inclosed by surfaces; it has length, breadth, and thickness. In art the term may be applied either to a model or an object.

Sphere. A solid bounded by one curved surface, every part of which is equidistant from its center. A solid formed by the revolution of a circle upon its diameter.

Hemisphere. Half a sphere.

Spheroid. A solid nearly spherical in form. Spheroids are oblate when flattened at the poles, like the earth; or prolate when extended at the poles, like a turtle's egg.

Ellipsoid. A prolate spheroid. A solid formed by the revolution of an ellipse upon its axis.

Ovoid. A solid having the form of an egg. A solid formed by the revolution of an oval upon its axis.

Cylinder. A roller-like body, with flat, circular ends. A solid formed by the revolution of a rectangle upon one of its diameters.

Half-Cylinder. A solid formed by dividing a cylinder upon its axis.

Circular Plinth. A very short cylinder. A cylinder in which the height is less than the diameter of its flat, circular faces.

Cone. A solid having a circle for its base, and tapering to a point, or vertex. A solid formed by the revolution of an isosceles triangle upon its altitude.

Circular Frustum. That part of a cone which remains when the top part is cut off by a plane parallel with its base.

Cube. A solid bounded by six equal square faces.

Half-cube. A solid formed by dividing a cube upon a diagonal of one face. A half-cube is a triangular prism.

Prism. A solid whose ends are similar, equal, and parallel, and whose sides are parallelograms.

Square Prism. A prism whose ends are squares.

Triangular Prism. A prism whose ends are triangles.

Pentagonal Prism. A prism whose ends are pentagons.

Hexagonal Prism. A prism whose ends are hexagons.

Octagonal Prism. A prism whose ends are octagons.

Square Plinth. A very short square prism.

Pyramid. A solid having one base bounded by any number of straight lines, and having the same number of triangular faces with a common vertex.

Square Pyramid. A pyramid whose base is a square.

Square Frustum. That part of a square pyramid which remains, when the top part is cut off by a plane parallel with its base.

Triangular Pyramid. A pyramid whose base is a triangle.

Pentagonal Pyramid. A pyramid whose base is a pentagon.

Hexagonal Pyramid. A pyramid whose base is a hexagon.

Octagonal Pyramid. A pyramid whose base is an octagon.

Truncated Solid. That part of a cylinder, cone, prism, or pyramid, which remains, when the upper part is cut off by a plane at an oblique angle with the base.

DETAILS OF SOLIDS.

Surface is space or magnitude inclosed by lines; it has length and breadth, but no thickness. In Art, the outside of a thing is considered its surface.

Face. A part of a solid (*a*) bounded by edges.

Edge. A part of a solid, where the surface abruptly changes its direction (*b b*). A part of a solid where two faces meet.

Outline. The apparent limit of a curved surface, or the line by which a figure is defined.

Corner. A part of a solid (*c*), where three or more edges meet.

Point. A point has position only, without size; but in drawing it is indicated by a dot, and represents a corner, or marks position.

Line. The boundary of a face. A line has length only; but in drawing it is indicated by a mark of the pencil or crayon, and represents an edge or an outline.

A Straight Line is one which has the same direction throughout its length. It is the shortest distance between two points.

A Curved Line is one which bends at every point, and has no part straight.

A Broken Line is one made up of very short straight lines or of dots.

NOTE.— *When the word line is used alone, a straight line is meant.*

POSITIONS OF LINES.

According to their direction, lines are *horizontal, vertical,* or *oblique.*

A Horizontal Line is one which is level.

In drawing, a line which extends directly toward the right and left of the page is said to be horizontal. *Thus, a is a horizontal line.*

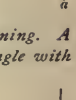
a

A Vertical Line is one which is perpendicular to a horizontal.

In drawing, a line extending directly toward the top and bottom of the page is said to be vertical. *Thus, a is a vertical line.*

NOTE.—*Do not use vertical and perpendicular as though they had the same meaning. A vertical line always points up and down; but any line which forms a right angle with another is perpendicular to that line, no matter what its direction may be.*

The line a is perpendicular to b, although not a vertical line.



