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THEORY AND PRACTICE

OF

PERSPECTIVE;

TOGETHER WITH THE APPLICATION OF THE SAME TO

Drawing from Nature.

BY

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PREFACE.

No apology need be offered by any one who endeavours to supply a deficiency which he has long observed to exist. There are, I think, only large and expensive works at the present time on this subject, and considering the numbers who learn drawing, and the glaring mistakes they make, which even a knowledge of the rudiments of perspective would prevent, it is surprising that no simple and cheap work has before made its appearance. A thorough knowledge of only the fundamental rules, would cause nearly all difficulties to vanish, and if these pages tend to increase the study of perspective, I shall consider my object attained.

THE AUTHOR.

Lee Park, Blackheath,

January, 1852.
INTRODUCTION.

1. **Perspective** is the science which teaches the art of representing objects on a plane surface, in such a manner as to present to the eye the same appearance which the objects themselves do, real or imaginary.

2. The necessity for such a science arises from the fact, that objects appear smaller the more distant they are. (This is merely the result of our seeing in straight lines.)

3. For suppose an eye at E, and two vertical or upright objects AB and CD, of equal height, placed on the same horizontal plane, nearly in the same straight line, and so that one is twice as far from the eye as the other. Now, it will be found that the more distant will appear only half the height of the nearer; i.e., they will present to the eye the appearance presented in fig. 2; fig. 1 being
a side view. In *fig. 1*, $AC$ is evidently parallel to $BD$; but since, in *fig. 2*, $AB$ appears twice the length of $CD$, $AC$ can evidently no longer seem to be parallel to $BD$; they must therefore appear to meet somewhere. The question is—"Where?" This is what the science of perspective points out.

4. This meeting of parallel lines *appears* to take place in reality.

5. For every one must have observed, when standing at one end of a long room, and looking straight at the opposite wall, that the lines of the intersection of the ceiling, sides, and floor, all seem to meet in a point in the opposite wall, in a line with the eye; as *fig. 1* and *fig. 2*. In *fig. 1*, the spectator is standing rather on one side, and consequently sees more of the opposite side.

6. This is one of the fundamental rules, viz., *all* parallel lines in perspective appear to meet in *one* point.

7. There is one exception; we observe that the end of the room at which the eye looks straight is not at all distorted, but can easily be represented on paper. Hence, we except all lines that are in any plane perpendicular to the direction in which we are looking. The opposite end of the room is clearly one of these planes.

8. To illustrate the rationality of the exception, let us
suppose that we are drawing a tall tower, say two hundred feet high, from a window one hundred feet from the ground, and that we are not far distant from it, the tower being of equal width throughout. We determine the width just opposite the eye at S. We then look at the top, and give it a width somewhat less, similarly with the bottom, since both appear so to us; we join the points at the middle, top, and bottom, thus determined, and fig. 1 is the result. This is evidently absurd; the corners offend our eye; we therefore try rounding them off, and fig. 2 is the result—as bad, or worse than before.

9. In short, the only way is to make the breadth the same throughout. This difficulty arises from our being too near the object we draw to take in the whole conveniently at one glance. But still, sometimes, as in drawing the interior of rooms, we cannot avoid being very close to the object; for it would never do to represent the whole of the room, in such a way that to see it so, we must take down one end, and stand forty or fifty yards off. The same reasons evidently apply to any lines in these planes.

10. Now it may not seem evident, why all parallel lines should converge to the same point. We hope to make this also intelligible. We must first give a mathematical definition of parallel lines.

11. Parallel lines meet in infinity. Now as infinity is nowhere in space, this is equivalent to saying they never meet; but we shall suppose it to be a plane, perpendicular to the direction in which we look, and at an immeasurable distance; then as a straight line not in this plane, can
meet it in only one point, it is evident, that as all parallel lines meet in this plane, they must all meet in one point in it.

