EASY LESSONS

IN

PERSPECTIVE.

INCLUDING

INSTRUCTIONS

FOR SKETCHING FROM NATURE.

"The most consummate master is tied to the observation of every one of these rules, on pain of pleasing none but the ignorant."

BOSTON:
HILLIARD, GRAY, LITTLE AND WILKINS.

1830.

TO

JOHN RAPHAEL SMITH,

Teacher of Drawing and Perspective,

THIS BOOK

IS RESPECTFULLY DEDICATED.

PREFACE.

It is the object of this book to explain the elements of Perspective, together with the art of sketching from nature, in a familiar manner, so as to render them intelligible to the young, and those not skilled in Mathematics and Geometry.

There are many learned and elaborate treatises on Perspective, but they are generally unintelligible to those who cannot command the assistance of a teacher.

The subject is abstract in its nature; an acquaintance with its principles, and a facility in its practice, cannot be gained without attention and labour, but *with* these, it is believed that any one, having a competent skill in drawing, may gain from this book all the knowledge requisite to sketch from nature correctly.

LESSONS

IN

PERSPECTIVE.

LESSON I.

LINES.

A straight line is the shortest which can be made between two given points: it is without curve or bend, as A, Plate 1.

Straight lines are horizontal, perpendicular, or oblique. B, is a horizontal line; C, a perpendicular line; D, E, & F, are oblique lines.

Parallel lines are alike, and keep the same distance from each other. A and B are parallel lines.

ANGLES.

An angle is formed by two straight lines which meet at a point. G R is an acute angle; H, an obtuse angle; I, a right angle; J, a triangle. A triangle has three sides, and three corners or angles.

An angle is the space included in any of these lines.

The size of an angle is measured, not by the length of its lines, but by the space included in them, and is accordingly that portion of a circle which this space contains.

A circle, whether large or small, is by geometricians divided into 360 parts, called degrees. A degree, therefore, is not any precise measure, as an inch, a foot, or a mile, but simply the three hundred and sixtieth part of any circle. In a large circle, the parts or degrees are larger than in a small one, but the number is the same (see Plate 2, circles A and D.) A line which passes through the centre of a circle, and divides it in two equal parts, is called a diameter. Thus the half of the small circle A, divided by the diameter B, is 180 degrees, as truly as the half of the larger circle D.

Any straight line drawn from the centre of a circle to the circumference, is called a radius. In the circle A are two radii E and F, proceeding from the centre; one a perpendicular, the other a horizontal line. These two lines include one quarter of the circle or 90 degrees. This is a right angle. If the circle were larger, as D, a right angle would be but one quarter of it. Therefore a right angle is a quarter of a circle, that is, 90 degrees, if it extend a thousand feet, or even to the heavens, for its size is estimated only by the portion of a circle which it includes. This is an idea of proportion, not of actual measured space, and it is important to perceive and maintain the distinction. An angle which includes a portion of a circle less than 90 degrees, is called an acute angle, and may be of any size from 90° to almost nothing. As E G (circle A, Plate 2) which is about 45 degrees, and H F which is not more than 10 degrees.

An angle which includes a portion of a circle larger than 90 degrees, is called an obtuse angle, and may include any number of degrees, from 90° to 180°, as K J (circle D) which is 135°, or K L which 155°.

LESSON II.

PLANES.

Planes cannot be so well described as lines and angles. Any even flat surface considered without regard to its thickness, is a plane. A table is a plane, the floor is a plane, the side of the house, &c.

Planes are perpendicular, horizontal, or oblique.

The wall of the house is a perpendicular plane. The floor is a horizontal plane, and so is the ceiling a horizontal plane, parallel with that of the floor.

Any even surface which varies or inclines from the perpendicular, is an inclined plane; as a writing desk.

A perpendicular plane is at right angles with a horizontal plane. Thus, if you place a book upright on a table, the book is a perpendicular plane, and the table a horizontal one, and they make a right angle.

An inclined plane makes an angle less than a right angle, with a horizontal or perpendicular one. For a writing desk, which is an inclined plane, does not make a right angle with the table on which it stands, as the book when placed upright does; but it makes a smaller angle, and this angle is more or less acute (that is, small) according to the greater or less inclination of the desk.

Two or more similar planes are said to be parallel.

Planes may be of any extent, large or small. Some really exist, as the floor or wall of a house, and some are only imagined to exist, for the purposes of science.

If two balls (M and N Plate 2) were suspended from a ceiling by cords of the same length, and were revolving about, they would be said to move in the same plane, though no plane or surface were actually under them; we know that if one were put under them, they would both touch it. Thus objects are said to be in the same plane, when they are neither higher nor lower than each other.

All objects situate on the earth are, in perspective, said to be on the same plane, called the ground plane.

There are three planes especially to be attended to in perspective, viz.

The ground plane, the horizontal plane, and the perspective plane.

The ground plane is that on which the objects to be drawn stand; as trees, houses, figures, &c.—And when drawing an interior, the floor of the room is a ground plane.

The horizontal plane, is an imaginary plane, supposed to extend from the eye of the spectator, to the verge of the horizon.

The perspective plane is also imaginary. It is a transparent plane, like a window or pane of glass, placed between the spectator and the landscape, or object to be drawn, standing perpendicularly. If the appearance of objects seen through this plane, were traced on it, as it might be on a window through which you were looking, it would make a correct drawing or picture of the view.

The paper on which you draw, in taking a view, is the representative of this perspective plane:—Could you hold it up in a perpendicular position, and see through it, as you do through a window, you would draw the objects beyond it correctly. But as this is impossible, you imagine it to be the case.

LESSON III.

VISION.

All objects are seen by means of rays of light proceeding from them to the eye.

These rays proceed in straight lines.

As they come in all directions, from every side of the object, and enter so small a place as the pupil of the eye, it is evident they must converge or draw together, as in figure O, Plate 3. Having this idea fixed and familiar in your mind, you will understand that, whether the eye be nearer to or farther from the object, the rays must converge to it; they therefore form an angle or cone whose apex or point is the eye, and whose base is the size of the object.

Now it is plain that the size of this angle will depend on the distance of the object from the eye. When near, the angle is larger than when the object is farther off.

Thus the rod P makes a smaller angle at Q than at R, and the angle is still smaller at S.

For an angle, as has been already explained, (see Lesson 1, Plate 2,) is a portion of a circle, and if you take one side of the angle for a radius, viz. semi-diameter, and draw a circle, making the apex of the angle the centre of the circle, it will then be seen how many degrees of this circle the angle occupies, and this shows the size of the angle.

To ascertain the size of an angle, it is only necessary to draw a quarter of a circle, that is, a right angle, (when the angle to be measured does not exceed ninety degrees, or a right angle). Take one side of the angle for a radius, as either T R, T Q, or T S, (Plate 3,) draw from the corner T a line perpendicular to it. The angle R T P it will be seen, is more than half that quarter, or about 50°; at Q the rod makes an angle of 23°, while at S it makes less than one fifth of a right angle, or 17°.

This difference in the size of the angles is caused by a difference of distance. The size of the rod and the position of the eye remaining the same in each instance.

This is called the angle under which an object is seen. It is the angle which the two external rays of light from an object make in coming to the eye.

Though somewhat technically expressed, it means nothing more than, that the greater the distance of an object, the smaller it looks.

In perspective, a line is always regarded as perpendicular to another, when it is at right angles with it. Thus, *u* is a line perpendicular to *v*, or *v* to *u*, (Plate 3,) because it makes a right angle, *i. e.* an angle of 90 degrees with it.

It has been said that we see objects by means of rays of light proceeding from them to the eye, and that these rays converge, and form an angle or cone of rays, whose apex is in the eye.

The side of a house w, (Plate 4,) is seen by rays coming from it to the eye. The two exterior rays form an angle, viz. *a l f.*

In drawing a house, (or other object,) you may imagine the perspective plane to be situate any where, between the house and the eye, as at *x* or *y*. The true drawing will be where the rays of light coming from the house, enter (that is, intersect) the perspective plane in their progress to the eye.

This point, where the rays pass through the perspective plane, is called the seat of their representation. 2 in the perspective plane *y*, and 3 in the perspective plane *x*, (Plate 4,) are the seat of representation for the rays *a b c d e* and *f*, proceeding from the house *w*.

It will be perceived that when the perspective plane is near the eye, as at *y*, the object must be drawn smaller, than when it is farther off, as at *x*.

This rule must not be confounded with the one already given, (see Plate 3,) that the angle under which an object is seen, diminishes in proportion to the distance of the object; for this regards the apparent size of an object, determined by its distance from the eye; but the other, only the drawing of the object, determined by the situation of the perspective plane.

Objects are drawn under their true angles, and preserve their relative proportions, whether the perspective plane is near or more remote; as appears from the figure, (Plate 4.) The house at y, is seen and drawn under the same angle as at x, and the same proportion of the windows and spaces between, is preserved in each.

For, take 1, 2 for a radius, and draw a circle or right angle, and you will perceive that the house is seen under an angle of 20°. So take 1 3, or 1 4 radius, the circle is larger, but the size of the angle (that is, the number of degrees) is the same.

The angle under which an object is seen, determines the size and nearness to the eye.

It will also be perceived, that the distance of the perspective plane from the eye is important; and having been once fixed, must not be varied in the same view.

To illustrate this still more, place a card between the eye and an object, a house or tree for instance, if the card is held near, say within a foot of the eye, it will cover or hide the object, and if it were transparent, this object could be traced on the small space of a card of two or three inches size. But hold the same card twice or three times as far off, and it will not cover half the former object; and if you drew on the card at that distance, you could not get all of the object in. This card represents the imaginary perspective plane on which objects are drawn, and by this experiment you can understand, that when it is near you, you can put more on the same space than when it is farther off, though each object in the view will preserve the same relative proportions in both cases.

LESSON IV.

HORIZON LINE, AND GROUND LINE.

The horizontal *plane* in perspective, is a plane *imagined* to extend from the eye of the beholder to the horizon, or farthest verge of the earth which the eye can reach, viz. where the sky appears to touch the earth.

Suppose the perspective plane interposed between the eye and the view, (like a window, as has been already described, see Lessons 2 and 3,) the horizontal plane would intersect it, or cut it through at right angles, and the line formed on the perspective plane, by this intersection is the horizon line.—What is called the horizon line on the paper or picture, is the representation of this line. For if you suppose the perspective plane set upright on the ground before you, higher than your eye; then the horizontal plane, to reach from your eye to the verge of the sky, must pass through the perspective plane, and thus make a line exactly parallel with the top and bottom line of your perspective plane.

Then draw such a line on your paper, and this is your horizon line. You will find, when sketching, that some particular point of a tree or window of a house comes just against it. The meeting of the sky with the earth, and the distant hills will also be on this line.

It is evident that the height of this line (viz. how far it is above the bottom line of the picture) depends on the height of the eye: and this is the case whether the spectator is standing or sitting,—is on the top of a house, or mountain, or on the plain.

Could an actual plane extend from the eye to the horizon, lines situate on the ground plane or earth would be under it, and the ground plane would appear to meet it in the horizon, and be inclined to it; making with it an angle, whose size would be determined by the height of the spectator. This is what is meant by the phrase, "having a high or a low horizon." The figures A B and C (Plate 4) are of about the same height. Their horizon varies in consequence of the difference in their position.

Lines being here necessarily used to express planes, the explanations are less clear than in experimental teaching. Let E be a table, which is a horizontal plane, representing the ground plane on which the spectator and also the objects to be drawn stand, A, a small figure stationed at one side of the table, representing the spectator,—D, another horizontal plane, parallel to the table, placed just as high as the eye of the figure A. Then the plane D, would represent the horizon plane. Now, if you had on the table objects to be drawn, models of houses, trees, &c.—and threads attached to the top and bottom of these objects, were brought through the eye of the figure A, after the manner of rays of light; you would perceive, that the ground plane appears to the eye to rise till it meets the horizon plane in the distance.—As E rises to meet D, and the angle these two planes make, as D E with figure A, or D E with figure B, or with C (Plate 4) depends on the height and position of the figures A B C, viz. the beholder.

The more distant the object, the higher up on the perspective plane, and the smaller they appear. If, for instance, the perspective plane were a window, the base of a house or tree near it would be seen through the panes at the bottom; while that of a similar object a mile or two off, would be seen through the upper panes, or those more nearly on a line with the eye.

When you begin to take a view, you first fix your position, which must be stationary, and determine on the height of your eye, and on the distance at which the perspective plane is to be placed or imagined, keeping in mind that your paper is the representation of the perspective plane. Then draw a line at the bottom of the picture G, (Plate 5,) which is called the *ground* line, and is the line formed by the intersection of the perspective plane, with the original ground plane; or in in other words, a line where the perspective plane rests on the earth. This ground line is the boundary of the bottom of the picture; for the nearest object or point which you design to include in your picture, must be on the ground line.*

Having drawn your ground line, then draw the horizon line H parallel with it, at the height of your eye; which line represents the place where the sky meets the earth.

The space D between these two lines represents the ground plane, or the earth on which objects stand. The nearer an object is to the spectator, the lower down it will be on the ground plane. I is nearer than J, and J than K. (Plate 5.)

Remember that it is only such lines as are nearer the ground plane than the eye, that are drawn under the horizon line. On looking at a tree or house, or any object taller than yourself, you look down to see the base, and you look up to see the top; consequently the base is below the horizontal plane, and the top is above it. If you had three objects to draw at different distances, as I J K, (Plate 5,) the base of each would be situate on the ground plane according to its distance, while the top would come above the horizon line. The more distant an object is, the smaller it looks. K

* It is best not to include in the picture any large object nearer than 100 feet, and even a small object, as a carriage, house, or man at that distance, would occupy a considerable portion of a perspective plane, situate ten or fifteen feet from the eye. Of this you may be easily convinced, by looking out at a window placed at this distance from the eye, and observing how large a portion of it such small objects when very near will occupy.

and J are not so far above, nor so far below the horizon line as I; this expresses at once that they are farther off.

LESSON V.

POINT OF SIGHT. PARALLEL PERSPECTIVE.

There is a point in the horizon line exactly opposite to the eye; which is called the point of sight. It is very important in perspective.

It is usually placed near the centre of the picture; but it may be on either side, according to the position of the beholder. You can, if you choose, put the objects on each side of you, into your picture; and then the point of sight will be in or near the centre; but if you wish to draw only what is on one side, and omit the other, then the point of sight will be near the extremity of the picture; because the object, which, in the position you have taken, is opposite your eye, is the one at which you will end your view.

The trees (Plate 5, L) are all on the left side of the spectator, and he must stand at B, opposite to S, to see them as they are drawn here; and if he choose to omit the objects on the other side, S will be his point of sight, at the extremety of the picture.

If he prefer to take in the objects on his right, he will have his point of sight in the centre of his picture. As the picture M, (Plate 5,) where S is the point of sight; because in this view are included the houses on the right, as well as the trees on the left of the spectator. Thus you perceive that you can have the point of sight wherever you please: provided it be on the horizon line, and opposite the spectator.

The point of sight then is the point in the farthest distance, exactly opposite the eye of the beholder, and is always on the horizon line. Its use may be illustrated by the drawing of a house.

This is usually a square or rectangular figure: suppose it to stand exactly before you, opposite your eye. It will then be correctly expressed by horizontal lines for the top and bottom, and perpendicular lines for the sides or wall. Its place on the ground plane, is determined by its distance from the perspective plane. You will see the front, but nothing of either of the other sides: as N. (Plate 5.)

But if the house is placed a little to the right or left of the spectator, one end can be seen as well as the front.—Look at a house from these two different positions.

(Plate 6) R. That part *a* of the end seen, adjoining the front, and next the spectator, is nearer than the part *b*, adjoining the back; therefore *a* must look larger than *b*. As this side (*a b*) actually recedes from the eye, it must be drawn diminishing in size, after the following manner.

