WHITE'S

NEW COURSE IN ART INSTRUCTION

OUTLINE

FOR

SEVENTH 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,
Geometry,
Working Drawing,
Development,
Color,
Historic Ornament,
Botanical Drawing,
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. Convention alization 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. Directions. { 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 SEVENTH YEAR'S WORK.

(FOURTH GRAMMAR YEAR.)

BOOK VII.

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

1. GEOMETRIC DRAWING.

I. MEASUREMENT.

Preliminary work (on practice paper):

Review the accurate measurement and ruling of lines; reducing to half and quarter size. Teach drawing to scale of $1\frac{1}{2}'' = 1'$.

Measure simple rectangular surfaces like those of the window pane, door panel, desk top, slate, box cover, etc.; make a freehand sketch of each, and mark the dimensions; make an accurate drawing of each to the scale of $1\frac{1}{2}'' = 1'$.

NOTE.—Continue this work in connection with other lessons in Geometric Drawing.

SUGGESTIONS.

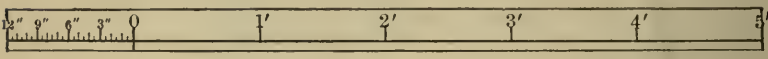
The best results will be secured if drawing scales similar to those used by draftsmen are furnished for each pupil.

If prepared drawing scales are not furnished, teach each pupil to make his own scale, as follows:

(*a*) Draw a fine sharp line 9″ long; divide it with the utmost accuracy into six equal parts of $1\frac{1}{2}''$ each. (*b*) Mark the first point of division 0, the second

1′, the third 2′, the fourth 3′, the fifth 4′, and the right end of the line 5′. (See illustration.) (*c*) Divide the first part of this line—the first *foot*—

Fig. 1.



into fourths. (*d*) Beginning at 0, mark the first point of division toward the left 3″, the second 6″, the third 9″, and the left end of the line 12″. (*e*) Subdivide these spaces into *inches* and *half-inches* as shown in the illustration.

Practice taking dimensions from this scale. For example, to obtain a radius representing 3′ 6″, open the compasses to a greater than the required distance, place the needle point on the 3′ division, and, gradually closing the compasses, bring the pencil point to the 6″ division.

II. GEOMETRY. (For illustrations, see pages 7 and 8.)

Preliminary work (on practice paper):

Review the simple geometric problems already taught, giving special attention to accuracy. Insist upon fine, definite lines. The light lines used in working out any problem ought to appear finer than a hair laid upon the paper beside them.

Page 3. *Construction of polygons.*

a. Draw margin lines ½″ from the edges of the page. (Unless otherwise specified, the margin lines should always be drawn this distance from the edges of the page.)

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

1. In the upper left space, draw an equilateral triangle on a 2¼″ base.
2. In the upper middle space, draw a regular hexagon on a 1½″ base.
3. In the upper right space, draw a regular pentagon on a 1⅜″ base.
4. In the lower left space, draw a regular hexagon, having one diagonal a horizontal line 2¼″ long.
5. In the lower middle space, draw a regular octagon on a ⅞″ base.
6. In the lower right space, draw a regular octagon, having one diagonal a horizontal line 2¼″ long.

Page 4. *Foils.*

a. Draw margin lines.

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

1. In the left-hand space, draw a trefoil on a 1¾″ equilateral triangle; or a cinquefoil on a regular pentagon having a 1½″ base.
2. In the right-hand space, draw a quatrefoil on a square having one diagonal a horizontal line 1¾″ long; or a sexfoil on a regular hexagon having a 1¼″ base.

Page 5. *Original inclosing form.*

a. Study Figs. 80, 81, 82, 83, and 84, on page 8, Book VII., to determine their geometric construction.

b. Draw margin lines.

1. Draw an original inclosing form for a bilateral design, similar in character to those studied, but having its long axis horizontal.

SUGGESTIONS.

Never tell a pupil what he may be led to discover for himself.

A pupil who has mastered the problems given in Book VI. will be able to construct the regular polygons with but little assistance.

Insist upon accuracy. A rough working drawing, if accompanied by correct dimension marks, may be useful ; an ill-drawn design may be ingenious ; a sketchy pictorial drawing may be artistic, but geometric construction has no value whatever if inaccurate.

The different problems on a page should correspond in size, and each should be placed symmetrically in its allotted space.

The different kinds of lines should be of uniform character, and the notation should be orderly and unobtrusive.

Solutions of Problems.

PROBLEM 1. *On a given base to construct an equilateral triangle.*

Draw the base AB. With A as a center and a radius equal to AB draw an arc above the base. With B as a center and with the same radius draw another arc, intersecting the first at C. Draw lines connecting AC and BC. ABC is the required triangle.

PROBLEM 2. *On a given base to construct a regular hexagon.*

Draw the base AB. With A as a center and a radius equal to AB, draw an arc above the base. With B as a center and with the same radius, draw another arc intersecting the first at 1. With 1 as a center and with the same radius draw a circle passing through the points AB. Set off the radius (which equals AB) upon the circumference of the circle beginning at A. The points thus obtained locate the corners of the required hexagon. Draw the sides of the hexagon.

PROBLEM 3. *On a given base to construct a regular pentagon.*

Draw the base AB. With A as a center and a radius equal to AB draw a circle. With B as a center and with the same radius draw another circle intersecting the first at 1 and 2. Connect 1 and 2. With 2 as a center and with the same radius draw a semi-circle intersecting the circles previously drawn at 3, A, B, and 4. Mark the point where the semi-circle intersects the line 1—2, 5. Connect 3 and 5 and extend the line to intersect the circle at C. Connect 4 and 5 and extend the line to intersect the circle at E. With C and E as centers, and a radius equal to AB, draw arcs intersecting at D. Draw BCDEA, the required pentagon.

PROBLEM 4. *On a given diagonal to construct a regular hexagon.*

Draw the diagonal AB. Bisect AB. With the point of bisection as a center and a radius equal to one half AB, draw a circle. The radius of this circle set off on its circumference from either A or B, will give the points for the required hexagon. Draw the hexagon.

PROBLEM 5. *On a given base to construct a regular octagon.*

Draw the base AB. Erect perpendiculars at A and B. Bisect the outer right angles formed at A and B. Make the bisectors AC and BD each equal to AB. Connect C and D, cutting the perpendiculars at 1 and 2. Set off a distance equal to 1—2, from 1 to 3 and from 2 to 4. Draw an indefinite line through 3—4. Make 3E, 3G, 4H, and 4F each equal to A1. Draw the octagon ACEGHFDB.

PROBLEM 6. *On a given diagonal to construct a regular octagon.*

Draw the diagonal AB. Bisect AB at 1. Bisect two adjacent right angles, and extend the bisectors to bisect the opposite angle. Set off one half of AB on each line radiating from the center 1. The points thus found locate the corners of the required octagon. Draw the octagon ACDEBFGH.

NOTE.—An approximate method for the construction of any regular polygon on a given base is given on page 7, Fig. 72. The solution of the problem is as follows: Draw the base AB. Bisect AB, and extend the bisector indefinitely. With A as a center and a radius equal to AB draw an arc cutting the bisector at C. Divide the arc BC into *six* equal parts, marking the points of division 1, 2, 3, 4, and 5. With C as a center draw arcs passing through the points 1, 2, 3, etc., and intersecting the perpendicular above and below C.