12. The same rule evidently applies to parallel planes, which must also meet in infinity.

13. Now if we can represent on paper, or fix the place of, this infinitely distant plane, it is obvious, that if we make our parallel lines converge to any point, we must have the point situated in this plane. This we actually do.

14. But what do we represent on paper? We represent exactly what we should see on a plate of glass, placed perpendicular to the direction of vision, close to, or nearly so, the object we wish to represent.

15. Perspective is generally divided into two kinds.

16. Parallel, i. e., where one side of the object is parallel to the plate of glass.

17. Inclined, or angular, (we prefer the former name), where no side is so, but all are inclined (whence its name), to the plate of glass.

18. Objects represented, are usually rectangular.

19. Parallel perspective being the simpler, we shall treat of that first, and take objects mostly rectangular. We would recommend the student to draw the figures gradually from the explanations referring to the plates.
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PART I.
ON PARALLEL PERSPECTIVE.

20. Referring to Pl. I., let us suppose ourselves standing at (DP), and looking straight in the direction of the line (DP) S, S'. Let ABCD be a square piece of pavement, or anything else; suppose we place, or imagine to be placed, a large plate of glass, perpendicularly on the line through S, from (DW') to (DW*); we should have to draw on it in the first place the point S, Pl. II., which must evidently be the same height above the bottom of the glass, which our eye is above that plane used as the ground, and straight before our eye; draw through this, the horizontal line, (written HL) from (DW') to (DW*). The reason why it is called the "horizontal line," we shall now explain.

21. Since we may be supposed to look straight forward, to an infinite distance, the line through S may be supposed to be at an infinite distance, and, therefore, be the place where the plane of the ground (supposed of course perfectly flat) appears to meet the plane parallel to it, at the height of the eye, this latter plane is represented by the (HL) as we only see the edge of it: and hence this line represents the horizon, which at sea, is said to be where the sky appears to meet the sea. This latter definition is not strictly true, but nearly so.

22. We then draw the line from X to Z, Pl. II. to represent the bottom of the glass plate, which is of course the boundary of the picture, for nothing before the glass can possibly be seen through it. This line is evidently parallel to
the (HL), and is usually called the base line (written BL.). We then observe that D lies directly under S, and that BD is (in this case) one inch long, in Pl. I. Now according to our definition, that "parallel lines meet in infinity;" DC, which is evidently parallel to the line, straight from the eye through S, must meet infinity in the same point; and as the line through S, Pl. II. becomes only a point on the paper, it is evident, that DC must be drawn to S: and the direction of BA can be determined in the same manner by drawing a line from B to S.

23. This evidently applies to all lines parallel to DC, or perpendicular to the transparent plane, (sometimes called the plane of the picture) viz., the glass plate.

24. Having thus determined the direction of DC and AB, the next thing is, to determine the length of DC; i.e. to find C, and it is evident that this obtained, we have only to draw CA, meeting BS in A, parallel to BD, it being in a plane perpendicular to the direction of vision.

25. To determine the position of the point C, we must refer again to Pl. I. We observe a dotted line through C, drawn to e, a point on the bottom of the glass, just one inch from D. Now since this point e, is easily found in Pl. II., by merely placing it an inch from D, on the line XZ, all we have to do, is, to determine the direction of the line eC.

26. Now if from (DP), Pl. I., we draw a line parallel to the line eC, these two lines must meet in infinity. Suppose a similar line parallel to this last, to be drawn just over it, in the horizontal plane in which the (HL) is. These two lines must meet in infinity, that is (on the paper Pl. II.) somewhere in the (HL); and supposing the glass placed as before, it is evident that the point on this line, must be exactly over (DW") Pl. I., as otherwise the lines could not be parallel.
27. Now both of these lines are parallel to eC, therefore the line eC goes to this point, and all lines parallel to eC go to this point, Pl. II.