Having drawn the front R, (Plate 6) exactly as in N, (Plate 5) excepting that it is farther removed from the point of sight,—draw two lines, one from the top, the other from the bottom of the house, meeting in the point of sight *s*, which is the vanishing point, or that where all the lines on this side, parallel with the top and bottom, would meet.

The lines for the doors, windows, &c. meet, that is, vanish in this point.

When a house, or other rectangular object, stands square before you, and not cornerwise or obliquely, two sides, viz. the front and back, are parallel with the ground line, and the other two are exactly at right angles with it.

Lines which in the original object are parallel with the ground line, are drawn parallel.*

Lines at right angles with the ground line, vanish or terminate in the point of sight.

Perpendicular lines which are parallel with the perspective plane, like the sides of a house, are drawn perpendicular and parallel.

Parallel lines (whether horizontal like the top and bottom lines of the front of the house, in Plate 6, R, or perpendicular, like the sides of the same house) are shorter than their originals, in proportion to their distance from the perspective plane. Thus the top, bottom, and sides of R, though parallel, like their originals, are shorter; because they are at some distance from the perspective plane, and the beholder. And if the house were farther off they would be still shorter, in exact proportion to their distance; which means no more than that the house would look smaller, if it were father off. Still, however, they preserve the same direction, and are parallel like their originals; but the lines on the side *a b* are smaller than their originals, and they take a different direction; instead of being drawn parallel, like their originals, they tend to, and meet in the point of sight.—In parallel perspective therefore, there are but three sorts of lines to be considered.

1st, Those which are parallel with the ground line, and are horizontal lines in a picture. 2d, Those which are parallel with the perspective plane, and are perpendicular lines in the picture. 3d, Those which are at right angles with the ground line, and when drawn, vanish in the point of sight. The length of all these lines, that is, how much smaller they are than their originals, depends on their distance.

This is parallel perspective, and these rules comprise

* Original lines are such as really exist in contradistinction to the drawing of them.

all that is requisite for the sketching of rectangular figures, placed parallel with the spectator. Further instructions for the drawing of circles and curves in parallel perspective, will be found in the lessons on circles, bridges, and interiors, &c.

In taking a view out of doors, you will be able to determine the apparent size, situation, and relative proportions of objects, with sufficient accuracy, by holding up a pencil or ruler before your eye, in a horizontal and perpendicular position, and comparing the object with this measure. If you nearly close your eyes while looking, it will facilitate the operation; for if you look at a house with your eyes shut as near as can be, and see, and hold a pencil before them, you can with your finger mark exactly how much of this measure the house occupies to your eye. By looking in the same way, at a house more distant, you will see how much less of the pencil this occupies than the first; you have only then to make this difference in their sizes when you draw them.

By the same method you can form a correct judgment, how much taller one tree is than another, or than a house or other object; how much higher one hill rises against the sky than another; or how large a space a sheet of water occupies on your ground plane. This space for water, fields, or any level surface on the earth or ground plane, will be much less on your picture, than you would believe, till you have made the experiment, and measured it in this way. You may observe, also, that the lines for the banks of rivers, lakes, &c. vary less from the horizontal, than you would be disposed to draw them, if you judged merely from your eye, without comparing them with your measure, or some horizontal line.

Observe that your measuring rule or pencil, must be held at the same distance through the whole sketch;

for an object which would occupy the whole at a distance of three feet, would not be equal to half of it, when held near the eye.

It is easy to preserve the same distance for the measure, by means of a cord fastened to its centre and held in the mouth.

Novices in sketching, are often at a loss to determine on the place for their horizon line, and think that because they see no such line in the landscape before them, they need not and cannot draw one; but it is difficult, if not impossible, to get a correct likeness without one, and it is easy to determine on its place.

Suppose you were out of doors, and looking at the view 4, (Plate 6) with a design to sketch it.

If you were on level ground, your horizon would be low; and the horizon line must be drawn about as far from the ground line, as it is in the sketch,—wherever you draw it, on the paper, would be the place for that part of the picture, where the sky meets the earth. Then observe by holding up a pencil, or other straight stick in a horizontal position, exactly at the height of your eye, what this line passes across. The distant hill *b*, is on the right hand, and there is another hill on the left; consequently S between them is opposite your eye, and is the place to mark the point of sight on the horizon line.

The hill *b* rises a little above this line, and comes a little below it,—the hill *d* rises higher and comes farther down on the ground plane: draw them so. Then notice the cedar tree *c*,—two thirds of it are above the horizon line, (that is, two thirds of it appear above any line held horizontally across your eye,) and the root is one third below. The elm tree *e* being nearer the spectator, its base approaches almost to the ground line, while its top reaches far above the horizon, to the top of the picture. The horizon line passes near the insertion of the lowest branch.

Next draw the house *f;* observe where the base comes above the foot of the tree, *e*, the horizon line passes near the middle, just above the lower row of windows; therefore you must draw these windows below the line, and the other row above it.

Thus this line helps you to ascertain the situation of every object you wish to draw,—and the observation of the relative position of these objects enables you to determine the place of the horizon line.

After a little practice, and with the help of these rules, no difficulty can be experienced in sketching any common view in parallel perspective.

The spectator in this view is placed at J, opposite to S.

Lines from the side of the house, to the point of sight, S, determine the drawing of the side *m*, which is at right angles with the ground line, and vanishes in the point of sight. The side *f* being parallel with the ground line, must be drawn parallel, according to the rules already given.

Throughout the book the following references are invariable :—H, horizon line ; G, ground line ; S, point of sight ; D, point of distance.

LESSON VI.

OBLIQUE PERSPECTIVE.

Oblique perspective teaches the drawing of objects situated obliquely to the ground line, as when a house or other object stands with the corner towards you, like W, (Plate 6).

As no side of the object W is parallel with the ground line G, no lines can be drawn parallel with it; since as has been said in lesson 5, original lines parallel with the ground line, are drawn parallel with it, but no others.

Each of the sides makes an angle with the ground line, and must have a vanishing point. This cannot be the point of sight, that being the vanishing point for such lines only as are at right angles with the ground line. They must have another vanishing point or points.

These are on the horizon line, and are thus ascertained.

Prepare your paper as before with a ground line G, (Plate 7, Figure 1,) horizon line H, and point of sight S.

Rule a perpendicular line through the point of sight: this is called the prime vertical line. Mark on this line the point D, called the point of distance.

This space from S to D, represents the distance of the spectator from the perspective plane: in other words, the distance at which you stand when taking a sketch, from the nearest object you intend to put into your picture. It may be arbitrary, but the distance here marked is a good proportion. It is rather more than twice the distance from the ground line to the horizon. If you refer to Lesson 3, Plate 4, you will see the use and importance of the distance point. The distance D (Plate 7, Figure 1) is set off, or marked on the prime vertical line. In other cases, which will be hereafter explained, it is measured on the horizon line.

Having proceeded thus far, look at the building, if you are sketching one, and estimate as well as you can (by means of your measuring stick held in a horizontal position) the angle which the bottom line makes with the ground line, and draw this from the ground line to the horizon G V. Where it intersects the horizon at V, is the vanishing point for this side. Draw a line from the point of distance D, to the vanishing point, making D V.

Draw the line D W so as to make up the complement of a right angle; that is, if the first line D V make an angle of 60° with the vertical line, let the second D W make an angle of 30°; or if one is 45° let the other be 45°, both being equal to 90°, and D V and D W form a right angle.

If you have not the necessary instruments at hand for taking angles, you can easily obtain a right angle, by cutting a bit of card exactly square, place one side on the line D V, letting the corner touch the point D; then the other side will give you the line which you are to produce from D to the horizon, to find the point W for the vanishing point of the second side of the building.

If the object you are drawing is rectangular, the lines to determine its vanishing points must form a right angle.

The point W is the vanishing point for the second side of the house, and for all lines, as doors, or windows on it.

Determine the nearest point in the base of the house, as A, by your eye, or measure. The line A V for the first side of the house is already drawn. Draw the other side to its vanishing point, making A W.

Raise the perpendicular A B I to the height the house appears to be. A little practice will enable you to judge of this height, with sufficient accuracy for all the purposes of sketching. Compare it with the objects in the view, or compare the height with the length. Draw C and F from the point I to their vanishing points V and W.

Draw the perpendiculars L and M, determine their place by your eye and the aid of your measuring stick.

Observe that windows and other parts, diminish in apparent size as they are drawn nearer the vanishing point. This rule applies also to the vanishing side, in parallel perspective, viz. the windows, doors, &c. of that side which vanishes in the point of sight. The eye is generally sufficiently correct to judge of this proportion; but the lessons in drawing from a ground plan will very much assist the scholar, who after having studied them, will be in possession of the principle upon which they are diminished, and can apply it with ease to any case, without making all the measurements required in drawing from a ground plan.

The point of the roof E, which in the original, is exactly over the centre of that side, must in the drawing be placed a little beyond; because that half which is farthest from the spectator, appears smaller than the other.

Further directions for drawing roofs will be given in Lesson 9.

The line E V for the top of the roof vanishes at V, because it is parallel with the bottom line of the house; and so would all the lines for the doors and windows, parallel with the base line. These are omitted, in order that the figure may not be too complicated.

If there are several buildings in the view you wish to take, some standing parallel, others oblique, you need not be puzzled by this circumstance, but regard them as so many different sketches. Thus, Plate 7, Figure 2, N O P are three houses standing in different positions, O is parallel, N and P oblique.

Having drawn the ground line, horizon line, point of sight, prime vertical line, through it and the point of distance; draw the parallel house O, the end *q* vanishing in the point of sight, because it is at right angles with the ground line.

The house N must have two vanishing points of its own, (R and *g*, on the horizon line,) because it stands obliquely. These are to be found, as already directed, in the house above, figure 1, and the lines for the top, the roof, and the doors or windows, must all be ruled to these vanishing points; for these lines are in the original, parallel with the base line of the house, and lines which are parallel, if they vanish, have the same vanishing point.

Having found the vanishing point for one side, nothing is easier than to draw all parallel lines on that side to this point. You cannot fail of getting them right by this rule; whereas if you trust to your eye alone, it would be scarcely possible that your drawing should be correct.

The house P standing obliquely, must also have its own vanishing points, found as already directed, by means of the distance point D on the vertical line, and making the complement of a right angle of both sides. These points are V for the side T, that for the side P extends beyond the plate. This often happens in oblique perspective, therefore the paper must be larger than the picture, and the horizon line extended far enough beyond the boundary of the picture, to receive the vanishing points. The side which makes the smallest angle with the ground line, is that whose vanishing point will be farthest from the point of sight. If it makes a very small angle, that is, stand nearly square, this vanishing point will be very remote, and the lines of that side will be almost parallel. In this case, the vanishing point for the other side will be very near to the point of sight, and vanish more suddenly. You will see less of this side, or rather the representation of it, will take up less space in the drawing than the other.

This can be easily proved by drawing houses with various degrees of obliquity, according to the foregoing rules; which will be very useful practice.

LESSON VII.

GROUND PLAN, OR ICHNOGRAPHY. PARALLEL PERSPECTIVE.

If you desire great accuracy in your view, or have occasion to draw from description, you will make use of a ground plan. This is called taking the ichnography of objects.

First make a scale or measurement, divided into equal parts, in which inches, or parts of inches are taken for feet or other dimensions. As A, (Plate 8) which is a scale of 40 feet, or other measures.

Adhere to your scale in all your measurements for the same picture.

Draw the ground line, horizon line, vertical line, and point of sight.

Measure the distance at which the spectator is supposed to stand from the perspective plane, and set it off in this instance, on the horizon line, from S. The point D thus ascertained is the distance point. Its use will presently appear. It is necessary to keep in mind, what has already been explained of the perspective plane, viz. that it is imaginary, and represented by the paper on which you draw, that it is a transparent plane held up before the eye, at some distance, on which you delineate the objects beyond, as they are seen through it; and that the drawing of each part or point is precisely where the rays of light pass through it, in their passage from the object to the eye. Though not visible as straight lines, these rays actually move in straight lines, and form an image of the picture in the eye, where, small as this image is, the relative proportions of every part are exactly preserved.

It is desirable for one who is learning perspective, to know something of the theory of vision, and a few hours study of any treatise on optics, with a plate of the eye, would be sufficient for the acquisition of all the knowledge requisite.

The objects to be drawn are always beyond the perspective plane, that is, this plane is between these objects and the eye; the nearest point coming just up to the plane, and the place where this nearest object comes, is the place for the ground line. All this has been repeatedly said, but it is necessary to call it to mind, and render the ideas familiar by repetition, that what follows may be fully understood. If the objects to be drawn are beyond the perspective plane, they may be at different distances, and it has been already explained, that the lines of light coming from the object to the eye form an angle, the size of which depends on the size of the object, and its *distance* from the eye. The drawing of it is also affected by the distance of the perspective plane: see Lesson 3. Now if you make the object of the same size and distance from the eye, and put the perspective plane in the same place as the original, (that is, the same proportion, measuring by a scale,) you will obtain the same angle as the original makes, and this angle will intersect the perspective plane precisely as the original angle would a pane of glass, at the given distance from the eye.

The use of a ground plan is to give these proportions and angles, with perfect accuracy, and of course to enable you to obtain a correct drawing of any object thus described and laid down.

It may be the case, that you cannot place yourself at a convenient distance from the object you wish most to include in your sketch; but you may imagine yourself there.

With a ground plan you can select any distance, which the situation of the objects warrants; and if you adhere to your points of distance, sight, &c. and your measurements, the drawing will always be in good perspective.

Having fixed the distance point on the horizon line D, you proceed to draw a plan of the object. Let B (Plate 8) represent the ground floor of a house; measured accurately by your scale, and placed at the same distance from the ground line as the original. Carry up, or as it is expressed technically, *produce* the two lines N O and K J, till they intersect the ground line. These lines are at right angles with the ground line, and therefore vanish in the point of sight.

From F and I, the points of their intersection, draw two lines to the point of sight, making I S and F S; I S is the true representation of I O and F S of F J.

Measure the distance at which the house stands from the ground line, viz. from K to F, and set this off on the ground line from the point of intersection F to M, and then the actual size of that side, and set it off to L, M L being equal to K J; from the points M and L draw two lines, meeting in the point of distance D, making the angle M D L, which angle is precisely the same that two rays of light would make, proceeding from an object of the same dimensions as that in the plan, and at the same distance from the eye and the perspective plane. The space F K influencing the size of the angle precisely in the same degree, when transferred to the ground line at F M, as it would do in the original.

Suppose a perspective plane, and an object of the same dimensions as B, placed at the same distance *beyond* it, that B is now placed before the perspective plane in Plate 8. Let the eye be stationed in front, just as high above the ground line, as S the point of sight is, and at the same distance from the perspective plane, that D is from S. Two threads from the side K J, carried in straight lines to the eye, as rays of light come, would form this same angle at M D L, and would pass through, or intersect the perspective plane in their passage to the eye, exactly at the points *b* and *a*. These are the points required, and give the apparent size on the perspective plane, of that side which is at right angles with the ground line, and vanishes in the point of sight.

b is the point which corresponds to K, rule *b d* parallel with the ground line, which represents N K. Then from the other point *a*, rule *a c*, which answers to O J, and the figure is complete; *a b c d* being the true drawing of K J N O.

