I. G. Wood delin. W. I. Bennett sculp.

PORTLAND PLACE.

Published March 1, 1809, by T. Cadell & W. Davies, Strand, London.

LECTURES

ON

THE PRINCIPLES AND PRACTICE

OF

PERSPECTIVE,

AS

DELIVERED AT THE ROYAL INSTITUTION,

ACCOMPANIED WITH

A MECHANICAL APPARATUS,

AND ILLUSTRATED BY ENGRAVINGS.

BY JOHN GEORGE WOOD, F. A. S.

Whoever would paint or draw must first learn Perspective.

LIONARDO DA VINCI.

THE SECOND EDITION,

CORRECTED AND ENLARGED.

LONDON:

PRINTED FOR T. CADELL AND W. DAVIES, STRAND.

BY J. M'CREERY, FLEET-STREET.

1809.

PREFACE.

ENCOURAGED by the flattering approbation these Lectures received when delivered in public, and by the hope that the accompanying apparatus might render the study of Perspective considerably less difficult, the Author has ventured to offer a second edition of this work; the professed object of which is to render the simple rules of the Art clear and intelligible by a more familiar mode of explanation, and by frequent reference to the apparatus in lieu of geometrical demonstration, which, although not so satisfactory to the mathematician, will be more readily comprehended by those who are not previously prepared by a course of study in geometry, and will enable them to pursue the subject through all its intricacies with greater facility hereafter.

In order to avoid the inconvenience of carrying the vanishing points out of the plate, the distance of the picture in several of the diagrams is taken too short, which occasions a degree of distortion in the Perspective of some objects; as for instance of the oblique wheel, Plate 3, Fig. 2, &c.

Complicated examples have been carefully avoided, as tending rather to confuse than assist the student in the general application of a rule, and those simple ones adopted, which are the immediate result of the preceding principles. For this reason the projections of the bases and pedestals of columns, with their mouldings, are omitted, as the simple rules contained in these Lectures will be fully sufficient for the Perspective representation of the principal lines of which they are composed, and the rest must depend upon correctness of eye.

In the former Edition the horizontal line was intended to have been the only vanishing line treated of, but it being found necessary to touch slightly upon the nature of vanishing lines in general, preparatory to the perspective of shadows, the Author has thought it advisable to enter still farther into that part of the science in the present publication. He takes this opportunity of acknowledging the advantage he has derived from the perusal of many treatises on Perspective of great merit, some of whose figures he has adopted, and also of apologizing for the frequent repetitions of the same expressions, which for the sake of perspicuity he has preferred doing.

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THE APPARATUS.

THE present Apparatus differs from the former in many particulars, but retains all its advantages, together with that of greater portability and less chance of injury. To prepare it for use, the glass must be raised perpendicular to the board, and kept in that position by opening the triangular support till it points to the letter T; the place of the eye E must be raised in a similar manner, and also the two planes upon the other part of the boards. If when the eye is applied to its place E, the tracings upon the glass do not coincide with the respective lines 1, 7—2, 8, &c. upon the raised planes, the fault most probably will be, either in the hinge of the two boards forming the ground plane, or in the inequality of the table upon which it stands, and must be altered till they agree. From the construction of this Apparatus the line R S O K P must be termed the bottom, or base line, of the picture, as it agrees with the bottom line of the glass, within its frame, when viewed from the Eye-hole E. The small tubes at each end of the line, marked H L upon the glass, are intended for the reception of the wires, in the small case, on the right of the Apparatus, in order to prolong the horizontal line. From the unavoidable shortness of the distance between the place of the eye and the glass, it will be necessary to accommodate the sight to that distance, and the perforation marked E is made large in order to admit of that accommodation.

LECTURES ON PERSPECTIVE.

PERSPECTIVE is the art of describing the representations of objects upon paper, canvass, or any plane surface, or as they would appear when viewed through a pane of glass, the appearance and reality being materially different; for example, the two sides of a regular street, appear nearer to each other, and the buildings lower, at the end most remote from the eye, than they do at the end nearest the eye; although in reality the street is known to be of equal width, and the buildings equally high at both ends. If objects seen through any transparent medium, as glass, or the pane of a window, are traced upon that glass, or pane, the tracing will of course be an exact representation of those objects, as they appear to the eye from a fixed point, and it belongs to the art of perspective, to furnish unerring rules for representing objects with equal accuracy upon a flat surface, such as paper, canvass, &c.

The utility of a knowledge of perspective to those who would excel in the arts of design is now so universally acknowledged,

knowledged, that it were almost superfluous to insist upon it. But, as we frequently observe the most glaring defects in this particular, even in the present highly cultivated state of art, it is impossible not to regret that such defects should have crept into works so highly to be commended in every other respect. An error in perspective renders the representation unlike the original; and, although the *cause* may not be discerned by the common observer, the *effect* is visible to every one; and an object so represented presents an appearance unsatisfactory, and in many cases peculiary unpleasant, for instance, a figure intended to be sitting, appears sliding out of the chair, tables meant to be represented flat seem inclined, and the objects upon the table consequently slipping off. It were endless to enumerate the variety of instances where a deficiency in the knowledge of perspective is apparent, we will therefore be content to turn to the works of the Chinese, which furnish the most striking examples of the extreme absurdities to which an ignorance of this art is liable; in all their pictures we may trace an attempt at perspective, but their knowledge does not seem to extend beyond that which is apparent to every one, namely, that objects appear to diminish in proportion as their distance from the eye increases. But even this most evident principle is sadly misapplied in their pictures, for human figures at a considerable distance are not unfrequently even larger than those in the foreground. Their buildings seem to encrease with their distance from the eye, and water to run up hill, &c. &c.

The assistance derived from perspective in that most gratifying branch of art, sketching landscape scenery from nature, is incalculable. It enables us to look upon the objects of which the picture

picture is formed with other eyes, and immediately determines the relative position, and also the direction of every line. It prevents the commission of those mistakes which the most correct eye would infallibly be guilty of, and determines the distance of the nearest object with which the picture may begin. In sketches made by those unacquainted with this science, the eye often appears to have been in several places at one and the same moment: the impossibility of which will be evident by the smallest attention to the nature of the picture; for two buildings equally high, will exhibit, the one its roof, the other not, &c. It has been occasionally alledged that a regular attention to the rules of this art, while drawing from nature, impedes the progress of the artist, but will not the man who clearly sees his road before him, arrive at the end of his journey sooner than he whose doubts oblige him frequently to hesitate lest he should wander from his path?

The position of the picture is supposed always to be similar to a pane of glass in a window, (i. e.) perpendicular to the ground, and if a piece of glass be placed in that position opposite to the eye, and the scene beyond traced upon it, the eye being fixed to one point, it becomes a picture of that scene.

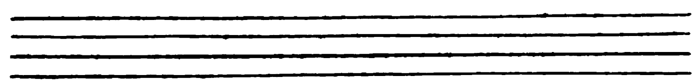
DEFINITIONS.

Although it is the professed object of this treatise to prove the truth of the rules without having recourse to mathematical demonstration, yet, it is necessary that certain geometrical figures should be understood; and, first,

1. PARALLEL

1. PARALLEL LINES.

Parallel lines are equally distant from each other in every part, and if continued to any length, would never meet nor approach nearer together; thus,



2. A RIGHT ANGLE.

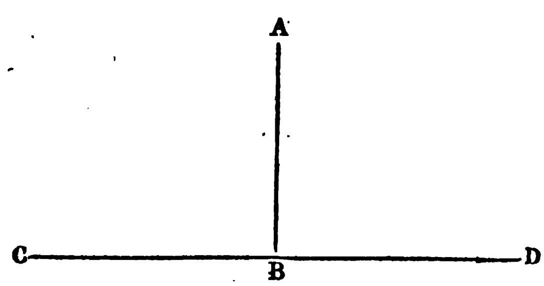
A right angle may be sufficiently explained by the junction of any two lines which form the two sides of a square; thus,

3. PERPENDICULAR TO THE PICTURE.

The term perpendicular to any plane, (as for example to the picture) so frequently occurs, and is so necessary to the general description of certain lines, that it merits particular attention. The term means simply, that *if a line falls directly upon any plane so as not to lean or incline to that plane on either side, such line is said to be perpendicular to that plane.* As a familiar example, suppose a candlestick, with a flat square base, placed upon the table, it would then be said to be perpendicular, because it did not incline towards the table on either side.

side. Let a wedge be placed under one side of the base, and the candlestick will lean on the opposite side towards the table, and would be said to be out of the perpendicular; it would be so with regard to the table or the ground, but would still retain its perpendicular position with respect to its base, and even if it were to be laid upon the table, the shaft would still be perpendicular to the base.—We are so much accustomed to associate the ideas of a perpendicular with that of an upright, (that is, perpendicular or upright with regard to the ground) that it is not without some effort that we can admit the more comprehensive application of the term which is the object of the present definition. A stick pointed directly towards a wall, neither inclining upwards nor downwards, to the one side or to the other, is perpendicular to that wall, let the wall be termed a *plane*, and a stick so directed would be termed perpendicular to that plane. In other words, the term may be defined thus,—a line is said to be *perpendicular* to a plane, or line, when its direction forms a right angle to the plane or line; thus,

The line A B is perpendicular to the line C D.



4. PLANE

4. PLANE OF THE PICTURE.

By the *plane of the picture* is meant, not only the picture itself, but an extension of it on every side; as for example, if a b c d, fig. 2, plate I, were the size of the picture, all the rest of the paper on every side of it will be in the *plane* of that picture, or if the scene beyond were traced or drawn upon one pane of glass in a window, all the other panes in that sash of the window will be considered in the *plane* of that picture; or if a view were painted upon one pannel on the side of a room, all the other pannels on the same side would be in the *plane* of that picture. In speaking of a line being perpendicular or oblique to the *plane* of the picture, it is not always meant that it would if continued meet the circumscribed limits of the picture, but, that it would meet a continuation of the *plane* of the picture. Thus upon the apparatus, the line G N cannot meet the picture itself, but would meet the *plane* of the picture if extended to R, therefore the line F A is said to be perpendicular, and G N oblique to the *plane* of the picture. The use of the plane of the picture is to receive those original lines which could not strike the picture itself, and thus the horizontal and ground lines may be continued to any required length in the *plane* of the picture.

5. GROUND PLANE.

In perspective, the ground is supposed to be divested of inequalities, and perfectly flat, that is, a perfect plane; thus, in the apparatus the bottom x represents the ground plane.

6. THE

6. THE POINT OF SIGHT.

The *point of sight* is the real situation of the eye when viewing any object in nature with intent to draw it; thus the *point of sight* is the aperture at the end E of the apparatus, where the eye is applied to see the representation upon the glass or picture.

The old writers made use of this term in a very different sense, and applied it to the point which Dr. Brook Taylor changed to that of, Centre of the Picture.

7. HORIZONTAL LINE.

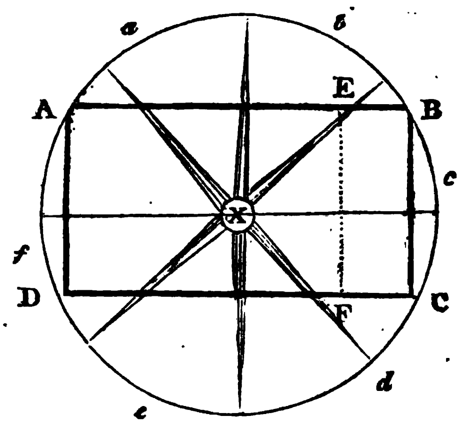
The *horizontal line* is a line drawn alone the picture, exactly the height of the eye, and parallel to the bottom of the picture: thus in the apparatus, the *horizontal line* H L is exactly the height of the point of sight or eye E, and drawn from one side of the picture to the other; if the eye be raised the *horizontal line* rises with it: and *vice versa.* The old authors were not acquainted with any other vanishing line, but the comprehensive principles of that excellent mathematician Dr. Brook Taylor, stripped it of its long enjoyed honours, and shewed that it had not the slightest title to pre-eminence over any other vanishing line, and lest his readers should still remain in the same error, he formed the schemes in his treatise, for the most part by means of other vanishing lines.

8. THE CENTRE OF THE PICTURE.

The *centre of the picture* is the point directly before the eye when looking straight forwards, neither upwards nor downwards;

wards; and if the wire be put through the place of the eye E in the apparatus, and carried straight forwards, perpendicular to the glass or picture, the point c, where it meets it, is the *centre of the picture*, and consequently falls upon the horizontal line.

Dr. B. Taylor substituted this term for that of the *point of sight*, used by preceding authors. By the centre of the picture he evidently meant the centre of vision; thus, if the eye be steadfastly directed to any one point, as for instance the point x, that point will be distinctly visible, and for a certain space around it objects may be clearly discerned, but as their distance from the point increases, they must appear weaker and weaker, till at length they become confused, and nothing can be seen beyond a certain space. Let that space be represented by the circle a b c d, and the gradual diminution of the strength of vision by the radii from the centre; thus a b c d is the circle of vision, and x its centre.



x then is the point termed by Dr. B. Taylor the centre of the picture. But as from the point so called rarely falling in the middle

middle of the paper, or canvass, much confusion may arise in the mind of the student; it will be necessary to observe, that the long square or parallelogram A B C D is found to be a more convenient form than the circle, and thus the centre of the picture X does not fall in the middle but nearer to the bottom D C, than to the top A B, of the picture, but still continues the centre of vision. Again, it is not unusual to find this point placed nearer to one end of the picture than to the other, and in such case we may conclude that a portion of the scene in nature was not consistent with the plan of the artist, and therefore rejected, and the picture terminated, as marked by the dotted line E F, the rejected matter, had it been introduced, would have filled up the space E B C F, but the picture now remains A E F D, and X, the *centre of the picture*, much nearer to E F than to A D, but still remaining the centre of vision.

9. DISTANCE OF THE PICTURE.

The *distance of the picture* is the distance of the eye from the picture. For example, in the apparatus it is the distance of the eye E from the glass representing the picture upon which the objects beyond it are drawn. In order to make this still better understood, if a small frame, with a glass in it, be held up before the eye in the position of the picture, and the objects seen through it, traced or drawn upon it, it is evident if this frame be held very near the eye, objects very near in nature may be traced or drawn upon the glass, and the drawing would be made with a very short or small distance: but if the frame be held much farther from the eye, many objects before traced upon the glass, cannot be introduced, not being included within the frame: and this drawing would be made with a greater distance; and as by moving the frame nearer to, or farther from, the eye, before the tracing upon the glass be compleated, would occasion an alteration in the appearance of the objects already traced; it is evident that the *distance of the picture* must never change during the representation of any one scene. In the first mentioned or short distance, a human figure standing very near the eye of the person drawing, might be seen within the frame, and introduced in the picture, and the proportion his representation would bear to other objects must appear preposterous. But by the last mentioned or longer distance, this figure could not be introduced, and the picture would begin with some object considerably farther removed from the eye.

Thus the *distance of the picture* appears to determine how far we should remove from an object, in order to represent it satisfactorily. It ought always to equal the greatest length of the picture, and if the frame and glass, before-mentioned, be 12 inches long by 9 inches high, it ought to be held at the distance of 12 inches from the eye, at least. Suppose a frame so placed, and a large building, such as St. Pauls', or Westminster Abbey, to be the subject about to be represented; it is evident, if the artist be near the building, but a very small portion of it can be seen, or traced, within the frame; and it will be necessary to retire to a greater distance, still keeping the frame 12 inches from the eye, and when the whole of the building occupies a convenient space within the frame, the distance at which it ought to be drawn is a proper one, and the perspective will be easy and agreeable, whereas apparent distortion, occasioned by the violence of the perspective, must be the consequence of standing so near the building as to be obliged

obliged to place the frame close to the eye, in order to comprehend the whole edifice within it.

10. VANISHING LINE.

It is well known that the end farthest from the eye, of a very long room, gallery, or avenue of trees, *appears* much smaller than the end *nearest* the eye: and if the two sides of the room, or avenue, are supposed to be continued to such an extreme length as to appear to meet, the line in which they appear to meet would be called the *vanishing line* of the two sides of the room, or avenue: and if the ceiling and floor of a room were continued to an extreme length, they would appear to meet in the *vanishing line* of the ceiling and floor. In either case the vanishing line is directly opposite the eye, but that of the ceiling and floor (or of planes parallel to the horizon) will always be the height of the eye, and parallel to the ground; and is the horizontal line (Def. 7.) Again, if the eye be directed straight forwards, neither upwards, nor downwards, and a thin plane, as of pasteboard or card, be held up exactly the height of the eye, and parallel to the ground, it will there appear to the eye as a line, the edge only being seen, and in that situation it is upon the *vanishing line* of the ceiling and floor, (which is the horizontal line) but if it be raised higher the under surface will appear, and if it be lowered the upper will appear. Again, if a pasteboard be laid upon the apparatus so as to form a kind of ceiling, it will be perceived to the eye at E, that the lines forming the sides of the ceiling, appear (if continued) to meet in the horizontal line upon the glass or picture; the lines also forming the sides of the floor from 1 to 3, and

3, and 6 to 4, appear to meet in the same line; therefore the horizontal line is the *vanishing line* of the ceiling and floor, or of all planes parallel to the horizon, and divides those objects of which we see the top, from those of which we see the bottom. A hoop held exactly as high as the eye, and parallel to the ground, will appear as a straight line. The hoop then would be lost in a line, or fall into its *vanishing line*, but let it be held either higher or lower, retaining its parallelism, and the space within the circumference will become visible. Thin planes approaching each other from the sides of a room, and keeping their parallelism to those sides, would, in their junction opposite to the eye, present the appearance of a single line, that is, the planes would no longer appear as planes but as a line, which is their *vanishing line*.

11. VANISHING POINT.

The *vanishing point* is that point upon the picture where the *representation* of lines parallel to each other in nature would meet in it; as for example, in the apparatus it is the point where the lines upon the glass or picture, representing from 7 to 9, and from 12 to 10; and from 1 to 3, and 6 to 4, would meet in the picture, and these lines continued on the glass (as is done by dots) would meet in *c*, the centre of the picture; which is, in this case, a *vanishing point*. If a straight wire be held below or above the eye, on the right or on the left, we perceive that it has length, but let it be gradually brought opposite, and pointing towards the eye, and all appearance of length is lost, and only a point becomes visible, which point is the *vanishing point* of such line, and if we suppose this wire to be the axis of a cylinder, and the ribs

of

of it to be parallel to the above mentioned wire, it is evident that the farther end of the cylinder will appear smaller than the nearer, and that the ribs will seem to converge towards the axis, till if the cylinder were extended to a sufficient length, they would appear absolutely to meet or come to a point, which would be their *vanishing point.* If two men were to walk in a direction parallel to each other, it is clear not only that they themselves would appear to diminish as they receded, but also the space between them would seem less and less, till both themselves and the intermediate space would be lost together, that is, would fall into their *vanishing point.*

12. ORIGINAL OBJECT.

By *original object* or *line* is meant the object or line to be represented.

13. INTERSECTING POINT.

If a line lying on the ground be continued till it meet the bottom of the picture, it is *there* called the *intersecting point* of that line; thus upon the apparatus, if the line G I be continued it will meet the bottom of the picture in K, which is its *intersecting point.* Again, if the line lie in another direction, as G N; the bottom of the picture not being long enough, may be continued (as is done by dots) and where it meets it at R is its *intersecting point.* Upon paper, Fig. 2, Plate I, if the line S R be continued, it will meet the bottom of the picture in U its *intersecting*

secting point, and the line V T would find its *intersecting point* upon the bottom of the picture continued at W.

The representation of lines which are parallel to each other in reality, and also parallel to the position or plane of the picture, will not have a vanishing point upon it, but will be drawn or represented parallel to each other; as upon the apparatus the tracing of the lines from 1 to 6, and from 7 to 12, are drawn parallel to each other upon the glass, and they are parallel also to the picture; for if they were continued to any distance, and the plane of the picture also, it is evident they would never meet, but always remain equally separated from each other.

If a person placed at one end of a room, directs the eye straight forwards, or perpendicular to the other end of the room, and holds the frame and glass before-mentioned in the position of the picture; then traces the lines of the cornice and floor of the opposite end of the room upon the glass, they will appear to be parallel to each other.