The point C is the center for a circle which will receive the distance AB *six* times upon its circumference. The first point *below* C is the center for a circle which will receive AB *five* times. The first point *above* C is the center for a circle which will receive AB *seven* times; the second point above C for one which will receive it *eight* times; the third above, *nine* times, etc.

The Foils.

The different foils are constructed upon the geometric figures as shown on page 7, Figs. 73, 74, 75, and 76. Each point of the figure is the center for one foil, the radius of the foil being equal to one half of one side of the geometric figure upon which the foil is drawn.

Inclosing Forms.

Extend the *outer* straight lines in Figs. 80, 81, 82, 83, and 84, on page 8, so as to complete the geometric figures of which they form a part. The centers for the various circles and arcs are now easily determined. By a careful study of these, the pupil will be enabled to design an original inclosing form.

Fig. 79 shows how a simple inclosing form (Fig. 77) may be repeated to form a surface decoration. Fig. 78 may be repeated in a similar way.

III. WORKING DRAWING. (For illustrations, see page 13.)

Preliminary work (on practice paper) :

Review the representation of invisible parts by means of *dashed lines;* the conventional use of other lines ; namely, *full lines* for outlines and edges, *dotted lines* for connectives, *dot-and-dash lines* for centers, and *light full lines with arrow points and figures* for dimensions.

Make freehand sketches, on practice paper, of two views of the cube, square prism, and square plinth, with their edges parallel to the plane upon which they are represented, and teach their representation when turned *at an angle* with the plane upon which they are to be represented. (See Fig. 43, page 13.) When the representation of faces oblique in one view is understood, draw accurately with instruments in the book.

Teach *three views.*

Page 6. *Plane faces oblique in one view.*

a. Draw margin lines.

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

1. In the left space, draw a two-inch cube, full size, turned at an angle of 30° to the left. Lowest point in the plan, $2\frac{1}{8}''$ from the left and $\frac{1}{2}''$ from the lower margin line.
2. In the right space, draw the plan and elevation of a stone block, 1′ 8″ long, 1′ 0″ wide, and 1′ 4″ high, turned so that its longest edges make an angle of 30° to the right. Scale $1\frac{1}{2}'' = 1'$. Lowest point in the plan, $1\frac{1}{4}''$ from the right and $\frac{1}{2}''$ from the lower margin line.

Page 9. *Three views.*

a. Draw margin lines.

b. Draw a vertical line dividing the space into two parts, the left $3\frac{1}{2}''$ wide, the right $6\frac{1}{2}''$ wide.

1. In the left space, draw two views of a $\frac{7}{8}''$ coupling bolt (Fig. 45). Draw full size, *from the object.*
2. In the right space, draw three views of one of the following : The step model (Fig. 46) ; the tin dipper (Fig. 48) ; the dovetail joint (Fig. 50), or of some other object requiring three views to show all its parts. Mark the dimensions, and give the scale.

Page 10. *Toy barn.*

a. Draw margin lines.

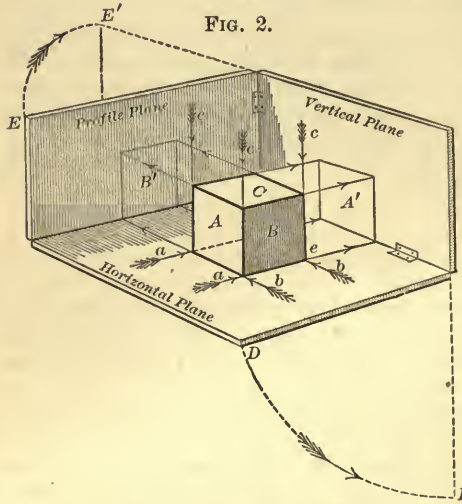
1. Draw three views of a toy barn, similar to that shown in Fig. 47. Length 2′ 0″, width 1′ 4″, height from ground to eaves 8″, roof 45° pitch. The barn has large folding-doors in the middle of one side ; size of each door, 4″ × 8″. Over the doors is a gable 1′ 2″ span, roof 45° pitch. Draw to scale of $1\frac{1}{2}'' = 1'$. Lowest right corner of end view (see Fig. 47) $\frac{1}{4}''$ from the right and $\frac{5}{8}''$ from the lower margin line.

2. In the upper left part of the space, draw three views of a flat glass bottle or flask. Arrange the views according to the space. Or draw any common object which will properly fill the space.

SUGGESTIONS.

The Projection of Three Views.

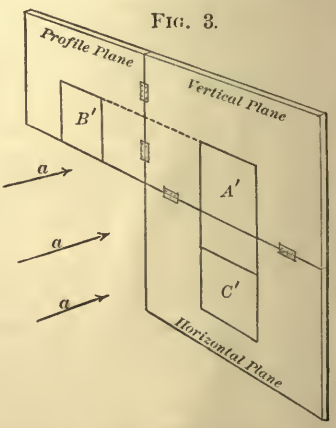
FIG. 2.



Working drawings are made according to the principles of Projection. These principles may be taught simply by using a book or slate held against the blackboard and revolved to represent the different planes; but three pieces of cardboard or thin wood, hinged as shown in Fig. 2, will more conveniently illustrate the principles. These three planes are named according to their positions: first, the *horizontal plane*, that upon which the object rests; second, the *vertical plane*, behind the object; third, the *profile plane*, at either side of the object (in Fig. 2, at the left).

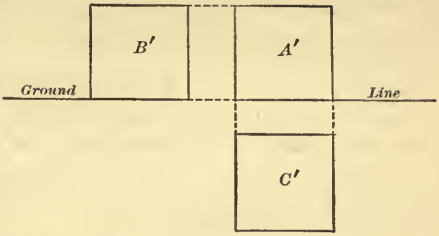
A person in front of the object, looking at it in the direction indicated by the arrows *aa*, would see only the face A. This would appear as a square seen against (projected upon) the vertical plane at A'. Looking at the object from the side, in the direction indicated by the arrows *bb*, the face B would appear as a square projected upon the profile plane at B'. Looking down upon the object in the direction indicated by the arrows *cc*, the face C would appear as a square projected upon the horizontal plane. Now suppose the cube removed, the horizontal plane dropped down or revolved, as indicated by the arrow, to D', and the profile plane revolved as indicated to E'. The three planes are now vertical, and the three *views* of the cube appear upon them in their proper relations, as shown in Fig. 3. Or, to a person viewing them from the front, in the direction indicated by

FIG. 3.



the arrows *aa*, the views would appear as in Fig. 4.* A′ is the front view or *elevation;* B′ is the side or end view (also called an elevation); C′ is the top view or *plan.* Some objects require but a plan and elevation to show all their parts; others require three or more views.

Fig. 4.



Objects Turned at an Angle.

An object is said to be turned at an angle when its principal edges are not parallel to the planes of projection. For example, if the cube in Fig. 2 were placed on the horizontal plane with the corner *e* nearer the vertical plane than any other corner of the base, the cube would be placed *at an angle.* If the cube were so placed that the edges of the base would make equal angles with the vertical plane, the cube would be placed *at* 45°. Were the corner *e* to be moved forward until the back edge of the base made an angle of 30° with the vertical plane, the cube would be placed *at* 30° *to the right.* The cube may be placed at any angle with the vertical plane, or with either of the other planes. A cube placed as shown in Fig. 43, page 13 in the drawing-book, is *at* 30° *to the left.* When the angle may be made either to the left or right, the cube is said to stand *at* 30° *and* 60°.

