THE PRINCIPLES OF PERSPECTIVE

AS APPLIED TO

MODEL DRAWING AND SKETCHING FROM NATURE.

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MODEL DRAWING & SKETCHING FROM NATURE.

WITH 32 PLATES AND OTHER ILLUSTRATIONS.

BY

GEORGE TROBRIDGE,

HEAD MASTER, GOVERNMENT SCHOOL OF ART, BELFAST.

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PREFACE.

The first edition of this handbook being exhausted, a new one has been prepared, which it is hoped will be found in all respects an improvement upon its predecessor. The text has been carefully revised with a view to clearness, and an additional chapter on the drawing of difficult forms and groups of objects inserted. A considerable number of the plates have been re-drawn, and nine new ones added. The whole now forms a tolerably complete manual of model drawing.

The value of scientific aids to the practice of art, such as perspective, anatomy, etc., has often been called in question: their danger lies in the tendency of the student to rely upon his knowledge instead of upon observation. Dependence on a theoretical knowledge of perspective often leads to unfortunate results, as is pointed out by Mr. E. R. Taylor in his lately published book on "Elementary Art Teaching"; "for," he says, "it substitutes that which in the hands of the pupil is a false and unreliable creed, for the education of the eye and the resultant power to see and judge correctly for himself." To guard against such deplorable misleading it is necessary that the student should be continually directed to the practical application of his scientific knowledge, and warned against the temptation to display it for its own sake. The lessons in this manual are arranged to convey necessary knowledge of perspective rules at the same time that the student's powers of observation are called forth and educated. The geometric models used in the early exercises are such as may be found in all Schools of Art; the private student may make them for himself out of soap, cardboard, or other materials, but he must be careful that they are accurate in form.

December, 1890.

THE

Principles of Perspective as applied to Model Drawing and Sketching from Nature.

INTRODUCTION.

A great part, indeed the greater part, of Art Education may be comprehended under the head of *learning to see.* A famous man once said of public speaking, "If a man *knows* what he wants to say he will find words to say it"; so in art the great difficulty is not in mastering processes and technicalities, but in educating the eye to perceive subtle beauties of form and colour. This eye-training commences at the very threshold of art; we have to learn how deceptive and unperceiving our senses are, and continually to bring our knowledge to bear upon our observation in a corrective manner. As soon as the student begins to look at solid forms with a view of representing them he begins to be perplexed with difficulties. To quote a familiar line, "Things are seldom what they seem." In his first attempts at object drawing the probability is that, however simple the form, no single line will be right. Our familiarity with the forms we are drawing constantly tends to mislead us in their representation. For instance, if we are drawing a box which we know to be longer in one direction than another, we shall, if the length is fore-shortened (that is, retiring from the eye), be inclined to draw it much longer than it appears. The commonest fault in model drawing is the enlargement of fore-shortened surfaces, and against this we have constantly to be on our guard. A knowledge of perspective will enable us to steer clear of these and other errors, and to see things as they appear, and not as we fancy they do.

The lessons in the following chapters, if carefully studied, will give the student all the knowledge of perspective he requires for ordinary purposes, and render model drawing intelligible and interesting. They must, however, be *worked out* from the models or objects, and not simply *read over*, or they will be almost useless. It is hardly necessary to add that the plates are not intended to be *copied*.

CHAPTER I.

GENERAL PRINCIPLES.

In commencing the study of any subject it is necessary first of all to understand thoroughly the meaning of the various terms employed. Without going into unnecessary particulars, the following definitions should be clearly comprehended.

A right line is a perfectly straight line in any position or direction.

Parallel lines are lines which are equi-distant from each other throughout their length, whether straight or curved.

A horizontal line is a line which is parallel to the earth's surface or the sea-level.

A vertical line is a perfectly upright one, pointing to the *vertex*, or zenith, and to the centre of the earth.

A perpendicular line is one at right angles to any other straight line, *but is not necessarily vertical.*

Lines are said to be at right angles to one another when they meet so as to make the angles formed at their intersection equal.

A plane is a perfectly level surface, which may be either horizontal, vertical, or inclined in any direction. A straight rod applied to such a surface would touch it throughout its length.

It must be understood that a plane has no thickness or substance, but is simply a surface.

For convenience of working, planes may be *produced* indefinitely in any direction. For example, we can imagine the top of a table, or the surface of a wall, being extended; the produced part will be *in the same plane* with the original surface.

If two planes are produced until they meet, their junction or intersection will be a straight line. If the planes are vertical, their intersection will be a vertical line. An oblique plane will always meet a vertical plane in an inclined line; but an inclined plane may cut it in a horizontal line. The intersection of any plane with a horizontal plane will be a horizontal line. These facts may be illustrated by placing several cards in the positions indicated.

A line is said to be *in a certain plane* when throughout its length it touches the plane, or, more correctly, *coincides with it.*

We may have any number of lines of varying direction and character in the same plane, provided they coincide with it throughout, as stated above. To illustrate this, upon a piece of card draw a number of lines and figures. (*See* Fig. 1.) The surface of the card is a

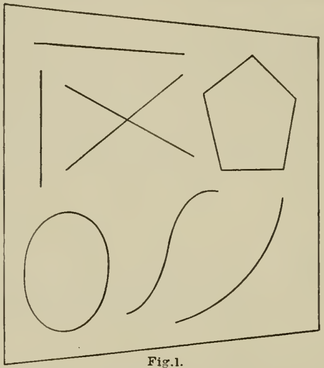


Fig. 1.

plane, and all the lines, &c., coincide with it, being drawn upon it. Hold the card horizontally, vertically, or obliquely, and the same lines and figures will be in a horizontal, vertical, or oblique plane respectively.

In perspective the *picture plane* is the surface—paper or whatever it may be—upon which the drawing is made. This is always supposed to be at right angles to the direction in which the spectator is looking. If we are looking straight in front of us, the picture plane will be vertical.

A point on the picture plane exactly opposite to the eye is called the *centre of vision;* sometimes, inaccurately, the *point of sight.*

The horizontal line indicates on the paper the

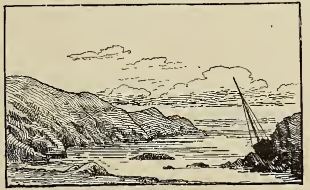


Fig.2.

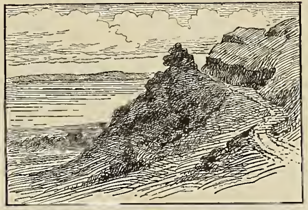


Fig.3.

position of the natural horizon. It will be higher or lower according to the elevation of the spectator. Thus a landscape taken from near the sea-level will have the horizontal line low, as in Fig. 2; while one viewed from the side of a hill will have the horizon higher, as in Fig. 3.

Although it is not always necessary to draw the horizontal line in sketching from models or from nature, it will be well to note its position in the drawing, and in early practice to indicate it by a line.

CHAPTER II.

VARIOUS METHODS OF REPRESENTING OBJECTS.

There are three principal methods of representing objects, or projecting their images upon a plane (the plane of delineation, or picture plane). They are known respectively as *orthographic*, *isometric*, and *perspective* (or *radial*) projection. The term "projection" is more commonly applied to mechanical representations, as the first two, in which the actual forms and dimensions of the objects are given; seldom to a perspective drawing.

A projection is obtained by means of rays, or *projectors*, passing from all points of the object to the plane of delineation. In orthographic projection these are parallel; in perspective they converge to the eye of the spectator.

In *orthographic projection* two planes of delineation are used, one horizontal, the other vertical; and the representation gives two views of the object, one as seen in front, or from behind, or from the side; the other taken from above, looking directly down upon it. The actual dimensions are transferred to the vertical and horizontal planes, giving an "elevation" and "plan" of the object. Thus, an *elevation* of a cube, looking directly

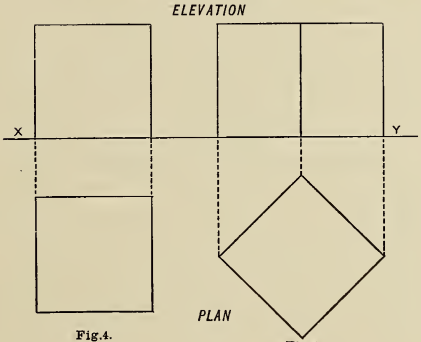


Fig.4.

Fig.5.

in front of it, will be a square, as in Fig. 4; and its *plan* a square also. Viewed from one of its angles, the representation will be as in Fig. 5. The two views in each case are shown upon the same piece of paper, the space above the line X Y representing the vertical plane; that below, the horizontal plane.

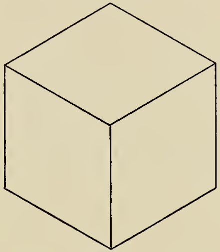


Fig.6.

Isometric projection has the appearance of perspective, but no account is taken of the diminishing of the parts with distance. A cube treated isometrically will be as in

Fig. 6. Three faces of the cube are shown, and all the edges seen are of equal length. The use of isometrical projection is for working or pattern drawings, when, from one representation, various dimensions are required to be taken.

It is obvious that neither of these methods represents objects *as they appear to us.* For example, if we look at a cube from such a position that we can see three of its faces, its edges will not all be equal in length, or parallel to each other, as in the isometrical drawing. Some of them will evidently converge towards each other, and few, or none, will be exactly equal in length. The laws which govern the position and convergence of the lines form the science of "linear perspective," and will be explained in the following pages in connection with a supposed course of model drawing.

CHAPTER III.

RIGHT-LINED OBJECTS.

Before commencing our practical illustrations, it will be as well to put down one or two of the elementary rules of perspective. We will number them as we proceed.

Rule I.—LINES AND FIGURES IN PLANES PARALLEL TO THE PICTURE PLANE retain their original relations and forms. Thus, parallel lines will be represented parallel; a square will remain a square; a circle a circle, &c.

We may illustrate this law by many examples. One will suffice. If you stand before a doorway, looking directly at it, the lines of the jambs and lintel will appear at right angles to each other, as they actually are, and the form and proportions of the opening will be the same as in a geometrical "elevation." (*See* Fig. 7.)

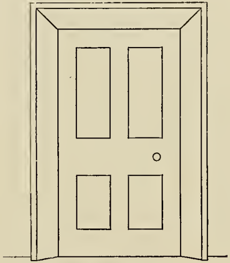


Fig. 7.

Rule II.—PARALLEL LINES, not also parallel to the picture plane, appear to converge towards each other, and in terms of perspective

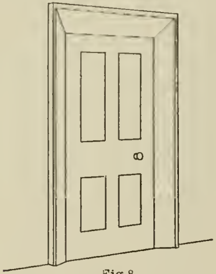


Fig. 8.

are said to "vanish." The point at which they would meet if sufficiently produced is called their "vanishing point." *Whatever the number of the lines*, if parallel to one another, they will *all* converge to the same vanishing point.

To take the door again as an example. If you stand on one side and look at it obliquely, the lines forming the top will appear to come downwards, while the bottom edge will run upwards, and all the other horizontal lines will tend to a common vanishing point. (*See* Fig. 8.)

Rule III.—LINES WHICH ARE PERPENDICULAR TO THE PICTURE PLANE will have the centre of vision as their vanishing point.

Rule IV.—HORIZONTAL PARALLEL LINES will converge to a point on the horizontal line. If above the eye, they will come downwards to the horizontal line; if below the eye, they will rise towards it.

This rule may be illustrated by looking at the horizontal joints in a brick wall. Looking along the wall, the lines of the joints above the eye will be seen to come downwards to the level of the eye, while those below the eye will run upwards to it; the joint which happens to be exactly at the height of the eye will alone be represented by a horizontal line. (*See* Fig. 9.)

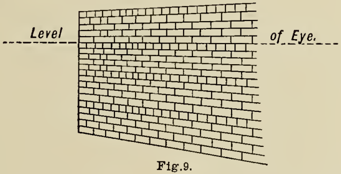


Fig. 9.

RULE V.—VERTICAL LINES will always be represented vertical.

The side posts of the door given as an illustration above are in each case upright, and in all positions would remain so. An apparent exception to this rule is in the case of a high column, or erection of any kind having parallel sides. *Looking up at it*, the top will appear smaller than the bottom, and the sides, in consequence, will converge. But the fact is, the position of the picture plane is changed, being no longer vertical, but at right angles to the upward direction in which you are looking. Remove to a sufficient distance to enable you to take in the whole height without looking up, and the appearance of convergence will be lost.