The representation of lines which are parallel to each other, but *not* parallel to the position or plane of the picture, will have the same vanishing point upon the picture; for the person remaining at the end of the room as in the foregoing case, knows, that the lines of the cornice, and floor of each side of the room, are in reality parallel to each other: but in the tracing upon the glass, the lines representing the cornice and floor on each side will appear to approach each other, and if continued would meet in a point.

The

The lines of the cornice and floor on each side of the room not being *parallel* to the plane of the picture, but *perpendicular* to it. In the apparatus, the lines upon the glass or picture, representing from 6 to 4, (which may be called the bottom of the room,) and from 12 to 10, (which may be supposed the cornice,) appear to meet, or have their vanishing point in c upon the horizontal line. The same may be seen of lines representing from 1 to 3 and from 7 to 9; they have the same vanishing point because parallel in reality to 6 to 4 and 12 to 10.

Thus upon the apparatus the representation of lines parallel to each other, and to the picture, as from 1 to 6, 7 to 12, 8 to 11, &c. are represented parallel upon the picture, and cannot have a vanishing point upon it.

But the representation of lines parallel to each other, but not to the picture, as from 6 to 4, 1 to 3, 7 to 9, &c. will have a vanishing point upon the picture, for if they are continued, they will meet upon the horizontal line in c, the centre of the picture.

To prepare the picture for drawing views from nature by the rules of Perspective, the horizontal line should first be drawn along it, and as its place depends upon the height of the eye, and the nature of the scenery, it must of course be regulated by these circumstances; about one third of the height of the picture is found the most useful for general practice. If the person about to draw is upon an eminence, with an extent of country beneath him, the horizontal line must be placed high in the picture, because the spectator is elevated;

elevated; and if he is on the contrary upon a plain, or low ground, the horizontal line will consequently be low.

The centre of the picture must be marked upon the horizontal line, in the middle, or inclining to either side, as may suit the plan of the artist: but in the closet the preparation may be carried still further, and the point of distance marked on the same table or board upon which the drawing lays, Plate I, Fig. 1, H. L, is the horizontal line C, the centre of the picture, and if the plane C E be raised till it be perpendicular to H L the horizontal line, then would E be the natural position of the eye, but as lines cannot be drawn upon the air, it becomes necessary to transfer that point over the picture to E, which may be done by laying down the folding plane C E.

In order to put the *ground plan* of a building, or of any other object, whose dimensions are given, in Perspective: the paper, or picture upon which it is intended to be represented according to rule, must be placed upon a table sufficiently large for the purpose; and the paper containing the ground plan adjoining the bottom of the picture: the picture must then be prepared, as already explained, by drawing the *horizontal line*, marking the *centre of the picture* on it, and also the *distance of the picture*, or *point of distance* over it: thus the picture upon which the ground plan is to be put in Perspective, is placed between the ground plan and the point of distance. The distance of the picture should always exceed its longest diameter, because the contrary is productive of distortion, as may be observed in Fig. 3, Plate I, for let A B D F be the ground plan of a square, the perspective representation

presentation of which is required; when put in perspective by the *longest,* being a *proper* distance of the picture, it will appear thus as A B d f, but by a shorter and *improper* distance it will appear thus A B g h; the first resembles a square seen in Perspective, but the latter is a distorted representation, and scarcely conveys a proper idea of that figure, arising from the circumstance of its being seen too near or under an improper angle.

LECTURE II.

Consisting of Demonstrations of those Rules by which the Vanishing Points of Lines are found.

THE rule for finding the vanishing point of any line, is, that *a line must be drawn from the place of the eye, or point of distance, parallel to the original line, or line about to be represented, till it meets the picture, and where it meets it is the vanishing point of that line; and also the vanishing point of all lines parallel to it.* For example, let it be required to find the vanishing point of the line G I on the ground plane of the apparatus. By attending to the foregoing rule, we learn, that it is to be found *by drawing a line from the place of the eye, or point of distance* E, *parallel to the original line, or line to be represented* G I, *till it meets the picture, and where it meets it is the vanishing point required.* Let the wire be put through the point of distance, or place of the eye E, and carried straight forwards parallel to G I, (or its dotted continuation on the ground plane) and it must strike the glass or picture in C, the centre of the picture, which is consequently the vanishing point required, according to the foregoing rule; but as F A and D B are parallel in reality

to

to G I, the line which was drawn from the eye E parallel to G I, must be parallel to F A and D B; therefore the point in the picture found to be the vanishing point of G I, must be the vanishing point of F A and D B, and of all lines parallel to them, as the lines connecting the tops of the pillars from 7 to 9 and 12 to 10, and the bottoms of the same pillars from 1 to 3 and 6 to 4.

The Perspective representation on the picture of any original line continued to an extreme length, is a line drawn on the picture from the intersecting point (see Def. 13,) of the original line to its vanishing point. For example, to give the Perspective representation of the original line G I upon the picture, (supposing I G continued to an extreme length,) a line must be drawn from its *intersecting point* K, *to its vanishing point;* which was found by the above rule to be the centre of the picture C; thus a line drawn from K to C is the *indefinite* * representation of G I, and if the Perspective representation of the original line F A be required, a line must be drawn on the picture from O its intersecting point, to C, its vanishing point, which line is the *indefinite* representation of the original line F A, and a line drawn from the intersecting point P to C, is the indefinite representation of D B upon the picture. Apply the eye to its place at E, and it will be seen that the original lines F A, G I, D B, are represented or traced on the glass or picture, by the lines

* By the term indefinite representation of an original line, is meant the representation of such a line if continued to an infinite distance, till it absolutely seemed to arrive at its vanishing point, thus if any two or more lines are drawn upon the picture, till they meet in the vanishing point, the intervening space between those lines, although in reality equally wide at either end, appears to diminish till it is totally lost, and vanishes into a point; such lines are the indefinite representation of original lines.

lines O C, K C, P C, which all meet in one point, C, the centre of the picture, which is their vanishing point. This is an unerring rule for finding the vanishing point of a line, and drawing its representation.

Thus the following general rules are established:

1. The vanishing point of any original line, will be the vanishing point of all lines parallel to it.

2. That the centre of the picture is *always* the vanishing point of all lines *perpendicular* * to the plane of the picture; therefore, in drawing from nature, if one end of a right angled building be parallel to the position or plane of the picture, the sides will of course be perpendicular to it, and the lines forming the top and bottom of the sides, being also perpendicular to the picture must be drawn towards the centre of the picture, as their vanishing point: and if one end of a square, or right angled room, be directly opposite the eye, or parallel to the plane of the picture, the sides of that room will be perpendicular to it, and the lines forming the cornice, and base of the sides, being also perpendicular to the picture, must be drawn towards the centre as their vanishing point.

To apply the foregoing to practice, let it be required to find the

* Since it has been proved that the centre of the picture is the vanishing point of the original line G I on the ground plane of the apparatus, and since the line G I (see Def. 3.) is *perpendicular* to the picture, it follows that all original lines parallel to G I must be *perpendicular* to the picture, and therefore have the same vanishing point, that is, *the centre of the picture,* thus the lines 1, 3,—6, 4, &c. app. being parallel to G I, *perpendicular to the picture,* vanish in the same point.

the vanishing point of the original line G I (Pl. I, Fig. 2.) The picture a b c d being prepared by drawing the horizontal line, making the centre of the picture C, and the point of distance or place of the eye E. According to the rule for finding the vanishing point of any original line, *a line must be drawn from the place of the eye, or point of distance, parallel to the original line, till it meets the picture, which is the vanishing point required.* For example, from E the place of the eye, or point of distance, a line must be drawn parallel to G I, till it meets the horizontal line in the picture, which it does in the centre, then is C the centre of the picture, found to be the vanishing point of G I. If the vanishing point of F A be required, a line drawn from E the point of distance, paralled to F A will meet the picture in C also; therefore is C the centre of the picture, the vanishing point of F A and G I, and since D B is parallel to G I and F A, the line drawn from E parallel to G I, must be parallel to D B, and consequently C the centre of the picture, is the vanishing point of D B also; and R S, T V, being parallel to D B, G I, &c. the same line from E, which was parallel to G I, must be so to R S and T V, therefore the same point C must be their vanishing point also. To draw the indefinite representation of G I upon the picture, a line must be drawn from its *intersecting point* K, *to its vanishing point* C, and K C is the *indefinite representation of* the line G I, continued to an extreme length. The same may be done by F A, and O C becomes its *indefinite representation:* P C the *indefinite representation of* D B; U C of S R; W C of V T; and thus of any other lines parallel to G I. Thus far concerning lines *perpendicular* to the plane of the picture.

It will now be required to find the vanishing point of lines which lie in an *oblique direction* to the position or plane of the picture.

picture. As for example, M K upon the ground plane or board X of the apparatus, which is oblique to the position of the glass or picture. The rule for finding the vanishing point of lines perpendicular to the picture, is also the rule for finding the vanishing point of lines in any other direction.

If the vanishing point of the oblique line M K, apparatus is required; a line must be drawn, agreeable to the rule, from the place of the eye or point of distance E, *parallel* to the original line M K, 'till this line from the eye E meets the picture; and the point where it does meet it, will be the vanishing point required. Put the wire through the place of the eye E in the apparatus as before, and carry it in a direction parallel to the original line M K, until it meets the picture; and as in the preceding case, it will give the vanishing point of the line M K; then will the line drawn upon the glass or picture, from the intersecting point K, to the vanishing point, appear to the eye at E to conceal the original line M K, or in other words to be the tracing, or indefinite representation of M K. But the original lines D A, G N, are parallel in reality to M K, and therefore are said to have the same vanishing point; this may be proved by placing the wire from S, the intersecting point of D A, to the vanishing point of that line, (just found to be the vanishing point of M K,) and if it conceals the original line D A from the eye at E, it certainly is the vanishing point of D A, i. e. it is the point upon the glass or picture, to which the representation of D A must be drawn. The oblique line G N, has its intersecting point at R; and if one end of the wire be placed at R and the other at the same vanishing point, it will be found to conceal G N from the eye at E; and thus of any number of lines parallel in reality to M K.

If

If the original line lies in a direction of considerable obliquity to the plane of the picture, a parallel to it from the eye will be carried beyond the margin of the picture, and therefore the horizontal line must be extended, in the plane of the picture, in order to receive it as C F, Plate I, Fig. 4. Upon the apparatus a wire must be fixed in the tube at the end of the horizontal line as its continuation, and the place of any vanishing point, when found, may be marked by a small piece of paper slipped on the wire.

Upon paper (Plate I, Fig. 4,) let D A be the line whose vanishing point is required; from E the place of the eye, or point of distance, draw a line E F parallel to the original line D A; this line E F meets the plane of the picture (for it is beyond the margin of the picture) at F upon the horizontal line, continued on purpose to receive it: F is therefore the vanishing point, as was just proved by the apparatus, and a line drawn from S the intersecting point of D A to F its vanishing point, will give the indefinite representation of the line D A. Thus S F is the indefinite representation of D A; but M K is parallel to D A, therefore the line E F drawn from E, parallel to D A, must be parallel to M K, and consequently the point F must be the vanishing point of the line M K also, and the line K F drawn from its intersecting point K, to its vanishing point F, is the indefinite representation of M K. G N being also parallel to D A, or M K, E F must be parallel to it, and F its vanishing point, and the line R F from the intersecting point to the vanishing point, must be the indefinite representation of G N.

Hence we learn the reason why in the representation of buildings, the lines forming the cornice and basement of any plane side

side of a building, must be drawn towards the same vanishing point upon the horizontal line; namely, because a line drawn from the eye, parallel to one, will be parallel to all, and consequently having found the vanishing point of one line, it becomes the vanishing point of all others parallel to it.—The upper and lower lines of the windows, &c. in the same side, and in short all lines parallel to them, must be drawn to the same vanishing point. But when the side of a building is parallel to the position, or plane of the picture, the lines will not have any vanishing point. That such lines cannot have a vanishing point may be easily proved, for let it be required to find the vanishing point of the original line A B (which is parallel to the picture) on the apparatus. According to the rule for finding a vanishing point, *a line must be drawn from the place of the eye* E *parallel to the original line* A B *till it meets the picture.* Put the wire to the place of the eye E in a direction parallel to A B, (for it cannot be put *through* E, as in other examples, so as to be parallel to A. B,) but since A B is parallel to the plane of the picture, and consequently can never meet it, or have an intersecting point; neither can the wire at the place of the eye meet the picture, to find a vanishing point; consequently lines parallel to the plane of the picture can neither have vanishing, nor intersecting points upon the picture, but must be drawn parallel. Let A B D F, Plate I, Fig. 1, be the picture, G I a line parallel to the plane of the picture; if a line N O be drawn through E the place of the eye, parallel to G I, it can never meet the picture, and consequently G I cannot have a vanishing point on the picture.

The indefinite representation of a line in nature, supposed to be extended to an extreme length, is produced by a line drawn from the intersecting to the vanishing point of that line. As for example, the indefinite representation of the line I G apparatus, supposed to be extended beyond G to an extreme length, is produced by a line drawn upon the glass or picture from K its intersecting point, to C its vanishing point, and K C is the indefinite representation of G I; by the same rule P C is the indefinite representation of D B, and O C of F A, &c. &c. Since the indefinite representation of a whole original line infinitely extended, is produced by drawing a line upon the picture, from the intersecting to the vanishing point; it follows that the representation of any part of that original line must be a portion of the representation of the whole. For example, the line drawn from K (apparatus) the intersecting point of G I to C its vanishing point, gives the indefinite representation of G I extended; but the representation of that part only included between G and I, must be found somewhere between K and C; that is, between the *intersecting* and *vanishing point* of G I. This part of the line is marked upon the glass or picture by two red dots, which to the eye at E will appear to conceal the points G and I, and consequently to include the representation of that portion of the line between them. The point between A and F will be found included in red dots upon the line drawn from O, its *intersecting point*, to C its *vanishing point*. The same may be said of D B. The representation of the part included between A and D in the oblique line A D will be found in the line drawn from S its intersecting, to its vanishing point upon the continuation of the horizontal line; the representation of G N or M K, &c. &c. in the same manner. Universally the representation of a *part* of a line, will always be found in the representation of the whole, i. e. will be found between the intersecting and vanishing points of that line. Upon paper, Plate I, Fig. 2, the line drawn

drawn from K the intersecting, to C the vanishing point of G I, is the indefinite representation of G I; but since K C is the indefinite representation of I G continued to an extreme length, the representation of the part included between I and G must be found between K and C; by the same rule the representation of the part included between A and F, must be found in the line O C, and so of all other lines.

Upon the apparatus, suppose a thread were drawn from the point F through the glass or picture, to E the place of the eye or point of distance, and another thread from the point A through the glass or picture, to E the place of the eye. It is evident that these two threads coming in straight lines from F and A, to E, must pass through the glass or picture exactly where the points F and A appear upon the glass to the eye at E, and the part included between the perforation of these two threads will represent that part of the line included between A and F, the same of G I, D B, or the oblique lines A D, N G, &c. &c. Now the thread drawn from F through the glass or picture, to E the place of the eye or point of distance in the apparatus, represents a visual ray, and consequently must be a straight line; and therefore upon paper, Plate I, Fig. 2, if a line be drawn from A, the point whose representation is required through the picture, to E the place of the eye or point of distance, it will cut O C in 1, which is the representation of the point A upon the picture, and if the point F be required, a line drawn through the picture from F to E will cut O C in 2, which will be the representation of the point F on the picture, and consequently that part of the line O C included between 1 and 2, is the representation of A F upon the picture; in the same manner the representation of B D will be found upon P C, and of R S upon U C. In Plate I,

 Fig.

Fig. 4, the representation of M K will be found upon K F, by drawing lines from M and K through the picture to the place of the eye, and K I will be the representation of K M. The representation of D A will be found upon S F, and G N upon R F, and so of all other lines where a ground plan is made use of. If the perspective representation of a line parallel to the picture is required, as A B, Plate I, Fig. 2, as this line has neither an intersecting nor vanishing point; it is necessary to draw a line from each end A and B to the bottom of the picture, in order to obtain intersecting points, and as we know the centre of the picture to be always the vanishing point of lines perpendicular to the picture, it is most convenient to draw them perpendicular, as A O, B P: O is now the intersecting point of A O, and P of B P; draw O C and P C for the indefinite representation of A O and B P. If a line be drawn from A through the picture to E the eye, it will cut O C in 1 which is the representation of A upon the picture, and a line from B through the picture to E gives the representation of B upon P C at 4, join 1—4, and the representation of A B is completed in the picture.

To find the *vanishing line* of any original plane, "*a plane must be passed from the eye parallel to the original plane, and continued till it cuts the picture, and where it cuts it is the vanishing line of that original plane, and of all planes parallel to it.*" The vanishing line of an original plane is found by a method very similar to that employed in finding the vanishing point of an original line; the only difference being, that in the one a line is to be drawn from the eye to the picture parallel to the original line whose vanishing point is required; and in the other, a plane is to be passed from the eye till it cuts the picture parallel to the original plane whose vanishing line is required;

quired; where the line from the eye cuts the picture is the vanishing *point*, and where the plane from the eye cuts the picture is the vanishing *line*. As an example, let a large card, which may serve as a plane, be passed from the place of the eye in the apparatus, in a position parallel to the ground plane, till it cuts the glass or picture, and it will be found to cut it in the horizontal line; then is the horizontal line the vanishing line of the ground plane, and since the ceiling is parallel in reality to the ground, the horizontal line will be the vanishing line of the ceiling also; but this must evidently be the case, because, if the card or plane be passed in a direction parallel to the ground, it must be parallel to all other planes parallel to that, and therefore gives the vanishing line of all those planes, as a line from the eye, parallel to any original line, gives the vanishing point of all other original lines parallel to that. So that as all original *lines* parallel to each other have one and the same *vanishing point* upon the picture, all *original planes* parallel to each other have one and the same *vanishing line* in the picture. If this required any further illustration, it might, perhaps, be rendered still more evident, by supposing the spectator to be placed on the first floor of a house, and that the front of the house in the opposite side of the street was taken down so as to expose the various floors of that house, it is evident that the floor nearest the level of that upon which the spectator stands will appear the narrowest; as the eye is directed upwards each floor will appear wider and wider, but the under surface only will be seen, those below the eye again will appear wider, &c., but the upper surface will be seen, shewing, that in order to represent this appearance, all above the eye must be drawn downwards, and all below upwards; the lines meeting in a point somewhere upon the horizontal line, that is, in the vanishing line

line of those planes.—The general rules resulting from this theory will be.

1. To find the vanishing point of an original line; a line must be drawn from the place of the eye or point of distance, towards the picture, in a direction parallel to the original line, until it meets the picture, and where it meets it is the vanishing point of that original line.

2. All original lines parallel to each other must have the same vanishing point upon the picture.

3. That the vanishing line of any original plane is that of all original planes parallel to it.

4. The vanishing points of original lines will always be found in the vanishing lines of the planes in which they lay, for if the whole plane vanishes into any vanishing line, consequently every line in that plane must vanish in the same line.

5. The centre of the picture will always be the vanishing point of original lines *perpendicular* to the position or plane of the picture.

6. The vanishing point of original lines oblique to the position or plane of the picture, will be on one side or other of the centre of the picture, and will be farther from, or nearer to the centre, in proportion as their position is more or less oblique; as for example, K T upon the apparatus is more oblique to the picture than K M, and consequently a parallel to K T drawn from E, the place of the eye, will find the vanishing point farther off upon

upon the horizontal line, than the vanishing point of K M, which may be proved by putting the wire through the place of the eye E, and carrying it parallel to K T until it meets a continuation of the horizontal line, and it will be found much farther from the centre of the picture than the vanishing point of K M, and if it lies still more oblique as K V its vanishing point will be yet farther removed from the centre, till it becomes quite parallel to the picture when it has no vanishing point at all. This may be proved upon paper by finding the vanishing points of oblique lines by rule 1st.

7. Original lines parallel to the position or plane of the picture cannot have a vanishing point upon the picture, but must be drawn parallel.

Thus rules have been established for drawing lines *parallel*, *perpendicular*, and *oblique* to the picture according to the principles of Perspective; and if these be well understood, most of its difficulties may be considered as conquered; this Lecture therefore requires particular attention, as very much of the science of Perspective is dependent upon it.

LECTURE

LECTURE III.

The preceding Lecture contained that part of the Theory of Perspective relating the Vanishing Points of Lines and Vanishing Lines of Planes. The Practice depending upon that theory must now be considered, and as the Square is a figure of the utmost importance, (almost every thing being done with a reference to it,) particular attention should be paid to the method of putting it into Perspective.