In practical work, objects are seldom represented at an angle, except when drawn in perspective; but in such objects as architectural and machine details certain parts sometimes must be so represented, and the underlying principles must be understood by the draftsman.

For convenience, plans are sometimes placed *above* elevations, and the side views are often transposed.

Coupling Bolts.

These are used with nuts to fasten together two pieces of metal. They may be seen in iron bridges, locomotives, looms, etc. If a $\frac{7}{8}''$ bolt cannot be obtained for use in this lesson, use a smaller bolt, and enlarge it to fill the space. In bolts of standard gauge, the *diagonal* of the hexagonal head is equal to twice the *diameter* of the bolt. The thickness of the head equals the diameter of the bolt. In Fig. 45, page 13, the *thread* is not shown. Few pupils at this stage can properly represent it. A thread is represented conventionally in Book IX., page 10, Fig. 65.

The Toy Barn.

This is made without projecting eaves, to simplify the development of its

* In this figure the lines dividing the planes are removed, with the exception of that between the horizontal and vertical planes—which, for convenience, is retained, and called the *ground line*—and the views are brought nearer together.

surface. Draw the end first, without the front gable, then draw the roof plan and the front. Place the front doors, and over them draw the front view of the gable. Add the side view of the gable, and then its roof plan.

Original Applications.

Select a familiar object. Make freehand sketches of at least three views. Mark the dimensions. The different views may be arranged in any convenient order; for example, the plan may be placed in the upper left corner, the side view at the right, and the edge view below. The connecting lines will explain their mutual relations.

IV. DEVELOPMENT. (For illustrations, see page 14.)

Preliminary work:

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

Page 12. *Plane faces at oblique angles.*

a. Draw margin lines.

1. Place a point $1\frac{5}{8}''$ from the left and $1\frac{1}{4}''$ from the lower margin. This point is the central point in the plan of a hexagonal prism 3″ long. A diagonal of its base is $1\frac{3}{4}''$ long. Draw the prism.
2. Develop the surface of this prism, drawing the flat in the space at the right. Place the lower right corner of the flat $\frac{3}{8}''$ from the right, and $1\frac{7}{8}''$ from the lower margin line. (See Fig. 14.)

Page 11. *Application.*

1. Develop the surface of the toy barn drawn on the tenth page, and draw the flat on this page. Draw a light horizontal line $1\frac{1}{4}''$ above the lower edge of the page. Use this as the lowest line in the flat of the sides.

SUGGESTIONS.

Method of Developing the Surface of the Hexagonal Prism.

Draw the flat on page 12 as follows: Locate the point $\frac{3}{8}''$ from the right and $1\frac{7}{8}''$ from the lower margin line, as previously directed. Draw an indefinite horizontal line from this point toward the left. Set off consecutively on this line the widths of the six faces. Draw parallel vertical lines 3″ long representing the long edges, and a horizontal line at the top, to complete the faces. With the upper and lower edges of the third face as bases construct the hexagons to represent the ends of the prism. Add the laps as shown in Fig. 14. Redraw the flat on "oak tag," and construct the prism.

Method of Developing the Surface of the Toy Barn.

Draw the indefinite horizontal line $1\frac{1}{4}''$ above the lower edge of the page, as previously directed. Set off consecutively on this line the lengths of the

four sides of the barn. Draw each side. Draw the lines representing the doors. Draw the flat of the main roof entire, placing it in the upper left corner of the page (1″ below the upper edge, and 1½″ from the left edge of the page). Draw the flat of the gable roof entire, placing it to the right of the drawing of the main roof. The length of the ridge of the gable is found in two of the views, the true length of the eaves only in the front view.

Redraw the flat on "oak tag," and construct the barn.

NOTE.—Other applications of *faces at oblique angles* are given on page 14. Still others may be suggested by the teacher or pupil. An original application is preferable to that already described, provided it illustrates the condition under consideration.

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2. DECORATIVE DRAWING.

V. COLOR.

Preliminary work:

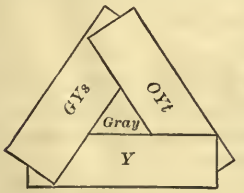
Review the previous work in color, especially that of the sixth year—namely, classification by composition.

By use of the wheel, show that the hues found upon either side of a standard contain a large amount of that standard color, and a small amount of another standard; that the spectrum scale may be said to contain three reds, three oranges, three yellows, three greens, three blues, three violets. In each of these six triads, one color predominates. The three tones in a triad are not the same, but are *analogous tones;* one color binds the three together. VR, R, and OR are analogous tones; GB, B, and VB are analogous tones. In both historic and modern art analogous tones of color are used side by side, producing an *Analogous Harmony.*

Page 34.

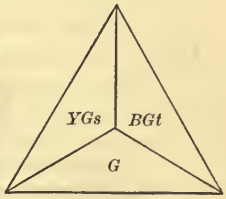
Make arrangements on this page with colored paper figures,—triangles, squares, oblongs, and circles,—illustrating analogous colors.

FIG. 5.



For example, cut oblongs ½″ × 1½″, and arrange them as shown in Fig. 5. Or cut triangles, and arrange them as in Fig. 6.

FIG. 6.



Apply knowledge of Color in Historic Ornament and Design.

NOTE.—In these triads the full colors need not be used. Tints and shades are often more pleasing. Neither is it necessary to use a standard in each triad; a hue may be made the central tone. Some fine analogous har-

monies may be produced by such combinations as the following : Yt, OY, Ys ; Yt, GY, Ys.

SUGGESTIONS.

Analogous Colors in Nature.

Fine illustrations of analogous harmonies of color are to be found in almost every natural object. Any pebble or metal-bearing mineral, as virgin copper, cuprite, etc.; the clouds, the plants, the plumage of birds (notably, of doves, humming birds, parrots, canaries, and peacocks) ; the hairy or other coverings of beasts, and the complexion, eyes, and lips of men, often exhibit exquisite combinations of analogous colors.

In nature, the analogous scale is often extended to include an infinite number of hues between tones as distant in the spectrum as red and blue (through violet), or yellow and blue (through green). In flowers, the following series is often found : Y, GY, YG, B, BG. Lead the children to discover and enjoy these delicate harmonies.

In art, perhaps the best analogous harmonies yet produced are to be found in the vases and wall decorations of the Greeks.

VI. HISTORIC ORNAMENT. (For illustrations, see pages 15 and 16.)

Preliminary work :

Review conventionalization, by studying the examples on pages 21, 22, and 24.

Study the illustrations on pages 15 and 16 to determine the following points in regard to the designs :

(*a*) *Plan of construction :* Bilateral main lines in the units of both borders and limited surface decorations.

(*b*) *The natural forms used :* Adaptation or conventionalization of these forms. (See description of illustrations.)

NOTE.—This part of the study is very important, because a good foundation may here be laid for the study of design from natural plant forms. The student should be encouraged to collect plants, that can be used in decorations similar to those studied, and carefully press and mount them for future use.

(*c*) *The technical principles* upon which the decoration has been constructed. The following are essential principles, some of which must enter into the construction of every good design : Fitness, order, growth, unity, and repose.

Teach *bilateral main lines.*

Page 17. *Conventional plant form on bilateral main lines.*

a. Draw margin lines.

1. Enlarge Fig. 47, 48, or 50, to properly fill the page. Place the axis exactly in the center of the page.

Page 18.

a. Draw margin lines.

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

c. Fold the leaf so that the left half of page 18 is visible, when the book is opened to page 16.