From the points *d b* and *a* raise perpendicular lines for the sides or walls of the house. In order to ascertain the apparent height, raise a perpendicular from the point I, this is the point at which the line O N, when produced, intersects the ground line; for could the house be moved up to the perspective plane, it would touch it at I F. Measure on this perpendicular, by means of your scale, the actual height of the house (of which it is presumed you have on your plan an exact description) set this off, from I to *u*, from *u* rule *u* S, which intersects the perpendicular *d e*, at *e*, this gives the apparent height.—You ascertain by this process precisely how much the house diminishes, in consequence of its distance N I from the perspective plane. Rule *e f* parallel with *d b*, because these lines are in the original parallel with the ground line. Rule *f*, S, which being parallel with *b a*, has the same vanishing point. The perpendicular from *c*, which would complete the four walls of the house, is not drawn, because it is not seen.

The height of the roof is set off from *u* to *v*. Draw *w* at the true angle, viz. making the same angle with the line *e f* as in the original. Draw *v* S; where it intersects at *x* is the apparent height for the roof. The point *y*, which, in the original is the centre of that side, appears a little beyond, in the perspective representation, because the half of this side which is farthest off looks smallest. To ascertain the precise place, divide M L exactly in halves at *z*, rule a line from *z* to the distance point D. Where this intersects at *g* raise a perpendicular till it intersects the line *x y* at *y*; this gives the place *y* for the centre. For *b a* correspond with M L, and *g* with *z*.

If the house were nearer the ground line, or farther off, you would proceed as above; only remember to produce the two lines which are at right angles with the ground line, (as O N and J K,) till they touch the ground line, and rule them to the point of sight. Set off the distance F K, whatever it may be on the ground line, as F M; and from M set off the true measurement of the side at right angles, viz. K J. This is the side which vanishes in the point of sight, and therefore is next the point of sight.

If the plan B were on the other side of the point of sight, then O N I would be laid down or measured off on the ground line, as F M L are now.

This figure is a sufficient rule for the drawing of any rectangular building, placed parallel or square before you, let the dimensions and distance be what they may; provided these are accurately laid down on the ground plan.

LESSON VIII.

GROUND PLAN. OBLIQUE PERSPECTIVE.

If you wish to put a house, or other figure, in oblique perspective, by a ground plan, you first prepare your paper with the ground line, horizon line, point of sight, and prime vertical line through it, and the distance point, set off on the vertical line from the point of sight, as in Lesson 6. Leave space enough below the ground line to draw your plan, of the same dimensions, position and distance as the original: see Plate 9, O.

Obtain the vanishing points A and B by means of parallels ruled from the distance point D, on the vertical line to the horizon, D B being parallel with *d b*, and D A with *d a*.

Produce the lines which mark the four sides of the house, *d b*, *b c*, *c a*, *a d*, till they intersect the ground line.

At the points of intersection *e f g h*, rule lines to the vanishing points. A is the vanishing point for the line *a d g*, and therefore for *c b h*, because they are parallel; and you must keep in mind the rule, viz. parallel lines *if* they vanish, have the same vanishing point. *f d b* and *e a c* are parallel and vanish at B; therefore make *e* B and *f* B. The intersection of these lines on the perspective plane, make the figure *i j k l*, which is the perspective representation of *a d b c* in the plan: because, these points of intersection on the perspective plane are the same which would be made by the rays of light coming from the points in the original to the eye, provided the dimensions and position correspond to those in the plate, as has been shown in Lesson 7.

From the points *k j l*, raise perpendiculars for the sides or walls of the house.

Ascertain their height by the following method: Rule perpendicular lines from the points of intersection, with the ground line *g* and *f*. If you look back to Lesson 7 you will find you did the same thing, and the reason is there given, excepting that there you ruled one line, whereas here you have two. As has been said in a former lesson, oblique perspective is twice as much work as parallel, because *both* sides have a vanishing point.

On these perpendiculars raised from *g* and *f*, measure by means of your scale, the actual height from the ground line.

Thus if the side *a c* is thirty feet, and the height of the house forty, make *f m* and *g m* one third more than *a c*.

Rule the lines *m* B and *m* A; they intersect on the perpendicular *k*, giving the top of the wall for each side.*

The point of the roof *n* is exactly over the centre of the house O, in the ground plan; to find which, rule diagonals across the perspective representation of the floor of the house, making *i k* and *i j*. These lines cross at the centre *o* which represents O in the plan.†

From *o* raise a perpendicular *o n*. Produce *m* to P, which is the height of the roof: rule from this to its vanishing point making P B, where it intersects at *n* is the point of the roof, rule lines from *n* to the corners of the house.

If the roof is not pointed, rule the lines for the ridge to their vanishing points. In the original, they are parallel with the top and bottom lines of the house, and therefore vanish at A and B.

If much accuracy is required, measure the space to be cut off from the peak on the line *m* P, and by ruling from this to the vanishing point, you get the precise place for the ridge.

* The line *m g* is not drawn all the way, but only at its commencement, at *m*. *n o* is not carried beyond S, as these lines come so near those for the nearest window.

† By producing the lines 5 7 and 6 8 (Plate 9) to the ground line, and ruling them to their vanishing points, as you have done the outside lines *a d*, *d b*, &c., you will find the centre as truly as by ruling the diagonals *i k* and *l j*; but this last method is more simple.

Divisions for the doors and windows are ascertained, as may be seen from the Plate, by being marked on the ground plan, produced to the ground line, and then ruled to the vanishing point A.

From the points at which these lines intersect the base lines of the house, raise perpendiculars, which will give the perspective place for all the windows and doors.

For as the sides of the house recede, the farther part looks smaller than the nearer, and you perceive that the method given shows this gradation with exactness.

When the ground plan is so large that the lines to be produced to the ground line (as *c b* produced to *h*) would extend beyond the paper, and thus be inconvenient to draw, the following method of making divisions, or measuring lines may be used; and perhaps it will be thought preferable in every case where there is a ground plan. If you wish to find J (the representation of the point *b*) on the line *k* B, (Plate 9) which is the point where the house terminates, lay your ruler from the distance point D, on the prime vertical line, to the point *b* in the plan, making D *b*.—You perceive that it cuts the line *k* B (which is the base line of the house) at J, precisely as the line from *h* to A, and answers the purpose of measurement equally well. And if you lay the ruler from D to *a*, you get the point *l*, previously obtained by ruling a line from *e* to B.

In the same manner places for the windows may all be found, by ruling lines from D to 1 2 3 4, which lines are not drawn on the Plate, to avoid confusion.

The angles are the same in the last method as the first, and both correspond exactly with the angles, which rays of light proceeding from the house to the eye (of the given dimensions and position) would make: see Lesson 15.

A third method of marking divisions in oblique perspective, somewhat more intricate than either of the above, but which dispenses with the necessity of a ground plan, will be given in the Lesson on bridges.

LESSON IX.

FURTHER INSTRUCTIONS FOR ROOFS.

In giving the true slant to all the lines of a roof, no two of which are drawn parallel, a knowledge of the rules of perspective is requisite; and this knowledge cannot be acquired without some labour, especially when the pupil is learning from books; the constant reference to plates, making the process far more tedious than when he has the assistance of a teacher. It is the object of this work to enable those who cannot obtain the services of a teacher, to acquire a knowledge of perspective by their own efforts. But it is not pretended, that this mode of learning, can be made as easy, or even as intelligible, as the instructions of a competent teacher.

The rules now to be explained, belong more properly to a future lesson, but their application to the drawing of roofs is here given, because this is necessary to render the instructions for drawing a house complete.

In Plate 7, figure 1 is a house B, standing obliquely; V and W are the vanishing points for the two sides. It will be remembered, that a perpendicular line ruled through the point of sight, as D S in this figure, is called the prime vertical line. It represents a ray of light coming straight from the perspective plane through the eye, and marks the point of sight as S, and also the distance of the spectator as D, and it is plain that the farther off the spectator is placed from the perspective plane, the longer would be this ray.

The learner must not be puzzled by the situation of this line in the plate. If a spectator were actually placed before a window, a ray of light coming straight from the object exactly opposite his eye, through the perspective plane or window would be a horizontal line, and not perpendicular, as it is in this figure. But such a line cannot be expressed on a flat sheet of paper, nor is this necessary; for the angle under which an object is seen, and the distance of the perspective plane, can be measured with the same accuracy when they are laid down on a flat sheet; as is done in Plate 7, and this is all that is requisite to obtain a correct perspective representation.

This subject, however, will be further illustrated in Lesson 15. To return to the prime vertical line, figure 1, Plate 7. This ray coming straight to the eye, on which the distance D is marked, is sometimes called the visual ray. A similar line drawn through the vanishing points of oblique planes, (viz. sides of houses, &c. standing obliquely,) as W in this figure, is the vertical line, or visual ray for these points, called also the radial or vanishing line.

Therefore the line drawn through W, viz. W X, and through V, figure 2, Plate 7, are the radials, or vanishing lines of these same points W and V. The roof of the house in figure 1, Plate 7, is a prism, whose base vanishes at W and V, and its sides must vanish at some point on the radial of one or the other of these points, as X. This point is determined by the angle of the slant line with the base, as E I, which being produced, till it intersects the radial, gives the vanishing point X, to which point draw the other line for the roof, as *g*; for *g* being parallel to E I, must if it vanishes, have the same vanishing point. All lines have a vanishing point, except such as lie on planes, parallel with the perspective plane or the ground line. The wall of a house which stands parallel or square before you, is a plane parallel with the perspective plane, or the window through which you look; but the roof is not, it makes an angle more or less large, with the perspective plane, consequently any lines lying on it, (viz. the outline of the roof,) have a vanishing point, found according to the directions given above.

In figure 2, Plate 7, the roof of the house P vanishes at *y*, (see figure 1,) on the the radial of its own vanishing point V, that is, on the perpendicular drawn through V, and the point *y* is ascertained by producing the line of the roof *r* to *y*.

In the house O, standing parallel, the peak of the roof is ascertained, by finding first, the centre of the ground floor of the house. This ground floor is an oblong rectangular figure, the perspective appearance of which may be found without the aid of a ground plan.

From the point *p*, rule a line to the point of sight, which will give the end not seen, parallel with *q*, and through the upper corner of *q* rule a horizontal line, and you have the floor of the house, as it would appear if the house were transparent, and you could see it all. To find the centre, rule diagonals from each corner, and the point of their intersection, as you see by the figure, is the apparent centre. Raise a perpendicular from this centre to the height required, and you have the point *b* for the roof: let the slant lines meet here, and cut them off by ridge poles if required.

The roof of the house N (Plate 7) is obtained in the same way, by drawing a radial through R, one of its vanishing points.

In Plate 8 the house is parallel, and the vanishing point for the roof is found on the prime vertical line, because the base of this roof, viz. the line *f* S vanishes in S, the point of sight.

LESSON X.

CIRCLES.

A circle may be circumscribed by a square, and if this square is put into perspective, the circle can be drawn within this perspective representation, or if accuracy is required, the square can be divided, and the corresponding parts in the representation will be a sufficient guide for drawing the circle. The larger the circle is, and the greater the degree of accuracy required, the more numerous must be the divisions of the square, put into perspective. All this, however, is only putting into perspective, horizontal, perpendicular, or oblique lines: the rules for doing which, have been fully given.

But as some difficulty may be found in applying these rules to new cases, the following illustrations are offered.

Plate 10, figure 1, represents a circle put into parallel perspective.

H, horizon line; S, point of sight; D, point of distance; G, ground line, sometimes in works on perspective, called intersection line, because it is the line formed by the intersection of the perspective plane with the ground plane.

The circle C, in the ground plan is circumscribed by a square, diagonals and diameters are ruled. The points at which the diagonals strike the circumference, make equal divisions on the circumference, though not on the square. Through these points are ruled lines, called sines and cosines.

Put all these lines into perspective, according to the rules already given in Lesson 7; this being a case in parallel perspective.

The lines A B F E L must be produced till they intersect the ground line: from the points of intersection rule them to the point of sight, because they are lines at right angles with the ground line.

Measure the distance of the circle from the ground line, viz. M L, set it off on the ground line, making M N, then the distances of the points K and I, which are equal to O P; rule lines from N O P to the point of distance D. The object of these lines is merely to mark the perspective size of the square, by means of the points of their intersection with the line M S, drawn to the point of sight; therefore at these points of intersection, rule the lines *u v t* parallel with the ground line, corresponding to A L, V K, W I in the ground plan.

Rule diagonals through the points *r t u w*, representing the diagonals in the plan.

Observe the points of intersection in the perspective representation, which correspond with those in the plan, and draw the circle through them. You perceive that the perspective circle is divided into parts like that in the plan, but in the former they are not equal, although they are so in the latter. The upper half of the circle is smaller than the lower half; this circumstance gives the figure a peculiar character, which you will, with a little practice, be able to draw with sufficient accuracy for the common purposes of sketching, without all these lines, or even without any, although you never could arrive at this, except by a knowledge of these rules.

Portions of circles, as arches, doors standing more or less open, (which describe portions of circles on the floor, by the movement which opens them,) are drawn on the same principles, and will be further illustrated.

Plate 10, figure 2 represents two circles in oblique perspective.

The ground plan is first made; then the vanishing points are obtained by drawing parallels. From the distance point D, (which in oblique perspective is always set off on the prime vertical line,) draw D B parallel with *c* W, and D A parallel with *c q*. The points of intersection with the horizon line, give A B vanishing points for the sides *c* W and *c q*.

The lines *c* K L M W are produced till they intersect the ground line, also *c e* N *f q*, and from these points of intersection lines are ruled to each vanishing point. O *h* P *g c* to B, and R T *u* V to A, and the circle is drawn through the points of intersection as in the original.

As the line W, if produced to the ground line would extend beyond the picture, the rule is laid from D to W, which gives the point *y* with equal correctness as by the other method, as has been shown in Plate 9: see D *b* and D *a*.

LESSON XI.

BRIDGES.

It is nearly impossible, with the most accurate eye, in taking a sketch, to draw a bridge of several arches correctly, without a knowledge of the rules of perspective; more especially if the bridge stand obliquely.

The following method with the figure is given, to to illustrate the application of the rules of perspective to the drawing of bridges; though somewhat elaborate, it has been made as clear and simple as the subject permits.

If this figure be studied faithfully, and the rules applied to new designs made by the pupil, he will meet with no difficulty afterwards, in sketching with sufficient accuracy, without the necessity of laying down all the lines and points in these figures. With the principles of perspective familiar to his mind, he will never make any glaring mistakes, even in the most rapid and careless sketching; while without this, his most laboured productions would be wanting in truth of expression. To this, every one acquainted with perspective, will readily assent.

Plate 11 represents a bridge in oblique perspective. Having drawn the horizon and ground lines, points of sight and distance, rule the line E F, making the angle with the ground line, which you presume the bridge to make. Of this you will judge by holding up your measuring stick. From F draw F D, F is one vanishing point; draw also the line D L at right angles with D F, which gives L for the other vanishing point. (as it is oblique, both sides vanish.) The angle F D L is a right angle. Select by your eye, with the aid of the measuring stick (described in Lesson 5) the nearest point in the bridge J, raise the perpendicular J *i* to the height at which the bridge appears to be; which you can determine, by observing how near it comes to the horizon: then rule *i* F for the top, because the top and bottom are parallel, and must have the same vanishing point.

Draw a line through the point J, parallel with the ground line; set off on this line the measurement of the size of each arch. This you may ascertain by comparing the size of the nearest arch with the height of the bridge. Perfect accuracy is not requisite, but the spaces for each arch must be equal. You thus get the points J K M N. Measure the space F D, (with compasses if you have them,) and lay it on the horizon from F, by describing the arc, making the point R.

This is called the radius* of its own vanishing point, and answers the same purpose as the distance point (set off on the horizon from the point of sight, in parallel perspective) for taking measurements.

Rule lines from the points K M N to R, they intersect the line for the bottom of the bridge J F, at the points O P Q, and give the apparent size of each arch, viz. the place for the foot of each arch. Then divide the space for each arch, viz. J K, K M, and M N equally, and rule lines from these divisions to R. These lines are not ruled in the figure; they intersect the line J F at T *u* *v*, the places for the centre of each arch. Raise perpendiculars from *t* *u* *v* to the top line of the bridge: draw a guide line A F for the tops of the arches, which line being parallel with the top and bottom of the bridge, has the same vanishing point.