LET it first be required to put the square A B D F (apparatus) into Perspective; in this case one side A B is parallel to the picture, and consequently A F and B D perpendicular to it, find the vanishing point of A F (by Rule 1, Lect. II,) and it will prove to be C the centre of the picture, (Rule 5,) which will also be the vanishing point of its parallel B D, (Rule 2,) find the intersecting points of F A, D B, at O and P, now if from O and P lines are drawn to C the centre of the picture, just found to be the vanishing point of F A, D B, these lines O C, P C will represent A F, D B, infinitely extended; and if threads, representing visual rays, are supposed to be drawn in straight lines from A and F to E the place of the eye or point of distance,

and

and the same from B and D to E, it is evident they would pass through the glass or picture exactly where the representations of A F, D B would prove to the eye at E, and these representations prove to be upon the lines O C, P C drawn from their intersecting to their vanishing points; join the points representing A B and F D, and the square is compleated.

Upon paper (Fig. 2, Pl. I,) let A B D F be the square upon the ground plan, a b c d the picture, H L the horizontal line, C the centre of the picture, and E the place of the eye or point of distance. To find the vanishing point of A F or B D a line must be drawn from E the place of the eye, parallel to the original line A F or B D, till it meets the picture, (see Rule 1,) which it does in C the centre. The lines A F and B D being perpendicular to the picture, C is found to be their vanishing point, (see Rule 5,) continue A F and D B to the bottom of the picture, and their intersecting points will be found at O and P: draw O C, P C, and you have the indefinite representation of A F, B D, infinitely extended; if from A and F lines be drawn through the picture to E the place of the eye, as by the dotted lines representing visual rays, they will cut the line O C in 1 and 2, which are the representations of the points A and F upon the picture, and if from B and D lines be drawn through the picture to E, the representations of B and D are obtained upon the picture at 3 and 4; join 1 4 and 2 3, and the square is compleated within the figures 1 2 3 4. If the ground plan consisted of a greater number of regular parts, still the operation would be the same; as for example, the line N M being continued, would find its intersecting point at X, and being parallel to A F has the same vanishing point

C, (by

C, (by Rule 2,) draw X C and you have the indefinite representation of M N, if from M and N lines be drawn to the place of the eye or point of distance E, they will give the points M and N upon X C at 5 and 6; draw lines parallel to the bottom of the picture at 5 and 6, till they meet the line O C, and the figure is compleated.

It may next be required to put the square in Perspective, having one side given in the picture; but before this is attempted, it is necessary to explain the method of cutting off any given portion from a line in Perspective. As for example, from the line A C in Perspective, (Fig. 5, Plate I,) let it be required to cut off a portion equal to the given line A B, A C is the line from which a portion is to be cut off, therefore place one foot of the compasses in the vanishing point of A C (which is C the centre of the picture) and the other foot at E the place of the eye or point of distance; transfer the point of distance E to the horizontal line at e, by making C e equal to C E; draw from B (the extreme end of A B) to e the point of distance transferred to the horizontal line, and where it cuts A C in F is the length required, and A F is in Perspective the representation of a portion equal to A B, but being foreshortened does not appear so long as A B. In the instance just given, the line A C from which the portion was to be cut off, was the representation of a line in reality *perpendicular* to the plane of the picture; for its vanishing point was the centre. (See Rule 5.)

The vanishing point of a line, already drawn in the picture, will always be formed by continuing that line till it strikes the vanishing line of the plane in which it lays, but as the

 horizontal

horizontal line is the only vanishing line made use of, hitherto the vanishing points of lines drawn in the picture will be found by continuing those lines till they strike the horizontal line.

Let it now be required to cut off a portion equal to A B (Fig. 5, Plate I,) from the *oblique* line A D. Because D is the vanishing point of A D, one foot of the compasses must be placed in D and the other in E the point of distance; transfer the point of distance to the horizontal line at f, draw from B to f, and where B f intersects A D at g, is the point required; and A g is in Perspective the representation of a line equal to A B; if A B is called twenty feet, A F or A g are each the representation of twenty feet in *Perspective*.

A sufficient proof of the truth of this method may be obtained thus: Let it be required to cut off from A C a portion equal to A B, (Fig. 5, Plate I,) complete the geometrical square A B M N upon A B; now the line A N is equal to A B being a side of the square; and being perpendicular to the picture, its representation vanishes in the centre, and A C is the indefinite representation of A N; draw from N through the picture to E the point of distance, and where it cuts A C in F is the point required, and A F is the Perspective representation of A N equal to A B, and it was found equal to A B by the method without the geometrical plan. As this rule is very useful, another proof may perhaps be allowed: draw the diagonal N B of the square A B M N; now if it be required to find the representation of the point N on the picture, it will first be necessary to find the vanishing point of the oblique line N B by drawing its parallel from E (Rule I,) and

and e is the vanishing point of N B; a line drawn from B its intersecting, to e its vanishing point, gives the indefinite representation of N B, and to find the point N upon B e in the picture, a line or visual ray must be drawn from N through the picture to E, cutting B e in F which is the representation of N, and A F is the representation of A N equal to A B, which was to be proved.

The rule for cutting off a given portion from a line in Perspective may be thus expressed: at the *vanishing point* of any line from which a given portion is to be cut off, place one foot of the compasses, and with the other transfer the point of distance to the horizontal line: upon the ground line set off the portion intended to be cut off, and draw from that point through the line in Perspective to the point of distance transferred to the horizontal line, and it will cut off the portion required. *

It will now be required to put the square in Perspective without the assistance of a ground plan, (i. e.) by having one side given in the picture, and let that side be *parallel* to the picture; for example, in the picture a b c d, (Fig. 6, Plate I,) A B is the line *given*, (i. e.) A B is the side of a square parallel in nature to the plane of the picture, and it has been shewn, that if an end of a right-angled or square object is parallel to the plane of the picture, the sides must be perpendicular to it,

* In cases where the line, from which a portion is to be cut off, does not begin at the ground line, but at some distance from it within the picture, it is generally more convenient to draw a parallel to the ground line from the nearest end of the line in Perspective, upon which line the given portion may be set off and a line drawn from thence to the point of distance transferred as before.

it, and consequently have their vanishing point in the centre; (see Rule 5,) therefore the lines drawn from A and B forming the sides of the square, must be drawn to C the centre, as A C, B C. Now A C and B C are indefinite representations of the sides of the square, and a portion is to be cut off from A C equal to A B; to do which one foot of the compasses must be placed in the vanishing point C of A C, and the other foot at E the point of distance; transfer or carry the point of distance to the horizontal line at e, and where the line drawn from B to e cuts A C in F is the point required, and A F is equal to A B, (i. e.) A F is the Perspective representation of one side of the square, of which A B is the side given; by transferring the point of distance E to the horizontal line at f on the other side of the centre, a portion may be cut off from B C at D equal to B A for the other side of the square, but since the line opposite to A B in the original square is parallel to it, and A B is parallel to the plane of the picture, a line drawn from F parallel to A B till it meets B C, will answer the purpose without the trouble of transferring the point of distance to both sides of the centre of the picture, and F D is in Perspective equal to A B, and the square A B D F is compleated.

This method may be explained thus. From the two extreme points of the given line draw to the centre of the picture which is the vanishing point of the sides of the square, set off the distance of the picture upon the horizontal line, and draw from one end of the given line through either of the forementioned, to the point of distance transferred to the horizontal line, and where that line cuts the line drawn from the other end of the given line to the vanishing point, is the point

point required; draw a parallel to the given line from that point and the square is compleated.

The square lying on the ground with one side parallel to the picture having been put in Perspective, it will now be required to put the square in Perspective, standing perpendicularly upon the ground and at right angles to the plane of the picture, (or perpendicularly to it,) having one side given as A B; (Fig. 7, Plate I,) the line of the bottom of the plane must therefore vanish in the centre, by Rule 5; and as the top and bottom are parallel to each other, they must have the same vanishing point, as A C, B C, (see Rule 2:) A B is the given side of the square, and it is necessary to cut off from B C a portion equal to A B for the bottom of the square; in order to do this draw from B a parallel to the bottom of the picture as B G, and set off upon it B D equal to A B; from C the vanishing point of B C transfer the point of distance to the horizontal line at e, and draw D e which will cut B C in I, and B I is equal in Perspective to B D, (i. e.) to A B, and consequently represents the bottom of the square; raise a perpendicular at I till it meets A C in K, and A B I K is the square required. If the plane be twice as long as high, cut off from B a length equal to twice A B as B F, draw F e and it cuts B C in N, erect the perpendicular N M, and A B N M is a plane twice as long as high; if it is required to be three times the length, make B G equal to three times A B, and draw G e which cuts B C in O, raise O P, and A B O P is a plane three times as long as high; and thus for any length. Let it now be supposed that the square plane (of which A B is the side given) stands in a position oblique to the plane of the picture, and it will consequently have its vanishing point on one side of the centre of of the picture, by Rule 6. Let I be the vanishing point of the oblique line B I upon which the square stands; draw A I; and A I, B I are indefinite representations of the top and bottom lines of the square plane. A portion must next be cut off from B I, which is done as in the preceding example, by drawing a parallel to the bottom of the picture from B, and setting off B D equal to A B; then with one foot of the compasses in I, the vanishing point of B I, and the other foot in E, transfer the point of distance to the horizontal line at 2, draw D 2, cutting B I in 3, and B 3 is equal to B D, (i. e.) to A B, and consequently represents the bottom of the oblique square. Erect a perpendicular at 3, till it meets A I in 4, and A B 3 4 is the square required. If twice the length in proportion to the height is wanted, make B F equal to twice A B, and draw F 2 cutting B I in 5, and A B 5 6 is a plane twice as long as high. The square A B 3 4 being more turned towards the eye, appears much wider than A B I K although they are the representations of the same square in reality, and A B is common to both.

Having put the square into Perspective with one side parallel to the plane of the picture, both by the ground plan and by one side given in the picture; it remains to erect a building upon this foundation: and as an immediate step to it, it may be advisable to put the cube into Perspective.* Let A B (Plate 2, Fig. 1,) be the given line, from A and B draw to C the centre as A C, B C, cut off from A C a portion equal to A B at F, and compleat the square A B D F: at A and B raise perpendiculars equal in length to A B, as A I, B G; join I G and

A B G I

* A cube is a solid figure consisting of six equal sides.

A B G I is the end of the cube parallel to the plane of the picture: from G and I draw to C the centre; raise perpendiculars at F and D till they meet I C, G C in K and M, join K M, and the cube is compleated. The same operation may be performed by No. 2, which is below the horizontal line; and also by No. 3, which is above it, the same letters of reference applying to each.

Fig. 2, Plate 2, contains buildings in Perspective one end being parallel to the plane of the picture, and having the same letters of reference with the cubes Fig. 1; excepting those which are hidden by the solidity of the building. A B Fig. 2 is the line given, let the height of the building be equal to A B, draw A I, B G; join I G and A I B G is the end of the building, No. 1; the same may be done by No. 2, and as the building is to be *twice* as long as it is high, a length equal to twice B G must be set off upon the base line, as B O, draw from O to the point of distance e upon the horizontal line, and it cuts B C in D, and B D is the representation of a portion equal to twice B G; compleat the figure, and B G K D is the side of the building perpendicular to the picture, and C is its vanishing point, (Rule 5,) the chimnies having one side parallel to B G K D must have C for the vanishing point of that side; the upper and lower lines of the windows being parallel in nature to G K or B D must have the same vanishing point, (Rule 2.) Having drawn the chimney nearest the eye at N, and knowing the other to be of the same height and size, draw from the upper corners to the vanishing point C, and these lines will give the proportion to the other, as is seen by the dotted lines. The windows in the end parallel to the picture, having their upper and lower lines

 parallel

parallel also to the picture, will consequently be drawn parallel and not vanish in any point; the same operation must be performed in putting No. 3 in Perspective, except that it is better to transfer the point of distance to f and draw from P to f, and A C will be cut at F, and A F in Perspective will equal twice A I. In the centre building the end only is seen; but a considerable portion of one side of each of the others appears. If the centre building No. 1 be removed, the two sides No. 2 and 3 may be continued to a regular street by making the length equal to 20 or 30 times instead of only twice. The same building above the horizontal line as at No. 4, will, from its situation, have its lines directed downwards toward the vanishing point.

LECTURE

LECTURE IV.

In the last Lecture the Square was put into Perspective, having one side parallel *to the Picture, both by the ground plan, and by one side given in the Picture; buildings were also put into Perspective with one side parallel to the Picture. The method of putting the Square into Perspective when neither of its sides are parallel to the Plane of the Picture, but every side oblique, will now be explained.*

LET K N G M be the square in the ground plan, (Fig. 3, Plate II,) the sides of this square are all oblique to x y the ground line or bottom of the picture; E is the point of distance, C the centre of the picture, and H L the horizontal line. The picture being thus prepared, find the vanishing point of the side G M or of its parallel N K by Rule I, and I will be the vanishing point required; by the same Rule S will prove the vanishing point of G N or of its parallel M K; continue G M and G N to their respective intersecting points Q and R, draw from Q and K to S the vanishing point of G M and N K, and from R and K to I the vanishing point of G N and M K, and

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the points in which they intersect each other in the picture at k n g m give the representation required. This may be proved by drawing lines from the points G M N K in the ground plan through the picture to E the point of distance, and they will pass through the same points k n g m in the picture. The method of finding the vanishing points of lines was so fully explained in the second Lecture, that it will be unnecessary to repeat this example upon the apparatus, but those who wish to do it may find the vanishing and intersecting points of the square K M G N on the apparatus, and covering the ground plan, compleat the figure upon the glass or picture by the rules of Perspective; remove the covering from the plan, and if the vanishing and intersecting points are true, the representation upon the glass will appear to the eye at E to be the exact tracing of the original square upon the ground plan.

Let it now be required to draw the square in Perspective when oblique to the picture, having one side *given* upon the picture, and let K m be the given side, Plate II, Fig. 3, (it is supposed that the line k m is the only line *first* drawn in the picture, as in No. 1, and that the square is to be compleated upon that line K m Fig. 3, as one of its sides) continue K m to the horizontal line, and where it meets it at I is its vanishing point, but in order to find the vanishing point of the other side of the square, a line must first be drawn from I the vanishing point of K m, to E the point of distance, and since a square is formed of *right* angles, a *right* angle must be made at the point of distance E with the line I E; continue the line forming the right angle with I E, from E till it meets the

the horizontal line, which it must do at s, thus is s the vanishing point of the other side of the square; draw K S: but a portion must be cut off from K S equal to the *given* side K m, and in order to find the *real* length of K m, (for K m is the Perspective or fore-shortened appearance of a certain length,) one foot of the compasses must be placed in I the vanishing point of K m, and the point of distance E transferred to the horizontal line at *e*, (making I *e* equal to I E,) draw from *e* through *m*, and it will meet the bottom of the picture at o, then is K o the real length of which K m is the representation upon the picture: from K set off a distance equal to K o on the other side of K as K P; set one foot of the compasses in s the vanishing point of K s, and transfer the point of distance E to the horizontal line at f; making s f equal to s E, draw from P to f and the point in which it intersects K s at *n* gives the representation in Perspective of a portion equal to K P, (i. e.) to K m, which was required: and because, of the four sides of a square two and two must be parallel to each other in reality, the representation of those sides will have the same vanishing points, (Rule 2,) draw n I and m s, and where they intersect at *g* compleats the square K *m g n*. The truth of this requires no other proof than that the same diagram answers for both demonstrations, whether the *ground plan* is used or a *line given* in the picture.

A *building* may now be put into Perspective viewed upon the angle, or having *neither* side *parallel* to the picture, but every side *oblique;* and K A (Plate II, Fig. 4,) shall be a perpendicular to the ground representing the corner of the building nearest the eye, and K n the inclination of the base line of the same building upwards, as near as the person about to

draw

draw it from nature can judge;* continue K n to the horizontal line, and where it meets it at S is the vanishing point of K n, and consequently the vanishing point of the top line of that side of the building from A, because the top and bottom of the *same* side are in reality parallel to each other. Draw A S: upon n, erect a perpendicular till it meets A S in B, and K A B n is one side of the building viewed upon the angle; the representation of the other side of the building is found by the foregoing rule, thus; draw from S the vanishing point of K n to E the point of distance, and at E make a right angle with S E, and continue the line till it meets the horizontal line at I, and I is the vanishing point of the other side of the building, as in the foregoing example of the square; draw K I and A I, and if each side of the building is as long as it is high, set off K P and K O upon a parallel to the bottom of the picture at K; equal to K A. Find e and f (the transferred distances) as before, and draw from P to f and from O to e, and the points n and m will be found upon K S and K I, erect the perpendicular m D; (n B being already drawn,) and the sides of the building are put in Perspective. The top of the roof, chimnies, windows, &c. will of course go to the vanishing points of their respective sides; suppose another building upon Q R, with Q T for its height; by continuing Q R to the horizontal line, its vanishing point will be found at V, and by proceeding as in the last case, the other vanishing point will be at W; compleat the figure as before.

This rule may be thus given. Having drawn the perpendicular

* It is of no consequence whether the upper or lower line is taken as the line given, but the line farthest from the horizontal line, is to be preferred, because its apparent inclination will be more evident.

dicular representing the angle nearest the eye of the building viewed obliquely, and determined as near as possible the inclination of the top, or bottom line of either side, (for, as before observed, it is of no consequence with which the operation is begun,) continue the line till it meets the horizontal line which is the vanishing point of that line, and of all lines parallel to it; draw from that vanishing point to the place of the eye or point of distance, and there make a *right angle;* continue the line to the horizontal line, and where it meets it, is the vanishing point of the other side, and also of all lines parallel to the top or bottom of the other side of the building.

In the example just given, the angle at the eye was to be a *right angle*, because the object was a *right angled* object, and that which most commonly occurs in buildings: but in every case, whatever may be the form of the original object, a similar angle must be made at the eye, in order to obtain its vanishing points.

Let it now be required to find the point of distance, with which any right angled building viewed upon the angle was drawn, having the two vanishing points and centre of the picture given. Suppose the building D A B n K m (Plate II, Fig. 4,) to have been drawn from nature; by continuing the lines K n or K m to the horizontal line, S and I will prove the vanishing points, C is the centre of the picture, and since the point of distance is always in a line perpendicular to the centre of the picture, draw C E at pleasure, upon C E assume a point as F; by laying a ruler from either of the vanishing points S or I to the point F, say S, it will be seen whether a right angle at that point, with

with such line, will meet the horizontal line in the other vanishing point I; and if it does not, the point F is not the point of distance required, but too short; for the second vanishing point would fall considerably nearer the centre of the picture than I. Assume the point G and it will be found too great, for the second vanishing point would fall beyond the point I; the true point of distance then lies between F and G, and will be found at E, where the right angle made with S E strikes the horizontal line exactly in I.

This will be found of great use where there are many regular objects in the same sketch, for having thus obtained the point of distance by means of the nearest object which is presumed to have been drawn with attention, the other may be corrected by the same point of distance, and their respective vanishing points, &c. determined.

It is recommended to every one who wishes to become thoroughly acquainted with these rules, to draw all the figures in their order according to the directions given in the general rules.

Thus have *right angled* buildings been put into Perspective, both when viewed with one side parallel to the plane of the picture, and when viewed upon the angle, and as the *right angle* is most generally used in the construction of buildings, these rules, well understood, will be found of great utility.

THE CIRCLE.

IN representing the Circle according to the rules of art, the square is found so necessary that the method of putting it into Perspective should be perfectly understood, and also that of cutting off any given portion from a line in Perspective, before the circle, or any figure depending upon it, can be attempted with success.

Let it be requiréd to put the circle into Perspective by the ground plan R M S K, (Plate III, Fig. 1,) draw the diameters R S, K M; describe a square about the circle touching the ends of the diameters in R M S and K; put the square A F B D into Perspective and also the diameter R S, (by drawing it to its vanishing point C the centre of the picture,) and R C is cut by B e at *p*, which is the representation of the centre P of the circle; for if a portion was required to be cut off from R C equal to R B, (i. e.) equal to R P, it would be done by drawing a line from B through R C to *e* the point of distance transferred to the horizontal line, and B e cuts R C in *p*, therefore *p* is the representation of the point P (i. e.) of the centre of the circle. *Through* the point *p* draw a parallel to the

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bottom of the picture, and the representation of the diameter K M is obtained at k m; therefore k m is the representation of one diameter and R S of the other; and if an oval be described through the points R m S k, it will represent the circle R M S K in Perspective. This carefully done will be sufficient for common purposes, but when a greater degree of accuracy is required, diagonals may be drawn in the ground plan, as F B, A D, and through their intersections with the circumference of the circle at 1 2 3 and 4, draw the lines N O, G I, T V, and U W; put T V and U W into Perspective, and the diagonal A D, by drawing it to d as A d, and where the diagonals A d and B f, cut W C and V C, draw the parallels n o and g i, and the points 1 2 3 and 4 are obtained upon the picture; draw an oval through S 2 k 1 R 4 m 3, and it is the representation of the circle R 1 K 2 S 3 M 4.