1. Enlarge Fig. 51, 52, 53, 54, 55, or 56, to properly fill the space.
2. Enlarge Fig. 49 to properly fill the right-hand space on the page.

Suggestions.

Supplementary Study.

For a still further practical study of this subject, examples of modern decoration, as nearly resembling type styles as can be found in paper hangings, textile fabrics, utensils, ornamental objects, and architectural detail, will be found of value. The students should be encouraged to make sketches of good examples of decoration, also to make collections of beautiful objects produced in the various industries, illustrating perfection of form, harmony in decoration, and propriety or fitness of the ornamentation to the surface decorated, with due consideration to the use of the object.

Reference Books.

Such books as Warnum's "Analysis of Ornament," Owen Jones's "Grammar of Ornament," and Redgrave's "Historic Ornament," will be found helpful in teaching Historic Ornament. These and other books on the subject should be in all public libraries.

Enlarging.

Compare the width and height of the figure to be enlarged with the width and height of the page. Determine the scale upon which the figure is to be enlarged, by comparing the widths and heights, remembering that the enlarged figure must have the same relative width and height as the original. Sketch the axis of the figure; locate its important masses and main lines; test the correctness of these parts; sketch the details; correct; finish.

Illustrations of Historic Ornament.

Fig. 44. This illustration represents the honeysuckle with parts conventionalized, and an ornament showing bilateral symmetry. It seems reasonable to suppose that the elements of this flower formed the basis of the pleasing arrangement so long known as the honeysuckle ornament. Authorities on historic ornament differ in their opinions, however, some believing that the natural flower never served as a model, but that the resemblance to the flower has been an after recognition; and when we consider that each part, or leaf, was done by a single stroke of the brush, we may easily suppose that the whole decorative form was generated by the brush of the painter. Still other authorities consider it a modification of the Egyptian lotus.

The sketches on the lower part of the page show natural and conventional sharp acanthus foliage. Another conventional form of this foliage may be seen in the lower part of Fig. 46.

Fig. 45. This ornament is the Greek anthemion border, or the so-called honeysuckle ornament taken from the eymatium of the raking cornice of the Parthenon. The example illustrates in a high degree ideal forms and beautiful flow of line. Each unit of the design is an illustration of bilateral symmetry and radiation from a point. In its arrangement, the whole design illustrates the vital principle of repetition and the still higher principle of variation (in this example an alternation of different units).

This design is also seen in flat, painted surface decoration, the following colors being used: orange red for the heart-shaped background to the palmettes, green blue shade for all the remaining background, and gold for the figures.

Fig. 46. This design is taken from a fragment of a Greek stela, or upright stone, used as a monument, from Asia Minor. The ornament consists of the acanthus leaf about a scroll, surmounted by a graceful palmette. It is a fine example of bilateral design in sculpture.

This plate affords a good opportunity to study treatment, handling, kind of line, and other means shown to express the character of the ornament (material, relief, etc.).

Fig. 47. This illustration is Assyrian. The style is not original, but was borrowed from the Egyptian, and modified by the religion and habits of the Assyrians. The figure is taken from the ornament called the sacred tree. It is a good example of balanced curves in design. Assyrian ornament was entirely painted, or gilded and silvered.

Fig. 48. This example is Egyptian. It is a representation of plants growing in a desert, and illustrates bilateral symmetry and radiation from a point. This ornament may have suggested the arrangement of parts in the Greek antefix.

The coloring is as follows: The stems, calyxes, and upper bands of the flower are yellow green shade; the flower is red tint 2; the space at the base representing the earth, is green orange tint; the band edging this is green orange, with fine red lines traversing it.

Fig. 49. This ornament is a Greek antefix, or a marble facing tile from the Parthenon. It is an illustration of bilateral symmetry in design, and consists of the Vitruvian scroll and the palmette.

Fig. 50. This is part of a Roman decoration found both in sculpture and in painted ornament. It resembles the Greek anthemion in a slight degree—that is, in general construction of the masses, but contrasts strongly with Greek forms, in its curves.

Fig. 51. This figure is the conventional Egyptian lotus, and symbolized the annual overflow of the Nile. The roots of the lotus served as food; the dried stalks were used as fuel, and the fiber was woven into mats and other fabrics. The shape of the lotus flower was imitated in spoons, cups, and other utensils, and in the capitals of columns.

FIG. 52. This illustration is taken from a Greek frieze, or cyma ornament, from the Erechtheion, Athens.

FIG. 53. This illustration is the Roman acanthus. It differs from the Greek in its greater freedom of curves and rounder contours, taking the *acanthus molles*, or the soft-leaved and more cultivated kind, for conventionalization. The acanthus is the parent of nearly all styles of decorative foliage down to our Early English. Callimachus, the sculptor, is credited with the first use of the acanthus in the capitals of columns. The illustration on page 15 shows the acanthus and a Greek conventionalization of the same.

FIG. 54. This ornament is Byzantine. The style is distinguished by broad-toothed and acute-pointed leaves, which in sculpture are beveled at the edge and deeply channeled. The illustration is found in the stone sculpture at St. Mark's, Venice.

FIG. 55. This illustration is Arabian. The decoration is taken from a soffit of a window in the mosque of Tooloon in Cairo. The marked characteristics of the Arabian style were refinement and elegance, originality and magnificence. In the general plan of their designs, they observed deflection of lines from a parent stem in tangential curves. Arabian ornament attained its fullest growth in the thirteenth and fourteenth centuries in the Alhambra, at Granada, Spain.

FIG. 56. This illustration is an example of Early Gothic ornamentation, and belongs to the thirteenth century. It is taken from a molding decoration in Notre Dame, Paris.

VII. BOTANICAL DRAWING. (For illustrations, see pages 21 and 22.)

Preparatory work:

Make collections of compound leaves, and also flowers and buds. Observe their characteristics, proportions, and arrangements of parts.

Study the illustrations on pages 21 and 22, to obtain some idea of how the different parts should be represented in pencil.

The manner of representing by a given means is called the *handling*. Try to show essential truths first, and with clearness.

Page 19. *Natural forms.*

a. Draw margin lines.

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

1. In the left space, draw a palmately compound leaf.
2. In the right space, draw a pinnately compound leaf.

Page 20. *Natural forms.*

a. Draw margin lines.

1. Arrange artistically two or more compound leaves, flowers, and buds, and draw them on this page.

Select a plant which may be adapted to clothe bilateral main lines in a panel.

SUGGESTIONS.

Compound Leaves.

Those leaves in which the blade consists of two or more separate pieces upon a common leaf-stalk are compound, their mode of division corresponding to that of the veining, whether pinnate (see illustrations 41 and 44, and Fig. 7), or palmate (see illustrations 40 and 43, and Fig. 8).

The *pinnately compound* leaves are those in which the leaflets are arranged on the sides of a main leaf-stalk. They correspond to the feather-veined (pinnate-veined) simple leaf. The pupils should be allowed to compare the forms, and notice that the continuation of the petiole, along which the leaflets are arranged, corresponds to the midrib of the simple leaf. Examples of this kind are the rose, common locust, ash, the vetches, the pea, acacia, etc.

The *palmately compound* leaves are those in which the leaflets are all borne on the end of the leaf-stalk. They correspond to the palmately veined simple leaf. The pupils should be led to observe that a palmately veined simple leaf, if more deeply cut, so as to separate the parts, would be like a palmately compound leaf. Examples of palmately compound leaves are the clover, sweet buckeye, Virginia creeper, horse chestnut, etc.