Draw a straight line from each of the points W X Y, to the points J O P Q, like the dotted lines in the plate. Describe arches on these lines. The arches may be drawn without these straight lines, but you will not probably do them as well.

Draw the line J L, which gives the other side of the bridge, L is the vanishing point for all lines parallel to J L; therefore rule O L, P L, and Q L, which lines represent the under part of the arch, as it leaves the water, and are, as you will perceive by a little observation, parallel in the original bridge, with the end J L.

You have now ascertained the direction of these lines, but not their size. Each arch, as you observe in

* A radius is the semidiameter of a circle, that is, a straight line drawn any where from the centre to the circumference. If you take F (Plate 11) for a centre, and putting one foot of the compasses in this point, and extending the other to D for the size, and draw a circle; F R would be a radius of this circle, as well as F D, and it is called the radius of its own vanishing point, because it is the radius of a circle, of which this vanishing point F is the centre, and F D the radius.

the figure, shows more of the under part, as it recedes farther from R its distance point. Measure by the scale you have used for your other measurements, on the line J, the space J Z, being the real size for the end of the bridge, then take the radius of the vanishing point of this side L, viz. L D, (as you did for the other side,) and lay it on the horizon line to *r*, making L *r*. Rule Z *r*, the point of its intersection at *a* is the size of this end; raise a perpendicular at *a*, rule *i* L parallel with *a* J, in the original, therefore, having the same vanishing point; from *b* rule *b* F, the top of the further side parallel with *i* F, for, as the whole bridge is below the horizon, you see this line, otherwise you could not. Rule a line from *a* to the vanishing point F, this line represents the base line of the further side of the bridge, parallel in the original with J F, therefore having the same vanishing point. The lines for the under part of the arches, viz. O L, P L, Q L, are already drawn. *a* F intersects these at *f j k*, giving the perspective finishing of the arches.

Observe the dotted lines continued from *l m n*, they show how each arch would appear, if the bridge were transparent, and they could be seen. Unless you understood the true drawing of the whole of each arch, you could not draw correctly the part which is visible, and is represented by the darker line, for each differs from the other, and to draw them all alike (as is frequently done, even in sketches otherwise correct,) is bad perspective.

Plate 12 represents a bridge in parallel perspective, which is easier than oblique.

The exterior arches are all alike, and are therefore drawn without the aid of any other rule than that of making them equal; lines ruled from the foot of each arch to the point of sight, give the direction of the lines for the under part of the arch, A B C E. These lines are at right angles with the ground line, and vanish at the point of sight: draw a line at the foot of the bridge parallel with the ground line, passing through the foot of each arch as it leaves the water: mark on this line the size of each arch, making the points F M N O, from these rule lines to the distance point D, viz. F D, M D, N D, and O D, cutting the base line of the arches at P Q R T. This gives the size for the under part of each arch, and also for the end T. Draw arches like those in the figure. The dotted lines show the true drawing for the arches, on the further side, (if they could be seen.) In this way, you get the true appearance of the under part of each arch of a bridge, situate as this is, with regard to the point of sight. As may be seen by the figure, each arch differs from the other in the drawing, although in the original they are alike.

LESSON XII.

INTERIORS.

Interiors are drawn in perspective by the rules already given, for they must consist of lines either parallel, at right angles, or oblique to the ground line.*

After having drawn the horizon and ground lines, and points of sight and distance, observe what lines are parallel with the ground line, and draw them parallel, their place being determined by their distance from the ground line.

Note what lines are at right angles with it, whether they are on the walls of a room or any articles of furniture; the vanishing point for all such lines is the point of sight.

* Except lines inclined to the ground *plane*, for which see Lesson 14.

If any objects or lines are oblique, you will determine their vanishing points on the horizon line, by their angle of obliquity, that is, by the angle they make with the ground line.

To illustrate this, see Plate 13. Make the requisite lines and points. D^1 S being equal to D^2 S, because you need a distance point for each side. In parallel perspective, you may set off the distance point on the horizon line, on either side of the point of sight.

Determine the size of the room by a scale, or your eye, and draw the boundary lines N E and O I. Measure the length of the sides which are at right angles with you, and lay it down on the ground line, making E F for one side and I J for the other; draw E S and I S. Draw F D^1, and also J D^2, (not drawn in the Plate.) These give the points of intersection K and M, which show the apparent length of the sides. Draw N S and O S for the top lines of these sides; draw the line K M parallel with the ground line; raise perpendiculars from the points K and M till they strike O S and N S; draw P Q, thus you get the back wall of the room P Q K M.

The lines for the top and bottom of the windows, with the bars which are parallel, go to the point of sight. The dimensions of the windows are marked on the ground line. R T for the first; U I for the second: rule lines from these points to D^1, making the points *r t u v;* at these raise perpendiculars, which gives the space for each window, *u v* being the smallest, because it is the most distant; mark the length of the windows on the boundary line of the side N E, and rule the lines X S and *y* S, also the lines for the window bars, vanishing at the point of sight. Divide the space R T and U I exactly in halves, and rule to D^1 for the middle line of the window:* smaller divisions are made in the

* In the Plate the larger window only has the middle line.

same way, but are not drawn on this figure, lest it should be confused. The same rule also answers for pictures or pannels, on the walls of a room.

On the opposite side of the room is a door. Mark its dimensions and place on the ground line *a* U, and rule to D², mark the top at *d*, and rule to S, getting *e f g h*; this is the door frame. The door stands open. A door in opening describes on the floor an arch or portion of a circle, of which the hinge is the centre, and the bottom of the door a radius or semidiameter. Open a door quite back to the wall, and you will find that it describes a semicircle; open it less, and the bottom of the door makes an angle (more or less large according to the opening) with the sill of the door, which remains stationary while you are moving the door. When you have ascertained this angle; in other words, when you have opened the door as wide as you wish, you have only to draw the door in your sketch at the same angle, by drawing a line through the hinge *g* parallel with the ground line, and letting the line for the door make with it the angle required. Produce this to the horizon line to obtain the vanishing point; thus *g* 3 produced, gives 4 for the vanishing point. Draw a line from *f* to 4 for the top; that being parallel with the bottom, must have the same vanishing point. The door, now it is open, is no longer a plane at right angles with the ground line, as it would be if shut, and as the wall of that side of the room is, but it becomes a plane standing obliquely to the ground line, and therefore has its own vanishing point, viz. 4, as already shown.

In order to obtain accurately the point 3, from which the perpendicular 3 9 is raised to finish the outline of the door, you must keep in mind, that the door in opening, describes a semicircle, *g h* is the radius. This circle, or a quarter of it, must be put into perspective, which is very easy, since this is only to put a square in perspective.

Lines drawn from D^2, passing through the points *g* and *h* to the ground, give the dimensions of the radius; they are identical with the space for the door, viz. the very radius in question.

Draw a line from U to S, which gives one side of the figure in which the quarter circle is to be contained, while *g h* already drawn, is the other. The figure in which a quarter of a circle may be comprised, is a square, one fourth less than the square by which the whole circle may be circumscribed: see Plate 10, where each circle is divided into four squares. Having drawn the line U S, draw a line through *h*, and another through *g*, both parallel with the ground line, and intersecting U S at 5 and 6. The square is then complete 6 *h* 5 *g*. Describe within it the quarter circle from *h* to 5, (which you can do, by inspecting Plate 10, figure 1, without making any more lines,) and where the line for the bottom of the door strikes the edge of the circle, as at 3, raise the perpendicular till it intersect (at 9) the line for the top of the door.

The two doors in the back side of the room are also open. Their vanishing points are found as in the door described above; 1 vanishes at 7, and 2 at 4.

LESSON XIII.

TO PUT FURNITURE AND OTHER SMALL OBJECTS FOUND IN INTERIORS, INTO PERSPECTIVE.

If you wish to put furniture, &c. into your picture, this also must be drawn according to the rules already given, as will be further illustrated. Keep in mind what has been taught with regard to the vanishing points for parallel and for oblique objects; and remember that for every oblique object, whether doors, tables, chairs, &c., you must have distinct vanishing points, which are all found on the horizon line, except in cases where the planes are elevated above, or depressed below the parallel of the ground plane, for which instructions will be hereafter given.

You must first determine what rule the object you are drawing requires, by observing whether it is parallel or oblique; elevated or depressed. When this is done, the difficulty vanishes, and you cannot fail in applying the rule, if you have become familiar with its use.

Very great practice is necessary to insure facility. Accustom yourself to regard the different aspects or sides of objects as planes. A chair for instance, may be viewed as composed of planes, perpendicular, horizontal or oblique. The floor on which the four feet rest, is one plane, the seat is another, parallel with the former. The back is another plane at right angles with the seat, or perhaps oblique to it. The four sides reaching from the seat to the floor, where the cross pieces are placed, are four upright planes, at right angles with each other: for if the chair were boxed up from the floor to the seat, this box would form the four planes or sides. Thus in a chair, you have only horizontal, perpendicular, or oblique planes to put into perspective, which, it is presumed, you can now do.

It may be well to mention, that in oblique perspective, the *distance* point is always marked on the prime vertical line, viz. that drawn perpendicularly, through the point of sight; and it is from this point that angles are taken, and parallels ruled for determining the vanishing points, and vanishing lines in oblique perspective.

Plate 14 represents several articles of furniture which afford further illustrations of the rules already explained.

The chair A is in parallel perspective, and the lines vanish at S, the point of sight; as will be seen by laying a ruler from them to this point. The boxes B and C, and also the footstool E, are parallel. The chair F is oblique: vanishing points N and M. It will be found that *d* and the lines parallel with it, vanish at M, and that *h*, and its parallels vanish at N. The table T is oblique, vanishing points V and W. The opening of the lid of the box C, is determined on the same principle as the opening of doors. The lid in opening describes the arc of a circle, of which *e a* is the radius, the hinge being the centre. Put this circle into perspective by means of a square. The circle being put into perspective shows where to draw *e i*, which must terminate at the circumference. Draw *f*.

If you did not understand the principle, you would be likely to make the line for the lid, *e i* of the same length as *e a*, it being so in the original; but in the perspective representation, you observe, that no radius which may be drawn in this circle is of the exact length of *e a*, for even the continuation of that line, as *e n* must be shorter than *e a*, because that half of the circle is farther from you, than the half in which the radius *e a* lies, and consequently must appear smaller.

Neither can the line *m* for the opening of the other end of the lid, be drawn parallel with *i*, for it is the corresponding radius to *e i*, of a circle *nearer* than the circle *e*, and must therefore look larger than that: *m* must also differ from *r*, in the same proportion, and for the same reason, as *e a* from *e i*.

The two circles or rather parts of circles, are given for the purpose of illustrating the importance of a thorough knowledge of the rules of perspective, in order to draw the most common or simple object with truth.

Having once understood the principle on which an open box is drawn, you will, without the necessity of putting circles into perspective, be able to draw the parallel sides of the opening with correctness.

You will observe that the two circles partly described on the plate, for the purpose of determining the opening of the box, are circles standing upright on the ground plane, and not laying on it, as are the circles in Plate 10. They are situate like picture frames on the walls of a room. The wheels of a carriage are drawn in the same way; each included in a square, put into perspective, according to its position, (whether parallel or oblique,) and its distance from the ground line. The spokes are so many radii, not one of which you could draw correctly, without an acquaintance with the rules.

As you have learned to draw squares, whether standing upright as windows, picture frames, &c., or lying on the ground plane, as the floor of a house: (see Plates 8 and 9,) you will have no difficulty in drawing the squares in which to describe your circles, whatever may be their position. After having gone through this book, you will, it is presumed, be able to understand more elaborate works on perspective, in which you will find a greater variety of cases.

Another method of obtaining the line *m*, for the second side of the lid of the box C, will be given in the explanation of Plate 16.

LESSON XIV.

LINES AND PLANES NOT PARALLEL WITH THE GROUND PLANE.

Lines and planes which are not parallel with the ground plane, but have an elevation above, or depression below it, find their vanishing points above or below the horizon line, determined by the angle of their elevation or depression.

A book lying flat on a table, and a house on level ground, are parallel with the ground *plane*, whether placed obliquely or parallel with the ground *line:* but houses on the side of a hill, a book with one end elevated, slanting sides, as roofs of houses, desks, prisms, or lines laying on them are inclined to the ground plane, and their vanishing points are found on the vertical line of the vanishing point of their base, either above or below the horizon.

The directions for drawing roofs in Lesson 9, contain the rules required for the drawing of planes and lines oblique to the ground plane; but it is thought that a further illustration of the subject is needful.

In Plate 15, the base line of the row of houses A makes an angle of 20° with the ground plane. This row also stands obliquely to the ground line, and the angle of its obliquity is 31°. This angle is taken from the distance point D, by the line D V; V is the vanishing point for a line laying on the ground plane, and inclined to the ground line, at an angle of 31°. Thus if the row of houses A stood on level ground, at its present degree of obliquity, it would vanish at V. Draw the radial or vertical line of the vanishing point V, which is (as has been shown in the instructions for drawing roofs) a perpendicular line drawn through this point.

Now you may mark on this radial, from V, the degree of elevation you determine on for the houses, as W: or if you would be exact, you can measure it by an angle, after the following manner.

Take the space V D and set it off on the horizon line from V, making the point *y*; this is the radius of the vanishing point V. From *y* as a centre, make the true angle of elevation which the row has, in this case

20°*. Where it strikes the radial of V, viz. at W, is the vanishing point of the houses A. And all lines parallel with B W, as the roof, windows, and the street, vanish at W.

You will seldom find it necessary to take angles. Draw a line from the bottom of the houses to the horizon, at the degree of obliquity, you judge right, and then make a point as W, directly over the vanishing point, at the elevation you choose. Make all parallel lines vanish at W; this will be sufficient for the common purposes of sketching.

The row of houses C is in parallel perspective, and stands at right angles with the ground line, therefore the vanishing point is on the prime vertical line. The angle of its elevation is 20°. The distance S D being laid on the horizon line to X, the angle J X S gives J for the vanishing point. The row M is parallel, and has an angle of depression below the horizon. The distance S D transferred to the horizon line at Z, gives the angle S Z P. P is the vanishing point for all lines parallel with the base line O P.

The row K is level and parallel, and vanishes at the point of sight.

Plate 16, figure 4 represents an inclined plane. A is a desk standing parallel. The drawer or base is level, and the side *a* vanishes at the point of sight S^2. But as the plane A is elevated at an angle of 17°, its vanishing point is at P, and the sides *b* and *c* are ruled to P.

If you wish to determine the size of the desk by measurement, set the real dimensions of the side *a* on the line *h i*, and from *h* rule to the distance point D^2.

* The line from V to W is the tangent of this angle. A tangent is a line drawn from the point where a radius touches the circumference, at right angles with this radius, and measures the angle. W V is the tangent of the angle W *y* V.

Where this intersects at *d* is the apparent size of this side, because it is parallel with the ground plane.

But in order to measure the inclined plane A, you must take another distance point, because you have another vanishing point.

Draw a horizontal line through P, (not entirely drawn in the figure, to prevent confusion, but should be drawn by the pupil in copying the figure,) which will be the horizon line for the inclined plane A. On this new horizon set your distance, viz. the space from P to D^2, making R. P R being equal to P D^2. R is the distance or measuring point for all lines vanishing at P. Lay a rule from *h* (the true measurement, on the ground line for the desk) to R, it intersects at T. This is the apparent size of the desk at this elevation, and which if laid flat and parallel with the drawer, would be of just the same size as the drawer; for the space from P to R is the radius of the vanishing point P, set off on its own horizon. Rule the line T *r* parallel with *i n*, to finish the desk.