The circle may also be put into Perspective, having one diameter given in the picture, as A B No. 2, Fig. 1; find the centre O of the diameter A B, which is the centre of the circle and also of the square in which it is described. The square of which A B is one diameter and O the centre, must first be put into Perspective; and since the given diameter is parallel to the picture, the sides of the square must be perpendicular to it, and therefore lines must be drawn from the vanishing point of the sides of the square (which is C the centre of the picture) through A, O, and B: transfer the point of distance to the horizontal line at e, and from e draw through O the centre of the circle and it will cut the line B C in M, and it will also cut G A continued in I. At M and I draw parallels to A B, as G M, I K, and G M K I is a square in Perspective of which A B is the diameter parallel to the picture, and consequently

consequently F D is the other or foreshortened diameter; draw an oval through the points F A D B, and it is the representation of a circle in Perspective whose given diameter was A B parallel to the picture.* This rule is useful for representing columns, round towers, or any other circular objects in Perspective in any part of the picture. As for example, if a circular piece of water form part of a scene in nature, its diameter parallel to the picture may easily be determined by its apparent proportion to the other objects already drawn, and the form of the oval be decided by the foregoing rule. Again, suppose A D B F, (Plate III, Fig 1,) No. 3, the base of a circular tower whose height is B N, and it is required to find the degree of curvature of the top and of the bottom; B N and A P are the sides of the tower, and P N the longest diameter of the circle at the top: first put the circle on the ground into Perspective, whose given diameter is A B, (in the same manner as No. 2,) then proceed with the top exactly as in the former case, by finding the centre of the given diameter P N at O, and O is the centre of the circle; draw from the vanishing point C through the points P, O, and N, and from e through the centre of the circle O, and it will cut P C in S, and C N if continued in V; draw the parallels S T, V U, and the shortest diameter R Q is obtained; draw an oval through the points P Q N R, and the representation of the top of the tower is compleated.

If a circle were to be described upon the diameter X Y so much nearer the horizontal line, it would have the appearance of a flatter oval, and, if *upon* the horizontal line, would

 appear

* The diameter may be taken parallel to the picture in most cases.

appear only a line as Z &c, which may be easily seen by proceeding at those points according to rule.

Thus far relates to circles laying upon the ground or in planes parallel to the horizon, but as carriage wheels, water wheels, &c. often occur, it will be necessary to shew how they are to be put into Perspective. Let it first be required to put a wheel into Perspective standing upright, or perpendicular to the ground, and in a position perpendicular also to the *plane* of the picture: its *given* height or longest diameter is A B, (Fig. 2, Plate III.) Proceed as in the former example by finding the centre O of the given diameter A B, and as the wheel stands perpendicular to the *plane* of the picture, the top and the bottom of the square in which the circle (or wheel) is to be described, must be drawn to C the centre of the picture as the vanishing point; (see Rule 2,) draw from the vanishing point C through A O B, and since B A is the *whole* diameter of the wheel, B O is the half of it: one half of the diameter of the wheel is required upon O C and the other half upon O P; in order to find the half upon O C, a portion must be cut off from B C, equal to B O, (i. e.) half the diameter; draw a parallel to the bottom of the picture from B, and set off B D equal to B O: draw from D to e (the point of distance transferred to the horizontal line) and B C is cut at F, then is B F the representation of a portion equal to B O: raise the perpendicular F G at F, and O C is cut at I, then is O I the representation of a portion equal to B O, or half the diameter, and B A G F is one half of the square in which the circle is to be described, and in order to find the other half on the other side of A B, draw from either of the corners of the square F, or G, through O its centre, till it meets the line C A continued

C A continued in K, or C B in M; raise the perpendicular M K, and the square F G K M is put into Perspective whose given or longest diameter is A B, and shortest found to be I P; draw an oval through the points A P B I and the wheel is compleated in Perspective. If another wheel of the same height stood nearer the centre of the picture or almost opposite the eye, as W U, the oval representing it would appear narrower, as may be seen in the figure. Let R S be the diameter of a wheel standing in an oblique direction and represented in the same picture, its vanishing point being at 3; the operation is the same as in the preceding case, only using the vanishing point 3 instead of C the centre of the picture; the point of distance transferred will be at 4 upon the horizontal line, and the shortest diameter found to be V T; draw an oval through the points R V S T, and the figure of the wheel is represented as required.*

A water wheel adjoining a mill will have the same position with regard to the picture, with the side of the mill to which it is fixed; and having drawn its *longest* diameter, its *shortest* may be determined by the rule, and the wheel compleated in Perspective, but as water wheels are frequently very broad, it may sometimes be necessary to describe a circle perspectively upon the inner as well as the outer circle.

In the first example of wheels standing upon the ground, when the half of the square B A G F was found; it was said, that in order to find the other half, lines should be drawn from

* The disadvantage of too short a distance is here evident, the nearer half T R S of the circle appearing disproportioned to the farther half V R S; this is unavoidable from want of sufficient space in the plates.

from the corners G, and F, through O the centre of the circle or wheel, and where those lines met C B, or C A continued, the other corners of the square were found, and a perpendicular raised from M to K would compleat the square M F G K. This may be easily proved by considering, that if diagonal lines are drawn from the corners of a square, they will intersect exactly in the centre; therefore, if from the two corners F and G of the square in *Perspective*, diagonal lines be drawn through the centre O, they will of course find the other corners by their junction with the two lines G A, F B continued. This method is very useful; for, if a door be in the middle of one side of a building thrown into Perspective, it is easy to determine its place, by drawing diagonals from the corners, and in their passage they will intersect in the centre, which centre will appear nearer to one end than the other, as may be seen in the example, where A B D F (Fig. 4, Plate III,) is the side of a building in Perspective, the diagonals cross each other at O, which is the *centre* in Perspective, of the side A B D F; the centre of the door would therefore be immediately under the point O and the middle window, if there be an odd number, as 5, 7, 9, &c. directly over that point as in the figure, but O appears much nearer to the end D B, than to the end F A, for the side of the building being seen in Perspective, the half nearest the eye will appear to occupy more space upon the picture, than the half farthest from it. By this method the centre house of a street may be determined, for if A B D F be considered as one side of a street consisting of 5, 7, 9, &c. houses, the point O would give the middle of the door of the centre house, &c. &c.

Doors or casements, when open, may be represented with great

great accuracy by means of the circle, for a door describes a compleat semicircle in revolving upon its hinge till checked by the wall; for let A B D F (Plate VIII, Fig. 6,) be the door, in its revolution upon its hinge A F it would describe a semicircle upon the ground which in perspective, (the distance of the picture being C E, and its transferred distance at e,) would be B I G; suppose the door opened as far as M, and A M represents the bottom of the door, continue the line A M till it meets the horizontal line at O, and O is its vanishing point; draw from O through F at pleasure, raise a perpendicular from M till it cuts O F continued, which it does at N, and M N F A is the representation of the door thus far opened. Let the door be supposed to open to the point K, continue K A to its vanishing point P, draw from P through F at pleasure, raise the perpendicular K R, and the door K R F A is compleated, for the upper and lower lines of the door being parallel to each other must have the same vanishing point. The same operation will answer equally well for windows, whether above or below the horizontal line.

If the door or window should be situated obliquely with respect to the picture, so that the vanishing point does not fall in the centre, a circle must be described upon the oblique diameter by means of the square, but in this case a second vanishing point must be found (as in the preceding part of this lecture,) for the other diameter.

LECTURE

LECTURE V.

The method of putting the Square and Circle into Perspective; Buildings both parallel and oblique to the Picture, round Towers, Columns, &c. has been explained: it now remains to shew how to give a due proportion to objects in any part of the Picture, &c.

UPON the glass in the apparatus, the lines from 1 to 3 and from 6 to 4, would, if continued, meet in a point upon the horizontal line, and as both vanish in the same point, they are the representation of original lines parallel to each other, and since the lines representing from 1 to 6, 2 to 5, and from 3 to 4 are the representations of lines of equal length, it is evident, that if any line be drawn parallel to 1, 6 between the two lines 1 c and 6 c, it will be the Perspective representation of a line equal in length to 1, 6, and when near the horizontal line will appear very short, because it represents a line very far removed from the eye. Plate 2, Fig. 5, the points 1, II, III, IV, V, 6, in the ground plan, are represented by 1, 2, 3, 4, 5, 6, on the picture, and from 3 to 4 is evidently the representation of III, IV, in the ground plan, but III, IV, is in reality as long as 1, 6, and 8, 9, is by the same reason equal in Perspective to 1, 6, therefore if from 1, to 6, be called six feet, from 8, to 9, is also six feet, but appears much shorter, because it is farther removed from the eye: if it were required to place an object six feet in length at a given point in the picture, as at A, it would be done by laying the ruler from A in a direction parallel to the bottom of the picture till it meet 1 C, in 7, there draw the parallel 7, 7, till it meet 6, C, measure 7, 7, and place it at A, and A B is a length in that part of the picture equal to six feet. If a length equal to six feet be wanted at D, draw from D a parallel to the bottom of the picture till it meets 6 C at 5, draw 5, 2, measure 5, 2 with compasses, and place it at D and D F represents six feet at D; by the same rule G M represents 6 feet at G. This method will do for objects lying upon the ground, or in planes parallel to the horizon, but if it be required to give to the human figure, or any other object standing upon the ground, its due proportion in any part of the picture, it will be necessary to make use of a line called the line of elevation: this is an exact resemblance of the forementioned line, except that it is raised perpendicular to the ground, instead of laying upon it. As for example, let 1, 6 be called six feet, or the height of a man; raise a perpendicular at 1 equal to 1, 6, as I, K, and by drawing from K to the same vanishing point as 1, C, we know that all perpendiculars between the lines 1, C, and K, C, will be the Perspective representations of lines equally high with 1, K, because I C and R C represent lines parallel to each other: this may be seen in the apparatus upon the glass as before, where the lines representing from 1 to 3, and from 7 to 9 meet in one point in the picture if continued, and the line representing from 3 to 9, is the Perspective representation of a line equally high with 1, 7; therefore

therefore in order to put a figure six feet high in Perspective at A, (Fig. 5.) a line must be drawn from A parallel to the bottom of the picture till it cuts 1 C in 7; raise the perpendicular 7 N, measure this line with compasses and place it at A, then is the perpendicular A b, the Perspective representation of six feet at A, or the height of a man. If it be required at D, a parallel to the bottom of the picture from D will cut 1 C in 2, raise the perpendicular 2, O, and place it upon D, then is D, d, the Perspective representation of six feet at D; if the same thing be required at P, draw the parallel from P and it will cut 1 C in a, raise a X and place its height upon P, and P i is the Perspective representation of six feet. If any other height be required, the line of elevation must be carried higher; as for example, if eight feet be wanted in any part of the picture, it must be raised to R by adding two feet to 1 K, and 1 R will be the representation of eight feet, and all perpendiculars between 1 C and R C, are the Perspective representation of lines equal to eight feet. It is of no consequence what part of the horizontal line is chosen for the vanishing point of the lines from the top and bottom of the line of elevation, as may be seen by supposing Q to be the point, and if the same operation be performed, (i. e.) drawing the parallels to 1 Q instead of 1 C; the lines will be found exactly the same length as when done by the other vanishing point; hence it will be perceived that the line of elevation may be placed out of the margin of the picture, in order to avoid a confusion of lines, but care must be taken that it stands upon a continuation of the bottom of the picture, and that the vanishing point of the lines from the top and bottom of it be upon a continuation of the horizontal line.

If the proportional height of a figure standing in a balcony be required, a perpendicular must be let fall from the feet of the figure to the ground, and the proportion obtained as if standing upon the ground, which proportion may then be placed in the balcony at any height, provided it be immediately above the point before mentioned; as for instance, if it be required to place a figure upon the point W, (Plate II, Fig. 5,) a perpendicular must be let fall from W to the ground at X, and the parallel will cut I C in 2, and 2 O will the height required, which must be measured and placed upon W as W T, for whether an object stand upon the ground plane, or upon a considerable elevation, its apparent height will be the same, if the distance of the picture be not too short. Two figures, one on the top of the Monument of London, and the other at the Base, would undoubtedly appear of very unequal proportions to a spectator, in Monument Yard, for the one on the top would be much farther from him than the other, and appear considerably foreshortened; but let the spectator retire to the opposite side of London Bridge, and there will be no sensible difference in the apparent heights of the two figures, for their distances from his eye will be very nearly equal. The figure in the balconette, (see frontispiece,) appears of the same height, that it would do if standing upon the pavement immediately under the balconette, and its proportion is determined from that point upon the pavement.

The most certain method of putting arches into Perspective, is by having the exact dimensions of one of them, and placing it upon the picture; as for example: let A B (Fig. 3, Plate III,) be the width from pillar to pillar, suppose it to be called ten feet, and the height to the capital as B D twice its width

width, or twenty feet, the height of the point of the arch from the capital may be ten more feet, so that the whole from B to G is thirty feet. At D draw D F parallel to A B, describe the arch D I F according to actual measurement, and draw G K through I parallel to A B; draw the diagonals F G D K, and through the points 1 and 2, where they cut the arch, draw the line R S, then put the row of pillars in perspective according to its position with regard to the plane of the picture; if perpendicular to the picture C the center will be the vanishing point, but if oblique, the vanishing point will be found in some other part of the horizontal line; in the present case let the centre be the vanishing point, and draw B C, G C, then set off B M equal to A B, and M T equal to whatever may be the width of the pillar B D; draw from M to e (the point of distance transferred to the horizontal line) and it will cut B C in N, and B N will be the Perspective representation of a space equal to A B, or to the distance between the pillars; draw N Q, then from T draw to e, and B C is cut in u, therefore N u represents the width of the pillar; raise a perpendicular at u. To put the line R S into Perspective, draw S C, and to put F D into Perspective draw D C. Draw the diagonals Q D and G P, and their intersection with each other gives the centre over which the point of the arch must be placed at V; draw the arch from V through the points 1 and 2, where the diagonals G P, Q D cut S C, as V 1 D, V 2 P, and it is of the same form in Perspective with the original plan F I D: the space between the two next pillars may be obtained by setting off a distance from T equal to A B, as T W, and a line drawn from W to e would cut B C in X, and u X will be the distance between the second and third pillars: but as this method would be very inconvenient if there were many

many pillars, owing to the space required for setting off the distances, it is better to draw from M to the vanishing point C of B N; then since B C and M C vanish in the same point, they must represent original lines parallel to each other, and u o will be the representation of a length equal in perspective to B M; draw from o to e, and it cuts B C in the same point x as it would have done if drawn from w to e, and therefore answers equally well in its operation, and is much more convenient; raise the perpendicular at x, and by the diagonals as before, put the next arch into Perspective. To get the width of the next pillar at x, draw from y to e, for o y is the representation of a line equal in Perspective to M T, for the same reason that u o was the representation of one equally long in Perspective with B M; and therefore drawing from y to e answers the same purpose as continuing the measurement from w to z, for both cut B C in the same point: the distance between the third and fourth pillars, &c. may be obtained by repeating the same operation. It may be here observed, that if the first arch in Perspective, as B D V P N, were drawn from nature, that by drawing from C (the vanishing point of the line of the top of the arches) through V as far as G, and continuing the perpendiculars B D to G, and N P to Q, that the diagonals G P, D Q, being drawn, would cut the arch in the points 1 and 2, through which points a line should be drawn to the vanishing point C, and if the arch is correctly drawn, this line will pass through the two points of intersection and the vanishing point, but not so if incorrectly; the other arches might be put into Perspective, as in the preceding example. If there be a corresponding row of arches parallel to the first, the lines they stand upon will consequently be drawn towards the same vanishing point; and lines

lines from the first pillars drawn parallel to the bottom of the picture, till they meet the line upon which the other row stands, will give the place of the corresponding pillars, except when they are viewed obliquely.

In the last example the pillars are expressed by one line only; but in order to give them their true dimensions, let A B (Plate IX, Fig. 3,) be the width of the square pillar, D E the capital; cut off from B C a portion equal to A B or B F, as B G, raise the perpendicular G I, draw E C, cutting G I in I, and the pillar is compleated; let F K be the space between the pillars, draw from K to e, and B C is cut in M, raise the perpendicular M N till it meets E C, continue the perpendiculars G I, M N, till they meet the line O C in P and Q, draw the diagonals Q I, P N, and their intersection gives the centre, immediately over which is the point of the arch at R, draw S C, and then the arch through their points of intersection at 1, 2, as in the preceding example. From A draw to C cutting M T in T, then is M T perspectively equal to A B, raise the perpendicular T V, and M N V T is equal to B E D A; from V describe the inner line of the arch, and the first arch is compleated; or if great accuracy is required, the inner arch may be described perspectively upon T V, W E, as is marked by the dotted lines. Draw M X; from F draw to C cutting M X in Y, and from K to C cutting it in X, then from Y to e gives M Z for the face of the next pillar, and X e gives Z a for the second space, &c. &c. Square pillars have here been chosen because the square must be first described in order to represent circular columns.

The same mode of proceeding will answer equally well for

for a bridge; as for example, let the bridge consist of five arches, the first and last of which may be called eight yards wide, the second and fourth ten, and the centre arch fifteen; the width of the piers between each arch four yards. If the first arch of the bridge begins from the bottom of the picture A D, (Plate 3, Fig. 5,) set off its dimensions from A towards D, making the first arch from A to F equal to eight equal parts or yards; the next division four equal parts for the first pier, then ten of the same dimensions for the second arch, the next pier to occupy four, and so on.* Let G be the vanishing point of the bridge, and A G will be its inclination towards the horizontal line; set one foot of the compasses in G, its vanishing point, and transfer the place of the eye or point of distance to the horizontal line, draw from F to e, and it cuts A B in I, then A I is the width of the first arch, a line from k to e cuts A B in M, and I M is the width of the first pier; from N to e cuts A B in O, and gives the width of the second arch; the next pier and the other arches may be obtained in the same manner; but to determine their height in Perspective, the line of elevation must be used; as for example, suppose the height of the first arch equal to its width (i. e.) to ten yards, make the line of elevation A Q of any height at pleasure, and upon it set off ten of the equal parts from the bottom, as A R, and a line drawn from R to the vanishing point, will give the height of the first and last arches; the second arch is thirteen yards high, therefore if from S a line be drawn to G, it will give its Perspective height, and also that of the fourth arch. The centre arch is fifteen yards high, therefore

* If the bridge begins farther within the picture, a parallel to the bottom of the picture may be drawn from the nearest end of the bridge, as A, and the dimensions set off upon it proportioned according to the situation of the parallel in the picture.

therefore fifteen equal parts or yards must be set off upon the line of elevation, and T G drawn; from the middle point between R and V, raise a perpendicular to T G, and the height of the middle arch is obtained. In order to give to the first and last arches the same degree of curvature, the plan of the arch Z A must be made,* and the line X U put into Perspective, which line intersects the diagonals of the last arch in the points through which the arch is to be drawn. If great precision be required, a plan may easily be made for the second arch; as for example, erase the plan of the first arch, and as A is the point of junction between the two lines A B and A D, raise a perpendicular at A, equal to the height of the second arch, thirteen yards: there make the plan of the arch thirteen yards high and thirteen wide, and of the exact form of the second arch, draw the diagonals and also the line passing through the intersections of the arch by the diagonals; put that line in Perspective, and it will cut the diagonals of the second and fourth in the points through which the arch is to be drawn, compleat the arch as before.

* This may be done in pencil, and afterwards erased.

STEPS IN PERSPECTIVE.