28. It is also evident, that in Pl. I., as De is equal to DC, S (DW') equals S (DP) and the angle at (DP), namely S (DP) (DW') is an angle of 45°. In Pl. II., and also on the glass, this line S (DP) is for convenience drawn above the (HL), and therefore the length of this line, which is called the "distance of the picture;" i.e., the distance we stand from the glass, written (DP), being known, we just measure the same length along the (HL), and that determines (DW²).

29. Joining—see Pl. II. e (DW²), we find C, where this line crosses DS, as in Pl. I., and drawing AC as above directed, parallel to BD (Art. 24), we complete the picture.

30. It is evident that similar reasoning applies to (DW'), the other point for determining width, i.e. diminished width; hence the name distance of the width, written (DW), or vanishing point for the width, a more correct name.

31. In Pl. I., the other angle S (DP) (DW') is also 45°; hence the whole angle (DW') (DP) (DW²) is an angle of 90°, i.e., a right angle, the form of the object.

32. It is evident, that the points (DW') and (DW²) depend for their position on the distance we stand from the glass. This is both rational and apparent.

33. For the nearer we stand to an object, the greater is the variation in the inclination of the lines. For suppose we stood at V, Pl. I., we look in the direction of VW¹ and VW² for these points, viz. W¹ and W², the new (DW's), and they being on the (HL) above the points W¹ and W² in Pl. I., would, in Pl. II. evidently alter the appearance of
the picture proportionally, DC being longer. This is what we should expect, as the object then appears broader.

34. We would here observe, that in Pl. II. S, and therefore the (HL) is really (as regards perspective measurement) at an infinite distance, or in other words SD, the line which measures the distance of the (HL) from the glass, is of infinite length. For to measure it, we should have to draw a line from (DW²) through S, and having found the point where it would cut the (BL) produced, measure the length of that part of the (BL) between D and this point; this would give us the real length of SD. But it is evident, that this line through S coincides with the (HL), which we made parallel to the (BL), this line therefore can never meet the (BL), and the line from D to the point of intersection, i.e., the length of SD, is infinitely great. This proves our theory.

35. Having thus explained and proved the theory of the points and lines, of parallel perspective, we shall now show the practical method of determining them.

36.—1. Determine the point of sight S.
2. Through this draw the horizontal line (HL).
3. And parallel to it, at a distance below it, the same as the height of S above the bottom of the glass, draw the base line (BL).
4. Draw a perpendicular from S, and take (DP), so that the length of the line S (DP) is equal to the distance we stand from the transparent plane.
5. Measure the same length on each side, on the (HL) to obtain the two (DW's); supposing of course that the object is rectangular.

37. We will now proceed a step further, and show how to represent the same object, removed to the position $ab\,cd$,\,
Pl. I. We find that the line $a b$ continued, meets the line at the bottom of the glass, that is the (BL) in Pl. II., at $e$, just one inch to the right of D, we draw this line to S, in Pl. II., as it is parallel to CD, and then determine $b$ and $a$, which are both on this line. This we do as before, by measuring along the base line the distance, $e b$, in Pl. I, and joining $g$ (DW²), in Pl. II.; then taking $h$, so that $g h$ is equal to $b a$, in Pl. I., and joining $h$ (DW³) in Pl. II., we have, where these lines cross S e, the points $b$ and $a$. We can now draw $b d$ and $a c$ parallel to the (BL). But we observe that as AC is not so long as BD, being more distant, so $b d$, being more distant, should not be an inch long. Referring again to Pl. I., we observe that $c d$ meets the line (DW¹) (DW²) in $f$, $c d$ being parallel to $a b$, and $e f$ being equal to $b d$ or $a c$, which we know to be one inch. We, therefore, take $f$ one inch to the right of $e$, in Pl. II., and joining $S f$, we determine $d$ and $c$ by the intersection of the lines $a c$, $b d$, and $S f$, and the picture is completed.

38. In the same manner any rectangular surface on the ground can be represented, and we would recommend the student to practice different forms before he goes further.

39. We would here observe, that having drawn the lines SB, and SD, it would evidently have been the same thing if we had joined D (DW³) to find A, and then drawn AC parallel to BD.