Unless you have a perfect acquaintance with these rules, you perceive that you would be very unlikely to draw the desk correctly, even if it were before your eyes. Were the desk a little more or less open, that is, were the elevation of the plane A a little more or less, the line T *r* could not be drawn as it is now; whereas, with the present elevation, if it were not drawn precisely as it now is, it would not belong to the bottom part of the desk. The measurement *h n* is the same for the drawer and for the desk: but for the drawer, the distance point is fixed on the horizon line D^2; and for the plane A, on a point (R) as much above that, as P is above the horizon.

Plate 16, figure 3 is a desk elevated at an angle of 15°, and placed obliquely to the ground line. V and W are the vanishing points for the two sides of the part which stands level. X is the vanishing point for the sides *k* and *l*, which are elevated. S^1 being the point of sight for the desk figure 3. D^1 above it is the distance point on the prime vertical line, whence angles are taken. Make V *u* equal to V D^1. The radius *u* is the measuring point of the side *o* of the desk, which is level; and the point above it Z, the measuring point for the elevated part of the desk. Lines 1 2 3 are parallel, and vanish at W; 4 5 are parallel, and vanish at V; and *k* and I are parallel and elevated above the ground plane, and vanish at X; lines from Q to *u* give the point 6, and from Q to Z the point 7.

The open box C, Plate 14, affords an example of lines depressed below the ground plane.

After one side of the lid, as *e i* is found by means of the circle, the other as *m*, may be ascertained by finding the vanishing point of the first. As the box stands parallel, this must be on the prime vertical line *below* the point of sight, because it is an example of depression, and not of elevation.

Produce *i e* till it intersect the prime vertical line below the point of sight, which is at *y*, and this is the vanishing point required. Rule a line from the point *y* through the edge or hinge *g*, till it intersect the line *f*, and it will give the line *m* with the same exactness as the circle does, and with less trouble.

For *i e* and *m g* are parallel in the original, therefore must have the same vanishing point, which point you ascertain by producing *i e* to the prime vertical line at *y*.

The lid of the box is a plane not parallel with the ground plane, as the bottom is, nor perpendicular to it, as the sides are, nor parallel with the perspective plane, as the front and back are; but it is inclined to the ground plane, and also to the perspective plane, having an angle of depression below the ground plane.

The base or edge of this inclined plane, (viz. the line *e g*, at which it touches the top of the box, where the hinge is,) is parallel with the ground plane, and the side *e a* at right angles with the ground line; therefore the vanishing point for the inclined lines *e i* and *m g* must be sought on the prime vertical line, that being the vanishing line for all planes at right angles with the ground line, as this end of the box is.

If the box stood obliquely as the desk, (in Plate 16, figure 3,) this point would be sought on the radial of the vanishing point of its own plane, and below the horizon line.

If you have any doubt whether any plane (as the lid of the box C, Plate 14) is depressed below or elevated above the ground plane, and therefore, whether its vanishing point must be sought above or below the horizon line, you have only to observe whether the bottom or the top of the plane is farthest from you; if the top, as the upper line of the roof of a house, or of a desk (like T *r* and 1 7, figures 3 and 4, Plate 16) recedes, then the vanishing point is above the horizon, for it is the receding part which looks smallest, and the lines of course converge to produce this diminution. But if the bottom is the receding part, (as the line *e g* in the box C, Plate 14,) then the vanishing point is below the horizon.

LESSON XV.

COLONADES AND STEPS.

Plate 16, figure 1 represents a colonade or row of pillars, on each side the point of sight, that is, on the right and left of the spectator. The lines which vanish go to the point of sight, therefore, it is parallel perspective. It is thought that this figure, and an inspection of Plate 11, where the arches of a bridge, in oblique perspective, are exhibited, will be sufficient to enable the pupil to apply the rules to colonades and arches in oblique perspective. The divisions are made, and the measurements taken for a colonade viewed obliquely, in the same manner as for a bridge or a single arch of a bridge viewed obliquely.

The columns appear shorter and narrower as they approach the vanishing points.

The floor in figure 1 is divided into squares to represent the figure of a carpet, or a pavement, after the following manner. Draw lines from the divisions on the ground line to S, the point of sight. Draw the diagonal E D from the first square to the distance point. This diagonal intersects each line, showing the size of each row of squares. Draw parallel lines through the points of intersection. By this process, you find (as appears by figure 1, Plate 16) the exact proportion in which each square diminishes as it recedes from the eye. It will be easy to draw any figure (a circle for instance) within the square, as is done in two of the nearest squares on the figure. The diagonals of each square will give the centre, through which centre rule a line for the diameter. If it is parallel perspective, the line for the diameter is parallel with the ground line; if oblique, it goes to its vanishing point.

This diameter will show how much larger the nearer half of the square appears, than the more remote. If the figures are of an oval shape, you must put parallelograms into perspective, instead of squares, which you can easily accomplish by observing Plates 8 and 9, or by the help of a ground plan.

Figure 2, Plate 16, shows the manner of drawing steps in perspective. E two steps parallel, F two oblique. It is in fact only putting so many boxes, or solid rectangular objects placed one on top of another in perspective. You could easily draw one box as *c*, in true perspective, and why not another as *h*, immediately below it? The parts E and *a* correspond with the tops of the boxes, as they appear seen below the horizon: see also the box B, Plate 14. If they were above the horizon, you could not see the tops. By this rule, in looking at an object, you may ascertain at once, whether any part of it is above the horizon, that is, above the height of your eye. When you are on level ground, you cannot see over the top of a house; but when you are on a high hill, you can see over the tops of the houses on the plain below. If you are in a room you cannot see the top of a piece of furniture which is higher than your head, while those articles which are lower than your eye, as a table, show their upper surfaces, occupying more or less space, (viz. looking wider or narrower) as they are nearer to or farther above the floor. Therefore, if in a view, the tops of houses are drawn, the horizon must be a high one, for it would be apparent to any one acquainted with perspective, that your sketch was taken from a height.

The steps F, Plate 6, figure 3, are, as it regards their drawing, two boxes, one on the other, placed obliquely, and having their vanishing points on the horizon line at V^2 and W^2.

That the rules given in these lessons will give the true perspective drawing of objects, may be experimentally proved by the following method. Provide a large table; this is a horizontal plane, and will represent the ground plane, viz. the earth, on which objects are situate. Station at the edge of one side of this table, a little figure to represent the spectator, or person taking the view. A stick of four or six inches in height, with a hole in the top for the eye, will answer the purpose, it must be securely fastened to the table.

At a suitable distance from the spectator, (say two or three times, the height of the figure) set up a frame like a picture frame without a glass, at right angles with the table, that is, standing upright upon it. This is to represent the perspective plane. Put a line across the perspective plane horizontally, at the same height as the eye in your figure. This line represents the horizon. The best way to fasten this line is to attach a small weight to each end of it, insert pins into the frame at the proper height, and lay the line across. The weight hanging down over the pins will keep the cord tight. If you wish a higher or lower horizon, elevate or shorten the figure, and alter the pins and line accordingly; always remembering that the line must be at the same distance from the table or ground plane as the eye.

Mark the point in this horizon line directly opposite the eye, whether it be the centre of the frame, or nearer to one side than the other. This is the point of sight. It is convenient to be able to move the figure to the right or left, as this changes the point of sight, and enables you to vary your experiments.

Through this point of sight pass another cord perpendicularly, and fasten it. This is the prime vertical line, passing through the point of sight. Plate 14, H W the horizon line, and D S *y* the prime vertical line, represent the two lines here described. Prepare a model of a house, box, bridge, or any object, the true drawing of which you wish to ascertain; place it behind the perspective plane, to the right or left of the point of sight, and at any distance you choose.

Attach threads to the corners, and to the top and bottom of the sides next the perspective plane, which are the only parts that can be seen; bring all these threads through the perspective plane, converging to the eye of the figure, and fasten them securely at the back. These represent rays of light in their passage from the object to the eye.

It will appear that the points at which the threads enter the perspective plane, in coming to the eye, give the same drawing which the measurements, points and angles do, in a drawing from a ground plan: provided the proportions, size, distances, &c. correspond.

If you look through the hole designed for the eye, at the same time placing a pencil or small rod on the perspective plane, so as to conceal the lines in the original object from the eye, you will find that it strikes just where the threads enter the perspective plane.

Lay a ground plan of a floor of a house, or of circles, like those in Plates 8, 9, and 10, on a table, behind the perspective plane, so as to have this plane between the eye and the ground plan. Substitute for the vacant frame, one with a plate of glass in it, as a perspective plane; you can trace with a pencil on this glass, or measure with compasses, the appearance of the figures beyond. By placing your eye in the hole for the eye of the figure, you will see that the drawing is the same as that resulting from the measurements, angles, &c. already given in the rules of perspective, the proportion and distances being preserved.

Objects may be placed in any position, and be of any shape, and their true perspective delineation can be ascertained by attaching threads to their outline or edges, and bringing them to the eye, after the manner detailed in the above description.—The proportions must be exactly preserved.

Your figure or spectator, which is presumed to be about six feet high, affords a good scale. A complete model of a person taking a sketch, with all the objects in their true situation may thus be made. The threads attached to each, and carried to the eye, will show the angles under which every object is seen, and thus determine the true drawing.

The diminishing of figures in a landscape according to their distance from the ground line, may be experimentally proved, by fastening one thread to the head, and another to the foot of each of the figures, placed at different distances on the ground plane. It will then appear how much smaller the angle is (viz. how much nearer the threads approach each other in passing to the eye) when the figure is far off, than when it is near. A figure of a man placed at six inches from the ground line, will in this experiment, be seen under a much larger angle than a similar figure twelve or twenty inches distant.

It will also appear that such figures never rise above the horizon line, unless they are on elevated ground. If the spectator is *sitting* on the level of the ground plane, a figure *standing up* will rise above the horizon, or if the spectator is on a hill or the top of a building, the figure will appear below his horizon.

It is evident that if a plane were extended horizontally from the eye to the verge of the horizon, every object on the ground plane, not higher than the eye, would be under this horizontal plane.

LESSON XVI.

RECAPITULATION.

The rules of perspective are not numerous or difficult to comprehend, but as they include ideas which are abstract, they should be practically applied to a variety of cases, by a course of drawing in perspective.

The pupil having once made himself familiar with the principles which these rules involve, will find no difficulty in sketching with truth and expression, any object within his sight, without having recourse to many of the elaborate methods described in this book. Let him not expect, however, to arrive at this facility, by any more expeditious course than that of copying the figures in the plates, and making practical applications of the rules here given.

To such it is believed, that the following brief enumeration of the rules and principles of perspective may be acceptable; although they may be scarcely intelligible to those who have no previous acquaintance with the subject.

1. Objects are seen by means of rays of light, proceeding from them in straight lines, and converging and entering the pupil of the eye.

2. These rays form a cone whose apex is the eye.

3. The true drawing of objects is at the points where these rays would intersect a perpendicular transparent plane, if such were interposed between them and the spectator.

4. The object, the rays of light, and the eye, form a triangle or cone, whose base is the object. The size of this angle is determined by the size of the object, and its distance from the beholder. When similar angles are made on a flat surface, a true linear representation is obtained; this is what perspective teaches.

5. The distance point represents the distance of the eye from the perspective plane. Lines drawn to it, from dimensions laid down on the ground line, form

the same angle as is made by the rays of light in the original.

6. Lines parallel with the ground line in the original, are drawn parallel: They have no vanishing point.

7. Original lines which are parallel, if they vanish, have the same vanishing point.

8. Original lines at right angles with the ground line, have their vanishing point in the point of sight.

9. Original lines oblique to the ground line, have their own vanishing and distance points.

10. These points are ascertained by means of parallels drawn from the point of distance on the prime vertical line to the horizon. The intersection of these parallels with the horizon gives the vanishing points, and the radii of these vanishing points, transferred to the horizon line, give the distance points, or as they are also called, the measuring points.

11. Circles and arches are drawn by means of squares, sines and cosines put into perspective, by the foregoing rules.

12. Planes and lines on them, which are inclined to the ground plane, find their vanishing points on the radial of their own vanishing plane. The place for these vanishing points is determined by the angle of their inclination, and their measuring points, are found by the radii of their own vanishing points, and have the same level above or below the horizon as these vanishing points.

LESSON XVII.

SHADOWS.

Every one has observed that the higher up the sun gets, the shorter the shadows of objects become. This fact teaches, that in making the shadows of a picture, regard must be had to the position of the light, which must be the same for every object in the same picture. You must not therefore put into your view a figure with a long shadow, as if the sun were not more than an hour high, and a tree or a house with a shadow no longer than it would cast, with the sun at three or four hour's height.

As light comes to us in straight lines, it is evident, that when any opaque object is in the way, it will intersect such rays as meet it in their progress. And there will be a space beyond the opaque object, which will receive no light from the luminous body, although it may receive some reflected light from surrounding objects, which will lesson the darkness of the shadow. This space of shade will bear a definite relation to the shape of the object; but it will not always assume precisely the same shape, because the shadow may be longer or shorter, according to the height of the light, and broader or narrower, according to the position of the beholder.

The first thing then to be attended to in projecting shadows, is the position of the light.

If the luminous body is larger than the opaque, the shadow will diminish as it recedes from the opaque body which casts it; but if the opaque body is larger, then the shadow will increase in width as it recedes.

There are three different positions of the sun to be attended to in sketching from nature. 1st, When it is before the perspective plane or picture ; 2d, when it is behind, and 3d, when it is in the plane of the picture.

If you imagine a window or perspective plane before you, on which the objects beyond may be drawn, and the sun is beyond the window and the objects, so that its light strikes on that side of them which you do not see, then the light is said to be behind the picture, and the shadows will be thrown towards you, and will appear larger than when cast from you.

2d, If the sun is behind you, and strikes on that side of objects which you see, and the spectator is situate between the sun and the perspective plane, then the sun is said to be before the picture, and you will see less of the shadow, which will be cast from you, than if the sun were behind the picture.

3d, If the sun is on a line with the perspective plane ; that is, so placed, that were the perspective plane extended till it reached the sun, it would go neither before nor behind, but just through it, then the sun is in the same plane as the picture, and the shadows fall in a line parallel with the ground line.

The general remarks already made, may be sufficient for the common purposes of sketching ; but further illustrations of the subject are given, for the use of such as desire to be accurate in the forms of their shadows. To understand these illustrations requires some study and attention ; they are however rendered as clear and simple as the subject permits.

To obtain the precise shadow cast by a given opaque object, first determine the position of the sun, whether it is before, behind, or in the same plane as the picture, and also its height, or altitude, as it is technically called.

In order to do this, draw a ground line, horizon line, point of sight, and prime vertical line, and the object whose shadow is required, which object must be drawn in true perspective.

The sun appears to be over some point of the horizon, either on your right hand or your left. You can select this point according to your judgment, but if you wish any particular place, as 40° from the point of sight, make an angle of 40° (Plate 17) from D, the distance point on the prime vertical line, obtaining the point C. This is called the angle of the sun's declination, through this point, C, rule a perpendicular, the sun's place is somewhere on this perpendicular. You can fix on any height, but if you wish to do it with exactness, take the radius, that is, the distance C D,* and set it off on the horizon line from C, making the point E. From E make the angle of the sun's altitude, (in this case 30°,) and the point where this angle intersects the sun's perpendicular, as at F, is the height of the sun. Thus you can determine with precision any given altitude, and position of the sun, by means of angles from the distance and radius points.