FIRST parallel to the plane of the picture, let A B (Pl. 4, Fig. 1.) be the length of the step A D its height, draw D F parallel to A B, join B F and A D F B is the face of the bottom step. From D and F, draw to G the center of the picture, because the lines forming the sides of the tread of the steps are perpendicular to the plane of the picture (Rule 3.) In order to cut off from D C a portion equal to A D (i. e.) the height of the step, measure A D and place it upon D F at d, draw from d, to the point of distance transferred to the horizontal line, and D C will be cut in I, and D I is the Perspective representation of a portion equal to D d or A D. From I draw a parallel to the bottom of the picture, and it will cut F C in G, and D F G I will represent the surface or tread of the lowest step, upon which the foot will be placed in ascending or descending. In order to give to each step its proportional height, raise the perpendicular A R and make D 2 equal to A D or the height of the step, draw Q C, and it cuts the perpendicular I N in N, and thereby gives the height of the second step; draw N M parallel to the bottom of the picture, and raise G M, and I G M N is the face of the second step,

make

make N n equal to N I, and draw from n to the point of distance transferred, and it gives the point K, for the width of the second step: draw the parallel K O, and N M O K is the tread of the second step. Proceed in the same manner for any number of steps required.

When the steps are obliquely situated, as A B, for example, (Pl. 4, Fig. 2,) the second vanishing point must be obtained by means of the first, as in the square viewed upon the angle, and A D being the height of the first step, D F must be drawn to the vanishing point of A B, because parallel to it in reality. Join B F, and A B F D is the face of the bottom step; but the tread of the step being at right angles to A D B F, must consequently go to the other vanishing point; draw D f F f, next draw a parallel to the bottom of the picture from D, and set off D d equal to A D, and a line from d to V, the point of distance transferred to the horizontal line, cuts D F in I; and D I is the Perspective representation of a portion equal to D d, or A D; draw from I to the vanishing point of D F, and F f is cut in G, then D F G I becomes the representation of the tread of the lowest step; or draw the parallel A Q, and upon it set off the intended width of the steps as A 1, 1 2, 2 3, &c. &c. draw from 1, 2, 3, &c. to V and A f will be cut in x y z, &c. where perpendiculars may be raised for the 2, 3, 4, steps, &c. and the widths required will be obtained. Raise the perpendicular A R, and make D Q equal to A D, and draw Q f, which by cutting the perpendicular I M in M determines the height of the second step, and by proceeding as before any number of steps may be represented.

For circular steps the diameter of the lowest must be first

 taken

taken as A B (Pl. 4, Fig. 3,) and a circle described upon it, A D B will be the visible part of the bottom of the step; raise the perpendiculars A F and B G equal to the height of the step, and F G will be the diameter of the upper surface of the lowest step: describe a circle upon the diameter F G; and F I G, B D A will give the representation of the first step; let k M be the lowest diameter of the second step: describe a circle upon it, and k O M is the visible part; raise k N, and M P, for the heighth of the second step, and N P is the diameter of its upper surface, upon which describe the perspective circle N Q P R, and two steps are compleated; by the same method any number of circular steps may be put into Perspective.

LECTURE

LECTURE VI.

Treats of Vanishing Lines in general. The Perspective of Shadows, &c.

THE horizontal line has hitherto been the only vanishing line made use of, it now becomes necessary to explain the nature of vanishing lines in general, and to shew their practical application. The more scientific definition of a vanishing line is, that *it is a line described upon the picture by a plane passing from the eye through the picture, parallel to the plane whose vanishing line is required.* Thus upon the apparatus: if a plane of pasteboard or card S be placed from the eye E (see Pl. 6. Fig. 1,) parallel to the ground plane X, and continued to the glass or picture, it will meet it in the horizontal line H L, which is the vanishing line of all horizontal planes; but if a bent card representing the roof of a building, like A D B r t, be placed upon the ground plane, then planes carried from the eye to the picture parallel to the respective inclined sides, will describe their vanishing lines upon the glass or picture above or below the horizontal line, according to the inclination of the original planes: the vanishing line of the plane r at P O, above

above the horizontal line; that of the plane t at v w, below the horizontal line. The plane A D B being perpendicular both to the ground and picture, will have its vanishing line pass through C, the centre of the picture, because a plane from the eye parallel to A D B will cut the picture in N C M. The vanishing line of plane a (Pl. 6, Fig. 2,) will be found at D F, by the plane A passing through the eye and picture parallel to it; that of the plane b will be found at G I, by the parallel plane B cutting the picture in that line, thus the vanishing lines of all planes which are *perpendicular to the ground*, will be *perpendicular to the horizontal line* in the picture.

In order to find the place of the vanishing line of any original plane, a line must be drawn from the eye to the picture, making an angle with the horizontal plane equal to the angle made by the original plane with the ground plane, as for example, the line E N. (Fig. 1, Pl. 6,) makes an angle with the horizontal plane S, or line E C, equal to the angle made by the line D B with A B, or the ground plane, and gives N for the point through which P O the vanishing line of the plane r is to be drawn; for the descending plane the same angle must be made with the horizontal plane S that the original plane makes with a parallel to the ground F D, as F D A, thus the line E M makes the same angle with the plane S, or line E C, that D A does with F D; and since M N is the *vanishing line* of the plane A D B, N will be the *vanishing point* of the line B D, and its parallel, and M the *vanishing point* of D A, and its parallel, P O the *vanishing line* of the plane r, and V W, that of the plane t, and hence we see that the *vanishing points* of *lines* must fall in the *vanishing lines* of the *planes* in which they lay.

To

To put this into practice; if a plane ascends in an angle of twenty-nine degrees, that is, makes such an angle with the ground plane, we must make the same angle (ascending) at the eye, but from necessity this angle must be made at the *point of distance transferred* upon the horizontal line, as in Pl. 6, Fig. 3, where E is the point of distance, C the centre of the picture, and *E* upon the moveable plane when raised represents the natural place of the eye, as in the apparatus; raise the plane E C D *E* and also the original plane e c d, and the angle C *E* D is by construction equal to the angle c e d, therefore *E* D being parallel to e d, gives D for the vanishing point of e d, and also the height of the vanishing line of the plane r, (Fig. 1.) Lay the moveable planes flat, and the angles still remain similar, but the line *E* D is now drawn from the *transferred distance* upon the horizontal line to the picture, and cuts it in the same point D upon the vanishing line of the perpendicular plane c e d. From hence we have the means of representing uphill or downhill views when regular buildings occur, for let the plane r, (Fig. 1,) be considered as an ascending road, bounded by two walls upon the lines B D, and its parallel; the vanishing line of the plane r is P O, passing through N, and N is the vanishing point of the two sides of the plane r, for E N is drawn parallel to B D. In practice let A B, (Fig. 4, Pl. 6,) be the width of the road, A 1, B 2, the height of the walls, and the angle the hill makes with the ground plane equal to the angle a b c; c is the centre of the picture, and E the point of distance, draw a line from E through C, as E G, which is the vanishing line of planes perpendicular to the ground and picture; transfer the distance to the horizontal line at e, and draw e F, making an angle with c e equal to the angle which b c makes with a b, and

and F becomes the vanishing point of the sides of the road, or walls; therefore draw from A and B to F, and also from 1 and 2 to F, and you have the representation of the two walls: if houses occur, the lines which are in planes parallel to the horizon, as the upper and lower parts of the window frames, tops of the houses, &c. will vanish in the horizontal line; but if it be required to represent a second house of equal height farther up the hill, a line must be drawn from the highest point of the first house to the point F, as in the figure, and it will give the height of the second, &c. if the road inclined either to the right or left, its vanishing point would be on one side of F, upon N M the vanishing line of the ascending plane or hill; the same operation must be performed for a descending plane, or down hill, the vanishing line being below the horizontal line; as for example, if the angle made by the descent with the ground plane is equal to f g h, the same angle must be made at e, the transferred distance, as C e G; through G draw A G B, and you have the vanishing line of the descending plane. The proportion of the human figure, &c. may be determined as before taught, except that the vanishing line of the plane upon which they stand, must be substituted in the place of the horizontal line before used. Thus in the ascending and descending views of Hay Hill, the vanishing line of the hill must be used instead of the horizontal line, but in Portland Place, and the Room, the horizontal line is the vanishing line of the figures. In order to represent a circle by means of the vanishing line of its plane, that vanishing line must be drawn through the vanishing point of the line upon which the plane stands, as for example, when the circle is placed perpendicular to the ground and picture, as a wheel, (Plate 6, Fig. 8,) C the centre of the picture is the vanishing point

point of the line A C, upon which the wheel stands, and E F is consequently the vanishing line of that plane. After having drawn lines from the vanishing point C, through the two extremities and centre of the given diameter A B, as in the case of circles, (Plate 3, Fig. 2,) the process is simply to draw from the eye or point of distance E, through the centre of the given diameter, in order to obtain the square in Perspective, which saves the trouble of finding the half of the diameter, &c. according to the method when the horizontal line is the only vanishing line; this will be very evident by turning the plate so that the line E F may appear as the horizontal line.

It is not material where the vanishing point of the square in which the circle is inscribed may fall, for, through its vanishing point, the vanishing line of its plane must always be drawn, the only difference in the process consists in the distance of the vanishing line, for instance, if C (Plate 7, Fig. 1,) be the centre of the picture, E the point of distance, and G N the vanishing line of the plane of the square, raise the moveable plane E C G upon C G, then is E the natural place of the eye or point of distance and the line E G the shortest line that can be drawn to the vanishing line G N, consequently E G is the distance of that vanishing line, which may be placed at L, G L is now the distance, and if it be transferred to G N at O, and a line drawn from O, through the centre of the diameter A B, it will give the square as before.

Roofs of houses being inclined planes may be determined in like manner, for suppose a building to vanish in the two points F and G (Plate 7, Fig. 2,) and if the angle made by the roof at the gable end N is equal to the plan A C B, a vanishing

nishing line must be drawn through the vanishing point G, perpendicular to the horizontal line, because the plane N is perpendicular to the ground, and it becomes the vanishing line of the plane N; transfer the distance of the vanishing line from G to L by placing one foot of the compasses in the vanishing point G and the other at E, and make the angle G L D equal to A B C, then D becomes the vanishing point of B C; draw P D; then make the angle G L R equal to the angle X C A, and R becomes the vanishing point of A C; draw R O, and continue it to Q, and you have the point of the roof; draw from Q towards F, the vanishing point of the side M, and from S to D, the vanishing point of P Q, and at T the roof is compleated; or it may be done by drawing parallels to A C, B C from L to the point of distance transferred. The vanishing line of the plane Q P T S is D T, for since F is the vanishing point of P S and Q T, and D of P Q and S T, it follows, that the line connecting or passing through those two vanishing points must be the vanishing line of the whole plane.

Portions may be cut off from lines, whatever their situation may be with respect to the picture, by means of their respective vanishing lines, in the same manner as by the horizontal line, Lecture III, for let it be required to cut off a portion from the line A B, (Plate 9, Fig. 1,) whose vanishing point is at D, in the vanishing line of an ascending plane; first, the distance must be transferred to F G the vanishing line of the plane in which the line A B lies; and in order so to do, a line must be drawn from the centre of the picture perpendicular to F G at M, the distance of the picture must next be transferred to the horizontal line at H, and H M is the distance of the vanishing line F G; (the distance of a vanishing line being always that

that of the eye from its centre:) if the triangular plane C H M be supposed to be raised upon C M till perpendicular to the plane of the picture, H will represent the natural place of the eye, and H M will evidently be the distance of the vanishing line F G. This will appear still more clear by making use of the apparatus, and applying the wire from the place of the eye to the centre of any vanishing line; this distance must then be placed over M perpendicular to F G at N, and transferred from D to F G at O, instead of transferring to the horizontal line; draw a parallel to F G from A at pleasure, and upon it place the given portion as A P, draw from P to O and it gives A R for the perspective representation of A P. In this example the vanishing line was parallel to the horizontal line. In the following it will be oblique as F G, (Plate 9, Fig. 2,) and the only difference in the operation is, that the distance of the picture C E must be placed upon C S parallel to the vanishing line F G, in order to obtain the distance of that vanishing line instead of using the horizontal line, and by substituting the triangular plane C S M, in the preceding example, for C H M, the truth of the method will be equally evident; S will represent the natural place of the eye, and S M will be the distance: from P to O gives A R for the perspective representation of A P, and from T to O gives A V equal to A T, or twice A P, &c. &c. In both these examples the same letters of reference are used.

The hand-rails of a flight of steps will vanish into the same line and point with the ascending or descending plane of the steps themselves, for example, the two lines D N, F M, (Plate 4, Fig. 1,) touching the angles of the steps, if continued, would meet in their vanishing point, which would be in the vanishing line of the plane of their ascent; to the same vanishing point the hand rails S T U W must be drawn, because parallel to the ascent of the steps in reality, but W X and T V vanish in the centre of the picture being parallel to the upper surface of the step, which is a horizontal plane. The same of the oblique steps, (Fig. 2,) the vanishing point of whose ascent will be found over the point f, towards which point the ascending hand rails must be drawn.

In cutting off portions from a line in perspective it is sometimes convenient to take half the distance C E, (Plate 7, Fig. 4,) as c d, and half the given portion A B as A b, and by drawing from b to G, half the distance transferred, the same point N will be obtained in the picture, as if drawn from B to e, the whole distance transferred; if a third, fourth, or any proportion of the distance be taken, and the same of the given quantity, it will answer the same end.

SHADOWS.

SHADOWS.

The projection of shadows is frequently so useful, that although the object of the present publication is merely to give those examples which most commonly occur, yet the advantage of devoting a few additional lines to the explanation of this part of Perspective is obvious.

Shadows are bounded by lines like other objects, and therefore must be subject to the same laws of Perspective, and as they often fall upon inclined planes, as the roofs of houses, &c. the application of the respective vanishing lines will be found indispensable.

Shadows are projected by the torch or candle and by the sun; it is with the latter that we are most concerned, but as those of the torch will assist in the explanation of those of the sun, it will be advisable to begin with them, and let A, (Plate 8, Fig. 1,) represent the light of the torch, B the torch itself, C an object; it is evident that the shadow of the object C would be projected by the light A in the direction B D, that is, immediately from the torch A B; the length of the shadow will be easily ascertained by a line representing a ray of light drawn from the luminary A through the top of the object C, and where it cuts the line or shadow B D, it gives E F for the length of the shadow of the object C, when projected by a luminary thus high. Suppose an object H on the other side of the torch, the shadow would then be projected in the opposite direction, and its length determined, as before, would be H L. If the objects are solids, then

then the point B may be considered as the vanishing point of their shadows. If these objects are supposed to stand upon a table, and others upon the ground, whose shadows are to be projected, it is evident, that the point B cannot be the point from whence the shadows of the latter are to be drawn, but a perpendicular, from the luminary to the ground, will give the point at M, the whole length A M being considered as the torch and M its base, and M N will be the line of shadow, but still its length must be determined by the ray A O from the light A, and P O is the shadow of the object K.

The distance of the sun from the earth is so great that its rays may be supposed to fall upon it in parallel lines, and when they come in a direction parallel to the plane of the picture, have no vanishing point like other lines of that description; but when the sun is before or behind the plane of the picture, its rays must have vanishing points.

First, suppose the rays to pass in a direction parallel to the plane of the picture, the sun's height thirty degrees, which may be determined as in the ascending and descending views. Let S (Plate 6, Fig. 5,) be the place of the sun, and A B an object, since the light comes parallel to the picture, the shadows will be cast parallel also, and neither the rays of light nor the shadows have vanishing points. Draw A D parallel to the ground line, and draw from S through B, and where it meets A D in D, gives the length of the shadow of A B.

2. Let the sun be at S (Fig. 6, Plate 6,) behind the picture, and consequently casting the shadows forwards; as for example, the shadow of A B must fall in the direction of A D;

and

and L the seat of the sun upon the horizontal line will become the vanishing point of the shadows, for since all lines parallel to each other in nature have the same vanishing point, the vanishing point of D A must be the vanishing point of all the other shadows of lines perpendicular to the ground, which are cast upon the ground plane by the sun at S, as for example, compleat the object A B G I and proceed by the other lines of which it is composed, as by the line A B; thus draw from L through F and also through I, then draw lines from S representing the rays of light proceeding from the sun, through B, E, and G, and where they meet the lines drawn through A, F, and I, at D, N, and O, is the length of their respective shadows; join those points, and you have the whole shadow compleat.

The point upon the horizontal line immediately under that, chosen for the situation of the sun, will be the vanishing point of all shadows cast upon horizontal planes; for lines forming shadows upon the ground plane must vanish into the horizontal line, and the vanishing point of such shadows will be that point directly under the sun; because a perpendicular, let fall from the place of the sun, in the picture, may be represented by the body of the torch in the preceding example, and consequently the shadows must be projected immediately from that line, and if they fall upon the ground plane, or any other horizontal plane, they must vanish into the horizontal line, and from the situation of the luminary, their vanishing point must be that part of the horizontal line in which the perpendicular from the sun strikes it; and in every instance the vanishing point of the shadow will be found in the vanishing line

of

of the plane in which that shadow lies, as in the case of lines in general.

3. Suppose the sun to be placed before the picture, or behind the spectator; in which case the vanishing point of its rays, or sun's place in the picture, will be at S (Plate 6, Fig. 7,) below the horizontal line, because a line drawn from the eye parallel to its rays, will meet the picture below the horizontal line, like the vanishing point of a line upon a descending plane; the shadow of A B will now be projected into the picture, and the lightest side of the object be next the spectator: the seat of the sun upon the horizontal line will be at H, which becomes the vanishing point of the shadows, and by drawing from S to B, A H is cut in D, and A D becomes the shadow of A B. By the same rule if the figure be compleated, its shadow will be determined as in the preceding case, by drawing lines from the bottoms of the respective perpendicular forming the angles of the object to H, the vanishing point of the shadow, and then from the sun S to the top of each perpendicular.

The cause of the sun being placed under the horizontal line may easily be explained by means of the apparatus; for if the real place of the sun be supposed behind and above the spectator, shining upon the face of the objects beyond the glass or picture, its rays will descend to those objects, and a line drawn from the eye parallel to any of those rays must of course fall upon the picture below the horizontal line, and there give the vanishing point of its rays. The nearer the sun is to the horizontal line the lower it is in fact, for if it be placed at O a ray

from

from thence will cut A H much nearer to H and consequently give a greater length to the shadow of A B, which proves the situation of the sun to be lower in the latter than in the former case.

By an attention to the three preceding examples, the shadows of objects, which are apparently more complicated, may be projected with equal facility.

Let the shadow of the arch B C D E (Plate 8, Fig. 3,) be required, the sun's place being at S, project the shadow of the perpendicular A B by means of its vanishing point T, and the shadow will take the direction of A F, and were it not for the interruption of the building, X would proceed to H, but being now compelled to fall upon the wall, it describes the line F G parallel to the original A B, and by the ray from S continued through B, F G is cut in G, and the shadow of A B is described by A F G, the shadow of E D by E I K, and in order to obtain that of the arch B C D, let fall a perpendicular from the point G to the ground which it will find upon the line A F, project the shadow of the line C M and it will describe the line M N O, and consequently a curve drawn through G O K will give the shadow of B C D with sufficient accuracy for common purposes.

Again, let the shadow of the projection Z be required. Let fall a perpendicular from b to the ground, which may be found by drawing a line from d parallel to a b, as d e, and where the perpendicular from b intersects it, is the ground plane, as at e, project the shadow of b e as e f g, and g being the projection of b, a line connecting a and g will give the shadow of a b; and for that of b h, if a line be drawn from the

 vanishing

vanishing point of h b, through g, as g k, it will give the shadow required.

The shadow of the plane A (Plate 8, Fig. 4,) is required upon the plane B. The shadow of the perpendicular D E appears to be E F G, and by the ray from the sun through D, G proves the shadow of the top of E D, or of the point D, by joining H G, that of H D is obtained, and thus the shadow of the whole plane A is described upon the plane B by the line E F G H, but the apperture I must be expressed, and may be done by letting fall the perpendiculars K N M and O P S to the ground at M S, and projecting the shadows of those perpendiculars, and also those of the points K O P N, and the apperture will be represented at W. The shadow of the whole plane B would fall upon the ground at Q and that of the window Y (Fig. 3,) upon the side of the building at L.