40. Also that in $a b c d$, we might, having drawn $S e$, $S f$, and found $b$ as before, have drawn $b d$ parallel to the (BL), and either have determined $a$, by joining $d$ (DW²), and then drawing $a c$ parallel to the (BL): or have found $c$, by joining $b$ (DW¹), and then drawing $c a$ as before.

41. We hence see, that only one point for determining the width, is necessary for practical purposes, i.e., that when the paper is too small to admit of both, we may place
S quite on one side of the paper, and one (DW) on the other side; while the other (DW) is in reality some little distance from the edge of the paper, and not on it: attending to the position of the object.

The DP also being determined in parallel perspective, we need not represent it on paper, but merely mark off on the (HL) the same distance that we should have taken for the length of the vertical line, that is the line joining S and (DP).

We would, however, recommend the student to draw for some time, if possible, every line, and mark every point, to accustom himself to their position and use.

42. We will now proceed to solid bodies, and will first take a cube, as one of the simplest rectangular solids, Pl. III.

Take a cube two inches each way.

Having determined S, &c., as before, draw a square ABCD, a little removed from the (BL), in this case, say nearly an inch; and two inches each way, as this will be one face of a cube two inches each way: then draw perpendiculars from each corner, and in order to find the proper height, as the nearest perpendicular even cannot be two inches, erect a perpendicular on either of the points X, Z, which are where AB and CD, if produced, would meet the (BL), and then make this perpendicular two inches high, that being the height of the cube; from L (supposing we chose the line XL, for it matters not which of the two) draw LiFES, cutting the two perpendiculars from A and B in E and F; these must evidently be two of the corners of the cube, since FE is parallel to BA, and is therefore drawn to the same point S, as shown above, and L is clearly the starting place, this being where EF, if produced, would meet the glass plane; and FG and GH, being parallel to BD, or the plane of the glass, are simply drawn
parallel to BD, meeting the perpendiculars from C and D, in G and H, which are evidently the other two corners of the cube. GH produced, ought evidently (being parallel to EF and CD) to go to the point S, and meet the glass in M, which it is found to do; indeed, if we had taken ZM for the perpendicular instead of XL, we should have joined SM, and determined G and H that way; which proves that it does not matter which plan we adopt. In all cases of this kind, we must study convenience and accuracy.

43. The cube is thus completed; and it is evident that in the same way any rectangular solid may be represented in parallel perspective. We would recommend the student before going further, to practice the representation of rectangular solids of different proportions, taking boxes, &c., as his models; to fix the principles in his mind; for acquiring a knowledge of perspective, must be a work of time, though not necessarily of difficulty.

44. We will now explain the method used in drawing pyramidal solids. In Pl. III., fig. 2, we have drawn part of the base line from P to Q, and and just behind it a square one inch each way, a b c d: suppose a pyramid, say two inches high, erected on this square.

45. We first represent the square fig. 1, a b c d in its proper place, which can easily be done by the preceding rules.

Now the top of the pyramid, however high, must evidently be exactly over the centre of the square, on which it stands; all we have to do, therefore, is to find the centre, e, draw a perpendicular line e h on it, and having determined the height of this line, draw lines from the point h, to the corners of the foundation.

46. Referring to fig. 2, we observe that the centre of the square is exactly where the diagonals cross: hence we have only to draw the diagonals a d, and b c, fig. 1, which
cross at \( e \), and we have the point on which to raise the perpendicular \( e h \).

47. We determine the height of \( e h \), in the same way as in the cube, that is by drawing \( S f \) through \( e \), taking a perpendicular \( fg \), on \( f \) two inches high (that being the height chosen for the pyramid), and joining \( S g \), it cuts \( e h \) in \( h \).

48. A very little consideration will show, that this is exactly what we did to find the height of the cube, only that here we take the height at the middle of one of the sides of the base, and there at one corner of the base. Having thus obtained \( h \), we join \( ha, hb, hc \) and \( hd \), and the pyramid is completed.