We will commence our model drawing with a cube—a simple object which will serve well to illustrate the principles just laid down.

Place it, first of all, a little below the eye, on a rectangular drawing-board, having its sides parallel to the edges of the board. Sit directly in front of it. Draw a horizontal line across the upper part of your paper to represent the level of your eye. If the object is much below the eye, it may not always be convenient to draw the horizontal line, but its position should be borne in mind. You may judge of its situation in relation to the objects you are drawing by imagining a line on the wall opposite to you, on a level with your eye, and noticing the apparent distance from it to the top of the cube or other object. See if this is greater or less than the height of the cube itself, and place the line acccordingly. (*See* Plate I.)

Now, remembering the laws above given, we will begin to draw the board first. The nearest edge, being parallel to the plane of the picture, will be represented by a horizontal line. The two ends at right angles to this edge, and consequently perpendicular to the picture, will evidently converge, and, by Rule IV., will vanish on the horizontal line. As we are sitting exactly opposite to the middle of the board, the vanishing point will be in the centre of vision, which mark, and draw the two lines towards it. Observe carefully the length of the ends in relation to the side you have drawn, using your pencil at arm's length as a measurer. Understand that you can only take *proportional* measurements in this way. The method is as follows: Hold your pencil at arm's length, *in a plane at right angles to the direction in which you are looking*—that is, parallel to your picture plane. Close one eye, that you may have a clear view of the pencil and the line you are measuring at the same time, and, sliding your thumb along the pencil, measure the apparent length of the end. Keeping your hand at the same distance from your eye, turn your pencil round *in the same plane*, and see how many times the length measured will go into the long side. You may check your measurement by making an imaginary isosceles triangle, as shown in Plate I. at A B C, of which one of the equal sides is the end of the board, and the other a portion of the nearest edge. If the proportion between the sides is much out, you will readily discover it by this means. Also hold your pencil vertically against the ends (still looking with one eye only) to test their inclination; and make a practice of using it in this way, horizontally, vertically, or inclined, to ascertain the direction of lines, being careful always to keep it in a plane at right angles to the direction in which you are looking. *You will find this of the greatest service to you in sketching.*

Having determined the length of the ends, draw the farther edge parallel to the near one, both being parallel to the picture plane. *You will find that you always have a tendency to make fore-shortened surfaces too wide;* so, before proceeding farther, see that the space between the two horizontal edges is not too great.

Take next the lower edge of the face of the cube directly opposite to you, which, being parallel to the edge of the drawing-board, will be horizontal. Make its length in true relation to this, noting the position of the ends of the two lines with respect to each other. See also that you do not make the space between the cube and the edge of the board too great, as you will be liable to do. Being parallel to the picture, the nearest face of the cube will be seen as a square, according to Rule I. The upright edges also will remain upright by Rule V. Test them by holding your pencil upright before you. The edges of the top, which go away directly from you, and are parallel to the ends of the board, will converge to the centre of vision. Determine their length by observation as before, and draw the back edge parallel to the near one to complete the representation. You may add the thickness of the board —making the upright edges vertical, of course.

Now change your position a little to right or left, still looking in the same direction—*i.e.*, at right angles to the long edges of the drawing-board. These, as also the edges of the cube parallel to them, will remain horizontal; the vertical lines will still be vertical; and the third set of lines will still vanish in the centre of vision, but this will now be to right or left of the object, as the case may be. (*See* Plate II.)

Remember that in drawing a cube, or *any* rectangular solid, you have *three sets* of parallel edges to deal with.

NOTE.—The cube, &c., will only appear as drawn in Plate II. when you look directly before you *at one side of it*. If you turn round, so as to look straight at the models, the lines will change their relations, as your picture plane will no longer be parallel to any of them except the vertical ones. The chief difference will be that the lines which are horizontal in the illustration will appear to run upwards and to converge. Test this by holding your pencil before your eye in a horizontal position.

For a third position, place the cube angle-wise, so that you see an equal width of the two nearest vertical faces. In this case, the board being placed as in the first exercise, its edges will vanish in the centre of vision, while the horizontal edges of the cube will converge right and left to two points on the horizontal line at equal distances from the centre of vision. To ensure getting the right inclination of these lines, hold your pencil horizontally before your eye against the nearest corner of the cube, and notice the angle which is made with it by the two edges. The vertical edges will be vertical as before. (*See* Plate III.)

The perspective in this and some other plates is a little exaggerated, in order to bring the vanishing points within the limits of the paper.

Move the cube so that you will see more of the right side than of the left (or *vice versâ*); the vanishing point for the lines on the left will fall nearer to the centre of vision, and for those on the right farther from it. Or move yourself so that you will see the board from an angle; all of the lines will change their directions (except the vertical ones), and none will vanish in the centre of vision. Still all, being horizontal, will converge to points upon the horizontal line. (*See* Plate IV.)

A little more explanation may be necessary in drawing this last position. It will be best to commence with the nearest angle of the board, taking the inclination of the sides carefully, as recommended above. The two distant edges will converge to the same points as the nearer ones. Having completed the board, note the position of the nearest angle of the cube as it stands upon it, and take the angle of the two lower edges, determining carefully their relative lengths. Then raise vertical lines at the three angles, and mark the length of the nearest one. *This will be the longest line in the cube*, being the nearest, and not being "foreshortened." From the top of it draw to the vanishing points of the lower horizontal edges, and from the points where these lines cut the outer vertical ones, draw again to the vanishing points to complete the top.

The rules demonstrated in the above examples may be applied to any rectilinear object the lines of which are either horizontal or vertical. Thus a box, a table, or the main lines of a factory building (not having roof or gable shown), with its openings for doors and windows, are all comprehended under the same laws. (*See* Plate V.)

In the last figure of this plate a ready method is shown of obtaining a gradually diminishing series of divisions on a straight line in perspective. A horizontal line is drawn to touch the angle of the building, and on this, from the angle, are set off a number of regular divisions. The last of these is joined to the end of the line to be divided, and the connecting line is produced to meet the horizontal line. To this point lines are drawn from each of the equal divisions, and the required line is divided into a regularly diminishing series of parts.

In this case the line to be divided is *horizontal*. If it were in any other position the vanishing point of the convergent lines would be on the vanishing line of the plane in which the line lay, and the equally divided line would be drawn parallel to the same.

CHAPTER IV.

OBLIQUE LINES.

All the lines we have hitherto had to deal with have been either horizontal or vertical. Fresh complications arise in the treatment of objects having lines neither parallel, nor perpendicular, to the ground.

Raise one end of the cube so that it may rest on one of its edges. One of the three sets of parallel lines will now be horizontal; the two other sets will be inclined to the ground; while none of the lines will be vertical.

Sit, at first, exactly opposite to the cube, so that the horizontal edges will be at right angles to the direction in which you are looking. You will see that the edge (A B, Plate VI.) nearest to you is the longest, the upper and lower edges (C D and E F) being somewhat shorter, and causing the inclined ones to converge upwards and downwards. In order to explain the law which governs their convergence, it will be necessary to enter a little more deeply into the science of perspective than we have previously gone.

Any plane produced indefinitely will appear to vanish in a straight line. Thus the horizontal line represents the extreme production of the ground plane, *or of any horizontal* *plane*, and is the *vanishing line* of such planes. On this vanishing *line* will be found the vanishing *points* of all lines which are horizontal. A vertical line passing through the centre of vision is the vanishing line of vertical planes at right angles to the picture plane. If a vertical plane meets the picture plane at any other than a *right* angle, its vanishing line will be a vertical line to right or left of the centre of vision, as the case may be. When a plane is inclined to the ground, and ascends or descends directly from the spectator (*i.e.*, not *obliquely*), as the two nearest faces of the cube in Plate VI., the vanishing line will be a horizontal line above or below *the* horizontal line. An oblique plane—*i.e.*, inclined to the ground, and *both* ways (laterally, and upwards or downwards) to the picture plane—will vanish in an oblique line.

With this explanation we may add another to our list of perspective laws: one which applies to all right lines in any position.

RULE VI.—THE VANISHING POINT OF ANY LINE WILL BE FOUND UPON THE VANISHING LINE OF THE PLANE IN WHICH THE LINE LIES.

NOTE.—A line may be in *several* planes at one and the same time, but the rule will apply in each case. The vanishing point of the line will be the point where the vanishing lines of the different planes intersect one another.

In order to understand this rule clearly, look at Plate IV. The horizontal edges of the cube vanish upon the horizontal line, which is the vanishing line of the planes of the top and bottom faces. These edges also form boundaries of the vertical faces, and consequently are in these vertical planes. The vanishing lines of these planes will be vertical lines drawn through the vanishing points on the horizontal line. The edges of the cube being common to two planes, their vanishing point is common to the vanishing lines of those planes.

The representations of the cube in Plates VI. and VII. will need little further explanation than is supplied in the diagrams. In the first position the horizontal edges will be represented by horizontal lines, and the others will vanish upwards and downwards upon a vertical line passing through the centre of vision, *the vanishing line of the vertical planes in which they lie.* In the second position the horizontal lines will vanish on the horizontal line to the left, and the inclined edges on a vertical line to the right of the centre of vision. To obtain this, draw a line upon the ground in the same plane with one of the vertical faces, cutting the horizontal line in v. p. 2, and representing the intersection of that plane with the board; or draw the horizontal diagonal of the same face, which will intersect the horizontal line in the same point. Through this point draw the vertical vanishing line. The vanishing points of the inclined edges will be more or less above or below the horizontal line, as the cube is more or less inclined to the ground. In both these illustrations we will imagine that the edges make angles of 45° with the ground, so that one of the diagonals of the vertical faces will be horizontal and vanish on the horizontal line. The inclined edges will vanish at equal distances above and below the horizontal line.

Before leaving the cube, one other position requires consideration. If placed on one corner all of its edges become oblique, and the drawing will consequently be much more difficult. It will be impossible, without mechanical construction, to determine all the various vanishing points which we shall require, and the working of the problem in this manner is a very complicated affair, and quite useless practically. You must depend upon observation more than upon rules. Remember you have three sets of parallel lines to deal with, which must converge towards their respective vanishing points, and *be careful to see in what direction they do converge.* It is sometimes a little difficult to determine this. It will help you if you take a single line of the set, and ask yourself which is the nearer end; the convergence will, of course, be away from this. If both ends appear equally near to your eye, you may decide that the lines do not converge, and the whole set will then be parallel.

The simplest plan to draw the cube in this position is to start with the angle upon the board and the one nearest to the eye, getting carefully the true inclination of the line joining them (A B, Plate VIII.). Then from this line proceed to construct one face of the cube, testing the inclination of its edges by holding your pencil against them. It is as well sometimes to place your pencil both ways against a line, and see whether it makes a greater angle with a vertical than with a horizontal line, or *vice versâ.* (*See* Fig. 10.)

Having obtained one face, draw convergent

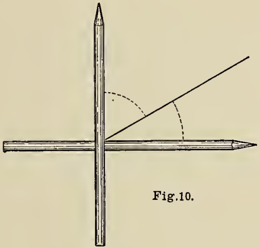


Fig.10.

lines from its corners for one set of parallel edges, and determine their lengths by careful comparison with the other lines. The remaining visible edges will be parallel to some that are already drawn, and of course will go in the same direction. The three lines meeting in B and forming the solid angle are the central lines of the three groups of lines, towards which all the rest will converge.

In the course of the foregoing chapters all that it is necessary to know regarding the perspective of right-lined objects has been explained. In actual work it will not always be found convenient to apply the rules as shown in the diagrams. You will seldom have space to carry out all your lines to their proper vanishing points; in early practice it is desirable to do so, when possible—at all times to keep them in mind, and see that the lines go in the right direction. But you must depend more upon your eye than upon rules; rules being given to *help* observation, *not to supersede it.*

CHAPTER V.

RIGHT-LINED OBJECTS (*continued*).

In this chapter we shall proceed to apply the knowledge gained in the previous ones to a variety of right-lined solids. The exercises given are based upon the geometrical models to be found in all art schools, but the lessons are amplified and illustrated by reference to familiar objects and architectural forms.