Having fixed on the point for the light, if you wish to find the exact shadow of any given object, as K, regard must be had to the perpendicular lines, or sides of the object, as *a b c*. C is a point on the horizon line, perpendicularly under the sun, called the seat of the light. Draw a straight line from C through the bottom of the side *a*, and another straight line from F the sun himself, through the top of the side *a*. They intersect each other at *d*, and thus determine this point. Then draw a line from C, passing through the bottom of the side *b*, and one from F, through the top, they cross at *e*, which gives this point. Then take the bottom and top of the side *c*, after the same manner, which gives *g*, and join-

* It cannot be made too familiar to the pupil, that the radius of any point, is the distance of that point, (as C,) from the distance point, (as D on the prime vertical line,) set off from the vanishing point on the horizon line, as C E Plate 17.

ing these points, viz. *d e g*, the whole figure of the shadow is determined.

Now if the sun were situate lower, that is, nearer the horizon, as at L, the lines from C through the *base* of the perpendiculars *a b c* must be produced, and lines from L, the sun's place, drawn through the tops, making *h i j*. Observe how much farther the shadow extends when the sun is low, and also that the shape is different. This plainly illustrates the necessity of fixing a height for the light in all pictures, into which shadows are introduced. Mathematical exactness may not always be required, but without a knowledge of these principles, you might be liable to incongruities.

In this example, the sun is behind the picture, and the shadows fall towards the spectator.

If the sun is before the picture, continue the perpendicular from C, (the sun's seat in the horizon,) below the horizon line. Let M be the sun, (figure 2, Plate 17,) C his seat on the horizon line. Draw lines through the top and bottom of the perpendicular sides of the solid P, as before. Those from C to the bottom, and those from M to the top. The lines from the light itself always go to the top, and those from the seat of the light, to the bottom of all perpendiculars of which you seek the shadows, C *m* for the base *m* of this side, and M *n* for the top intersecting at O. You must also ascertain the shadow of the side not seen, (but which is drawn in dotted lines.) The lines for this side intersect at *p*. Join *p o*, the shadow is then complete.

If the sun is lower than at M, mark its place nearer the horizon line, as at R: if higher, farther from the horizon line. The shadow is obtained correctly by this mode, because the lines or angles drawn, are the same which the rays of light proceeding from the sun, at the given height and position, and arrested by the given object, would make; and all rays within the two exterior ones drawn in the figure, are intercepted, and do not reach the ground.

When the sun's place is beyond the picture, it is truly represented by a point above the horizon line; and when it is before the picture by a point on the other side, that is, below the horizon line.

3d, When the sun is in the plane of the picture, Plate 18, figure 1, draw horizontal lines through the base of the object, as *a b* and *c d*. Intersect them by lines touching the top, and making the same angle with the horizon, as the angle of the sun's elevation. The dotted line *b* gives a less elevation than the dark lines, consequently a longer shadow.

The opaque object A (figure 1, Plate 18) is oblique both to the horizon and the ground plane. Draw horizontal lines from the base of its perpendicular sides *i* and *f*, intersected by lines through the tops of these sides, drawn at the angle of the sun's elevation. This gives the points *g h*; from *g* draw a line to the lowest point in the object *e*, and you have the shadow. For the shadow of every other perpendicular line in the object taken in the same way, would fall within this figure.

LESSON XVIII.

SHADOWS. CONTINUED.

If the light proceed from a lamp or other luminous body on the earth, situate in a room or out of doors, it must be perpendicularly over some place in the ground plane. This is called its seat; whereas the seat of the sun's light by reason of his immense distance, is always supposed to be on the horizon line.

Mark this point (Plate 18, figure 2, C) on the ground plane of your picture, viz. the floor or earth on which objects stand. Rule a perpendicular through it, and mark the height of the light on this perpendicular.

Draw lines from the seat of the light C, on the ground plane, through the foot of the object, as the lines *m n o* on the solid *o*; and lines from the light through the top P *r* S. The points of their intersection *t u v*, mark the extent of the shadow. The only difference between this light and the light of the sun, is, that the sun is always supposed to have its seat on the horizon line; but when the light is stationed on the earth, its seat is on the ground plane. In both cases, the seat is always perpendicularly under the luminous body. In the case of the sun's being before the picture, his position is marked below the horizon, as figure 2, (Plate 17.) This method is resorted to, because all the lines are drawn on a flat surface, as a sheet of paper; but the sun is nevertheless supposed to be above the horizon line, although on the nearer side of it.

Thus in projecting shadows, you have only to mark two points, the one perpendicularly over the other, viz. the *seat* of the light, either on the horizon or ground plane, and its *height*. From these points, rule straight lines to the top and bottom of every side of the object, remembering that those to the top of the object, must always proceed from the luminous body; those through the bottom, from its seat.*

If the object which casts the shadow is oblique, as B, figure 2, (Plate 18,) rule a horizontal line M through the seat of the light, and a line from the height of the light N, passing through the top of the oblique object. W, the point where these lines intersect, is the extent

* Unless the light be below the object, as when it is suspended in the air, or a room, and strikes the under part of the object, in which case, lines from the light go to the *bottom*, and from its seat, to the *top* of the object.

of the shadow. From this point, draw a straight line to its extreme base, or lowest point, and this gives the exact form of the shadow, as W X.

Shadows take the form of the objects on which they fall; thus the shadow of a line on a circular object will be curved.

If shadows are intercepted by objects, draw them first, as if nothing were in the way, and then raise perpendiculars from the points of interception to the top of the intercepting object, and continue the shadow across.

The reflection of objects from the water is an exact image of the object reversed.

Draw this image reversed from the foot of the object, and of the same dimensions, and that part which extends over the water, will be the part reflected. (See Plate 18, figure 3; 2 being farther from the water than either 4 or 1.)

CONCLUSION.

Many more illustrations of the rules of perspective might be given, which would be useful to the learner, but they would too much increase the size of this volume. It is hoped that any one, after a faithful study of what is here explained, may be able to understand more scientific treatises, and obtain from them any additional knowledge he may require. A few hints are added as to the finishing up of sketches.

Linear perspective, which regards the drawing and outline of objects, is scarcely more important than ariel perspective, or their tinting and shading. An object must be drawn smaller and coloured fainter, in proportion to its distance. The lights should be less bright, and the shadows less strong, as they recede from the foreground.

The observation and study of nature, is the best guide for the composition of light and shade in a picture. Beautiful effects of light and dispositions of shadow, may at times be seen to lend a new and indescribable charm to the landscape. These should, if possible, be secured as soon as they are observed, by sketching the scene, and putting it in the same light and shade.

It is also of advantage to consult fine engravings and paintings, and when a happy composition occurs in any of these, imitate it in one of your own sketches as nearly as the difference of the subjects will permit.

Let the shadows be broad and in masses, and the lights sparing, and not scattered indiscriminately. The most common fault with beginners, is to have too many lights, and these equally bright. The brightness of a light depends on the depth of the shade with which it is contrasted. White paper in the distance, shaded by a faint tint, will look remote, but the same white in the foreground, opposed to very dark touches, will be brilliant and near. Aim at simplicity of effect. This will render imperfect execution agreeable, but what is elaborate must be skilful to please.

As the light comes in one direction, the picture will have a light and a shadow side. Be careful not to disturb the shadow side by introducing into it bright lights, but let the light parts of this side be of a darker tint than some of the shadows on the other. Determine on the disposition of your light and shade before you commence, and pass a tint over that part of your picture designed to be in shadow. This will secure you from leaving bright lights here, and produce breadth of effect.

Objects situate between the eye and the light, look dark. The sail of a vessel, so placed, looks darker than the sky or the water. A tree in the foreground, with a similar disposition of light, may receive a deep tint, and contrasts finely with the sky and the lights which catch on the distance or nearer objects.

A landscape usually looks best in a morning or evening light, when the shadows are long.

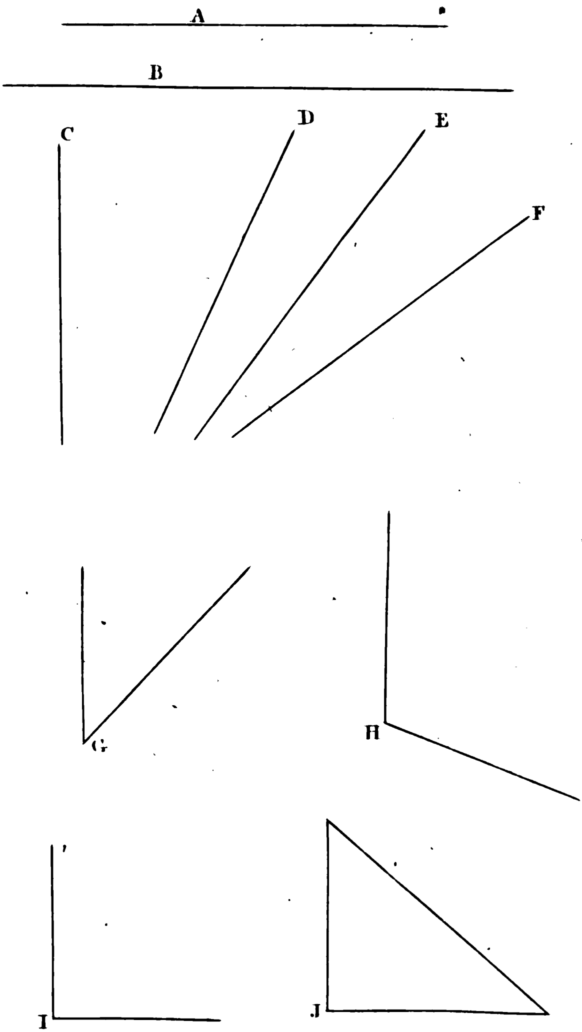
On many accounts, India ink is the most suitable medium for a beginner to use in finishing up a sketch. Having disposed the light and shade, as directed above, begin with a light tint (your pencil being well filled with the colour) and make out the sky, doing the clouds first, let these assume generally a horizontal character. Next put in the blue sky, leaving out the lighter edges of the clouds. This you will do with more grace and freedom if the cloud is already designed. With the same light tint, pass over the mountains or any distant parts, leaving out such lights as the sun, striking on the hills, buildings or water, would produce. Cover every other part of the picture with this tint, except the brightest lights of the foreground. Then take a tint somewhat darker, and finish those parts next the most distant; carry down this tint like the first, over every other part of the picture, leaving out such parts only as are to be lighter than the tint in your pencil, and so proceed with as many tints as you have distances.

If the distant parts look too strong, pass a sponge wet with pure water, over them; this will give them softness. When you commence, after having made the outline, wet the paper with a sponge, and press it with a cloth or blotting paper. This gives a little dampness, which makes the ink work favourably.

With regard to foliage it may be observed, that the more distant it is, the less distinct and the smaller is the character of its touch. Each tree should have a touch of its own, by which its species is expressed. A hill covered with foliage is represented by a touch which resembles a set of curves with indented edges; the more distant such foliage is, the nearer the curve approaches a horizontal character, and the closer are the lines or touches.

END.

Pl. 1



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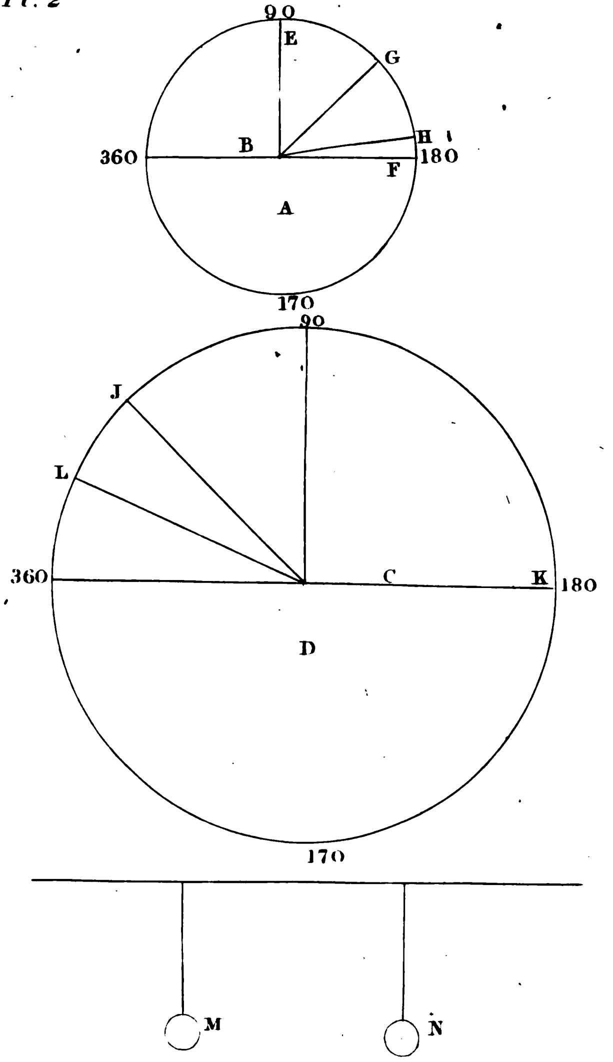