49. The intersection of diagonals gives the centre of any parallelogram, as is shown in Pl. III., fig. 3.

50. One more solid being described, it will be seen that all common forms can be made up of these. We mean, one shaped like the roof of a house. In Pl. IV. fig. 1., we first draw a solid, \( FP e \), one inch and a-half high, the same in width, and two inches in length, as is seen by measuring PT. We then draw the gable end \( AFa \), by taking \( VA \) a perpendicular from \( V \), the bisecting point of \( Fa \), the proper height (in this case three quarters of an inch), and joining \( AS \); the other point \( E \) is easily determined on this line, in a similar manner; then joining \( E e \), the roof is finished by joining \( AF, Aa \).

51. We have here divided the roof into four equal parts by the lines \( Bb, \text{&c.} \), and we observe that the lines \( Aa \) and \( Ee \) are parallel on the paper (for they are in planes parallel to that of the glass, \( i.e. \) perpendicular to the direction of vision); hence these lines \( Bb, \text{&c.} \), must also be parallel to them, and if we can determine the points \( bcd \), they can be drawn at once.

52. This is easily done, for in the same way as we
found PM by means of the (DW), we can divide it into what parts we like; and a e can be similarly divided, by merely raising perpendiculars from the points $b', c', d'$ just before obtained in PM.

53 In fig. 2 we have the same object, but turned so that we look straight at the side $a M$. The letters correspond in both figures. In this, we would notice that we get the points $b c d$ by simple measurement, and similarly BCD, since neither AE nor a e are at all distorted.

54 We find, however, neither A a nor E e any longer parallel, [A and E having been in this case determined by raising perpendiculars from the points where the diagonals of the ends cross, and taking them the proper height, which evidently gives the same result as, and is perhaps simpler than, finding them by reference to the (DW)]. This we might expect, for AE must evidently be less than a e, and being parallel to it, the lines A a and E e cannot be parallel.

55. We have in Pl. V., fig. 1, a representation of a solid body like half the roof in the preceding plate; and as AC and ED are not parallel on the paper, and are so in reality, they must meet in infinity.

56. Now the point Q, where they meet, is evidently on the line CA, produced. This line is in the plane CBA, and must therefore meet the infinitely distant plane before mentioned, at the intersection of these two planes, which is evidently a straight line drawn perpendicularly through S.

57. Hence Q is determined by the intersection of CA produced, and the perpendicular line.

58. Now the height of Q above S evidently varies with the angle BCA; and at a future time we will explain how to find Q at once, without first finding where one of the lines (as in this case CA) crosses the perpendicular line, and drawing to this point all lines parallel to A a.
59. We will now give some instructions how to draw curved lines in perspective, which is evidently attended with more difficulty than the drawing of straight lines since two points only of a straight line being found, its direction is determined at once.

60. Pl. V. fig. 2. We here show a simple way of obtaining several points of a circle, which points being always found by the intersection of straight lines, can be easily placed in perspective, and a curve then drawn evenly through them is sufficiently correct.

61. We have taken a quarter of a circle, and first drawing a square framework for it (the centre being at one of the corners), divide the two sides opposite the centre into four equal parts, and joining the different points (as shown in the plate), we obtain the points MNO, which are very nearly on the circumference of the circle. Fig. 3 shows half a circle in perspective, one quarter being lettered as fig. 2, to show the corresponding points. It is, we think, unnecessary to explain it further.

62. We would observe, that if the three points thus obtained, are, from the size of the picture, too few, more can be obtained by dividing the lines AB CD into eight or nine parts, and proceeding in a similar manner.

63. Any curve may be put into perspective in a similar way; draw the curve on paper, take several points in it, put a rectangular framework round it, corresponding to the square round the circle, and draw the intersecting lines, obtaining guide points by merely putting these lines in perspective.

64. We would caution the student against taking too many guide points, as that makes it complicated, and a very few fix the curve pretty accurately.