We will commence with a triangular prism, and see what suggestions we can get from it for the drawing of other objects of a similar class. We must first study it geometrically. Its section is an equilateral triangle, and an "elevation" of one end is given in Fig. 11. (Of course a triangular prism is not necessarily equilateral, but this form will best suit our purpose.) A perpendicular line dropped from

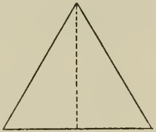


Fig.11.

the apex of the triangle to the base is called its "altitude," and will divide the base into two equal parts. The long edges of the prism are parallel straight lines.

Let the prism lie upon one of its sides. Viewed directly from the end, and on a level with the eye, the perspective representation

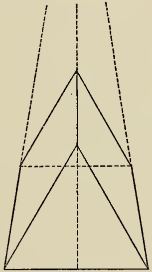


Fig.12.

will be similar to the elevation given in Fig. 11. If below the eye, the appearance will be as in Fig. 12.

Sitting directly opposite to the side, the drawing will be almost a parallelogram, the ends converging upwards very slightly, as the edge upon the board is a little nearer than the upper edge. (*See* Fig. 13.) The convergence

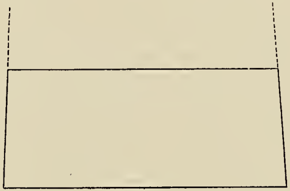


Fig.13.

of these lines will be governed by the rules laid down in the previous chapter.

Plate IX. represents the prism placed with one angle towards the spectator. Fix a point upon your paper for the position of the nearest angle (B), and draw first the two edges upon the board or table, testing their inclination by your pencil held horizontally as before, and noting carefully their relative lengths. Now complete the nearer triangular end, holding your pencil vertically against the lines to determine their proper inclination. You will find that one of the edges is a little steeper than the other, so that a vertical line dropped from the apex will cut the base of the triangle unequally, the nearer half, of course, being longer than the more distant one. The uppermost of the long edges will converge, with the lower edge already drawn, to a point on the horizontal line, and the sloping end, D E, will vanish upwards with the corresponding near edge, B C. The vanishing point will be upon a vertical line passing through the vanishing point of the edge, A B, upon the board.

A useful application of the above lesson is to the drawing of the roof and gable of a house. On Plate X. three drawings are given of the same building:—Fig. 1, as viewed directly from the end; Fig. 2, as seen immediately in front; and Fig. 3, as seen from an angle. In the first it will be seen that the representation is nearly an elevation, the lines of the gable being equal in length and of similar angle. In the front view the sides of the roof are seen to converge upwards, while most of the other lines of the building will be similar to a front elevation. In the third illustration the lines of the roof are governed by exactly the same principles as are applied in the last position of the prism, the only difference being that the horizontal lines, being above the eye, *come down* to the horizontal line, and do not rise, as in the prism. To find the situation of the apex of the gable, draw a line from one corner of the roof to the opposite one. This will, of course, be a horizontal line and parallel to the ground, forming with the upright edges of the wall a rectangle. Find the centre of this by drawing its diagonals, and through their intersection draw a vertical line; the summit of the gable will be upon this line.

The prism may now be placed in other positions. Standing upon one of its triangular ends, the long edges will, of course, be vertical, while the edges of the ends will vanish on the horizontal line. (*See* Plate XI., Fig. 1.)

One end being raised from the ground increases the difficulty of the drawing. (*See* Plate XI., Fig. 2.) Commence with the nearest angle, A, upon the board or table, and draw the edge, A B, which rests upon it. Then test with your pencil the inclination of the long edges, and draw the nearest of them, A D. Place your pencil also against the lines of the visible end, and hold it vertically against the apex of the triangle, C, marking on your paper where an upright line would cut the base. It may fall beyond it if the prism is much inclined. Looked at obliquely, as shown in the illustration, the long edges of the prism will vanish in a point above the horizontal line, and the visible edge, D E, of the distant end will go in the same direction as the corresponding near one, converging slightly with it upwards.

We will next take a hexagonal prism, the drawing of which will need a little explanation.

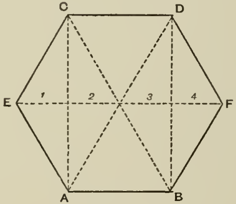


Fig. 14.

Its ends are regular hexagons, having three pairs of opposite, parallel, and equal sides. By joining the opposite angles we have a third line in each set parallel to these edges; these diagonal lines will intersect each other in the centre of the hexagon. Notice, also, that in an elevation of the end of the prism (Fig. 14) points C and D are vertically over A and B, and the divisions 1, 2, 3, and 4 on the diagonal E F are equal.

Let the prism lie upon one of its sides, having one end turned somewhat towards you, as shown in Plate XII. Start with the nearest angle upon the board, and determine the direction of the two edges upon the same; also their relative lengths. The shorter line will correspond with line A B of elevation. At A and B erect vertical lines, and draw the perspective of the rectangle A, B, C, D, comparing the proportions of the sides carefully, and making A B and C D converge together. Draw the diagonals of this figure, and through their intersection a line vanishing to the same point as A B and C D. The two remaining angles of the hexagon, E and F, will be upon this line. Test the inclination of the sides B F, F D, C E, E A with your pencil, and note that, in your perspective drawing, the spaces 1, 2, 3, and 4 will no longer be equal, but gradually diminishing in width. You will observe that you have three sets of parallel lines, A B, C D, and E F, converging to a point on the horizontal line; C E, D A, and F B vanishing together downwards; and F D, B C, and A E upwards.

Having completed the nearer end to your satisfaction, draw the long edges of the prism to their proper vanishing point on the horizontal line, and the edges of the farther end in the same direction as the corresponding ones of the nearer end, H G converging with F B, J K with D C, and H J, very slightly, with F D. Point J will be exactly over G, as D and C are over B and A.

Plate XIII. shows other positions of the hexagonal prism. In Fig. 1, lines A B, A C, and B D should be first obtained. At A, B, C, and D erect vertical lines, and draw E F, E G, G H to the same vanishing points as A C, A B, B D respectively. H J, F K, and K J will converge to the same vanishing points as the three nearer edges of the top, and E K, G J will also converge. All the vanishing points will be on the horizontal line, as all the convergent lines are horizontal.

Fig. 2, Plate XIII., is a more difficult position. Proceed exactly as in Plate XII., only making lines B D, A C inclined, and converging downwards, instead of upright.

The instructions given above will apply equally to an octagonal prism. A section or

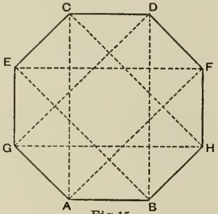


Fig. 15.

end elevation is annexed (Fig. 15), with construction lines to assist the drawing. You will see there are four sets of parallel lines, one set parallel to the ground, one vertical, and two others inclined. Points C, D, E and F, also, are exactly over A, B, G and H.

In drawing pyramids of different forms, attention must first be given to the base; and it must be borne in mind that, in a *right* pyramid (which is usually meant when a pyramid is spoken of), the apex is vertically over the centre of the base. In Fig. 1, Plate XIV., a square pyramid is shown, and in Fig. 2 a hexagonal one. The centre of the base is found in each case by drawing the diagonals. The apex will be immediately above this point. The proportion of height to width in the pyramids must be carefully noted, taking the relative measurements with your pencil.

Applications of this last lesson occur frequently, as in the piers of a gate, a church spire, a polygonal turret, &c. (*See* Plate XV.)

CHAPTER VI.

CURVILINEAR OBJECTS.

The drawing of curves in perspective presents new difficulties, and their correct representation depends more upon observation than in the case of right-lined objects. Nevertheless, we may formulate certain rules which will help us in practice.

We will examine first the simplest of regular curves, a circle. Placed immediately in front of the spectator, in a plane at right angles to the direction in which he is looking, it will of course appear quite round, as it actually is. You will be assisted in drawing it if you get two diameters at right angles to each other, and draw the curve in quarter sections. (*See* Fig. 16.)

Seen edgewise a circle will appear as a straight line, and the only thing to be considered in this case is the direction of the plane in which the circle lies.

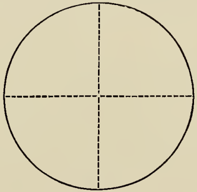


Fig. 16.

In any other position a circle will assume the form of an ellipse, wider or narrower as its plane is inclined more or less to the eye. In

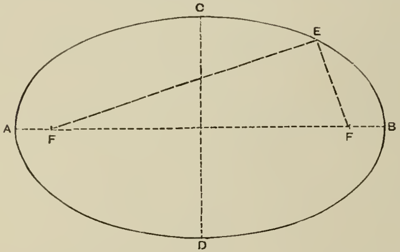


Fig.17.

order to draw the curve correctly it is necessary to study the nature and character of ellipses. An ellipse (*see* Fig. 17) is a regular curve described around two centres or foci (F, F, Fig. 17). A straight line across the widest part of the curve will divide it into two equal and similar parts; and a line bisecting this at right angles will also cut the figure into equal portions. These lines (A B, C D, Fig. 17) are called the *major* and *minor axes*, or the *transverse* and *conjugate diameters.*

In order to familiarise yourself with the forms of ellipses of different proportions, stick two pins into your paper a little distance apart, and tie a piece of fine string loosely round them. With the point of your pencil stretch the string tightly into a triangular shape (*see* F E F, Fig. 17), and, keeping it always tense, draw the curve around the pins. This line will be an ellipse, and the pins will be its foci. By putting the pins further apart the ellipse will become narrower; bringing them together will produce a wider ellipse, or more nearly a circle. A common fault in drawing ellipses freehand is to make the ends too sharp, or the sides too flat. By experimenting a little with the pins and string you will get to understand the true form and avoid these errors.

A circle placed horizontally immediately in front of the spectator, above or below the eye, will appear as an ellipse having the long diameter horizontal. If placed horizontally on the right or left hand, the direction of the long diameter will be slightly altered, as shown in Plate XVI.

The long diameter of the ellipse representing a circle will always be at right angles to an imaginary line from the eye of the spectator to the centre of the circle.

A circle in a vertical plane (not parallel to the picture plane) will appear as an ellipse, having the long diameter vertical when exactly opposite to the eye. If below or above, on either side, the direction of the diameter will change, as shown in Plate XVII.

The illustration will be best understood by holding a coin in the positions indicated, and will be further explained in the following exercises. It may be well to state that the circles represented opposite to the eye are slightly inclined to the picture plane; if at right angles to the same and directly in front, no curve would be seen, but a straight line.

Circles in inclined positions will appear as ellipses, whose long diameters will assume different inclinations according to the angle which the plane of the circle makes with the ground or picture, and its situation with reference to the eye. The direction of the long diameter must be determined by careful observation before drawing the circle.

Our first exercise in the drawing of circles shall be a cylinder standing upon one of its ends, its sides being vertical. Its appearance, as seen in front of the spectator, also to right and left, is shown in Plate XVIII. It is supposed to be a little below the eye. Notice that the curve of the base is rounder and fuller than that of the top, and remember that *in a series of circles in parallel planes, the nearest one to the eye will be represented by a narrower ellipse than any of the others; and each will become a little wider in succession as it is more and more removed from the eye. (See the hoops of the barrels in* Plate XXI.)

We will now place the cylinder on its side, and draw it in three similar positions. The plate (No. XIX.) will need little further explanation than has already been given. Observe that the axis of the cylinder is in each case at right angles to the diameters of the ellipses; and note for future guidance that this is always so in every cylindrical object. (*See* Plates XX. and XXI.)

The only exception to this rule is in the case of a cylinder or similar object when placed to right or left of the spectator, as the two outer cylinders in Plate XVIII.

Plate XX. shows the cylinder in three positions, with one of its ends raised.

The principles illustrated in these three plates may be applied to the drawing of a variety of objects, such as jars, vases, a cup and saucer, a candlestick, a saucepan, barrels, &c. &c. (*See* Plate XXI.) In drawing these, the first thing is to get the direction of the *axis* of the object, the central line around which the circles and other lines are arranged. The ellipses representing the circles will be at right angles to this, as already explained. As you proceed you will find it

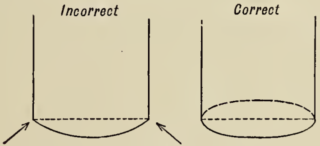


Fig.18.

best usually to draw the circles first (not all at once), and adjust the contours of the form to these. For example, in drawing the barrel (Plate XXI.) make the top and bottom first, and then draw the curves of the sides to meet these. When straight lines meet circles, as in the cylinder, be careful not to make a sharp angle, but *draw the ellipse and the straight line tangential to each other.* (*See* Fig. 18.) To ensure correctness, it is better in all cases to draw the *whole* of the ellipse first, and afterwards to rub out the portion not seen.