In the example, (Plate 8, Fig. 5,) the shadow of the plane X, describes the line A B C D E F upon the steps, and passes over the cylinder y, the tread of each step being a horizontal plane, the shadows laying upon them, as C D E F, &c. must vanish in the horizontal line immediately under the sun's place at T; the line A B upon the ground plane of course vanishes in the same point, the length of the whole shadow is determined by the ray from the sun to the top of the object as before: its appearance upon the ground after passing the steps, may be ascertained by laying a ruler upon A D, and observing the line it forms after passing the steps towards the cylinder; or it may be done by letting fall a perpendicular from the point E to the dotted line representing the bottom of the farthest side of the steps, and from the point of intersection draw to the vanishing

vanishing point T: the same may be done by the other line of the shadow.

If the shadow of an object falls upon an *inclined plane*, as that of a chimney upon the roof of a house, the vanishing point of such shadow must be in the vanishing line of the roof, for it is described by means of lines upon that roof, and it has already been shewn, that the vanishing points of lines are always in the vanishing lines of the planes in which they lay. Now the vanishing line of the inclined plane A B D K (Plate 8, Fig. 2,) is F G, let the shadow of the line N O upon that plane be required, the sun's place being at S. In the first instance, a perpendicular was let fall from the sun's place to the horizontal line for the vanishing point of the shadows laying upon the ground or on any other horizontal plane, but in the present instance, this perpendicular must fall till it reaches the vanishing line of the inclined plane upon which the shadow lays, thus it must be continued till it meets the line F G at M, then is M the vanishing point of the shadow of N O, draw N M for the direction of the shadow, and S O for the ray of light, cutting N M in P, then is N P the shadow of the line N O, fold back the plane X, and the inclined plane A B D K forms one side of the roof of a house, N O the chimney, and N P that part of its shadow which falls upon the roof. The shadows of the other lines forming the chimney may be obtained in the same manner, and the whole compleated. The shadow of the whole building may be projected by that of each of the perpendiculars forming the angles, and by letting fall perpendiculars from the highest point of the roof, as in the example.

In the frontispiece, representing Portland Place, the shadows are projected upon the ground plane, and their vanishing point upon the horizontal line, out of the picture, and the sun's place higher than the top of the picture; the shadows of the wheels driven by a man, in an oblique direction, describe straight lines, they being in the plane of the sun's rays.

In the representation of the room, the light of the window upon the carpet is determined in the same manner, for the floor being a horizontal plane, the vanishing point of the shadows will be upon the horizontal line near the margin of the picture, and the sun's place near the upper corner.

The shadows, in the ascending and descending views of Hay Hill, will be found to vanish into the respective vanishing lines of the hill, whether ascending or descending.

LECTURE VII.

Containing the Perspective of Rivers, Reflections in Water, &c. &c.

A River meandering through a vale, if truly drawn, will considerably assist the apparent flatness and extent of the country through which it flows. This appearance is produced by keeping the most remote windings almost parallel to the horizontal line, and also nearly close to each other: but as they approach nearer the eye, their windings will be more evident, and less parallel to the horizontal line; for let D (Plate 4, Fig. 4,) be the vanishing point of A B, the first reach of the river, and F the vanishing point of B C, another reach of the river, and, by way of example, let it be supposed that the windings of the river are alternately parallel to each other, as in the ground plan K: continue the representation of the river from C towards D, the vanishing point of A B; the next turn goes towards F, and the next towards D, &c. &c. it plainly appears they become more inclined to a parallel to the horizontal line, in proportion as their distance from the eye increases. The course of of a river is so capricious in its meanders, that it must not be concluded they will vanish in any two given points, but the inference to be drawn from what has been said, is, that the distant reaches of a river must take nearly the direction of the horizontal line, let the real direction be what it may; and that, however great its distance, it never can rise above the horizontal line; hence the means of giving to a lake its apparent width without carrying it very high in the picture, for if its extreme shores are represented nearly parallel to the horizontal line, and the due proportion of objects (there situated) attended to, the desired effect will be produced. The eye being above the nearest part of the lake must also be above every other part of it, a lake being a perfect plane; and therefore since the horizontal line is exactly the heighth of the eye, no part of the lake can be represented above it. Hedges, walls, &c. will be obedient to the same rule, and whatever their direction in nature when upon a plain, they will appear to incline towards a parallel to the horizontal line, in proportion as their distance from the eye encreases, and consequently be represented closer and closer to each other in the picture. In the representation of lakes, bays, &c. whose shores are curved, a recollection of the figure described by the circle when seen in perspective may be useful. The bases of mountains, rocks, &c. rising from a plain obey, in some measure, the same principle as the rivers and shores of lakes, but being like them, varied, something must, of course, depend on correctness of eye.

REFLECTIONS

REFLECTIONS IN WATER.

Nothing adds more to the transparency and clearness of water, than the reflections of surrounding objects, which in a tranquil day are almost as distinct as the objects themselves, and appear nearly of equal length: for example, let A B (Plate 4, Fig. 5,) be the representation of an object whose reflection in the water is required; measure A B with compasses, and with the same measure set off A C from A, and the reflection of A B is obtained; again, suppose the reflection of D E required, a little removed from the brink of the water but not upon rising ground; measure D E, and from D with the same measure mark the point E in the water at I, do the same by G H and F, and the reflection is produced. In order to give the reflection of the tree k, standing upon a bank, its elevation above the level of the water must be added to the measure of the tree; as for example: from the bottom of the trunk of the tree a perpendicular must be supposed to fall till it meets the level or plane of the water continued, and from that point, as L, measure to the top of the tree, and with the same measure, from the point L, mark the reflection of the top M in the water, and in order to know how much of the trunk would be reflected, measure from L to O, and from L with the same measure towards the water, and as it will not reach it; consequently the base of the trunk cannot be reflected. The reflection of the inclined object x y will be obtained by letting fall a perpendicular from y to the surface of the water at z, measure z y, and make z r equal to z y, and r becomes the reflection

reflection of the point y; join x r, which is the reflection of x y.

The preceding rule depends upon a principle in optics, namely, that the angle of reflection is equal to the angle of incidence: for example, let A G (Plate 8, Fig. 7,) represent a reflecting surface, A B an object, E the eye, B O a ray from the top of the object A B, reflected at O, and making an angle E O G with the reflecting surface A G, equal to the angle of incidence B O A: to the eye E, the point B will appear at O, but will be transferred to H immediately under A B, and A H will consequently be equal to A B; but if the eye be raised to F the point B will appear at L, for the angle of reflection F L G is equal to the angle of incidence B L A, but the reflected image still appears equal to the original object. In the first instance the spectator requires a space of reflecting surface equal to A O to see the reflection of the whole object A B, but when elevated to F the whole will be seen within A L.

The *station* or *point of view* comes next under consideration, and in drawing from nature is of great importance, for the same scene taken from different stations or points of view, will frequently appear so unlike each other, as scarcely to be recognized; in one point many of its beauties are concealed from the eye, but by altering the station a point may be found from which it appears to the greatest possible advantage. If a single building, as a church, be the object to be drawn, care must be taken to remove to a sufficient distance from the building or the angles will appear violent by vanishing too suddenly. Some writers are of opinion that when a single building is the principal object of the picture, it it ought to be viewed upon the angle; if otherwise (say they) a degree of distortion is the consequence; but we have authorities of no less weight than Canaletti, Gaspar, and N. Poussin, Claude Lorraine, &c. for a contrary practice, (i. e.) viewing the building with one side parallel to the picture, whether the vanishing point of the lines perpendicular to the picture falls in the centre of the horizontal line or not. As examples: let Fig. 4, Plate 5, represent a church viewed upon an angle, and consequently both sides will vanish in different points. Let B be the vanishing point of the side A, and by the rule the vanishing point of the other side C, will be found at D; compleat the church, and nothing distorted will be apparent; let it now be viewed when the end A, Fig. 5, has no vanishing point, but the side B vanishes into G the vanishing point of lines perpendicular to the picture,* and the end A will have an appearance of not standing at right angles, to B, but making rather an obtuse angle with that side. When extensive scenes become the subject of the picture, take the following example. Suppose Fig. 1, Plate 5, a profile or section of a view in nature: to the eye placed at V the wood D would conceal the lake H I, and also every object, except that part of the mountain between B and F, and the appearance of that view when drawn, would be as under, at Fig. 2, where the mountain B would appear just above the wood D, and no intermediate objects be introduced. Now let the eye be placed upon an eminence at E, and as may be perceived, a line passing from the eye touching the wood G, would meet the lake at H, and the whole space from H to I be seen, the

* In this case the vanishing point of those lines is beyond the limits of the picture.

wood I would also appear with the building K, and even the plain beyond it; the mountains would be seen rising from their base, and N would appear above F, and discover another line of hills, as appears at No. 3; the advantage of the higher station in views of this kind is too evident to need further explanation. In these scenes the horizontal line would in the first case be only equal to A V, but in the latter case A E will be its height.

If it be required to place the nearest angle of a building at any given distance, as five yards within (or from the bottom of the picture A B, Plate 7, Fig. 6,) and ten yards from one side, as the side A F, according to a given scale; it is first necessary to divide correctly the bottom, and one side of the picture, according to the annexed scale; draw A C, measure five yards from A, and draw 5 e, giving g for the five yards in the picture; from A set off ten yards, and draw 10 C, a parallel from g, to 10 C, gives ten yards when removed five yards within the picture; with that measure from N mark o, which is the place required for the nearest angle of the building, i. e. five yards within the picture, and ten from the side A F; if the building is to be of a given height, as fifteen yards; draw from A and 15 to any point upon the horizontal line *out* of the picture, as P, and a parallel from O as O Q, gives Q R for the fifteen yards high at O, (vide Lect. V. where the use of the line of elevation is taught.) The side O S is to make an angle of forty-three degrees with the plane of the picture; through E, the point of distance, draw M G, which line is called *the parallel of the picture;* at E make the angle M E X, equal to forty-three degrees, and continue E X to the horizontal line, and T is the vanishing point required; for the angle M E T is equal

equal to the angle B A V; M G is parallel to A B, and E T to A V; consequently T is the vanishing point of A V, and A T is its indefinite representation, of which O S is a part.* This is therefore a convenient method of finding vanishing points when the angle is given: the proportions of the sides of buildings may be placed upon the ground line A B or upon its parallel g r, but in the latter case the reduced proportion of parts upon the line G r, removed further from the eye, must be attended to; the measures may then be determined for each side of the building as before directed; and the proportional widths given to windows, or any other parts of known dimensions, by marking those proportions, as is done by stronger lines upon O r, (Plate 7, Fig. 6,) and dividing the line O S perspectively by the usual method.

In order to put the equilateral triangle A D B (Plate 3, Fig. 6,) into perspective by the ground plan, with one side A B parallel to the picture; continue D A and D B to their intersecting points F and G, and find their vanishing points I and K, draw their indefinite representations F K, G I, and find the representations of the points A and B upon the picture at a and b, and a d b will be the perspective representation of the triangle A D B.

The same by one side given in the picture as A D (Plate 3, Fig.

* The use of this line will be more evident by applying it to the apparatus, when, if the vanishing point of any original line, laying upon the ground beyond the picture, be required, a line from the place of the eye parallel to such original line will give its vanishing point, and it will appear that the line from the eye, or point of distance, by which the vanishing point is found, will make the same angle with the line parallel to the picture, passing cross the eye, that the original line makes with the picture itself.

Fig. 7,) continue A D to F its vanishing point, and from F transfer the point of distance to the horizontal line at G, draw A B parallel to the bottom of the picture, and from G draw through D till the line cuts A B, in B; and A D B is the triangle required.

The triangle, with every side oblique to the picture, as A D B ground plan, (Plate 3, Fig. 8,) find the respective intersecting and vanishing points of each side of the triangle, either by making the same angle with the parallel of the picture, that each side makes with the plane of the picture, or by drawing parallels to the respective sides from the eye, and their intersection in the picture at a b d will give the triangle in perspective as required.

To put a regular hexagon into perspective one side being given.—Through the point b (Plate 7, Fig. 5,) of the given line b d, draw a line a n parallel to the horizontal line, and continue b d to its vanishing point H, from H transfer the distance to L, and from L draw a line through d, cutting a n in n; then b n represents a line of which b d is a perspective representation; make a b equal to b n, then is a b the representation of one parallel side; from d, draw d L, and from a, draw a H, cutting d L in f; then is f another corner, and d f represents another side; again from d, draw d i parallel to the horizontal line, and a L cutting it in i, then i is another corner, and a i another side; draw H i and the parallel f g, which compleats the figure.

In the representation of extensive scenes it is almost impossible to produce a grand effect by giving to every object a separate a separate light and shadow, therefore a general light and shade adapted to the subject, considered as one whole, is to be preferred. A partial light and shade may sometimes be applied with good effect by supposing the intervention of clouds, whose shadows cover that portion of the scene where a shadow would be useful, and a light diffused where required. A number of lights and shadows in the same picture will occasion confusion, and should be guarded against by large masses of shadow, produced by the supposed intervention of a cloud, as before observed, or by any other natural means.

In sketching from nature, the paper or picture must be prepared by drawing the horizontal line, and marking the centre of the picture, as taught in the first Lecture; and as the horizontal line is exactly the height of the spectator's eye when looking straight forwards, it will of course pass along those objects in the real view which are exactly the height of the eye. All such objects must therefore be placed upon it in the picture; and as the centre of the picture is the point directly before the eye, that object upon which it falls in the view, must be placed upon it in the picture: thus the centre of the picture and horizontal line are of the greatest use in determining the relative places of objects. Those to the right of the centre of the picture, or point directly opposite the eye in nature, must be so placed in the representation: and the same of those on the left; and great attention should be paid to the chusing a proper distance of the picture, since it enables those who are not much in the practice of drawing from nature to avoid the bad effects of beginning with objects too near them. This was explained in the first Lecture, and a frame and glass supposed to be held

held before the eye, and the same scene traced upon it when at different distances from the eye, shewing the different representations produced by those different distances, &c. &c. The proper distance of the picture for landscape drawing was considered to be at *least* equal to its longest diameter, and that it generally should exceed it. A small frame, as in Fig. 7, Plate 7, made of tin, may be very convenient to carry in a sketch-book or port-folio; and, when a sketch is about to be made, hold up the frame at a distance from the eye, equal to, or exceeding its longest diameter, and in the position of the picture (i. e.) perpendicular to the ground like a pane of glass in a window; then observe how much of the view is seen within the frame, and put the same portion upon the paper. If it should be necessary to hold up the frame several times, attention must be paid to its coinciding with the same parts of the scene; it must also be held exactly at the same distance from the eye; and, in order to be correct as to the distance, a thread may be fixed through holes at each end of the frame, and, when the distance is determined, a knot tied, which, by being brought near to the eye every time the frame is used, will preserve the same distance.

The greatest attention to truth and correctness is strongly recommended in making sketches from nature, with the addition of written notes, marking every peculiarity of effect, or colour, deserving of notice in the scene; if any alteration should be necessary to the perfection of the picture as a composition, it may be made at a future opportunity, but not in the original drawing.

If the foregoing pages have been carefully considered by the

the Student, he will have acquired enough of the science of Perspective to apply its rules to all the general purposes of drawing; but, if he is desirous of enquiring into the intricacies of the art, he must have recourse to more elaborate Treatises, in which he may find enough both to gratify curiosity and to exercise the most persevering industry.

THE END.

Vanishing P.t of Shadow

J. C. Wood del.

W. J. Bennett sculp.

INTERIOR of a ROOM.

Published March 1,1809, by T. Cadell & W. Davies, Strand London.

Vanishing Line

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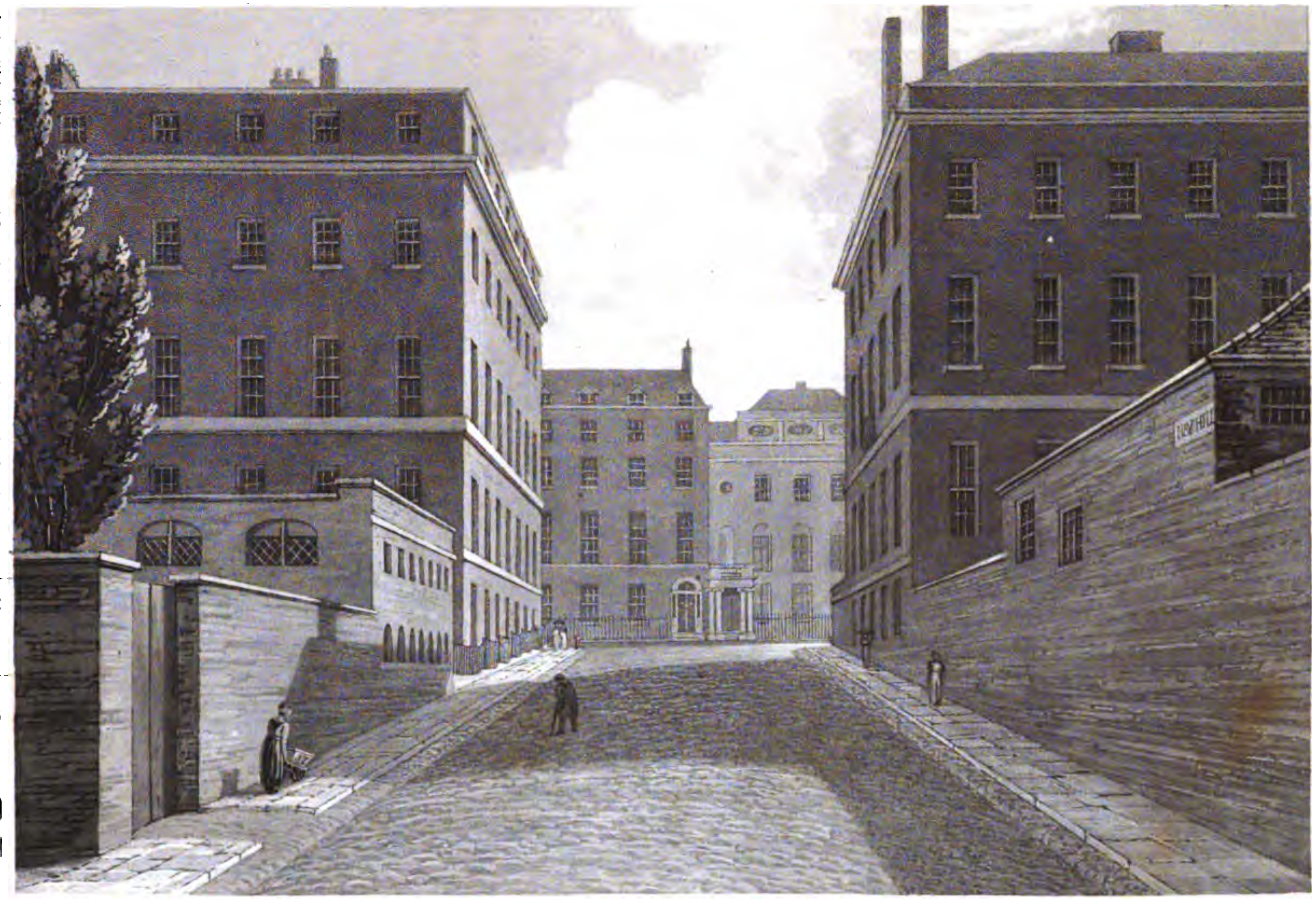

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Plate 1.