The parts of the compound leaf differ in size ; and opposite leaflets are not the same size. Figs. 7 and 8 illustrate the usual order in which the leaflets diminish in size from the apex to the base of the leaf.

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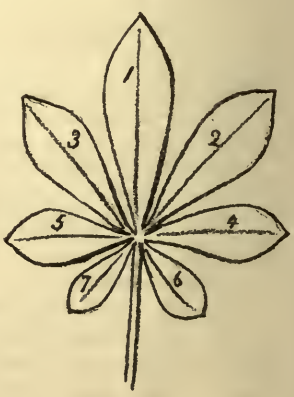
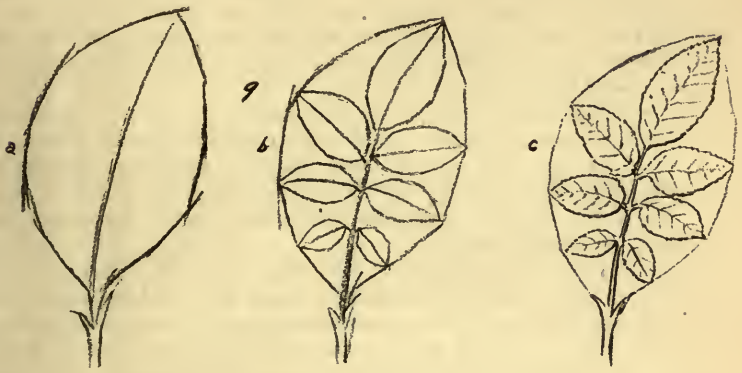


These observations will help the pupils to represent the direction of the midribs of leaflets in compound leaves. Thus, in the pinnately compound leaf, the midribs of leaflets articulate from the main leaf-stalk; in the palmately com-

pound leaf, the midribs of leaflets radiate from the end of the main leaf-stalk, or the base of the leaf.



NOTE.—In drawing a compound leaf, first determine the shape of the whole leaf ; then the swing of the entire mass (dependent upon the midrib) ; then the number and shape of the leaflets, making a careful observation of the directions of their midribs. Sketch lightly at first, then draw the details and finish with a line expressing the character of the leaf.

Fig. 9—*a*, *b*, and *c* give progressive stages of study.

Illustrations of Botanical Drawing.

Fig. 40. The Virginia creeper. A common woody vine, with tendrils fixing themselves to trunks and walls by dilated sucker-like disks at their tips. Leaves digitate, with five oblong lanceolate, sparingly serrate, leaflets. It blossoms in July, and ripens its small bluish berries in October.

Fig. 41. The common wild rose. A shrub; the leaves are alternate, compound and stipulate with serrate margins ; the stipules are sometimes united, and sometimes free, at the base of the petiole. The flowers are simple and five-petaled. *a*, *b*, *c*, *d*, and *e* are parts conventionalized for design.

Fig. 42. The common apple. The leaves are simple, with evenly serrate margins; the flowers are showy, in clusters, or umbels. *a*, *b*, *c*, *d*, and *e* are parts conventionalized for design.

Fig. 43. The clover. Low weeds, with ascending stems and compound leaves. The leaflets are obovate or oval, often notched at the end. The flowers are in heads, on pedicels, each flower on a slender naked peduncle. The head is surrounded by the upper rows of leaves. *a* is a leaf conventionalized for design.

Fig. 44. The jessamine. A shrub with compound leaves and from four to eight-parted leaflets, lanceolate in shape.

Fig. 45. Japan quince. A thorny shrub, smooth, and widely branching. Leaves oval or wedge oblong. The flowers come earlier than the leaves on side spurs; they are single or more or less doubled, and there are scarlet, red, rose-colored, and almost white varieties. The calyx has short and rounded lobes.

Fig. 46. Whiteweed, or daisy. A herb from two to four feet high, common in fields. The flowers are in sub-hemispherical heads ; disks, yellow ; the rays white, narrow, linear, and very numerous. Receptacle flat or convex, and naked; the involucre in scales nearly in one row. The leaves alternate sessile, coarsely serrate, ovate to lanceolate; the lower on winged stalks.

Fig. 47. Bindweed (hedge), or wild morning-glory. Twining freely. Leaves triangular, arrow, or halberd-shaped, with the lobes at the base obliquely truncate, sometimes toothed or sinuate. Flowers, white or rose.

Fig. 48. Marsh marigold, or *cowslip* (incorrectly so called). Aquatic, found in wet meadows. Leaves one or more, reniform, smooth and glossy, with entire or slightly crenate margins. Stems, hollow. Flowers few, with showy, bright yellow calyxes ; sepals from five to nine, resembling petals ; petals none. *a* and *b* are parts conventionalized for design.

VIII. DESIGN. (For illustrations, see pages 23 and 24.)

Preliminary work :

Review Historic Ornament, giving special attention to the *law of symmetry* as manifested in the examples given on pages 15 and 16.

Study Figs. 102 and 103 on page 24. These show the application of the same law.

Review main lines. Study the main lines on page 23. Notice the application of the principle of *radiation* discovered in compound leaves.

Review conventionalization. Study A, C, and D, in Fig. 92. In these the stiff, conventionalized forms are made more graceful by the introduction of curved midribs. Notice the same effects in Figs. 102 and 103 at *c* and *e*, and in the designs.

Teach *free conventionalization* of plant forms.

Study the clothing of the main lines with these forms. (See the various figures under 92 on page 23.)

Page 25. *Design from Copy.*

a. Draw margin lines.

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

1. Enlarge one of the figures on the right half of page 23, to properly fill the left space. (Fold the leaf so that the figure may be seen while drawing.)

2. Enlarge the completed design on page 24 (Fig. 103), to properly fill the right space.

Page 26. *Original Design.*

a. Draw margin lines.

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

c. On practice paper, make an original design on bilateral main lines in an ornamental inclosing form, using as units the plant forms already studied. When the design is accepted by the teacher, continue work in the book.

1. In the left space, draw the inclosing form of the original design. In it, sketch the main lines.
2. In the right space, draw the natural forms used in the design, and below them their conventional forms.

Page 27.

a. Draw margin lines.

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

1. In the left space, redraw the inclosing form with the main lines, and reproduce the original design, half-tinting the field or ground.

Suggestions.

The Original Design.

An original design is simply the result of the pupil's own thinking, and need not, necessarily, entirely differ in all its details from any other design. If the proper steps are observed, every pupil can produce creditable work.

Complicated designs are not to be required nor encouraged. A few well-placed main lines, in which the principles of growth and radiation are observed; a few carefully studied units, beautiful in outline, and symmetrically placed, with a regard for the principles of variety, rhythm, and repose, will give a more chaste and pleasing design than will a great variety of forms thoughtlessly combined, or drawn with painful precision on deformed main lines.

Half-Tinting.

The half-tinting used in designs to give clearness and relief to the figure, may be either mechanical or freehand. If mechanical, the lines should be fine, clear, equidistant, and apparently continuous over the surface of the ground or field. If freehand, the lines should be fine, distinct, broken lines, approximately equidistant. In either case the half-tinting, when held at arm's length, should give the effect of an even gray tint over the uncovered portions of the field.

A design which, in outline, appears weak and insufficient to cover the field properly, may sometimes be strengthened by half-tinting it instead of the field.