65. Fig. 4 is meant to represent a pyramid; but here the rectangular solid out of which it may be supposed to
be cut is drawn. We observe that the intersection of the top of course gives the vertex of the pyramid, provided that the rectangular solid and the pyramid are of the same height.

66. Hence, as the lines intersecting the square horizontal surface go to the (DW's), we can get L by simply drawing GC the real height, and joining C (DW) [N.B. It must be the proper (DW), as the other will not do at all] and taking L where it crosses the perpendicular raised from k. This is much less trouble than taking MN, and joining SM.

67. Hence, as is easily seen, AC and GE are proved to be parallel to each other. This is evidently true, as one is merely raised directly over the other; we should therefore have expected them to go to the same point in infinity, i.e., one of the (DW's).

68. We have given these different ways of doing the same thing, to show how they prove one another, as well as for the sake of convenience; it being always allowed to be a good thing to have "Two strings to one's bow."
PART II.

ON INCLINED PERSPECTIVE.

69. In Plate VI. let the line from (VP¹) to (VP²) be the bottom of the transparent plane. ABCD an object as before. (DP) the position of the spectator. (DP) SS' the direction in which he looks.

70. It is evident, that instead of there being but one vanishing point (written (VP) as before, viz., S, two will now be required. These are found by drawing the line (DP) (VP¹) parallel to AB, to determine the (VP) for all lines parallel to AB; and (DP) (VP²) parallel to AD for all lines parallel to AD; meeting the line (VP¹) (VP²) in (VP¹) and (VP²), which are thus determined.

71. The angle at (DP) is evidently a right angle, being of course the same as the angle of the object, viz., DAB.

72. In Pl. VII., S (DP) is drawn perpendicularly as before, above S, and the points (VP¹) and (VP²) are on the horizontal line; the angle (VP¹) (DP) (VP²) being a right angle. The principle is the same as that of parallel perspective.

73. It is unnecessary to justify the way of determining these points, as it would be merely repeating what we said in Part I.

74. But a new difficulty here arises, viz., how to determine the diminished width. The way universally adopted differs but little from that used in parallel perspective. We take SE, equal to SB, and join EB, Pl. VI.; we then draw a line from DP parallel to EB, and meeting the line
(VP₁) (VP₂) in (DW¹). Similarly for (DW²), we take SF equal to SD, and draw a line from (DP) parallel to DF, meeting the line (VP₁) (VP₂) in (DW²). The two points are thus determined.

75. The correctness of this is evident, when we consider that whatever length we take SB, provided that SE equals SB, the direction of EB is constant. Similarly for DF.

76. Now, it will be found universally true, and many will no doubt perceive why it must be so, that the length of the line from (VP₁) to (DP) is exactly the length of the line from (VP₁) to (DW¹); in the same way the line (VP₂) (DW²) equals the line (VP₂) (DP).

77. Hence, in practice we merely bring down (VP₁) (DP) and (VP₂) (DP), Pl. VII., on the (HL), and thus fix the positions of (DW¹) and (DW²).

We would here remark, that (DW¹) and (DW²) must be on different sides of the perpendicular line, and that the (DW) for the lines vanishing in one (VP), is on the opposite side of the (PL) to that (VP); and that

78. In inclined perspective, two (DW's) are absolutely necessary, whereas in parallel perspective only one is wanted.

79. To draw ABCD, in Pl. VIII., we merely, after determining A as before, draw AB AD to their respective vanishing points, for their direction; then taking AE equal to AD, draw a line from E to (DW¹), the (DW) for lines going to (VP¹), and cutting AB in B, which thus gives the diminished length of AB. Similarly taking AF equal to AD, join F (DW²), determining D and the length of AD; draw BC to (VP²), the (VP) for all lines parallel to AD, and DC to (VP¹); these intersect at C, which, being thus found, the figure is completed.

80. It would be superfluous to describe how a b c d is drawn, after our full descriptions in Part I., as the student
must have perceived that inclined perspective differs from parallel perspective more in the construction of the framework than in the practice.