An Oblique Line is one which is slanting to the right or left. *Thus, a and b are oblique lines.*

If the upper end of the line leans toward the right, it is sometimes called a *right-oblique* line; if toward the left, it is called a *left-oblique* line.

RELATION OF LINES.

In their relation to each other, lines may be *parallel* or *at an angle.*

Parallel Lines are such as are the same distance apart throughout their length.

Lines at an Angle are such as are not parallel.

Angle. The difference in direction of two lines, which meet or tend to meet at a point, is called an angle. *Thus, a is an angle.*

NOTE.—*The angle is the space between the lines, and not the lines themselves.*

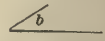
Angles are divided according to the directions of their lines into *Right Angles* and *Oblique Angles.*

A Right Angle is formed by one line meeting another in such a way as to make the two adjacent angles equal. *Thus, a and b are right angles.* The lines forming these angles are *perpendicular.* (See note under "Vertical Line.")

Oblique Angles. All angles which are not right angles are oblique. Oblique angles are either *obtuse* or *acute.*

An Obtuse Angle is one which is greater than a right angle. *Thus, a is an obtuse angle.*

An Acute Angle is one which is less than a right angle. *Thus, b is an acute angle.*



NOTE.—*The lines forming an angle are called its sides; the point at which they meet is called the vertex of the angle.*

GEOMETRIC FIGURES.

Plane. A plane is a surface on any part of which a straight line may be drawn in any direction.

NOTE.—*The top of the desk, if it can be imagined without thickness, may illustrate a plane.*

A Geometric or Plane Figure is a portion of a plane limited by lines.

A Rectilinear Figure is a portion of a plane limited by straight lines.

A Curvilinear Figure is a portion of a plane limited by curved lines.

A Mixtilinear Figure is a portion of a plane limited by both straight and curved lines.

RECTILINEAR PLANE FIGURES.

TRIANGLES.

A Triangle is a plane figure having three sides and three angles.

Triangles are divided into six classes: according to their angles, into *Right*-angled, *Obtuse*-angled, and *Acute*-angled Triangles; according to relative length of their sides, into *Isosceles*, *Equilateral*, and *Scalene* Triangles.

A Right-angled Triangle is one which has one right angle.

An Obtuse-angled Triangle is one which has one obtuse angle.

An Acute-angled Triangle is one which has all its angles acute.

An Isosceles Triangle is one which has two of its sides equal.

An Equilateral Triangle is one which has all its sides equal.

A Scalene Triangle is one which has no two of its sides equal.

NOTE.—*Any triangle may have two names—one given it on account of its sides, the other on account of its angles. For example, an equilateral triangle is also acute-angled, for having three equal sides always gives it three acute angles.*

QUADRILATERALS.

Figures which have four sides are called **Quadrilaterals.**

A Rectangle is a quadrilateral whose angles are all right angles.

A Square is a rectangle whose sides are equal.

A rectangle whose adjacent sides are unequal is often called an **Oblong.**

A Rhombus is a quadrilateral whose sides are equal; two of its opposite angles being acute, and the other two obtuse. A *Diamond* is a Rhombus.

A Rhomboid is a quadrilateral whose angles are like those of a Rhombus, but only its opposite sides are equal.

A Trapezium is a quadrilateral no two of whose side are parallel.

POLYGONS.

A Polygon is a rectilinear figure having more than four sides. When all the sides and angles of a polygon are equal, it is a *regular polygon*; when the sides or angles are unequal, it is called an *irregular polygon.* Geometrically, triangles and quadrilaterals are frequently classed as polygons, since they all have many principles in common.

A Regular Pentagon is a polygon having five equal sides and five equal angles.

A Regular Hexagon is a polygon having six equal sides and six equal angles.

A Regular Octagon is a polygon having eight equal sides and eight equal angles.

A Polygon having 7 sides is called a **Heptagon.**
" " " 9 " " " " **Nonagon.**
" " " 10 " " " " **Decagon.**
" " " 11 " " " " **Undecagon.**
" " " 12 " " " " **Dodecagon.**

CURVILINEAR PLANE FIGURES.