IX. PAPER CUTTING.

Preparatory work:

Practice cutting bilateral inclosing forms and units and simple bilateral designs, such as *c* and *d*, Fig. 92.

Page 27.

Upon the right half of this page, construct the original design drawn upon the left, using colored papers, to illustrate analogous harmony.

Suggestions.

Colored Papers.

No definite directions can be given for selecting the proper papers for this design. The taste of the pupil and teacher must be the guide. As a general rule, however, the colors chosen should not be from the spectrum standards and hues, but from their tints and shades. One color should be used for the field, one for the figure, and one for the inclosing form. A good effect is sometimes produced by using a double inclosing form, one part an eighth of an inch larger on all sides, and of a different color from the other part. The two parts when combined in the design give the effect of a frame with an *insider*, such as is often seen upon photographs and engravings. Analogous colors may be used in the figure, and in the double inclosing form just described, upon a field of gray. Beautiful effects are often produced in this way.

Cutting Bilateral Designs.

Fold the sheet from which the design is to be cut, with the colored surface inside. Taking the crease as the axis of the design, draw accurately one half of the design upon the back of the sheet. Cut the margin and then the figure, always holding the paper between the thumb and fingers, as near as possible to the cutting point of the scissors. When cutting a design of one color having an inclosing form of another, the two sheets should be folded together and two inclosing forms and two designs cut at the same time. This gives a choice of coloring, and the design, as finally constructed, may have the warmer color for the figure and the cooler for the inclosing form, or *vice versa*.

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3. PICTORIAL DRAWING.

X. MODEL AND OBJECT DRAWING. (For illustrations, see pages 29 and 30.)

Preliminary work:

Review convergence in objects having one set of retreating edges, and continue the study of objects having two sets of horizontal edges *retreating at equal angles;* namely, the cube, square prism

(standing upon one square face), and the square plinth, turned at an angle of 45°.

Study such objects when the retreating edges make *unequal angles* (*a*, Fig. 47, and *a*, Fig. 51).

Sketch these objects upon practice paper, until the correct method of drawing is established.

Page 28. *Convergence at unequal angles.*

a. Draw margin lines.

1. Draw a square prism in the position indicated at *a*, Fig. 47, or draw a square plinth (*a*, Fig. 51). Make a large drawing to properly fill the space.

Page 31. *Application.*

a. Draw margin lines.

1. Draw some object based on the solid previously drawn. (See illustrations on page 29.)

Page 32. *Convergence at unequal angles.*—Continued.

a. Draw margin lines.

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

1. In the left space, draw a cube turned so that its horizontal edges retreat unequally to the left and right.
2. In the right space, draw some cubical object placed in a similar position.

Page 33. *Group.*

a. Draw margin lines.

1. Draw a group of objects illustrating convergence at unequal angles, and one or more principles previously studied. (See page 30.)

Suggestions.

Convergence at Unequal Angles.

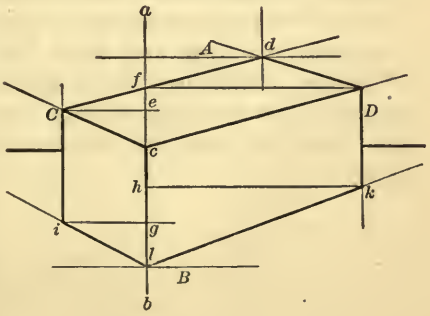
The representation of objects having edges retreating at unequal angles is not difficult, if the pupil has understood the previous work. The method is similar to that already given for the cube with edges equally foreshortened. (See Fig. 10, this page.)

1. Determine whole width (*CD*) and height (*AB*).

2. Locate nearest vertical edge (*ab*).

3. Locate position of front and back corners of top face (*c*, *d*).

Fig. 10.



4. Determine level of left corner of top face (*e*); of right corner (*f*).
5. Sketch top face (*cCdD*).
6. Determine level of lower left visible corner (*g*); of lower right visible corner (*h*).
7. Sketch the lower edges (*il*, *kl*).
8. Test the sketch by re-establishing proportions, levels, and angles.
9. Correct.
10. Finish.

Applications.

Allow the pupil great freedom in selecting his applications of principles. Encourage him to do his very best.

Show that the same principles apply to large objects like houses or barns, and interest the pupil in sketching from nature.

Groups.

Make interesting groups. As a rule, place the larger objects in the background and the smaller objects in front. The general mass of the group should be triangular, the highest point being the top of the principal object.

In the groups made during this year, one object at least should have some ornamentation, or other details, upon it, involving the principles studied during the previous year. (See Book VI., page 30.)

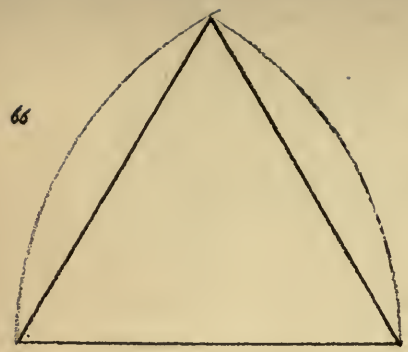
NOTE.—In sketching a group of objects determine first the entire width and height of the group, and indicate these upon the page. Notice next the width and height of principal parts, and indicate these. Sketch the general shape of each object *entire*. Study the details, and represent them. Erase guide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

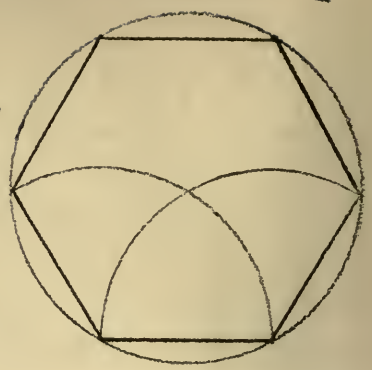
Encourage sketching in connection with work in Language, History, Geography, and Natural Science.

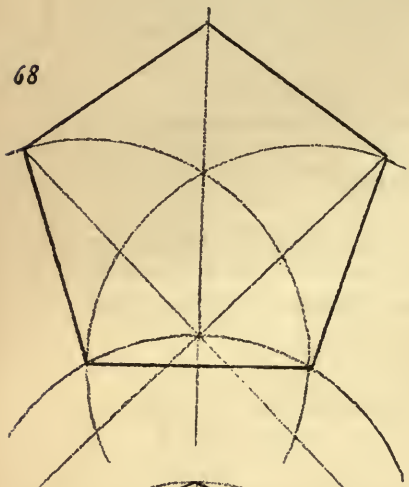
Show the pupils examples of good pictorial art, photographs of historic buildings and their ornament, examples of carved and molded enrichment, vases, and other beautiful forms. If a museum of art is in the vicinity, encourage the pupils to visit it often, and lead them to love and look for the beautiful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

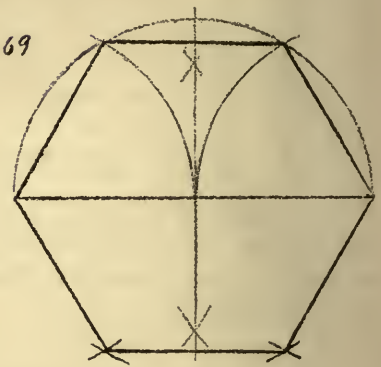
ILLUSTRATIONS.