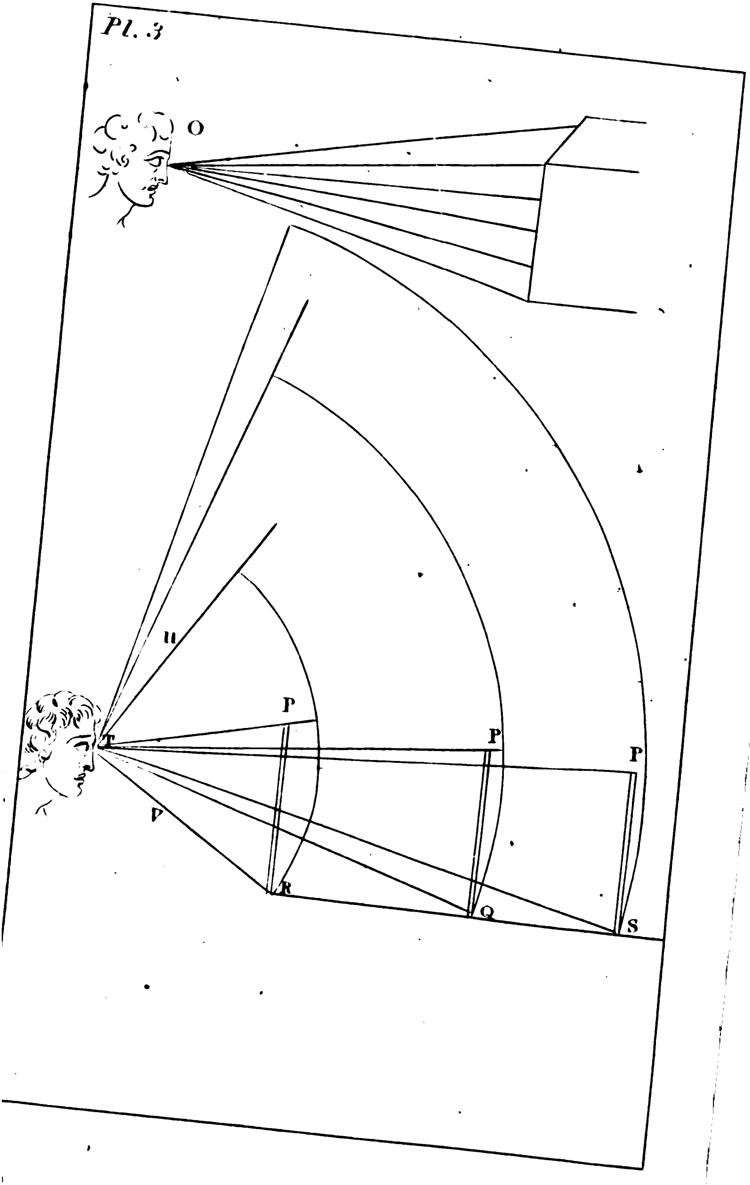
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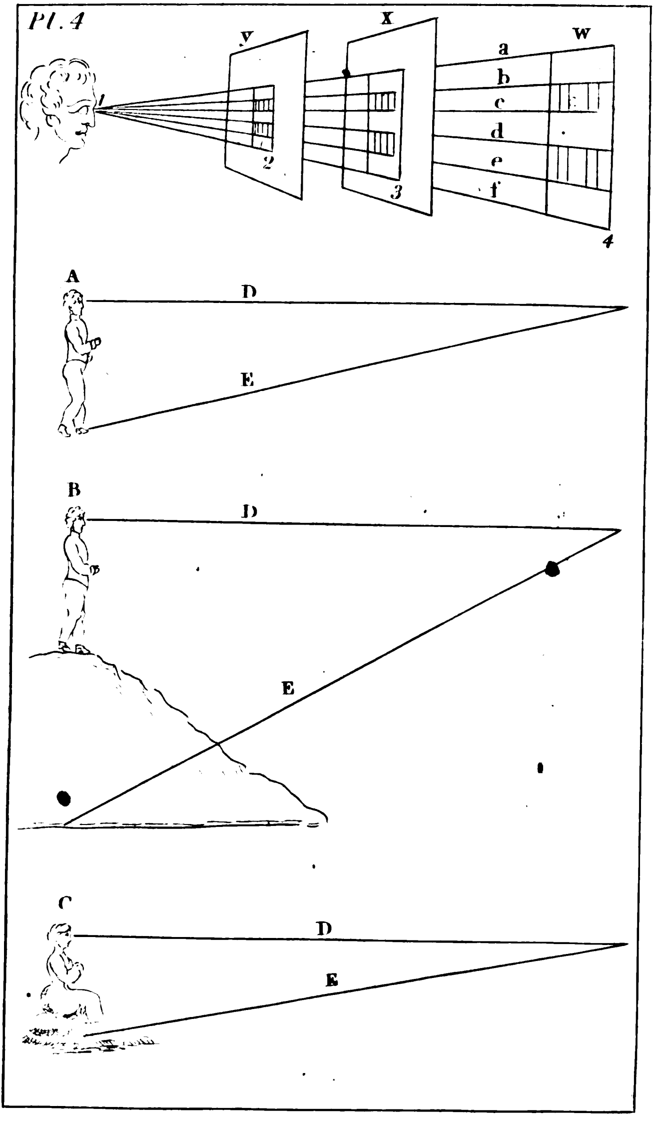
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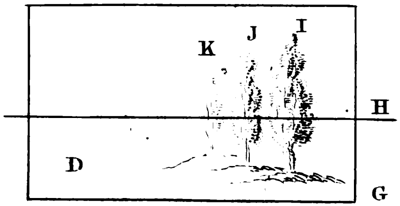
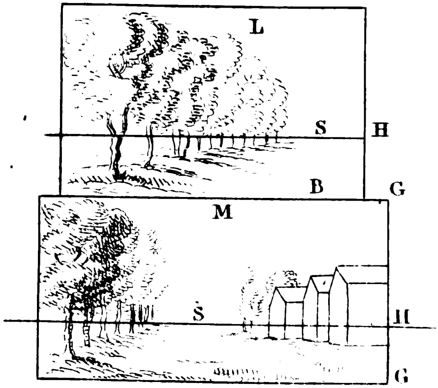
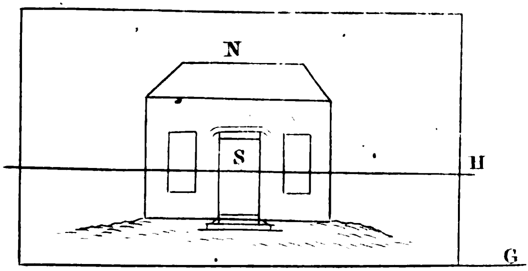
Pl. 5







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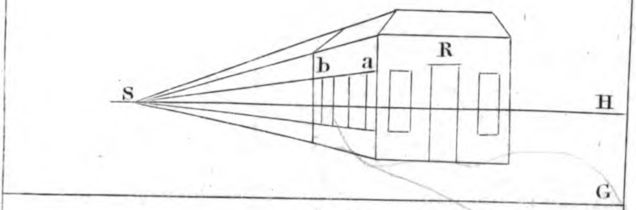

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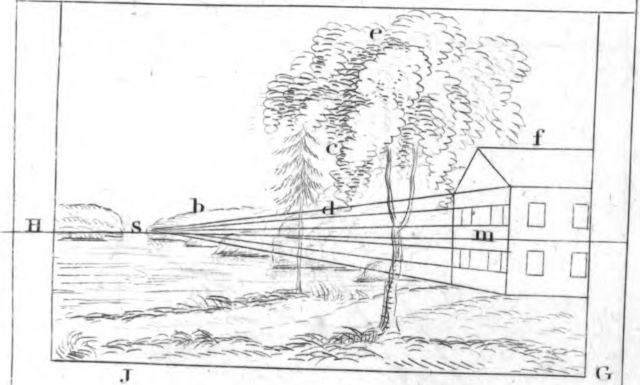
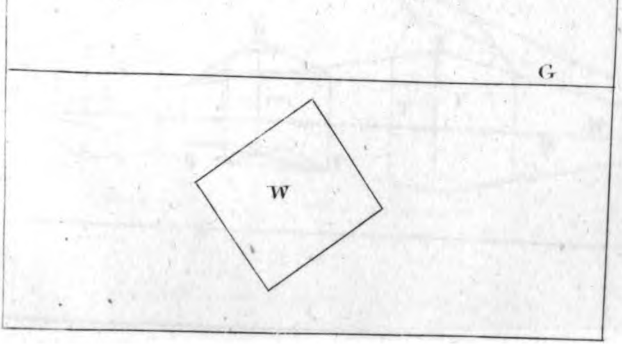
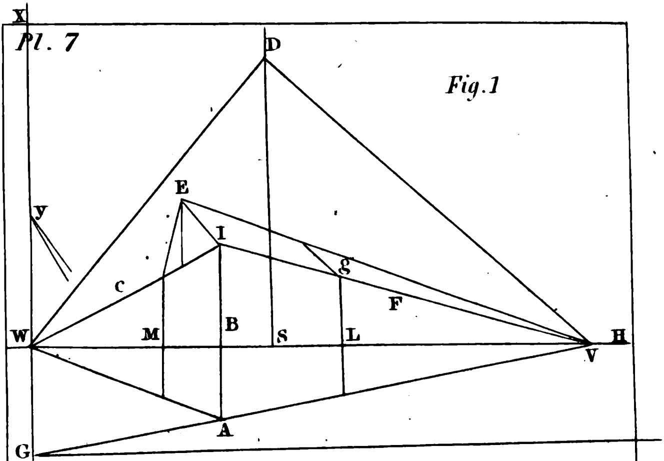




Pl. 7

Fig. 1



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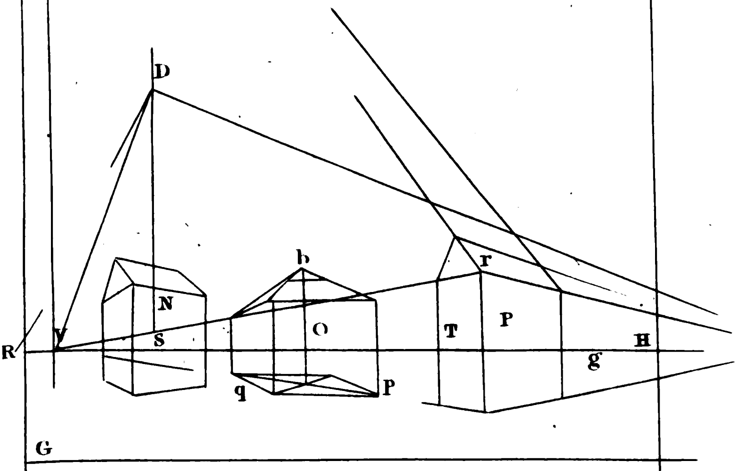

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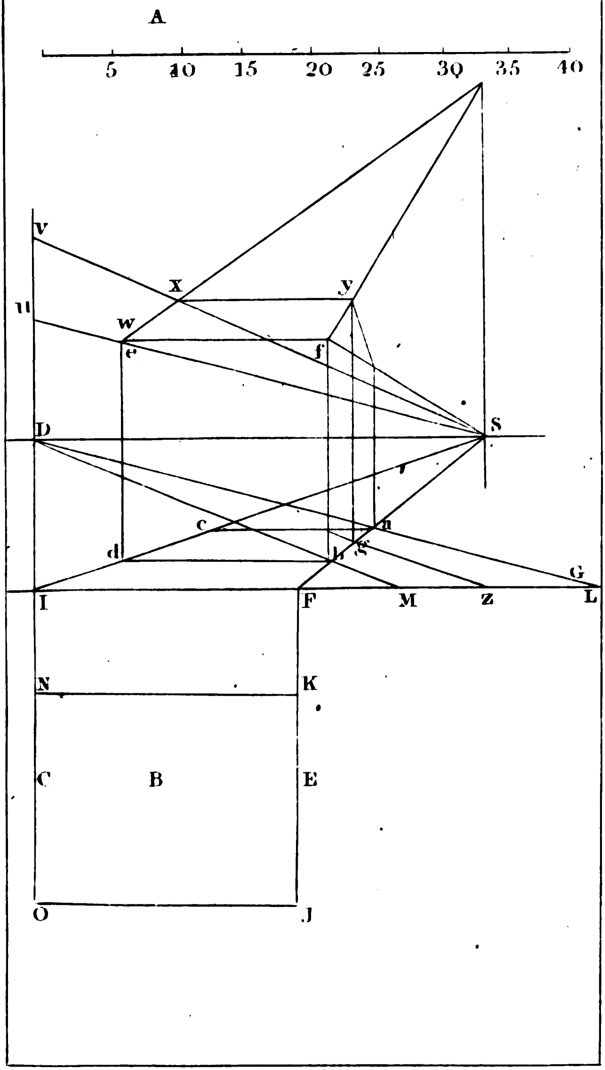

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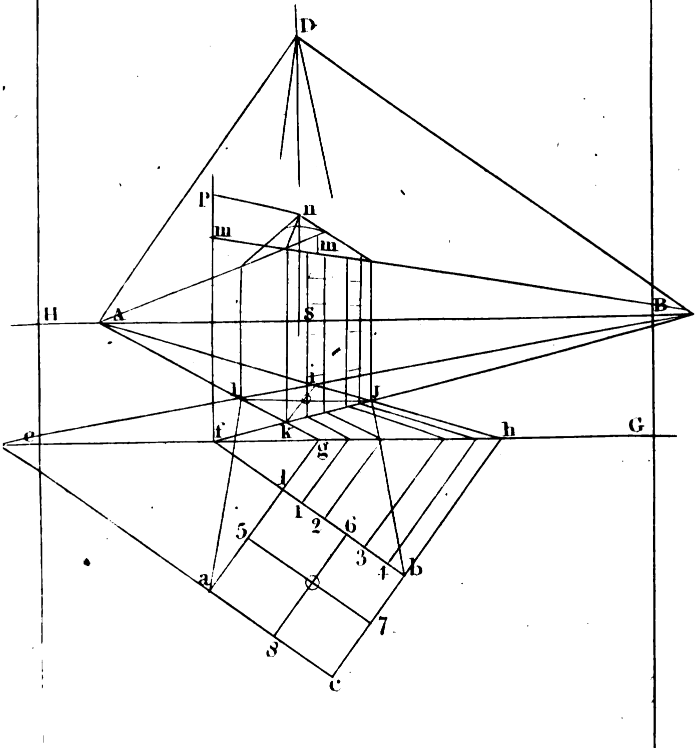
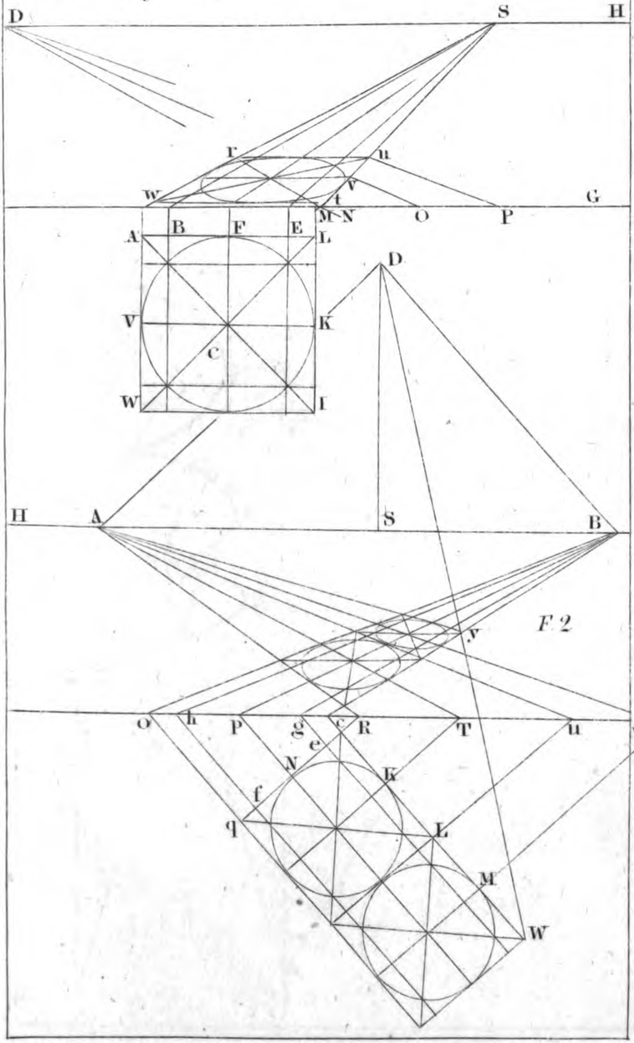
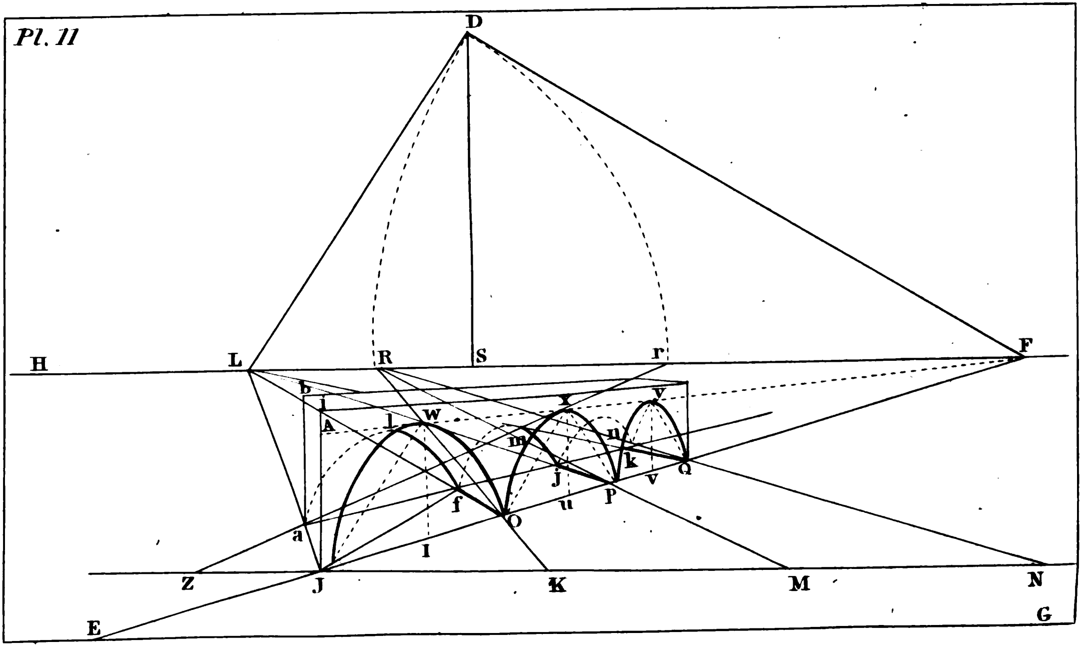