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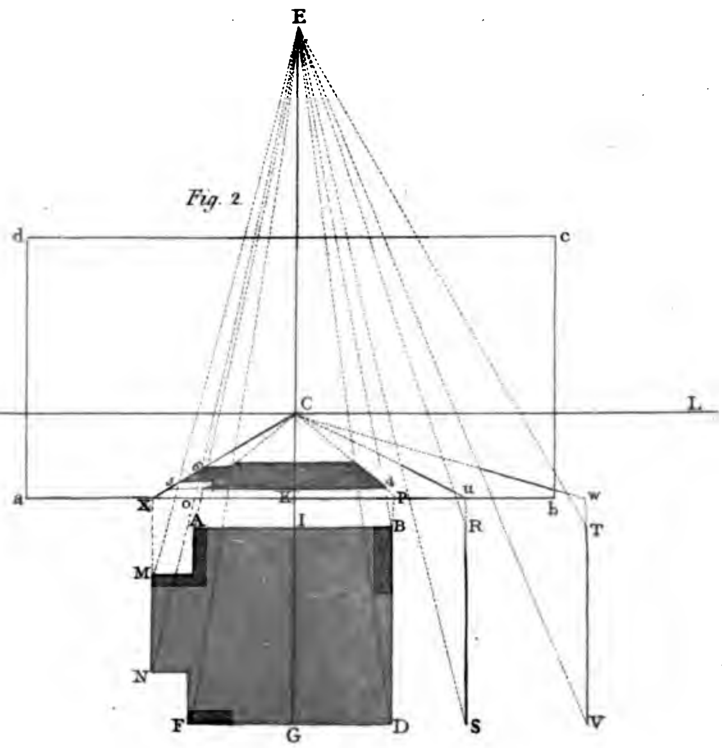

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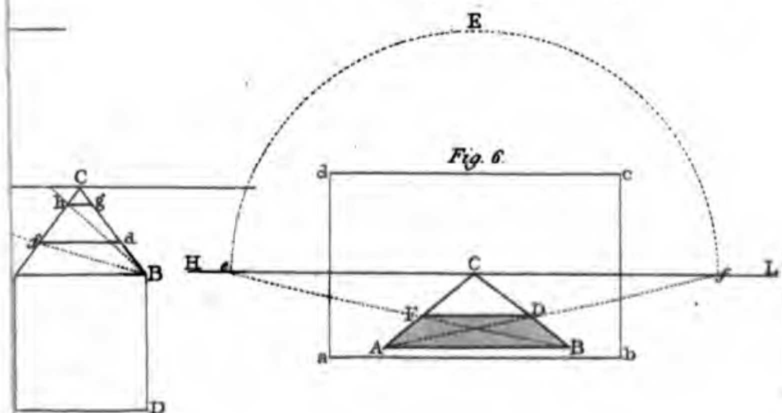

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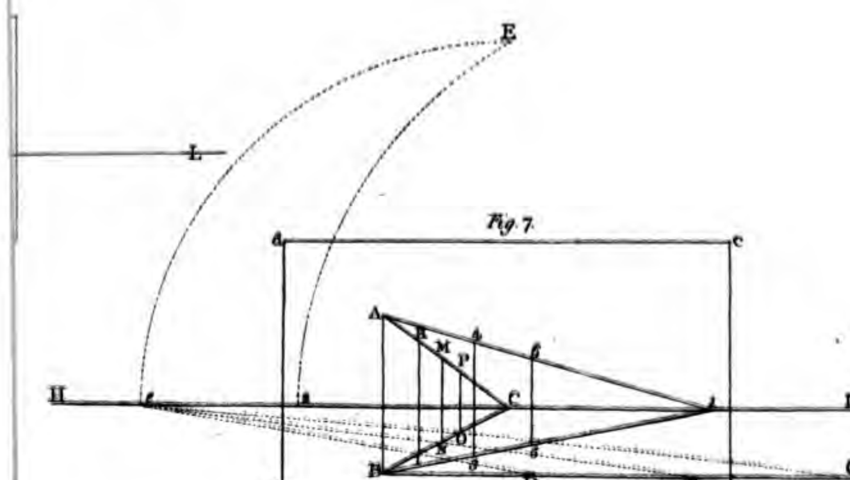

Fig. 7.

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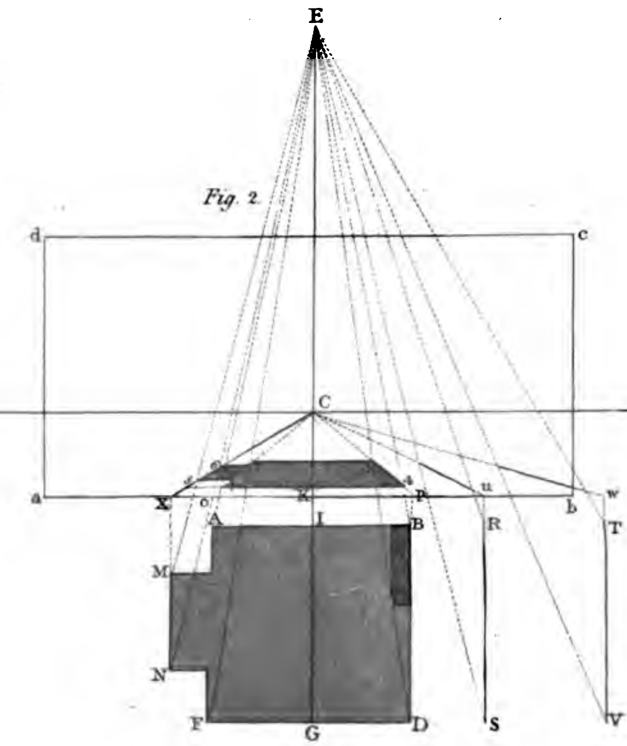

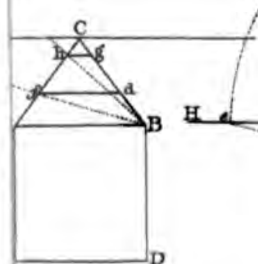

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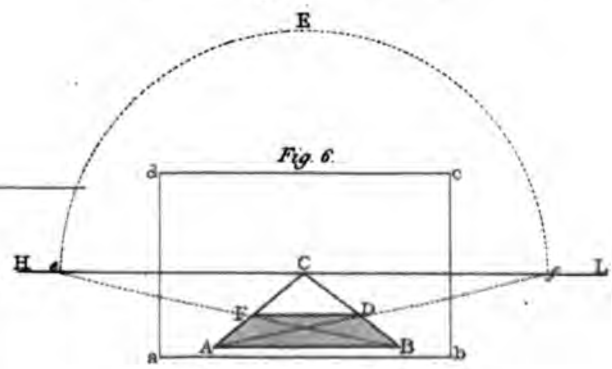

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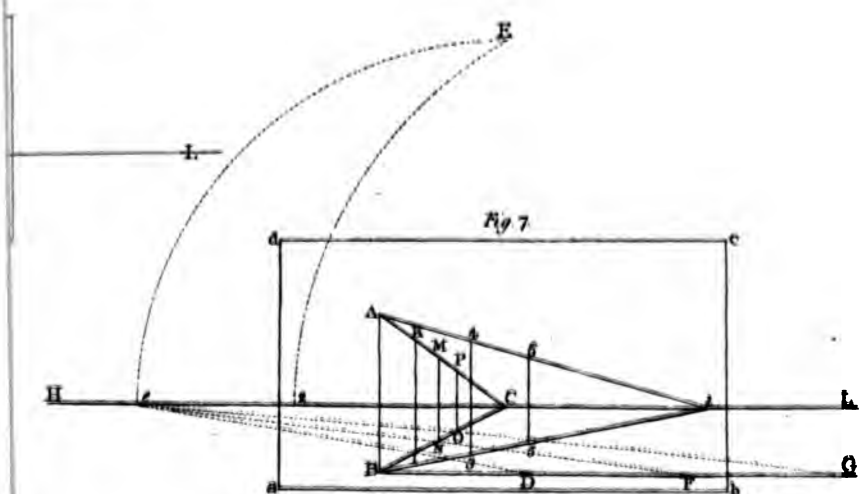

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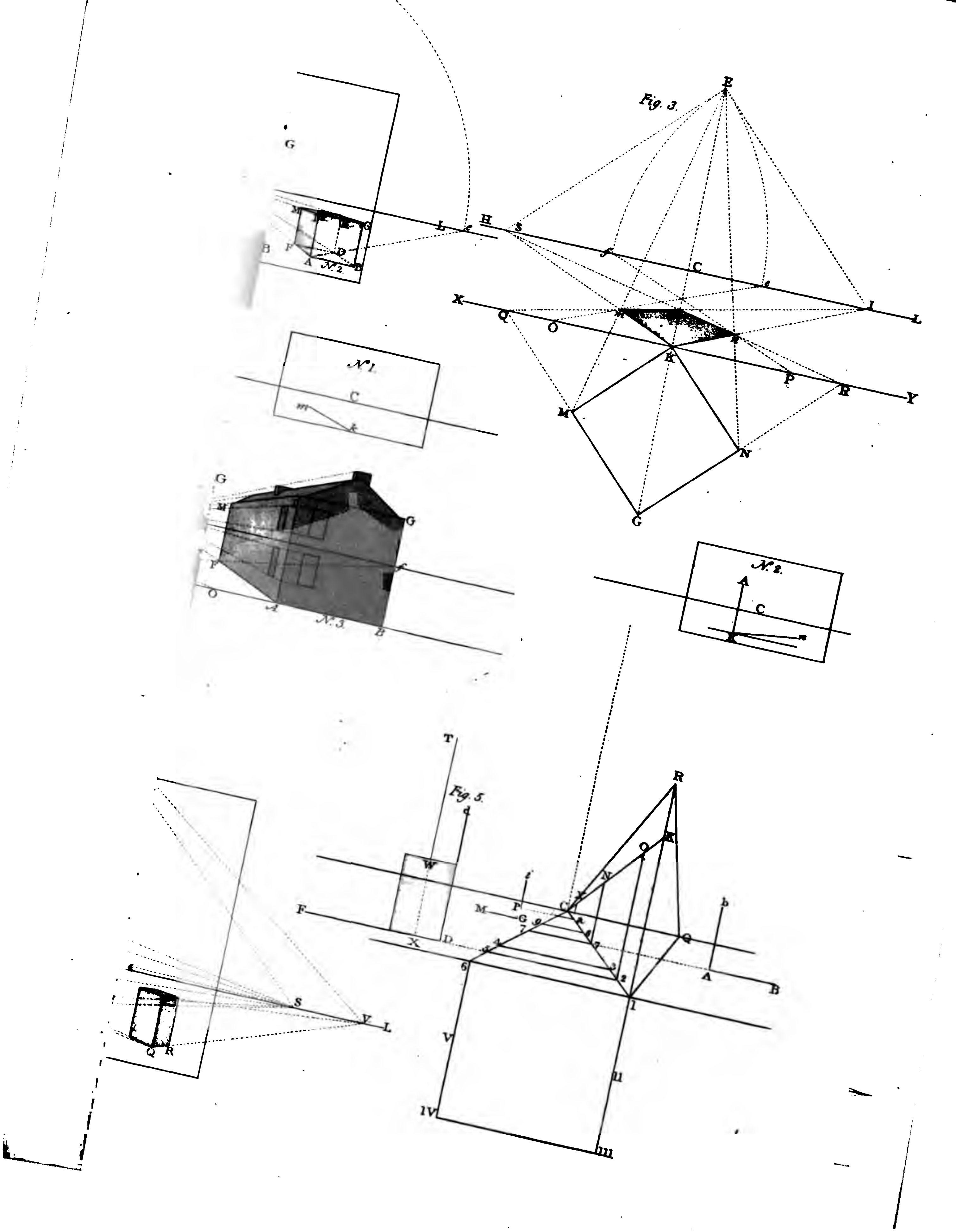

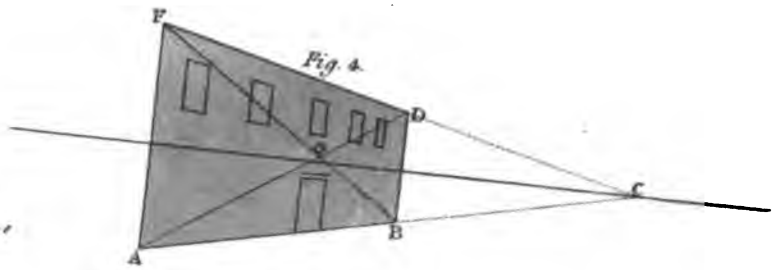

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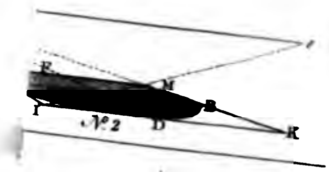

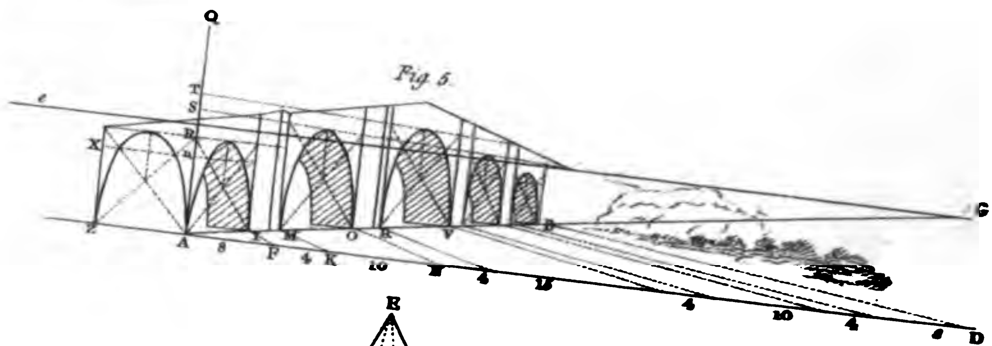

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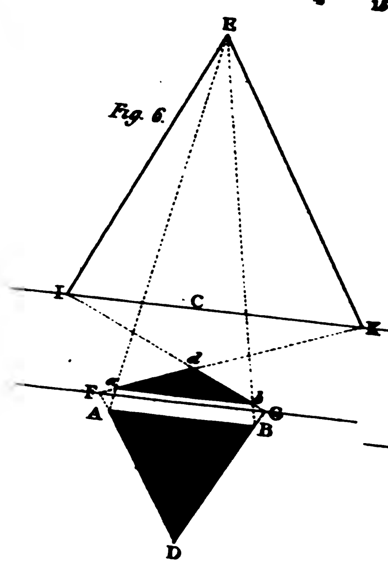

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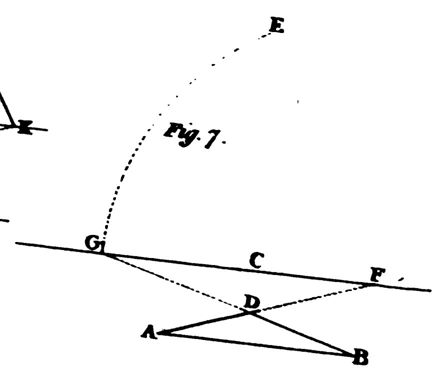

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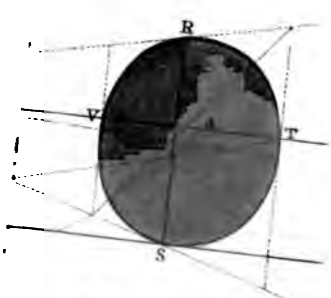

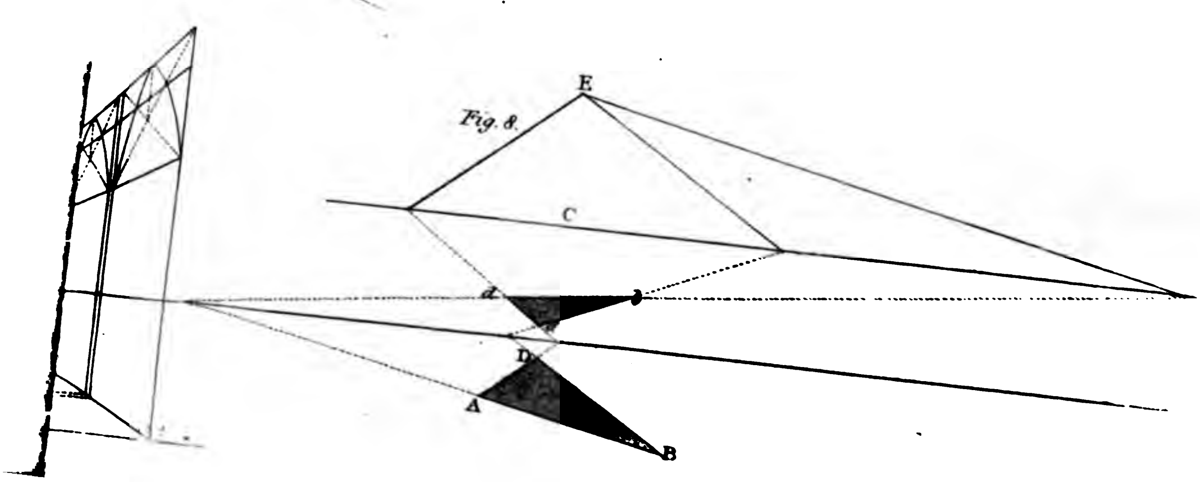

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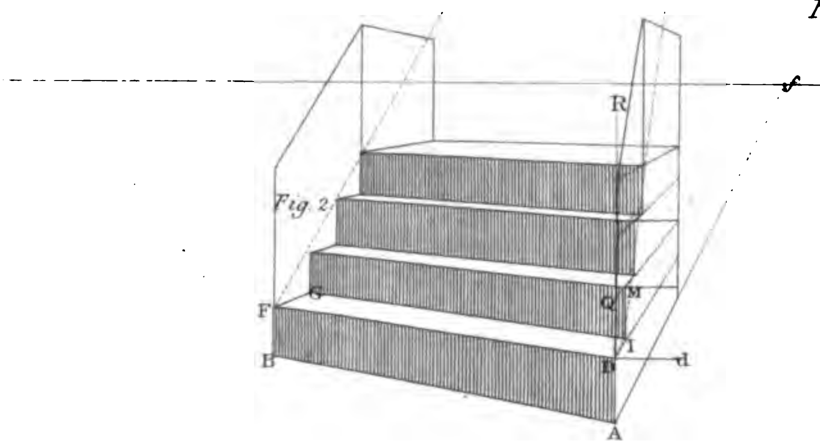


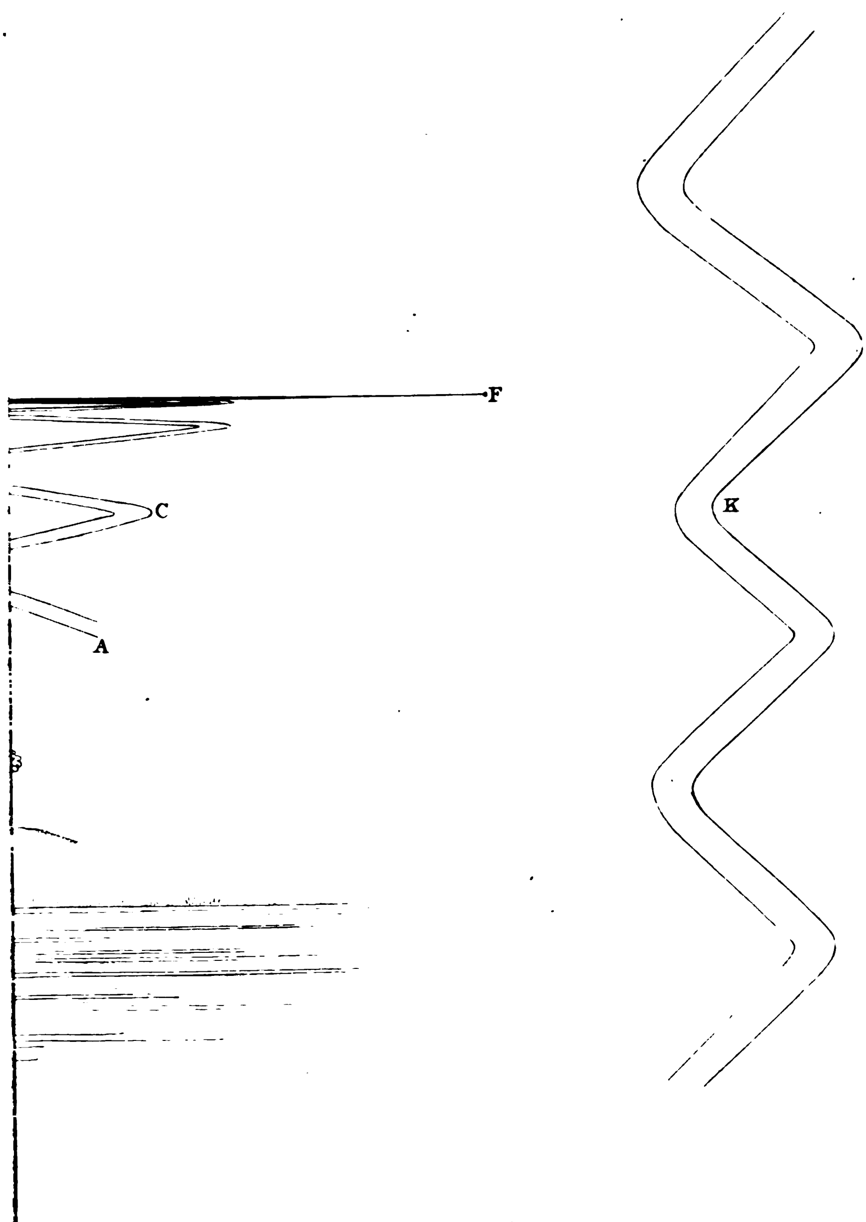
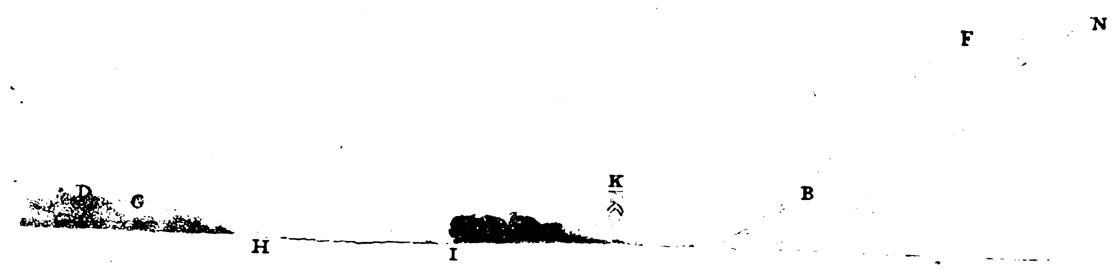
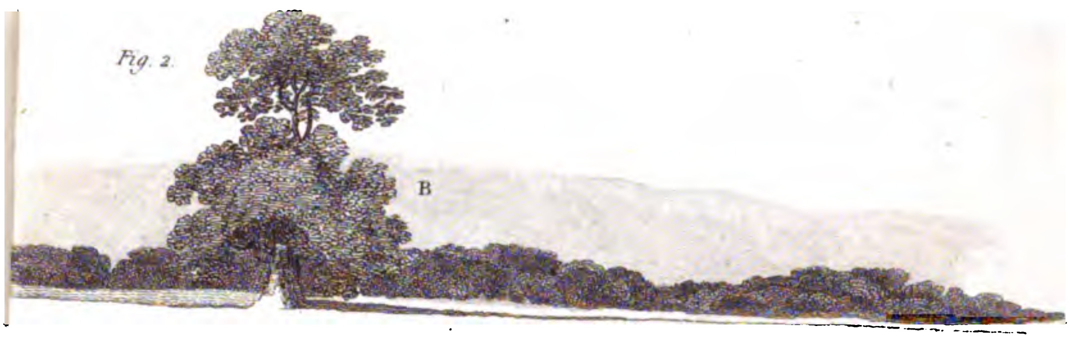


Plate 5.