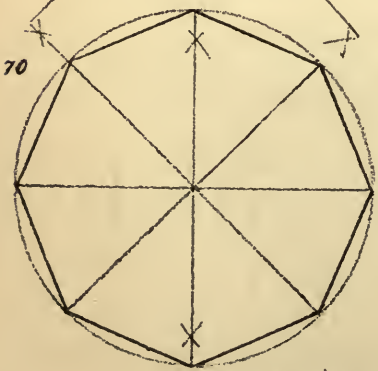
In the following plates are given representative illustrations selected from Book VII., exemplifying the three main divisions of the subject; viz., Geometric Drawing, Decorative Drawing, and Pictorial Drawing.

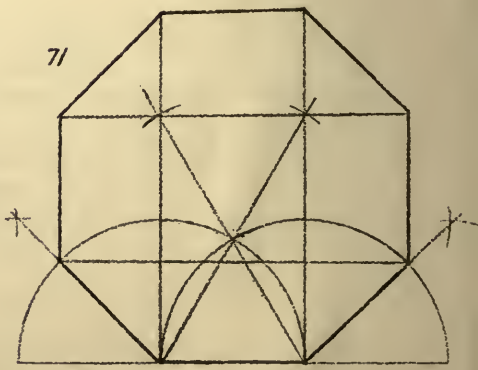




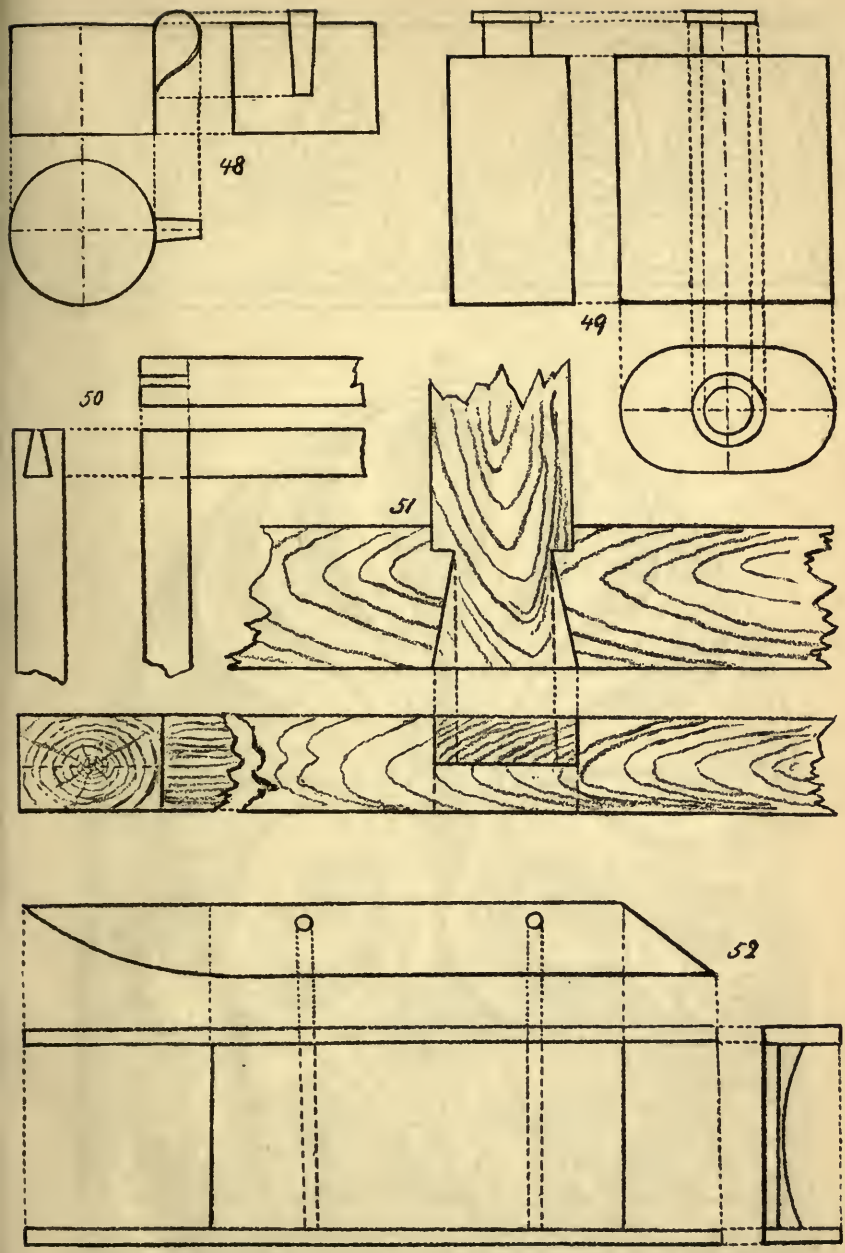








ILLUSTRATIONS OF GEOMETRIC DRAWINGS.



ILLUSTRATIONS OF WORKING DRAWINGS—THREE VIEWS.

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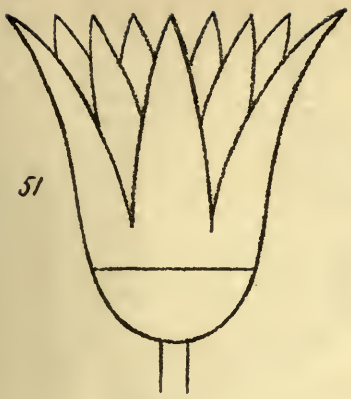
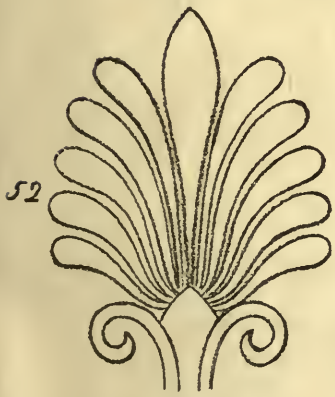
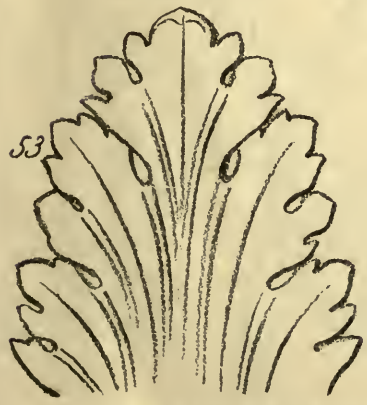
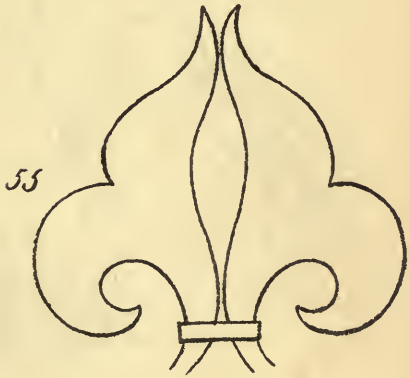