Pl.10 Fig.1

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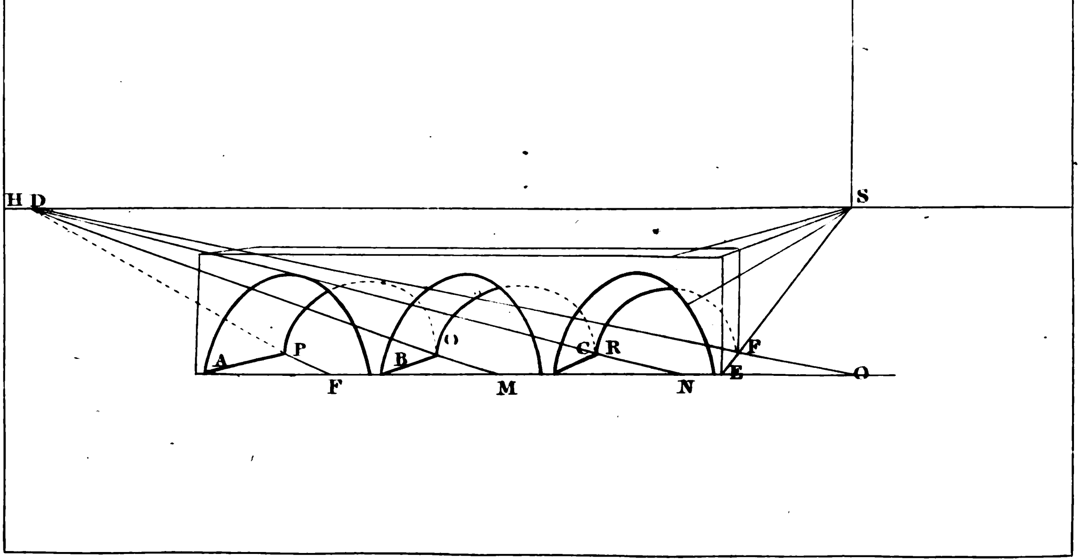
Pl.12



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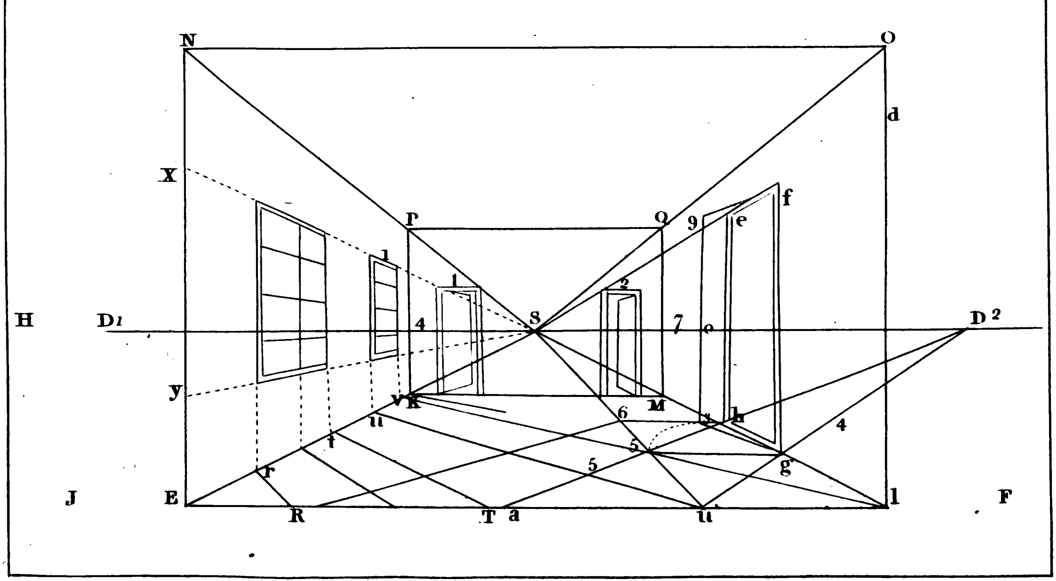

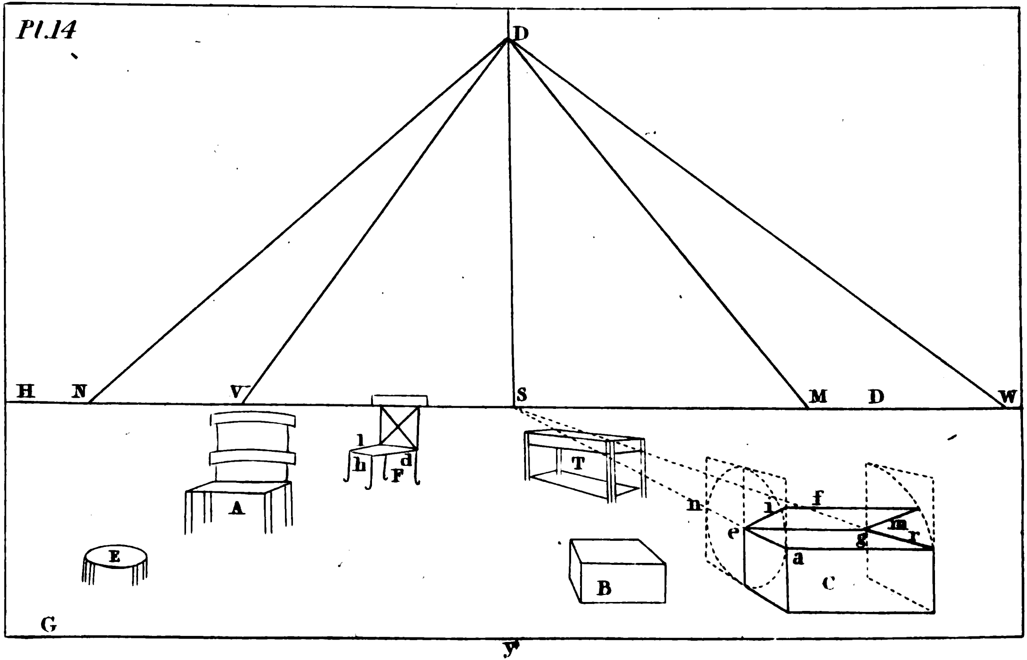
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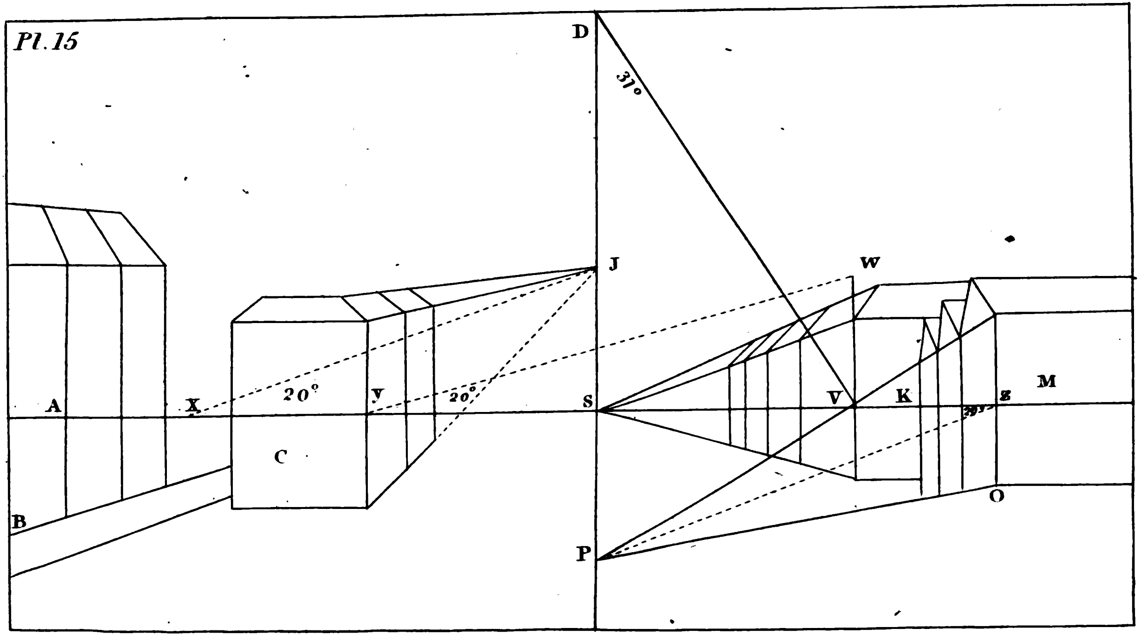
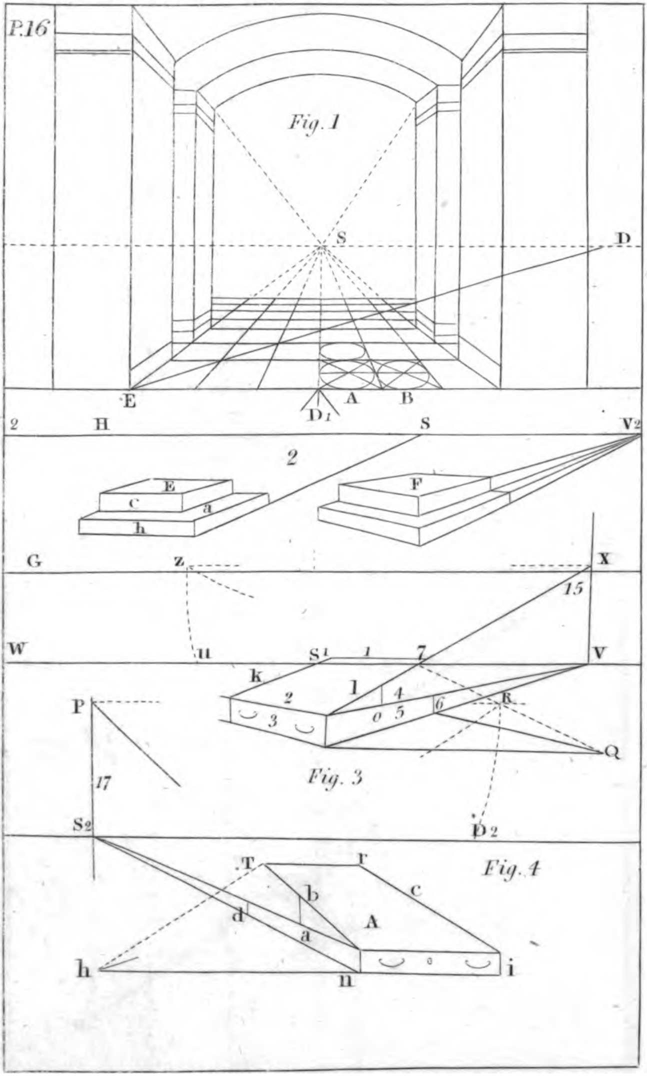
Pl. 15




P.16
Fig. 1
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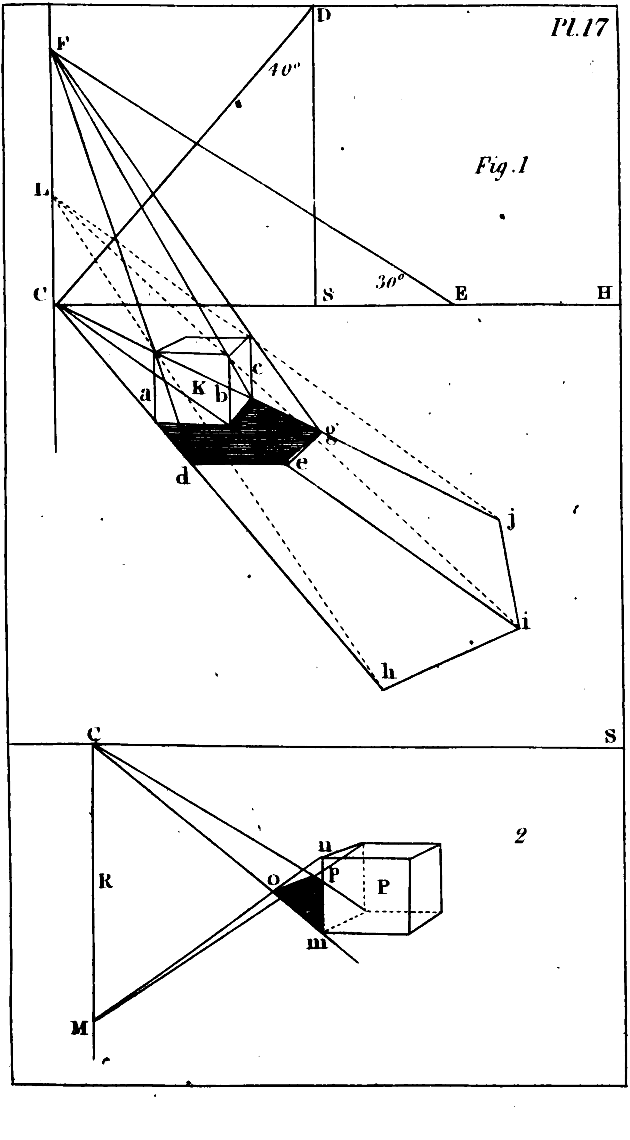
Pl. 17
Fig. 1
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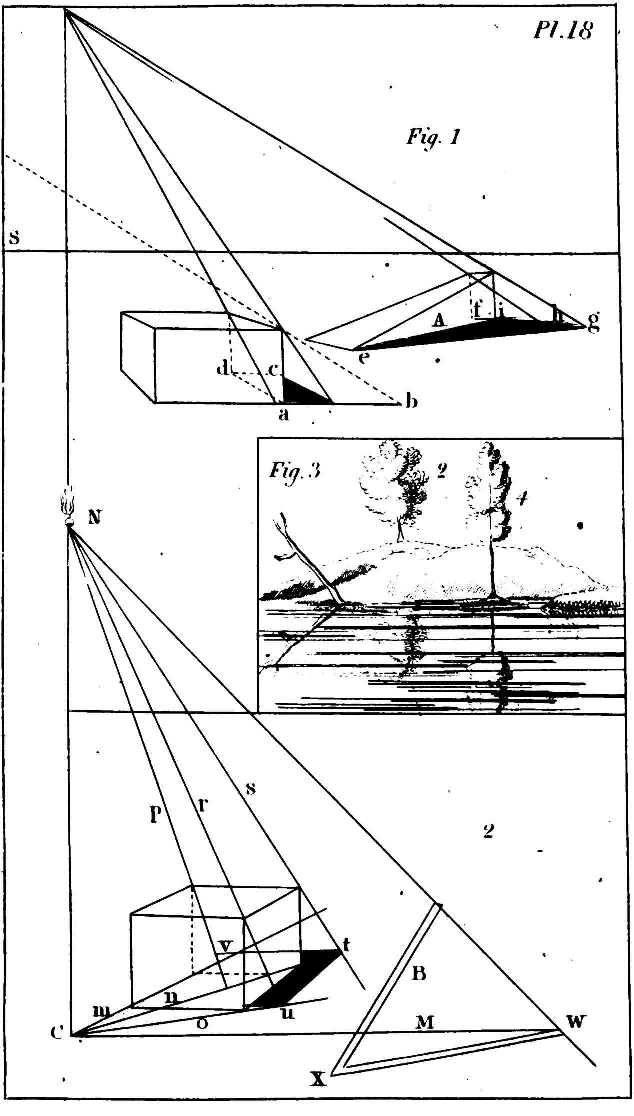
Pl.18
Fig. 1
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