In Plate XXI. the dotted "construction" lines will explain sufficiently the method of proceeding in the drawing of the various objects represented.

The constant occurrence of arches in buildings renders the correct drawing of circles and other curves in perspective of the greatest importance in sketching architectural subjects. The drawing of a round or semi-circular arch will be easily mastered if the perspective of the simple circle is understood. In Plate XXII.

three views of a semi-circular arch are given: Fig. 1, as seen when the eye is exactly opposite to the springing of the arch; Fig. 2, when the arch is below the eye, as the opening of a culvert; Fig. 3, a window opening above the eye. In each case the curve will be a portion of an ellipse, the long diameter in Fig. 1 being upright, while in Figs. 2 and 3 it is inclined, as shown by dotted lines. When the arch is below the eye, the sharpest part of the curve will be beyond the actual summit of the arch; if above, on the near side of it. The reason for these changes will be seen if the ellipse is completed in each case. The direction of the long diameter changes with the position of the eye, as explained in reference to Plate XVII. In drawing any arches, perhaps the best plan is to get the upright jambs in the first place, and note carefully the relative position of the points from which the arch springs. Then get the perspective centre

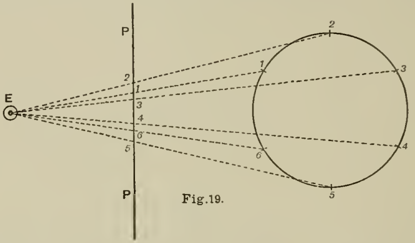


Fig. 19.

of the space, as shown in Plate XXII., and observe the nature of the curve on either side of the central line. It is not necessary to draw the whole of the ellipse in the case of a half-round arch, but it may be safer to do so.

It is to be observed with regard to the drawing of curves in perspective that the portions of any curve *across* which you are looking become flattened, while the portions which you look *along* appear sharper in drawing. This is illustrated in the annexed diagram, Fig. 19: point E represents the eye, which receives an image of the circle by means of rays proceeding from all points in its curve. Divide the circle into, say, six equal parts, and from them draw lines to E. Line P P

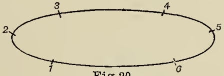


Fig. 20.

represents the picture plane intercepting the rays from the divisions on the circle. The corresponding divisions on the line will be seen to be unequal, the curve being much fore-shortened at the sides and less in the middle. Thus the portion 1.2 is represented by the space 1.2 on P P, whereas a similar portion 1.6 is represented by the much larger space 1.6. The diagram is a plan view: the actual appearance on the picture plane will of course be an ellipse, in which the portions of the curve at the sides (1.3 and 6.4) will be sharp, and the middle portions (1.6 and 3.4) flattened. (*See* Fig. 20.)

Plate XXIII. represents several kinds of arches, and shows the method of setting them out. Fig. 1 is a bridge having an elliptical arch, and the view is taken from below. The centre of the space is found as already explained, and the arch divided into two equal portions by a vertical line passing through the intersection of the diagonal lines. The chords of the two arcs thus formed are drawn to show the nature of the perspective curve. The near half of the curve, it will be seen, is both longer and fuller than the distant half. The curve of the farther edge of the under side of the bridge, of which only a portion is seen, will be similar in character to the near one, and should be drawn completely, as shown by the dotted line, to ensure correctness.

Fig. 2 shows an elevation and perspective view of a pointed arch. The arch is an equilateral one, and the centres from which the sides are struck are marked with dots. The joints of the voussoirs (the stones forming the arch) are directed towards the centres of the arch, as will be seen in the "elevation." To make the perspective sketch, draw the rectangle formed by the sill, the two jambs, and a line connecting the points from which the arch springs, and find its perspective centre by drawing the diagonals. Through that point draw a vertical line, which will pass through the apex of the arch. Join the apex to the springing of the arch, as in the elevation, and then draw the curves, noticing that the distant one is more flattened than the near one. The joints of the voussoirs will be drawn to the centres of the arch as in the diagram. It is needless to add that the vertical line through the apex of the arch will divide the space unequally, the nearer half appearing wider than the more distant portion.

The arch in Fig. 3 is what is known as a four-centred one, the points from which the curves are struck being indicated as in Fig. 2. The chords of the arcs are drawn to show where the two curves meet; and the joints of the voussoirs, it will be seen, are drawn to the centres from which the portions of the arch to which they belong are struck. No further explanation will be needed.

CHAPTER VII.

DIFFICULT OBJECTS AND GROUPS OF OBJECTS.

In the preceding chapters sufficient explanation of the rules of perspective has been given to enable the student to draw correctly any ordinary object. Some further hints may be useful in regard to the drawing of intricate forms and groups of objects.

Plate XXIV. represents a skeleton cube resting against an upright cone. Draw the outer edges of the cube first; these are shown in thickened lines, and will converge together in three sets, similarly to the cube in Plate VII. Having got the perspective of these correctly, draw the diagonals of each face, and obtain the width of the wood on one of them (say, the nearest vertical one), making the lines converge with the outer edges and intersect each other on the same diagonals. Produce these lines every way to meet the outer edges of the cube; you will then have the proper widths of the ends of the bars which are at right angles to the face you are dealing with. To save confusion, this has only been done at the nearest corner of the cube in the plate, the shaded space showing the form of the end of one of the horizontal bars. By starting from the points thus obtained, and drawing lines to the vanishing point of the horizontal edges, we shall obtain the width of the bars on the other two faces of the cube, also some of the interior lines. The intersection of these lines with the diagonals of the faces will determine the width of the wood in the other direction, and by working from face to face and point to point in this way all the remaining lines of the cube will be obtained. The cube looks complicated, but remember you have only three sets of lines to deal with, and see that you make them all converge together in their proper groups.

Although no drawing of a cone has been given in the previous plates, little explanation will be necessary. It comes under the rule laid down for all cylindrical objects. Draw the base first as a horizontal ellipse, and at the middle of its diameter set up a vertical line for the axis. Determine the height in proportion to the width of the base, and from the apex draw straight lines *tangential to the ends of the ellipse.* You must not draw them to meet the ends of the diameter of the ellipse, but just to touch the curve.

In Plate XXV. we have a double cross in two positions. It is composed of three square prisms intersecting each other at right angles. In the first position commence with the upright prism, and mark the points where the others cross it. Only one of the long edges of each prism is seen in its entirety; they intersect each other in point A, and give a key to the direction of all the other lines of the cross. In the plate they are shown in thickened lines, and it will be observed that all the other lines converge towards them, or are parallel to them.

In the second position the cross is resting on three points. The position of these points on the board or table should be indicated, and one of the prisms should be completed first. If this is drawn correctly, the drawing of the arms of the cross will not be difficult, as all of the lines follow the directions of the three sets comprised in the first prism. The central lines of each group are shown in thick lines, as in the first figure, and dotted lines are added joining some of the angles, to suggest methods of testing the accuracy of the drawing. These may be applied in a variety of directions.

Plate XXVI. shows an open umbrella. Lines joining the extremities of the eight ribs will form a regular octagon, the drawing of which will be assisted by reference to Fig. 15, p. 32. Begin with the points which rest on the table, and remember in drawing the octagon that you have four sets of four parallel lines each to deal with. Two sets only are indicated (by dotted lines) in the plate; the directions of the others will be understood by referring to Fig. 15. Having got the octagon correctly drawn, find its centre by drawing two of its long diagonals: the stick of the umbrella must pass through this point. Be careful to get its direction right, observing how the point upon the table where the handle rests lies in relation to the ends of the two ribs, which also touch the table. Then proceed to draw the ribs from point to point of the octagon, noticing that the curves they take are very much flattened in some parts and sharp and sudden in others. Draw them right through from point to point, as shown in dotted lines. Then connect the ends of the ribs by curves representing the edge of the covering material; these will vary greatly in character, and must be studied carefully as you proceed. The curves of the top of the umbrella are formed partly by the ribs, and partly by the surface of the silk stretching from one to the other. Reference to the plate will explain this.

The ends of the struts, or wires which support the ribs, form another octagon (shown by dotted lines in the plate), the sides of which will be parallel to the larger one, and must, of course, be made to converge with them. The drawing of the smaller details will not need explanation.

Plate XXVII. gives a drawing of a common Windsor chair; an object which is somewhat irregular in form, and presents many difficulties to the student. The best plan is first to mark the position of the feet upon the floor, joining the points to form an irregular quadrilateral figure, whose opposite sides will converge together. Observe that the back legs are nearer together than the front ones; lines joining their extremities will therefore converge considerably. Draw a centre line through the middle of each leg, and then get the form of the seat and the slope of the back. What further explanation is necessary may be included in the general advice (which will apply to the drawing of many other objects also) to *look for parallel lines.* The cross-bars will be approximately parallel to the lines joining the ends of the legs, and to the sides of the seat. Lines drawn from the turnings on one of the legs to those on the adjacent ones will also belong to the same sets of parallels: and so with the cross-pieces of the back, though they are not straight they are parallel in direction, and lines joining their ends will converge together, and with the back edge of the seat. In drawing the turnings on the legs remember that they are parallel circles, and therefore their curves in perspective will be elliptical. You will observe that they are much flatter in the nearest leg than in any of the others, because it slopes forward.

Plate XXVIII. shows a bedroom water-can. The sectional form of the body is neither circular nor elliptical, but is composed of two semi-circles united by straight lines where the sides of the can are flattened. The drawing of the curves will be easily understood by reference to the plate, in which the diameters of the semi-circles are shown in dotted lines. These, of course, are parallel, and will converge together in your drawing, as also will the lines representing the flat sides of the can. Other parallel lines are also indicated. In drawing the handles get the nearest edge (of which you see the complete form) first, and remember that the back edge is an almost exactly similar curve. Trace it through, as shown in dotted lines, in both handles. The upper handle is semi-circular in form, or rather a stilted semicircle, the lower part being straight and upright. Draw carefully the junction of the spout with the body of the can, and the curve of the joint in the spout. The mouth of the spout is circular and will be represented by an ellipse, whose long diameter is at right angles to the axis of the horizontal portion.

Little need be said about the drawing of the hat, Plate XXIX. Everything depends on careful observation of the curves; perspective rules will be of little help to you. It may be well to continue the edge of the brim through where it passes behind the crown. (*See* dotted lines.)

Plate XXX. will not require much explanation. In drawing books in any position it is best to draw them as plain rectangular blocks first, adding the curves of the backs and the edges of the leaves afterwards. When a book is lying on its side the corners of the upper cover will, of course, be exactly over those of the lower one. In other positions lines joining the corners will be either parallel or convergent according to the view taken. The ridges or toolings on the back will be parallel curves; you will get these best by drawing straight lines first, as shown in the plate. These lines will be parallel to lines joining the corners of the covers, and must converge with such lines when they are converging. The dotted lines in the plate will make these instructions clear.

Plate XXXI. represents several objects the general drawing of which will be easily accomplished if the lessons already learnt have been assimilated. The only points in which the student will require assistance are the drawing of the lips of the bowl and jug, and the setting on of the handles of the jug and cup. In the former case it will be wise to draw the ellipse representing the top of the object complete, and add the lip afterwards, watching the changes in the curve carefully. In drawing the handle of any vessel care must be exercised to see that the junction of the lower end of the handle with the body comes exactly under the upper attachment. Of course this will not appear so, but the right position may be found by drawing a line following the contour of the vessel, and touching both ends of the handle, as shown by dotted lines in the plate.