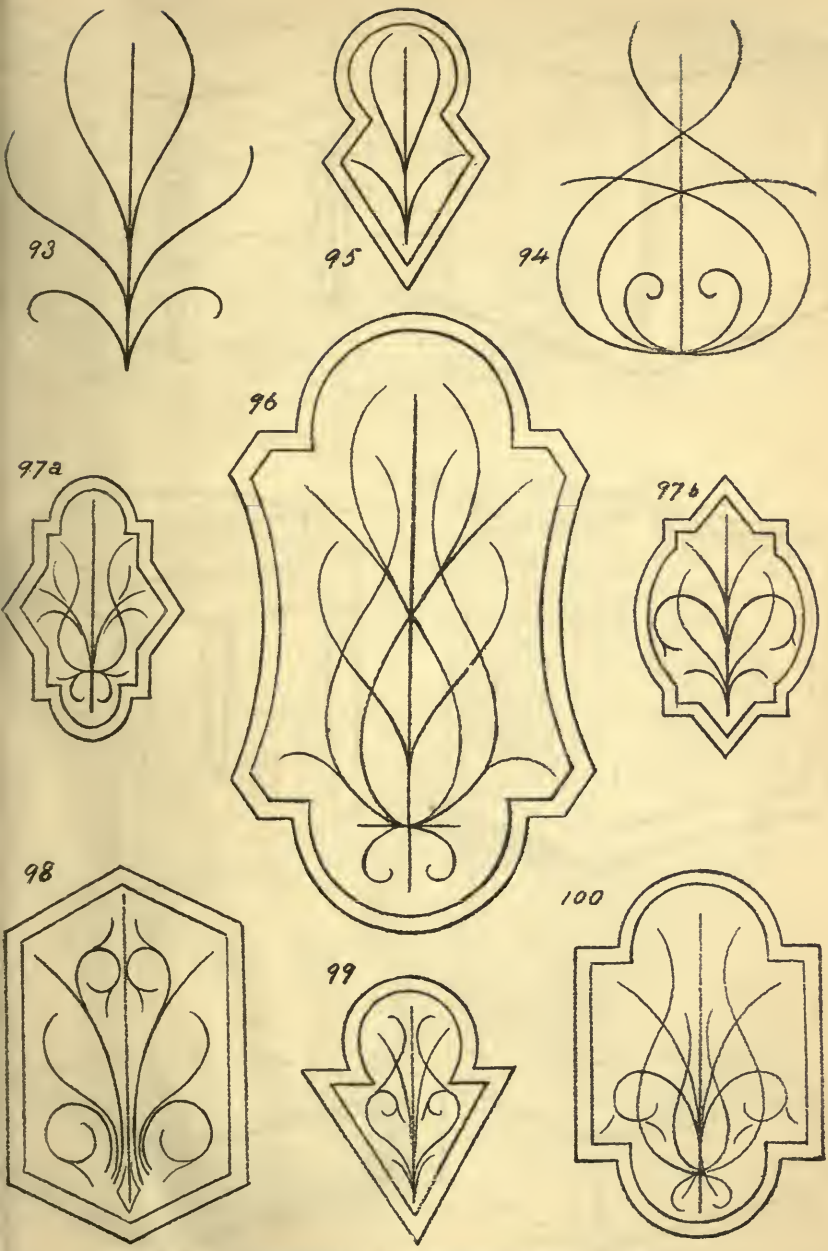




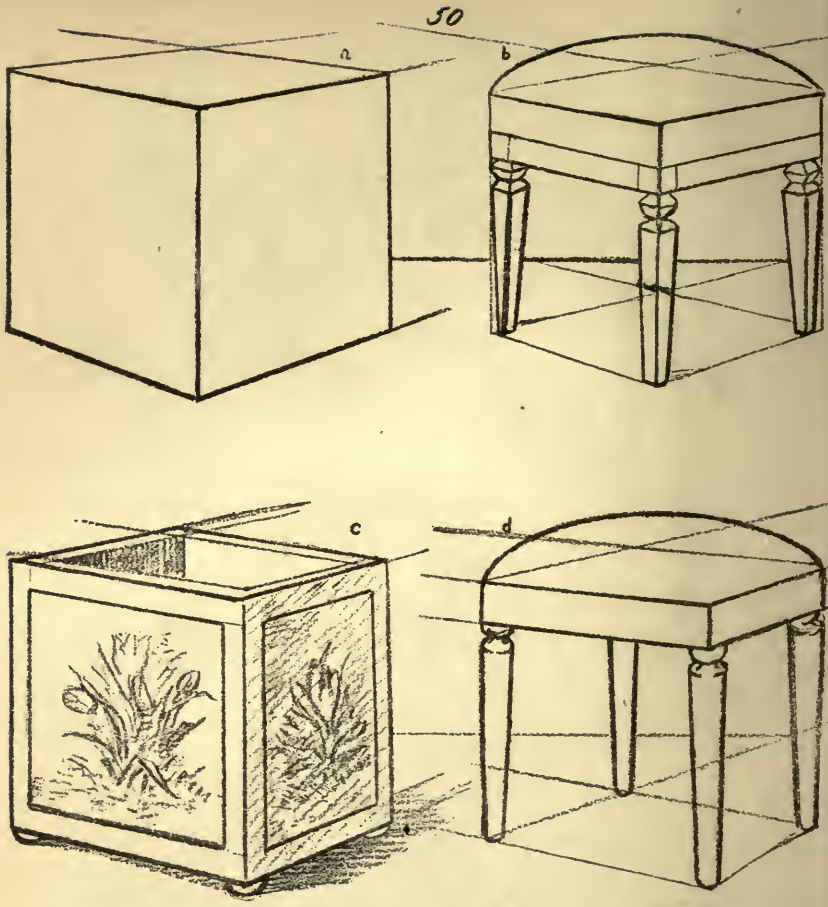


ILLUSTRATIONS OF HISTORIC ORNAMENT—DETAILS.

ILLUSTRATIONS OF BOTANICAL DRAWING.



ILLUSTRATIONS OF DESIGN—MAIN LINES.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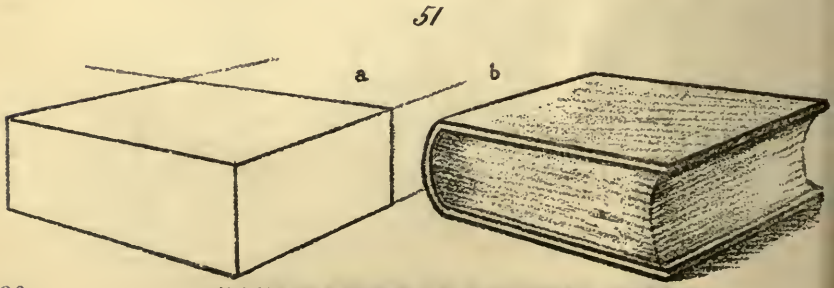
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ILLUSTRATIONS OF PICTORIAL DRAWING.

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.

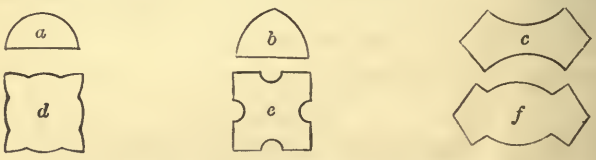
A Lens is a symmetrical plane figure bounded by two curved lines, curving in opposite directions.

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*.

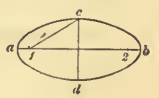
An Arc of a circle, or other curve, is any part of that curve, as *d b* or *a e*.

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.

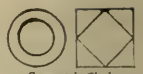
Center Line. A line representing the center of a solid.

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.

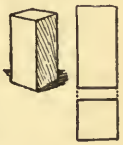
Distribution. An orderly disposition of the units in the field of the design.

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.



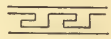
Elevation is opposed to *Plan*, which gives the actual form and proportion of an object as produced on a horizontal plane. Thus, in the three figures given, the first shows the appearance of a prism, the *plan* shows the actual form and proportion of the base of the prism, and the *elevation* gives the 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.

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