Fig. 1.





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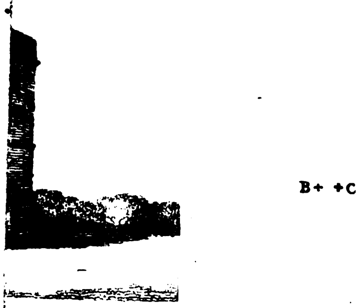

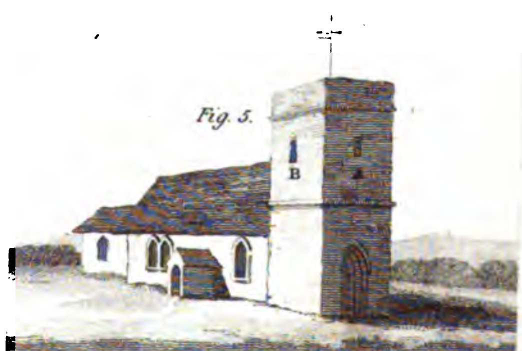

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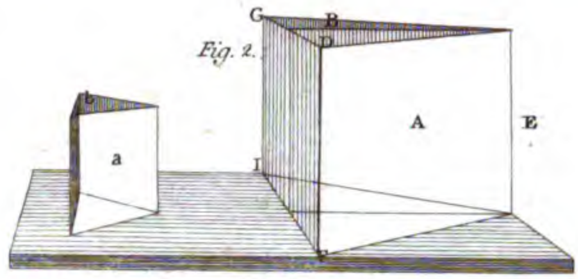

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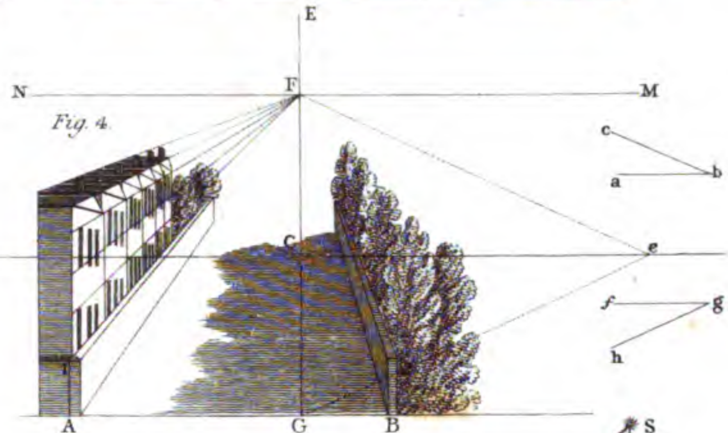

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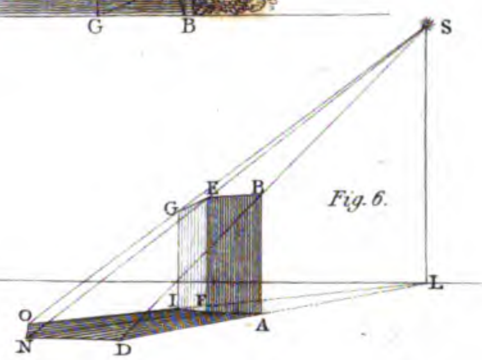

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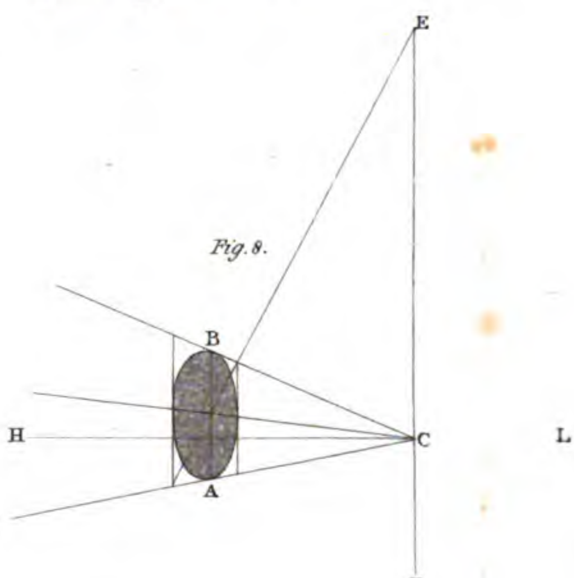

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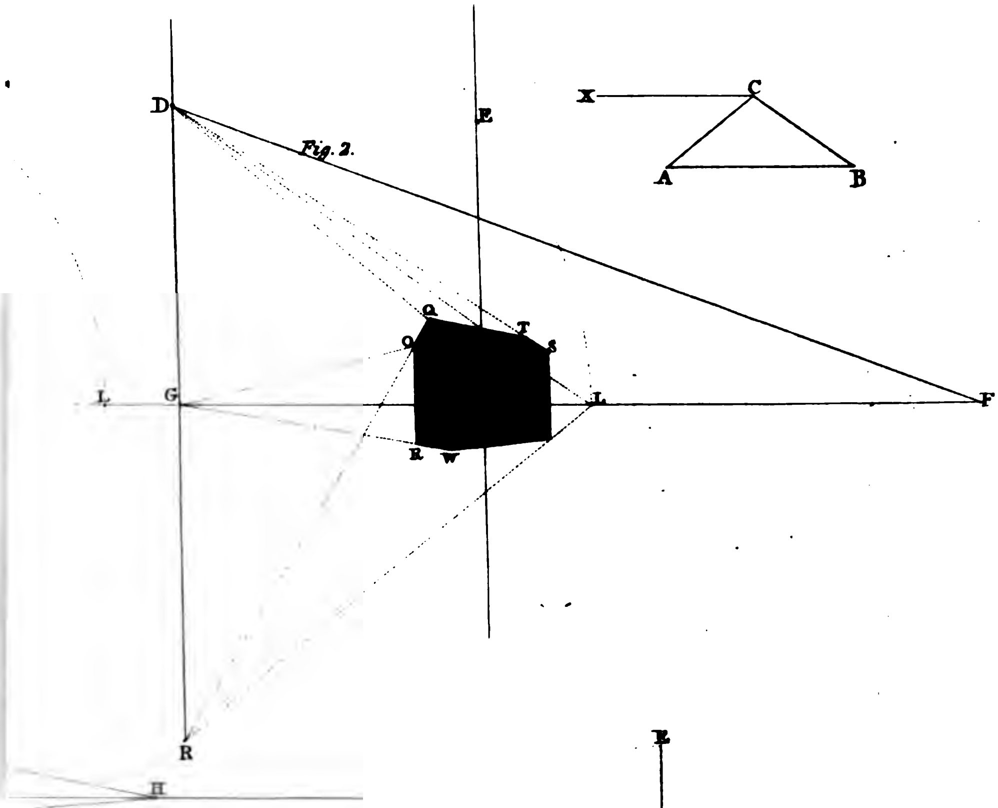
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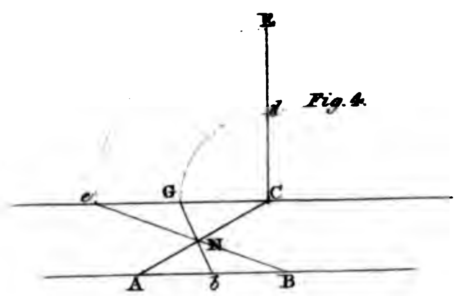
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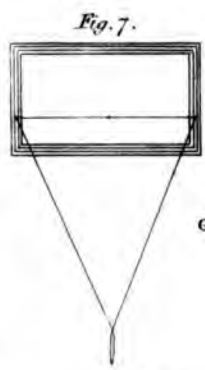
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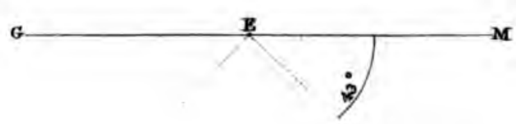
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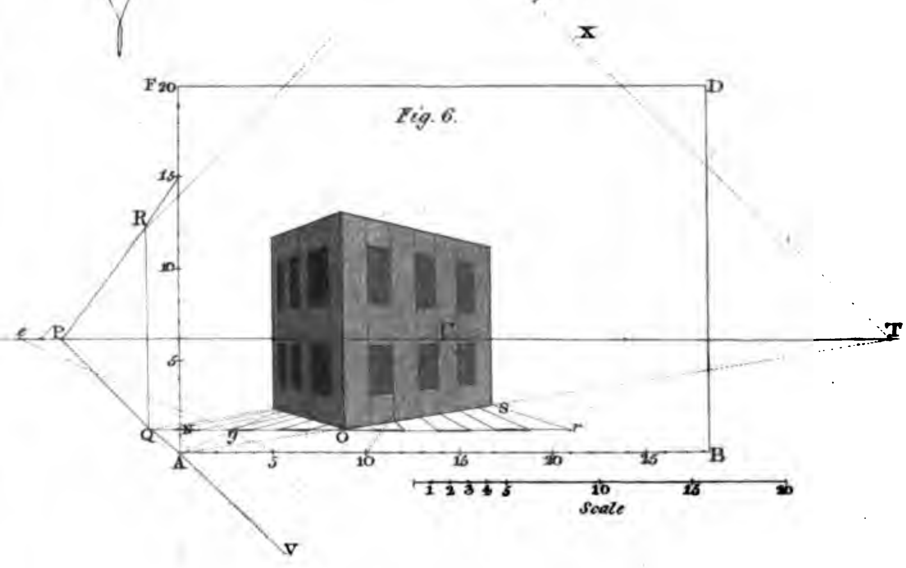
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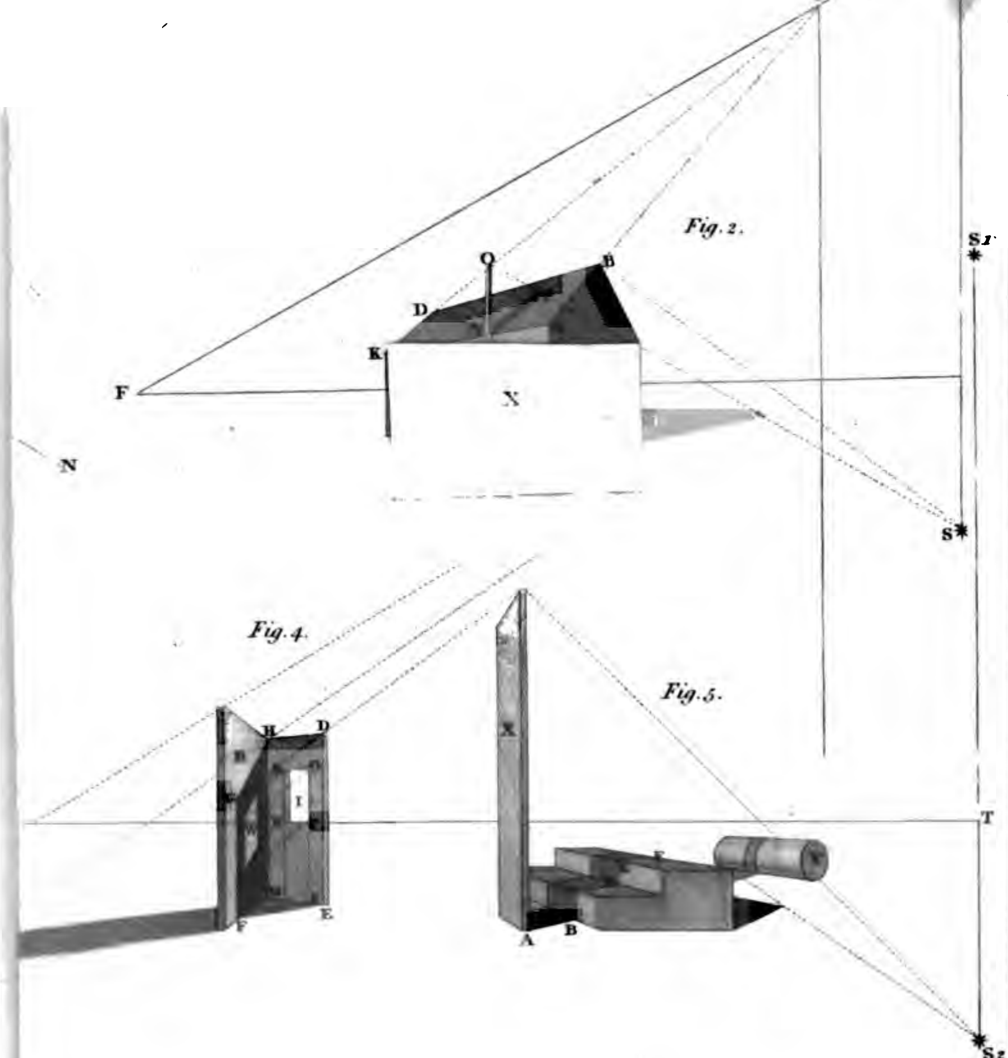

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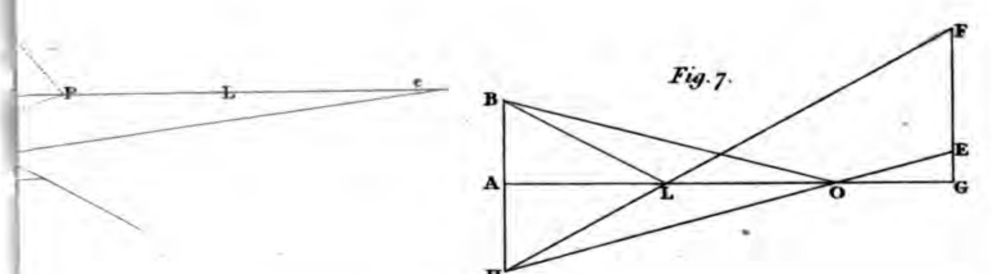

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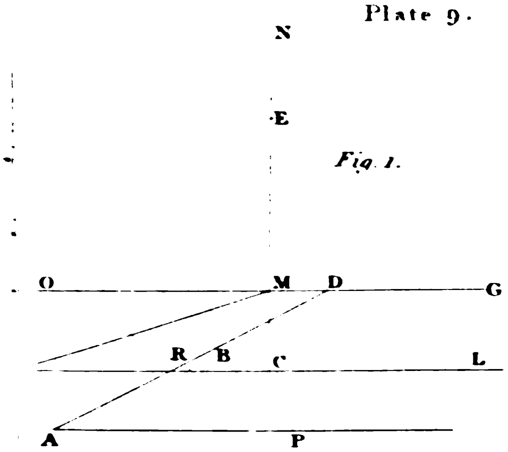

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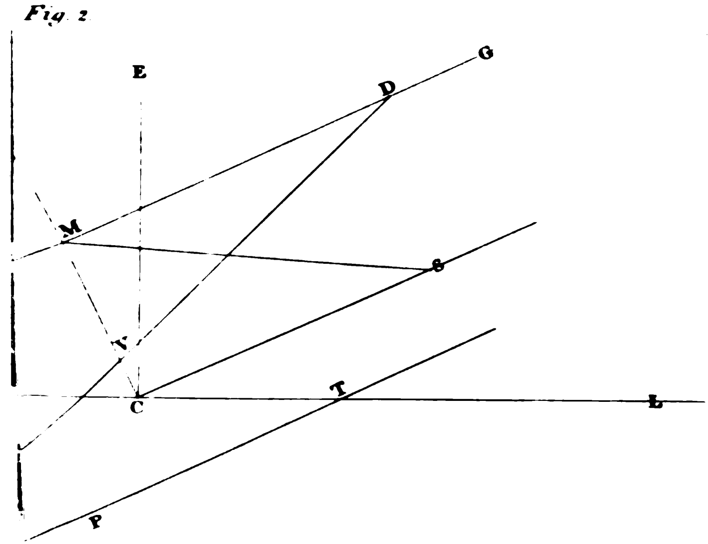

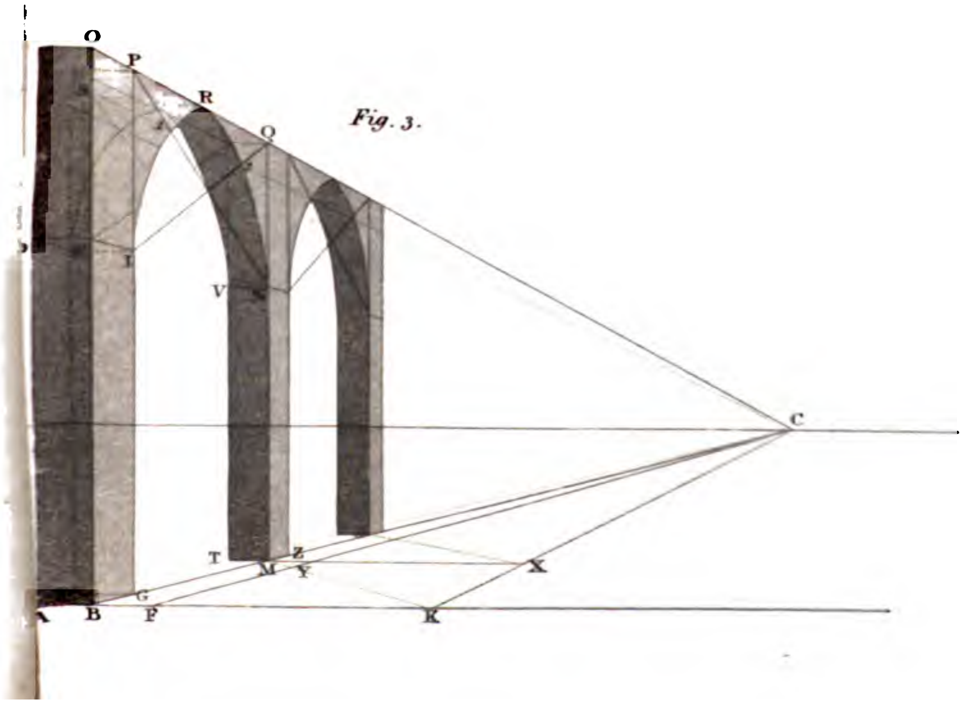

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