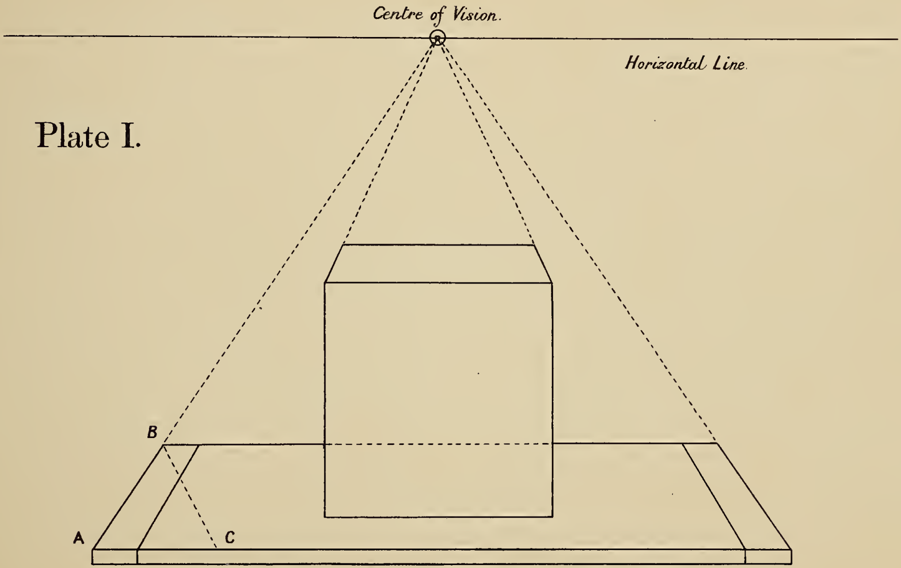
In Plate XXXII. we have a group of objects, for the drawing of some of which a little help may be needed. You had better begin with the board first and then sketch light lines, as shown in the plate, from one outside point to another, so that you may make sure of getting the whole group properly upon the paper. Next, place the bottle in its proper position upon the board. The only remark to be made about the drawing of this is to suggest the advisability of carrying the curve of the body across from side to side, as shown by a dotted line. You will find this will often assist you in getting a proper balance of the sides in such objects.

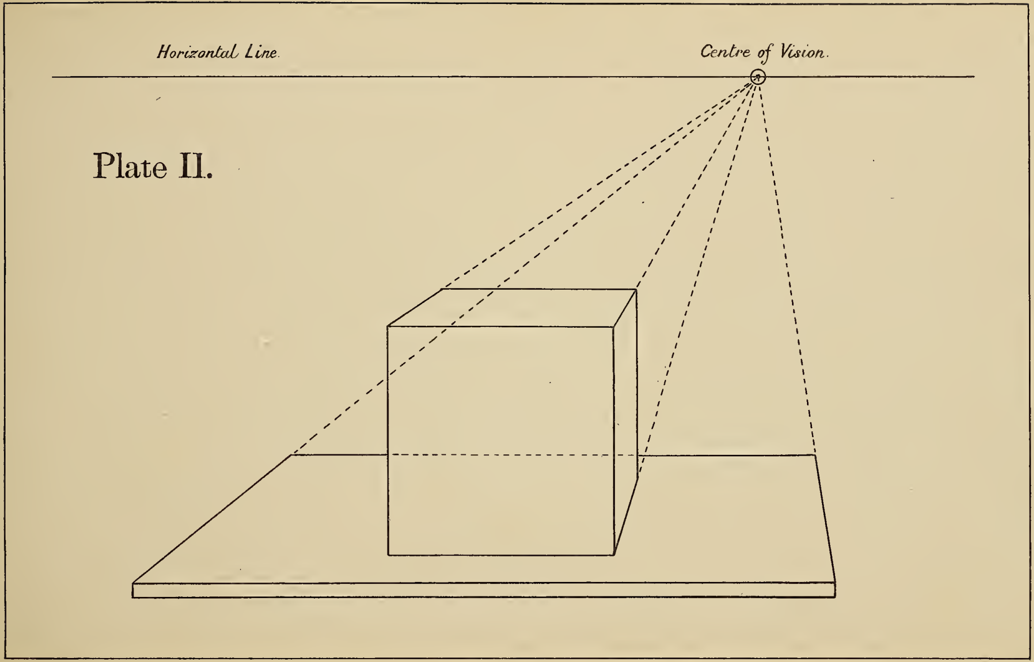
The drawing of the octagonal prism will be understood by referring to Fig. 15, p. 32, and the dotted lines will explain all that is necessary about the setting out of the cone.

In drawing the ring on the left of the group, it will be best to begin with the top, which will be an ellipse, the major axis of which will be slightly inclined as the object lies away from the centre of the group. The reason for this is explained on page 35 in reference to Plate XVI. The inner circle of the ring is also represented by an ellipse of similar proportions. Observe that the width of the ring is much greater at the sides than in the middle, the proportion being as the major axis of the ellipse is to the minor axis. The lower edges of the ring will be portions of two ellipses almost similar to the two upper ones and lying exactly under them. The safest plan to ensure accuracy will be to draw all the ellipses complete and join their extreme edges by upright lines. Of course the vertical depth of the outer edge of the ring will diminish slightly towards the sides, the curved lines tending to converge.

One final piece of advice—don't draw piecemeal, considering each object in turn independently of the others; but draw every form with reference to its surroundings, taking the bearings of the leading points: otherwise your drawing will not hold together and satisfy the eye.

Plate I.




Horizontal Line.
Centre of Vision.
Plate II.

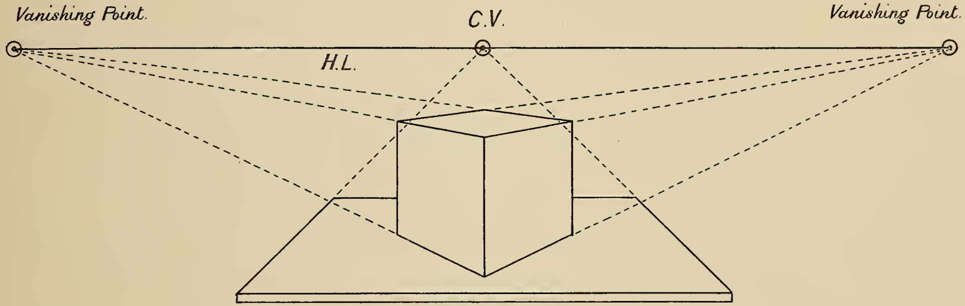


Plate III.

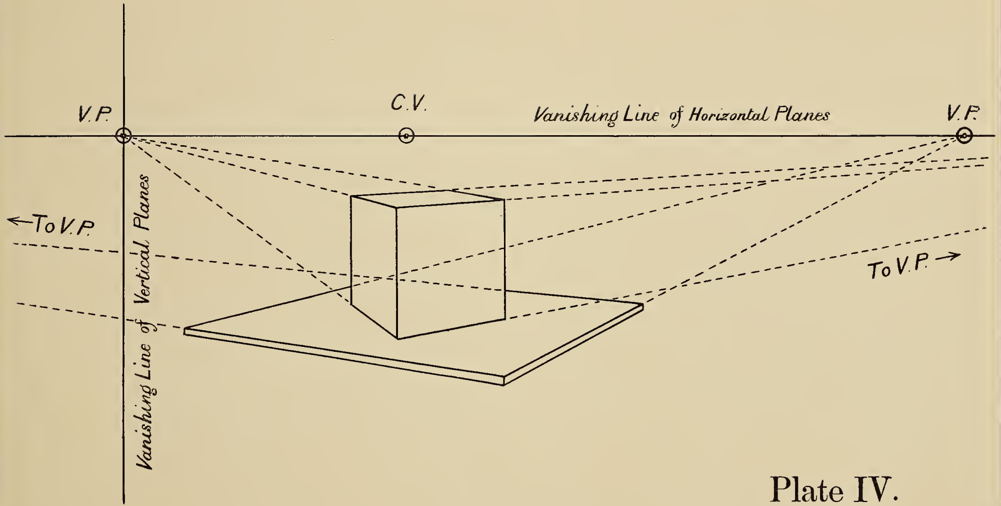

V. P.
C. V.
Vanishing Line of Horizontal Planes
V. P.
←To V. P.
Vanishing Line of Vertical Planes
To V. P.→

Plate IV.

Plate V.

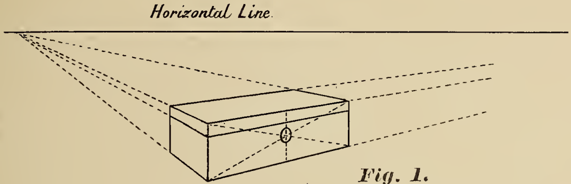


Fig. 1.

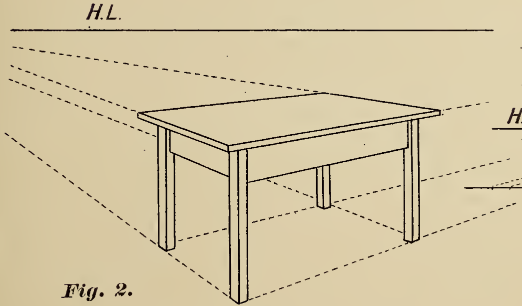


Fig. 2.

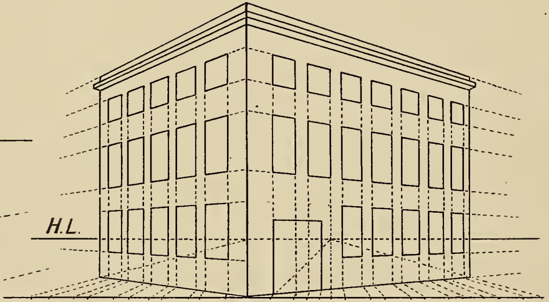
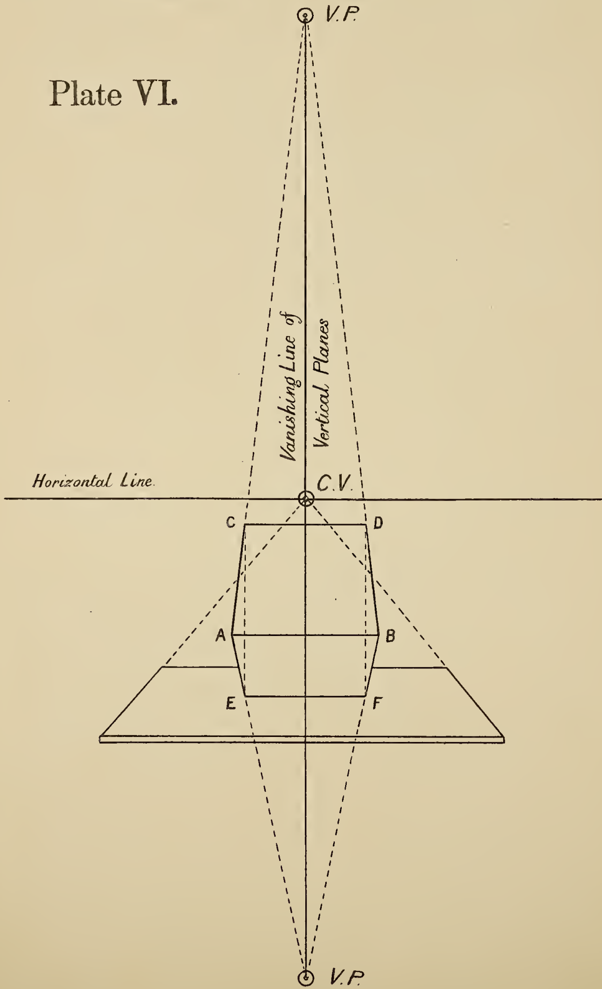


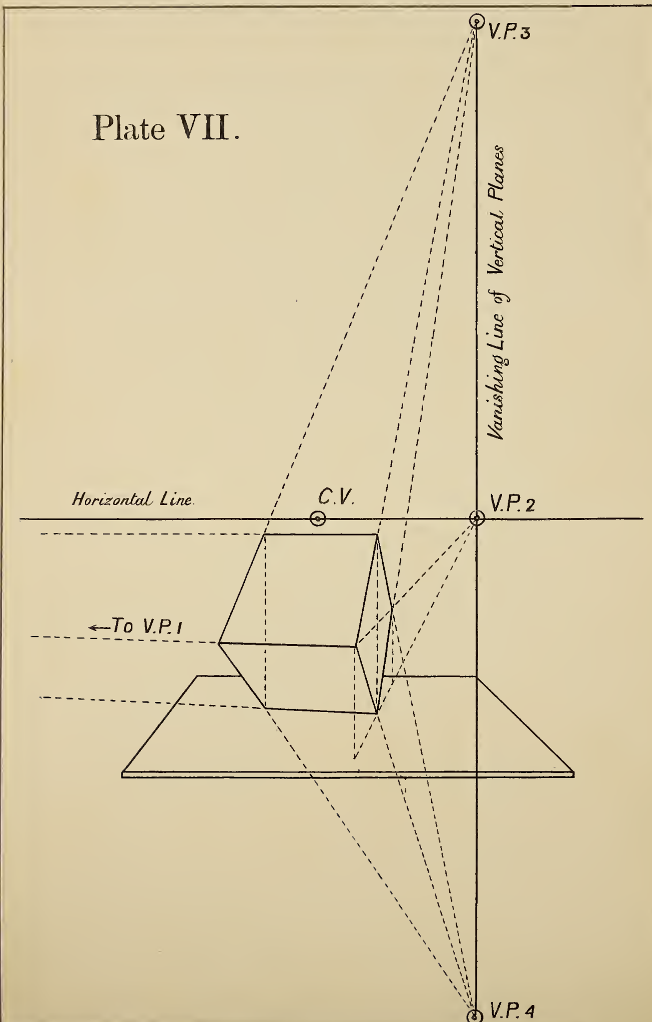
Fig. 3.