81. The student will have no difficulty in seeing what is represented in Plate VIII. We have, however, here made use of various artifices, which we shall explain at a future time.
PART III.

ON ARTIFICIAL SHADOWS.

82. Before we commence this part of the subject, we shall offer a few remarks on shading and outline.

83. Distance always has a tendency to diminish, not only the size, but the clearness and brightness of objects. Lights and shades are not so easily distinguished, and the outline is not so sharp.

84. Lights and shades not being so easily distinguished, is a proof that they more nearly resemble one another in the distance.

85. But there is no reason why one should change in intensity more than the other, we must therefore adopt the theory, that they both partially lose their character; i.e. that—

86. Lights become darker, and shades become lighter in the distance.

87. This corresponds with experience, for we observe that in general, the appearance of the distance is one uniform medium tint, formed by both lights and shades losing their intensity.

88. The outline, for the same reason, should be formed of finer and lighter strokes in the distance than in the foreground.

89. In Pl. IX. fig. 1, let L be the source of light, as the flame of a candle.

We shall presume that the point L is higher than the object, the shadow of which is to be drawn, as otherwise the shadow could not be terminated on the ground, and
we should require a wall, or something of that kind to throw the shadow on.

90. Let us first consider how to find the shadow of a point; let P be this point.

91. Let PB be the height of this point above the ground, and LA the height of L.

92. Now it is evident that the shadow of this point will be a point on the ground, in a perpendicular plane drawn through L and P. This plane will evidently cut the ground in a straight line, which passes through B and A, the points where the perpendiculars from L and P meet the ground.

93. The shadow of the point must therefore be in this line AB, or rather AB produced.

But we know, also, that the shadow is in a straight line, drawn from the point L to P and produced behind P; this line is also in the vertical plane before mentioned, since both L and P are in the plane.

94. Draw this line, and produce it till it meets the line AB, produced in p: these lines must evidently meet at p, as they are both in the same plane, and LA is greater than PB, and not towards the opposite side of LA, p is therefore the position of the shadow of P.

95. The practical way is to draw a straight line from L through the given point, meeting the straight line drawn through A and B; the point of intersection is the point required.

96. It is evident that the shadow of a straight line on a plane surface must be a straight line, and the way to find it will be simply to find the position of the shadows of the two ends, and join the points thus found.

97. From this we see, that with straight lines all we have to do, is to find the intersection of a plane passing through L and the straight line given (which we shall call
the shadow plane) with the surface on which the shadow is thrown, and then determine how much of this line of intersection is wanted.

98. We have an example of this in fig. 1, where the shadow of a straight vertical object is thrown partly on the ground, and partly on a vertical wall FD, L as before being the source of light. The intersection of the plane of the shadow with the wall is a perpendicular line, the height of which is, as before, determined by its intersection with the line LQ q', at q.

99. In the remaining part of the figure, we have shown how to find the shadow of a vertical object RG, thrown partly on the ground, and partly on the inclined plane HM.

100. We wish to obtain two points on the inclined plane, where it is cut by the plane of the shadow, in this case perpendicular. One of these points we already have, viz., m, and another may be found by fixing on a point in the line m r', the intersection of the ground with the shadow plane, either r' itself or another point as o; drawing o l vertical, and therefore in the plane of the shadow, and by means of the lines o n, n l, determining l, the point where this vertical line o l meets the inclined surface. This is evidently one point in the line of intersection of the surface and shadow plane, and joining m l, we can determine its length as before.

101. In fig. 2, Pl. IX. we have the light placed on a box, the shadow of which is found by merely finding the shadows of the four corners BCDE, viz. b c d e and joining them.

102. We have also the shadow of a plane object without thickness, thrown partly on the ground, and partly on a wall, which is not parallel with the surface above-mentioned; the shadows of the corners are found as before, but one falling on the wall, the other not, we must find
what part of the object will throw its shadow on the wall by drawing a line from A to V, cutting XM in W, draw WT vertical, and find the shadow of the point T, which will evidently fall on the edge of the wall; the shadow of the rest is found as before.