A Circle is a plane figure bounded by a curved line, every part of which is equally distant from a point within called its center.

An Ellipse is a plane figure, bounded by a regular curve, every point in the outline of which is at the same combined distance from the foci.

An Oval is a plane figure similar in shape to the longitudinal section of an egg.

A Crescent is a plane figure bounded by two curved lines, so arranged as to resemble the shape of the new moon.

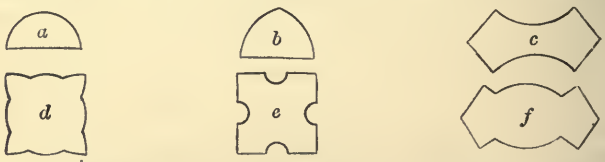
A Lens is a symmetrical plane figure bounded by two curved lines, curving in opposite directions.

A Trefoil is an ornamental figure of three foils or leaves, resembling a clover-leaf.

A Quatrefoil is an ornamental figure of four foils or leaves, resembling the petals of a flower.

MIXTILINEAR PLANE FIGURES.

Of these there are, of course, an infinite number. They are used in art largely as inclosing forms for designs. The figures given below (*a*,*b*,*c*,*d*,*e*,*f*) illustrate these.

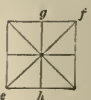


DETAILS OF GEOMETRIC FIGURES.

Base. That part of a rectilinear figure upon which it is supposed to rest, as *a b*.

Apex. The highest angle above the base, as *c*.

Altitude. The perpendicular distance from apex to base, as *c d*.



Axis. Any line which divides a symmetrical figure into two equal and similar parts, as *c d* or *g h*.

Diagonal. A line connecting opposite angles, as *e f*.

Diameter. A line connecting the centers of opposite sides, as *g h*. Diameters are sometimes distinguished as *vertical* and *horizontal*.

The Circumference of a circle is the line which bounds the figure.

The Diameter of a circle is a straight line drawn through its center between opposite points in the circumference, as *a b*.

The Radius of a circle is the distance from the center to any point in the circumference, as *c d*.

A Semicircle is half a circle, as *a d b*.

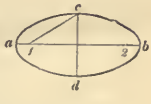
An Arc of a circle, or other curve, is any part of that curve, as *d b* or *a e*.

A Chord is a straight line connecting the extremities of an arc, as *a e*.

A Segment is the space inclosed by the arc and its chord.

A Sector is the space between any part of the circumference and two radii of a circle, as *b c f*.

A Quadrant is the space inclosed by one quarter of the circumference and two radii of the circle, as *d c b*.



Long Diameter. The longest straight line which may be drawn in an ellipse, as *a b*.

Short Diameter. The shortest straight line which may be drawn in an ellipse, cutting the figure into two equal parts, as *c d*.

These diameters in an ellipse are always perpendicular and bisect mutually.

Foci. Points in an ellipse from which the curve may be drawn mechanically, as *1*, *2*. The distance from *c* to *1* always equals one half of *a b*.

The terms *long* and *short diameter* are sometimes applied to the axis and the line representing the greatest width in an oval; as, long diameter *a b*, short diameter *c d*.

MISCELLANEOUS TERMS.

Alternation. The repetition of one set of units separated by another set of units of a different character, in reciprocal succession.

Axis of Symmetry. A line drawn through the middle of a figure, so that the parts on one side are exactly repeated in a reverse order on the other. The axis may be drawn in any direction, being governed by the character of the figure; in the ornamental figure next below, it is vertical.

Bisect. To divide into equal parts.

Bisymmetrical Design. A symmetrical arrangement in which one half is the exact reverse of the other.

Blocking-in Lines. Sketched lines which indicate masses.

Border. An ornament which consists of a regular repetition of ornamental units, along a line of indefinite length. The cut shows a familiar Greek border, composed of scrolls or spirals.

Botanical Drawing. The representation of vegetable form.

Center. A radial design.

Center Line. A line representing the center of a solid.

Cinquefoil.

Cinquefoil. An ornamental figure having five foils or leaf-like curves, used for windows, panels, etc.