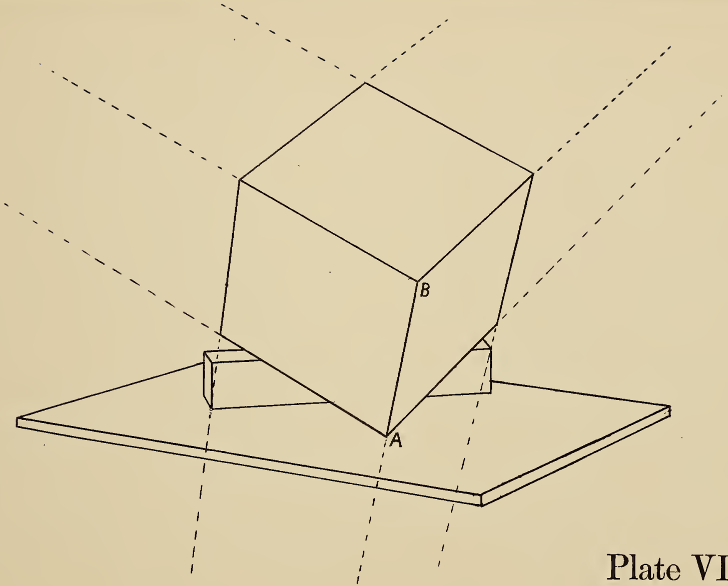
Plate VI.



V.P.
Vanishing Line of
Vertical Planes
Horizontal Line.
C.V.
C
D
A
B
E
F
V.P.

Plate VII.


V.P.3
Vanishing Line of Vertical Planes
Horizontal Line.
C.V.
V.P.2
←To V.P.1
V.P.4



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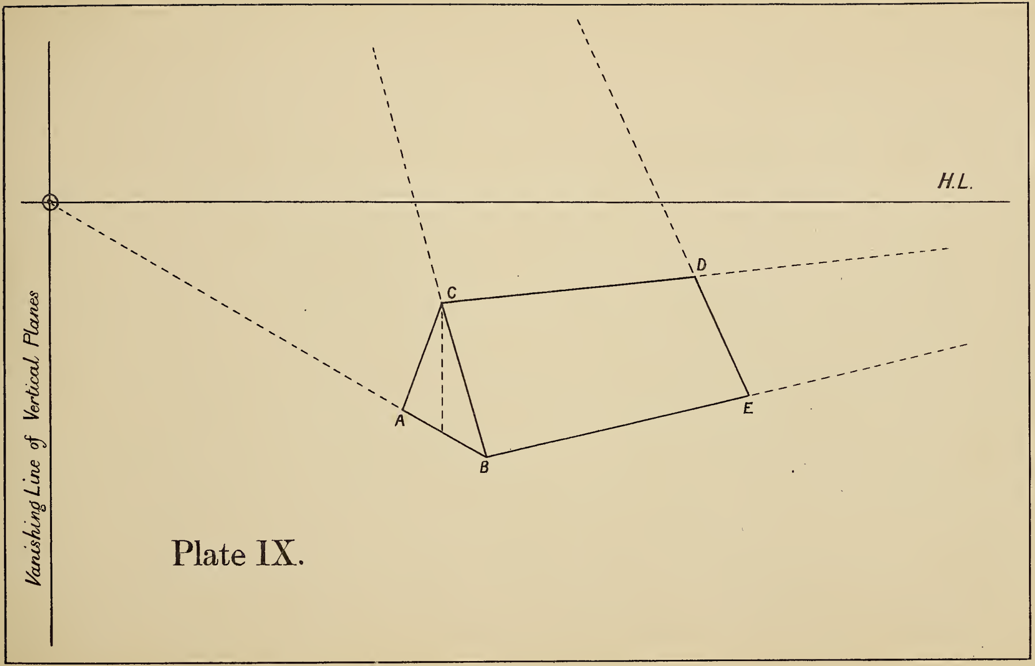


Plate IX.

Plate X.

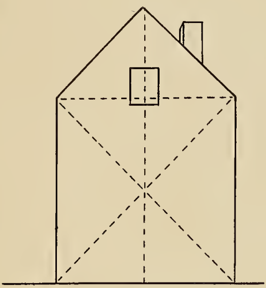


Fig. 1.

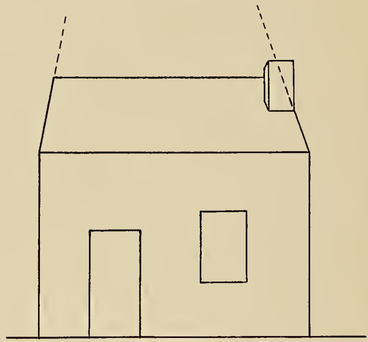


Fig. 2.

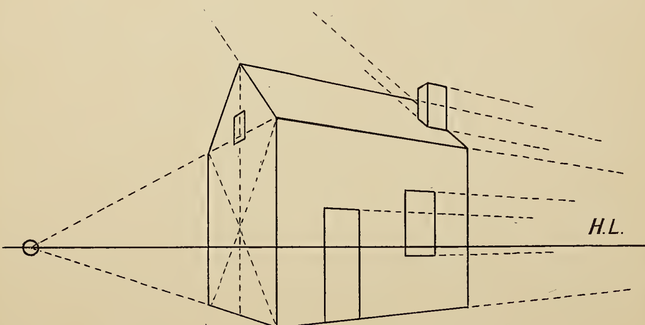


Fig. 3.

Plate XI.

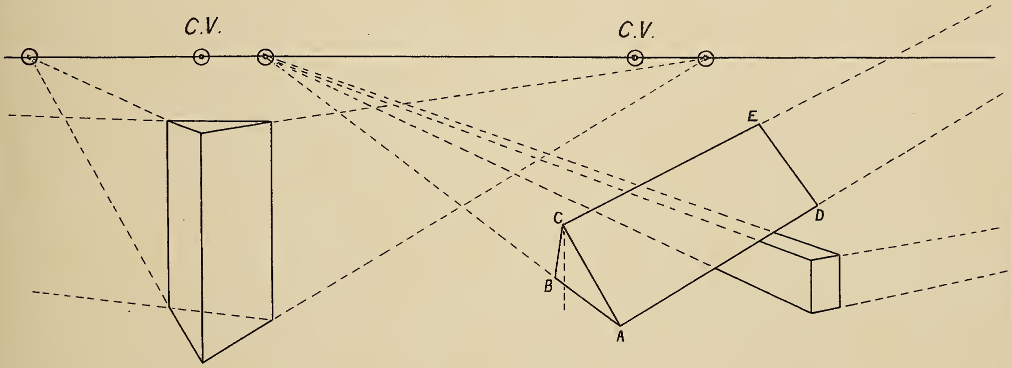


Fig. 1.

Fig. 2.

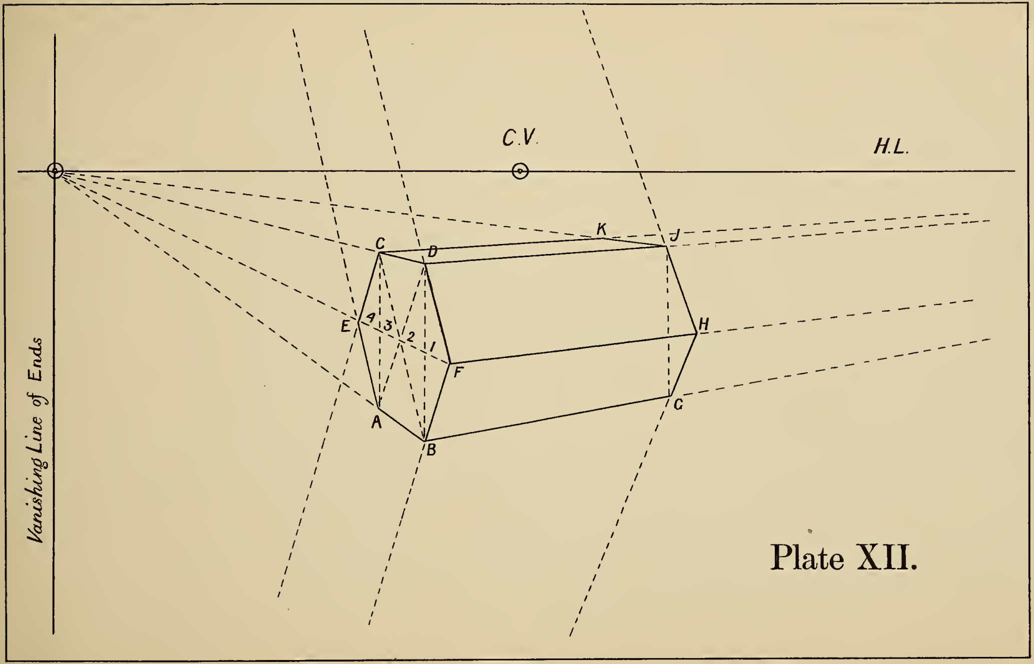


Plate XII.

Plate XIII.

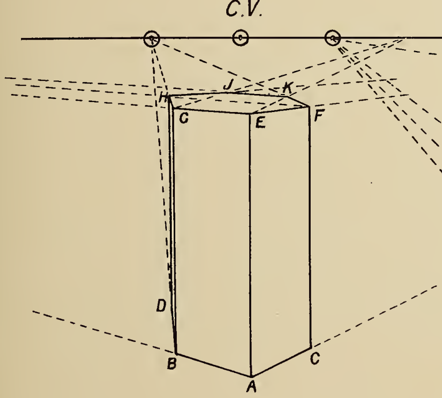


Fig. 1.

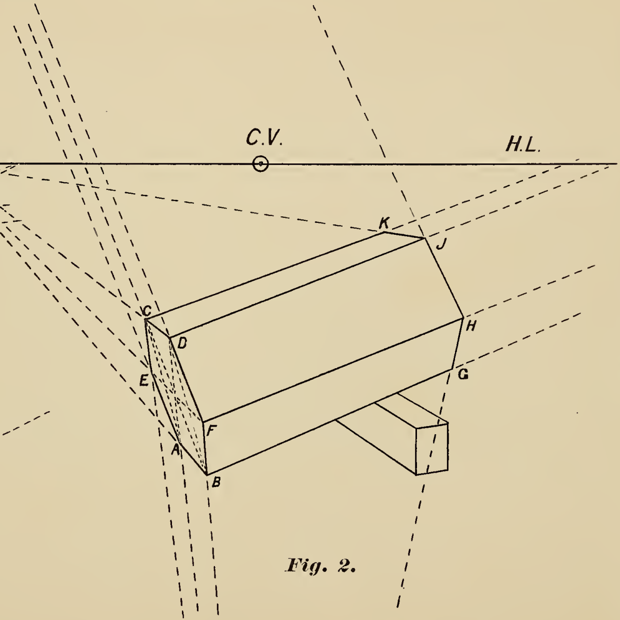


Fig. 2.

Plate XIV.

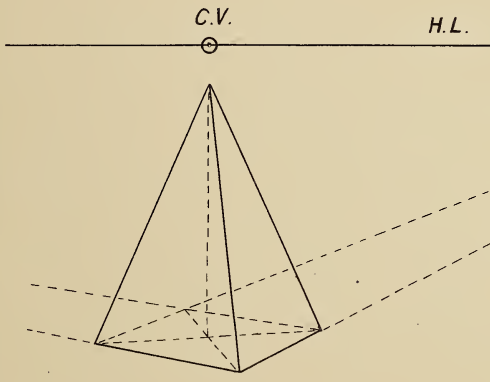


Fig. 1.

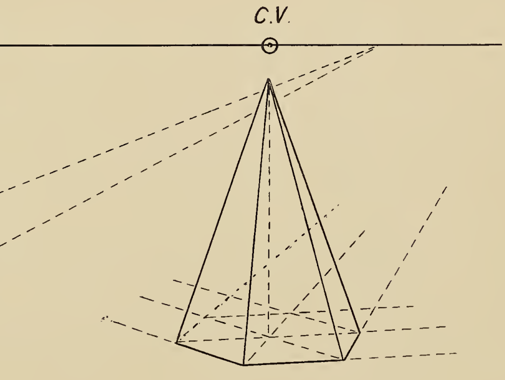


Fig. 2.

Plate XV.

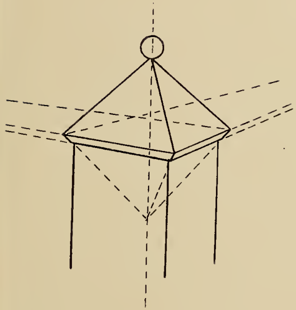


Fig. 1.

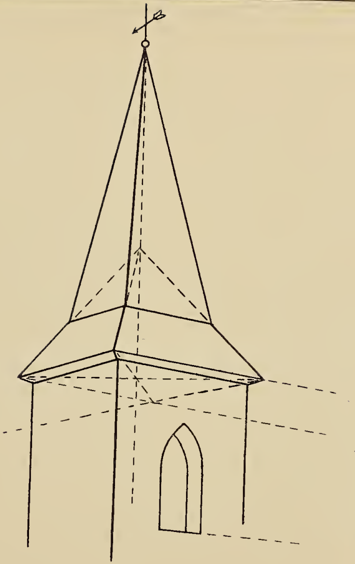


Fig. 2.

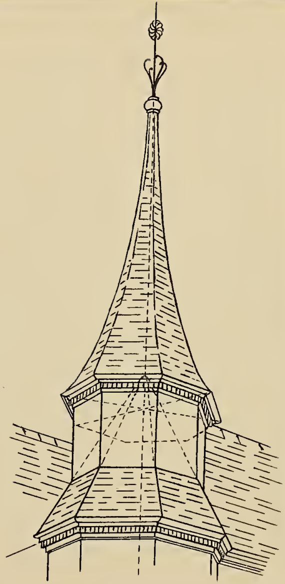
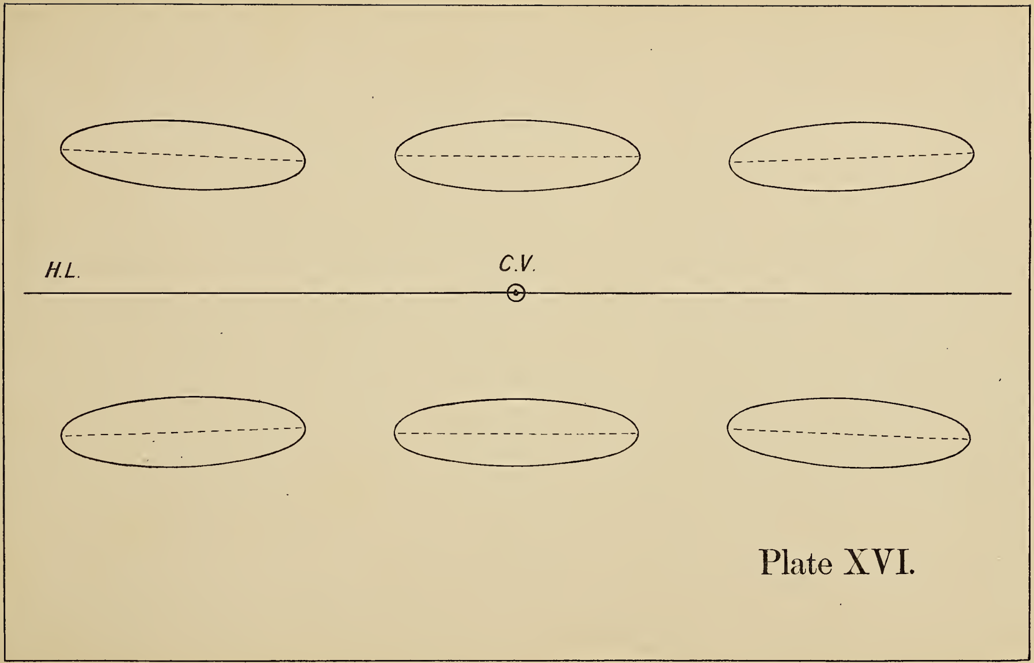


Fig. 3.



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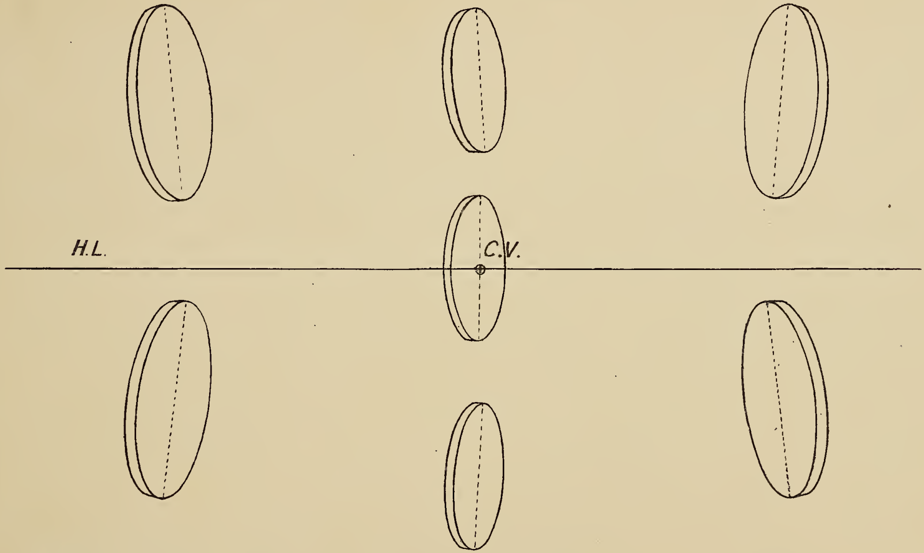

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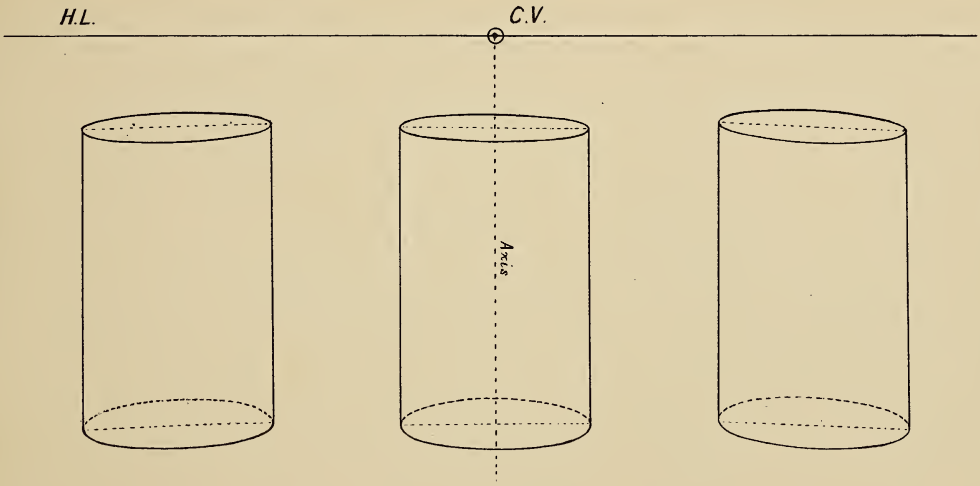
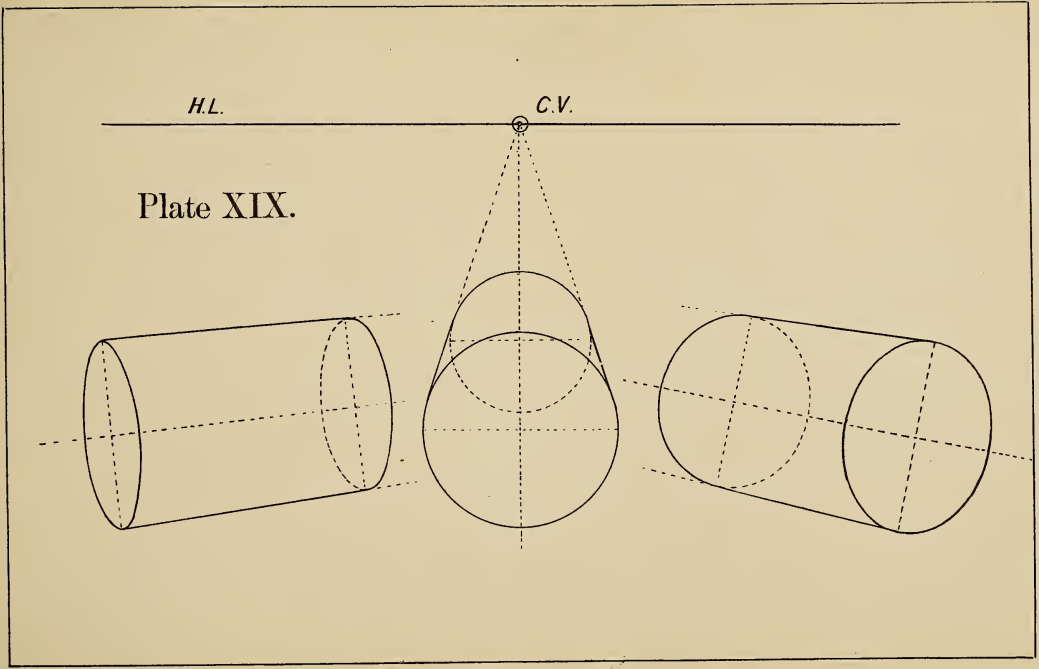


Plate XVIII.

Plate XIX.



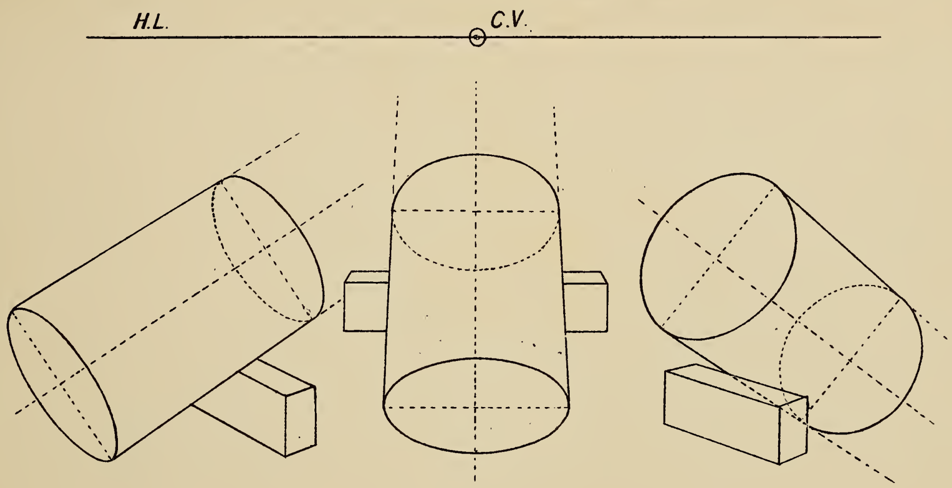


Plate XX.

Plate XXI.

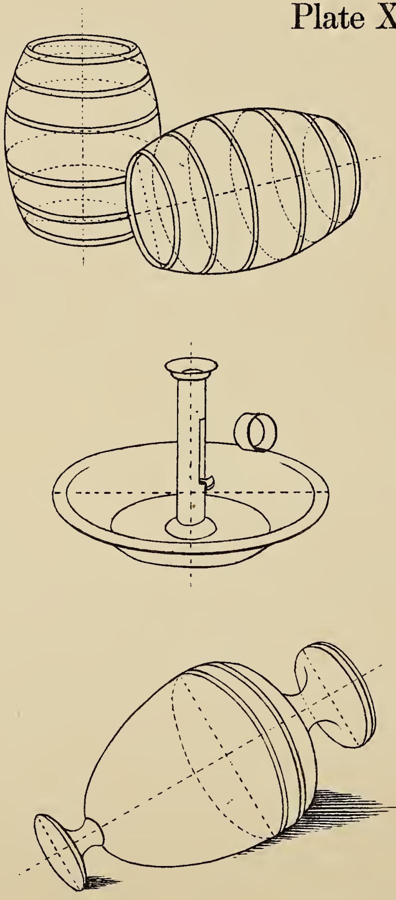


Plate XXII.