Circle. In Christian art, a symbol of eternity.

Concentric. Having a common center.


Concentric Circles and Squares.

Connecting Line. A line connecting similar parts in the drawings of two views of an object.

Construction. Making or building: putting together the parts of any figure so as to give its peculiar form and structure. *Construction lines* are the framework upon which a drawing is made; they determine the distances, proportions, etc. *Construction*, as applied in geometrical problems, refers to the measurements and steps taken in the solution of the problems. The light lines in the cut show a method of construction in erecting a perpendicular at the end of a given line.

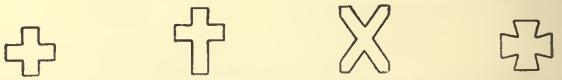
Contrast. The result of a juxtaposition of lines, forms, or colors of different characters.

Contrasted Harmony. (See "Harmony of Color.")

Conventionalization. The modifying of natural forms in such a way that the principles of their growth are retained and unimportant details omitted or simplified. A conventional form is a form, idealized according to the evident intent of nature.

Cordate. Resembling a heart in outline.

Cross. Two bars placed transversely upon each other in various ways, each having its own name. A symbol of suffering. Some of the more common ones are shown in the illustrations.


Greek Cross. Latin Cross. St. Andrew's Cross. Maltese Cross.

Dashed Line. A series of dashes arranged in line. Invisible edges are represented by dashed lines.

Describe a Circle. To draw with a compass. The accompanying cut shows the position of the hand, while describing a circle with the compass.

Design. The plan, combination, or arrangement of any construction or ornament for a given purpose, whether constructive or decorative. The word is often misused to apply merely to ornamental subjects.

Detail. A selected part of a figure or object, usually drawn on a larger scale than is convenient for the whole composition.

Develop. To represent on a plane the entire surface of a figure.

Development. The entire *surface* of any solid or object when laid out upon one plane, as in the cut, which shows the development of a square prism. (See "Flat.")

Diaper. A panel or flat recessed surface covered with wrought work in low relief. This form of decoration was used greatly by the Moorish artists for the enrichment of the walls of the Alhambra. An all-over pattern.

Distribution. An orderly disposition of the units in the field of the design.

Dot-and-dash Line. A series of dots and dashes alternated in line. Center lines are drawn with dot-and-dash lines.

Dotted Line. A series of dots, or very short dashes, arranged in line. Connecting lines are drawn as dotted lines.

Elementary Design. A pleasing arrangement of units within a given form, based on certain recognized principles.

Elevation. A drawing giving the actual form and proportions of an object, as produced on one or more vertical planes.

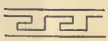
Elevation is opposed to *Plan*, which gives the actual form and proportion of an object as produced on a horizontal plane. Thus, in the three figures given, the first shows the appearance of a prism, the *plan* shows the actual form and proportion of the base of the prism, and the *elevation* gives the form and proportion of one of the sides of the prism. Some objects require several different elevations, to show all the facts of form of all their details.

Field. That portion of any surface to be occupied by the design.

Flat. A development of the *whole* of an object ; *e. g.*, the *flat* of a paper windmill is like a square with its diagonals.

Flat Ornament. An enrichment of a surface by means of contrast obtained by colors, or the use of light and dark.

Fret. An ornament consisting of a series of lines or bands called *fillets*, which form a succession of angles, usually right angles, and are sometimes interlaced.



Full Line. A continuous line. Outlines and visible edges are always drawn with full lines.

Geometric Drawing. The drawing of lines, surfaces, and solids with instruments.

Ground. That upon which the object rests. The field of a design.

Half-Tint. The darkening or shading of a surface, by means of a succession of parallel and equidistant lines, which may be either vertical, horizontal or oblique.

Harmony. Such an adaptation of the parts of a design to each other, that they form a complete and pleasing whole.

Harmony of Color. A pleasing arrangement of colors. There are six principal Harmonies :

1. **Neutral.** Composed of black, white, and gray. (Really a dominant harmony.)
2. **Contrasted.** Composed of one color with neutrals.
3. **Dominant.** Composed of tones of color in one scale.
4. **Complementary.** Composed of colors which, when mingled, will produce white or gray.
5. **Analogous.** Composed of colors closely related in the spectrum.
6. **Perfected.** Usually composed of analogous or dominant combinations, with color complementary to the prevailing tone.

Neutral colors may be added to all of these combinations.

Hue. Any color found in the spectrum, except the six standard colors.

Mass. General shape, regardless of detail.

Neutral Color. A term used in decorative arts, to denote a color which has little or no effect upon the hue of a juxtaposed color.
The Neutral Colors are white, gray, and black.

Ornament. Any decoration or enrichment of form, color, or construction, intended to beautify the object ornamented.

Overlap. To lie over or upon. When a part of an ornament seems to lie upon another part, it is said to *overlap*.


Overlap.

Perspective. The art of representing an object exactly as it *appears* to the eye from one fixed point of view. The first cut under "Elevation" is a drawing *in perspective* of the prism represented.

Petal. One of the leaf-like parts of the corolla of a flower.

Pictorial Drawing. A representation of the appearance of an object or group, as seen from one point of view.

Plan. A top view. (See "Elevation.")

Plinth. A square member forming the lowest part of the base of a column; hence, any flat rectangular block, such as might be cut from a plank.

Proportional Measurement. A method of obtaining relative distances upon distant objects, by means of a pencil or similar implement.

Quadrisect. To divide into four equal parts.

Quality of a Color. The character of a color relatively considered. The quality of a color is said to be *warm*, when it approaches in appearance any of the colors in the red part of the spectrum; or *cold*, when it approaches in appearance any of the colors in the blue part of the spectrum. Colors acquire certain qualities by juxtaposition.

Quatrefoil. An ornament having four foils or lobes, used in panels, windows, etc. A symbol of the Evangelists.


Quatrefoil.

Radiation. A method of arrangement in ornamental design, in which the parts diverge from a point. The *rosette* shown in the figure below is an example of radiation from a center. The horse-chestnut leaflets radiate from a point not in the center.

Repetition. A method of arrangement in which a number of similar forms or objects are placed in a row, or arranged round a center.

Representation. Delineation by means of lines, light and shade, or color. All drawing is representation.

Rhythm. The frequent recurrence of some characteristic in the various parts of a design, without being obtrusive.

Rosette. A radiating ornament made of petal-like parts.

Scale of Color. The entire range of tones, from white, through its tints, a standard or hue, and its shades, to black.

Spectrum. A band of colors, produced by allowing rays of sunlight to pass through a triangular prism of glass, or other refracting medium. The spectrum contains red, orange, yellow, green, blue, and violet, usually called the *standard*, or *primary*, colors, and an indeterminate number of intermediate hues.

Standard Color. One of the six primary colors of the spectrum. A standard pigment color is one which imitates one of these, as closely as possible.

Symmetry. The result of a proper disposition and proportion of the parts of a design, forming a complete whole or unit.

Tangent. Touching at a single point. A line touching a curve which, even when produced, does not intersect it.

Tint. A color produced by adding light, or white, to a standard or hue.

Tone. One color in a scale of colors. Tone is also used to describe the general effect produced by any combination of colors.

Trefoil. An ornament of three foils or lobes, used for panels, windows, etc. A symbol of the Trinity.


Trefoil.

Trisect. To divide into three equal parts.

Unit of Design. One of the distinct fractions, or parts, of a design, repeated uniformly to complete the figure. One of the spirals in the design under "Border" is the *unit of design*, which, repeated, makes the completed figure shown.

Unity. Such a combination of parts as to constitute a complete and pleasing whole. The result of uniformity in the character of the main lines or units in a design.

Value. In color, the power or force of a color upon the eye. The value of a color is directly proportional to the amount of light it reflects.

Variety. The result of variation, or difference, in the details of a design, without affecting its unity.

View. A term used to indicate the stand-point of the observer, when making a drawing of an object, as the *end view*, when only the end is seen.

Working Drawings. Drawings which represent facts of form. Drawings from which objects may be accurately made or constructed. In making a working drawing, the eye is supposed to be opposite each part of the object represented.