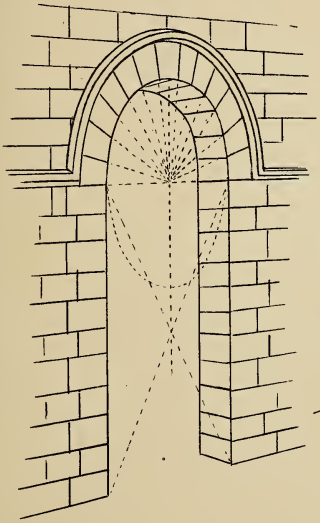


Fig. 1.

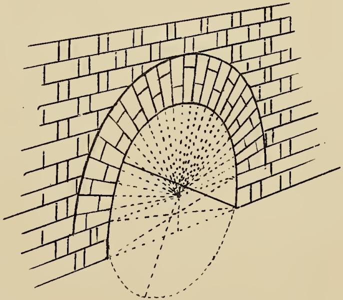


Fig. 2.

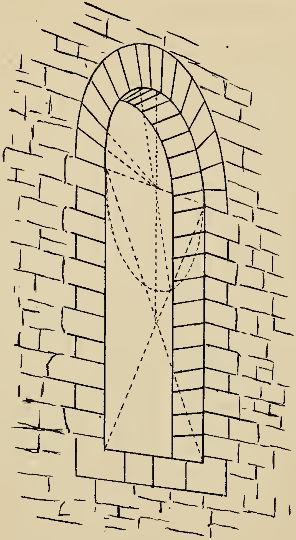


Fig. 3.

Plate XXIII.

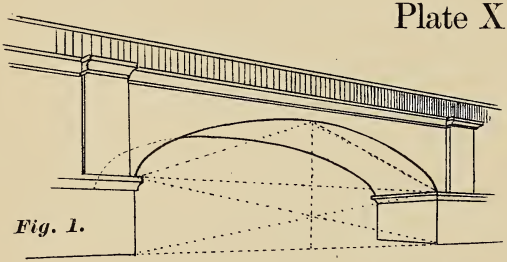


Fig. 1.

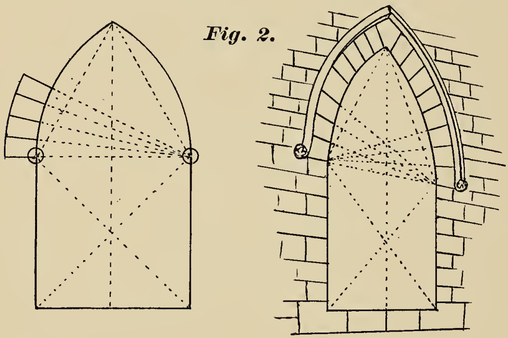


Fig. 2.

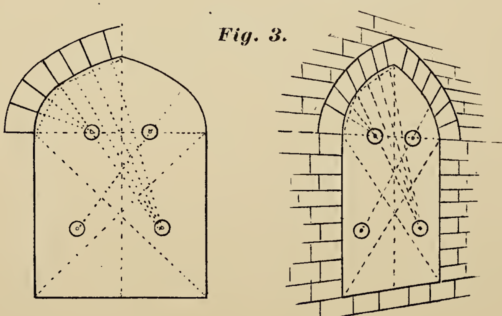
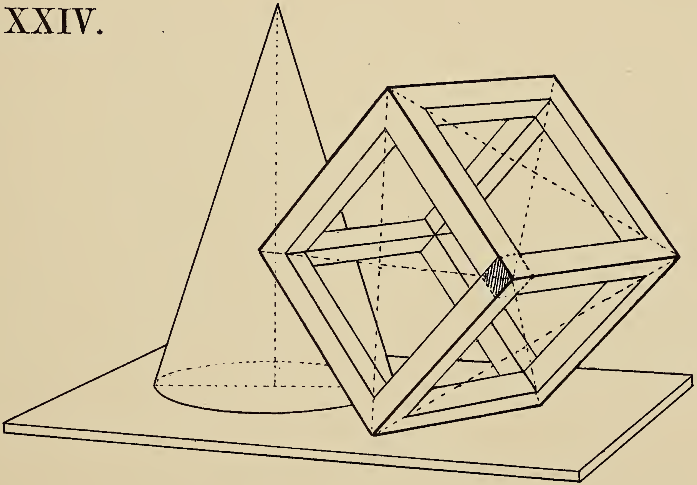


Fig. 3.

Plate XXIV.



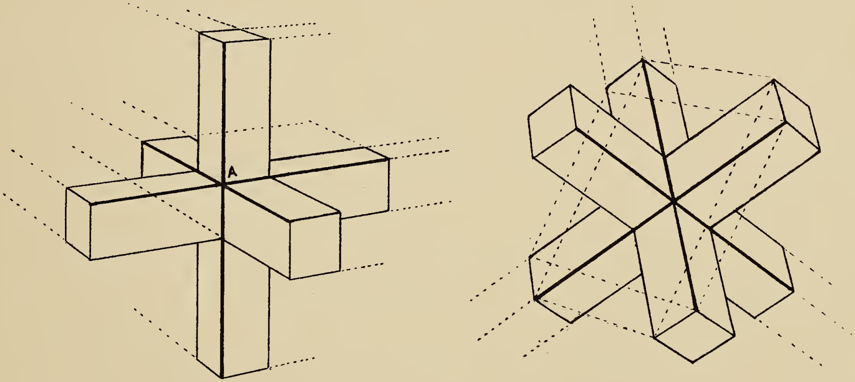
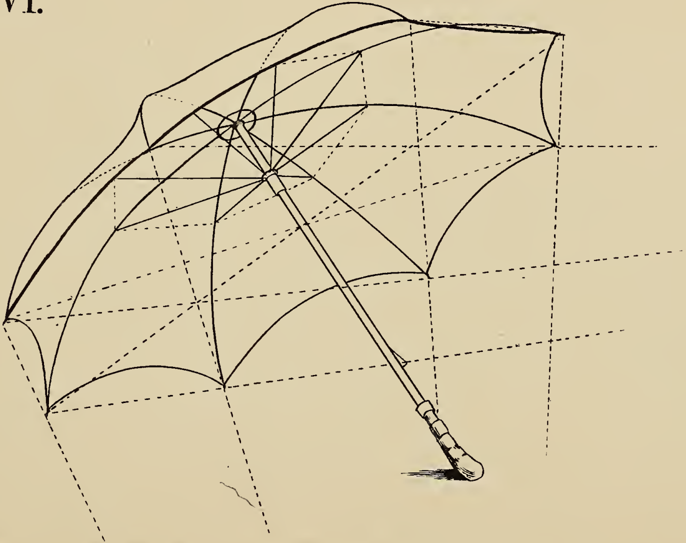


Plate XXV.

Plate XXVI.



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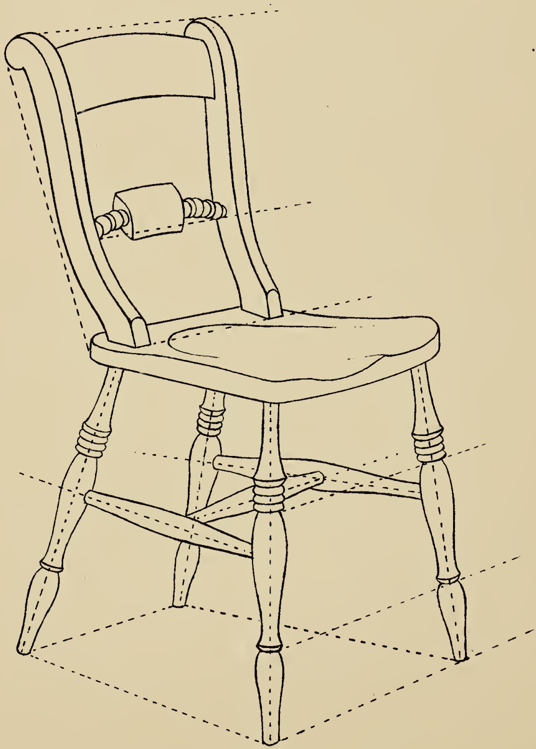
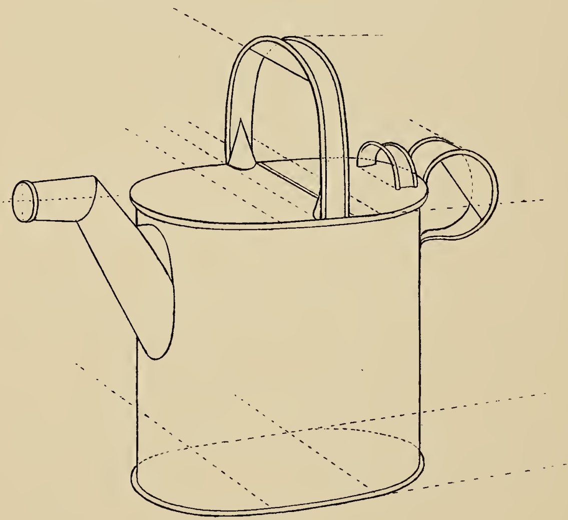
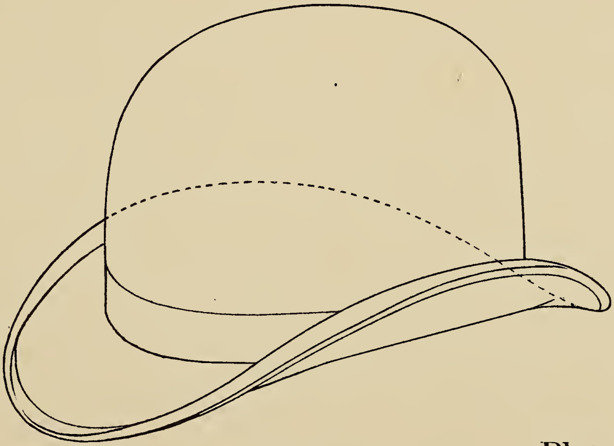


Plate XXVIII.





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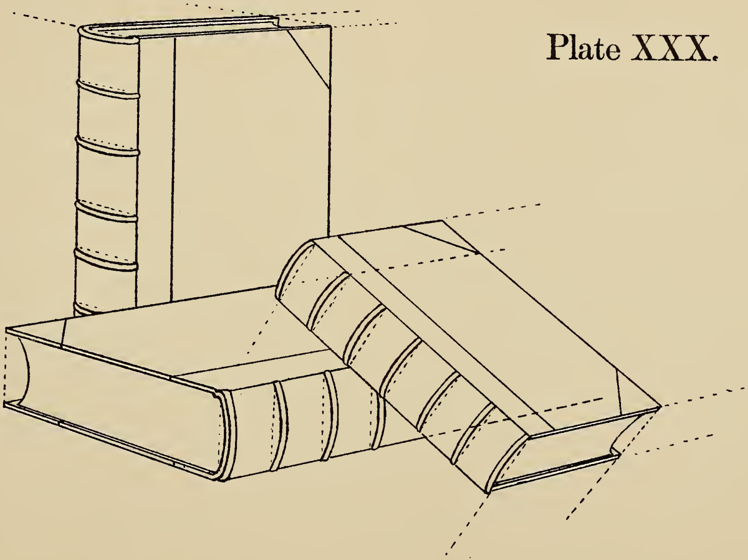

Plate XXX.

Plate XXXI.

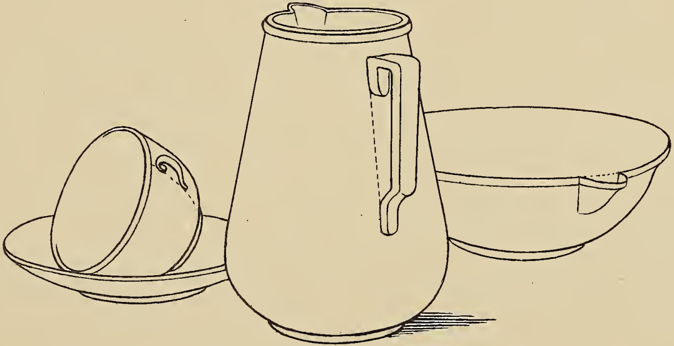

Plate XXXII.