103. If we find the shadow of a straight line parallel to the plane on which its shadow is thrown, we shall find that the shadow itself is a straight line, parallel to the line of which it is the shadow.

104. This we should expect, for since we may suppose a plane drawn through the object line parallel to that plane on which its shadow is to be thrown, we have in fact these two parallel planes intersected by a third plane (the shadow plane), and it is a mathematical fact, that under these circumstances, the lines of intersection of these planes, are themselves parallel.

105. The knowledge of this is of great use, as much trouble may thereby be saved: e. g. in finding the shadow of the box; fig. 2, having found c and e as before, draw through c, c d parallel to CD, and c b to S, similarly e b, and e d, and the shadow is completed.

106. The great thing is, to determine the intersection of the shadow plane, with the surface on which the shadow is thrown.

107. In determining the shadows of curves, we must determine several points in the curves, find their shadows, and connect them as well as we can: by finding a sufficient number of points, any degree of accuracy may be obtained.
PART IV.

ON NATURAL SHADOWS.

108. The sun, with respect to shadows formed by it, may be regarded as at an infinite distance, the point A is therefore at an infinite distance; A as before, being the foot of the line drawn vertically from the source of light to the ground, Pl. X. fig. 2.

109. There are three cases only.—

The first, when the sun is exactly to the right, or left of the spectator.

The second, when the sun is before the spectator.

The third, when it is behind him.

110. We will treat of these separately; in the first case, when the sun is exactly to the right or left of the spectator; as in Pl. X. fig. 1, where AD is a wall, and a D the shadow cast by the sun, which is exactly to the right. Here the point A cannot be represented, being in fact, at an infinite distance to the right, and the lines a C, b D, that would otherwise have been drawn to A are parallel.

111. This corresponds to the case of drawing the side of a roof, as in Pl. IV. fig. 1; and as a universal rule, when the sun is exactly on one side, the lines corresponding to A a, B b, a C, b D, are always parallel.

112. When we have the shadow thrown on a wall, or any other object, we treat it in the same way as in artificial shadows; i.e. we find the intersection of the plane of the shadow with the surface on which the shadow is thrown.

113. In fig. 2, we have the sun before us. Here A
must evidently be on the (HL), being on the ground at an infinite distance. Its position must be determined in exactly the same way as one of the (VP's) in inclined perspective; by taking the proper angle at the (DP). The sun is of course just above this point.

114. But the height of AL must be properly determined, this is evidently done in the same way, that the height of SQ was determined in Pl. V. fig. 1. We shall not enter at present into this, but leave it till the next part, when the theory will be fully explained; at present, it is sufficient to know that the height of AL varies with the height of the sun.

115. If the sun is vertical, the height of AL must be infinitely great, and the lines Bb Cc must be parallel and perpendicular.

116. In all other respects, the practice of the second case is, precisely similar to that of artificial shadows.

117. In fig. 3, we have the third case, where the sun is behind the spectator. Here the sun cannot be represented on the paper, neither can A; but since the lines Bb, Cc are in reality parallel they must go to some point infinitely distant exactly opposite to the sun.

118. This point L' must therefore be in a line perpendicular to the (HL), and meeting it in A', which is determined in a way similar to that used in fig. 2.

119. A' will of course be on the left of S, when the sun is on the right, and vice versa; and the angle at (DP) viz., A' (DP) S, is less or greater, as the sun is more or less behind the spectator.

120. Now L' must evidently be below the (HL), since the sun is above it, and the length of AL' varies as the altitude of the sun, just as in the second case. The practice of this case, is precisely the same as that of the second case.
121. The only difference between the practice of artificial and natural shadows, is the result of the different positions of the source of light, the flame of a candle cannot be, while the sun always is (practically), at an infinite distance. In the second and third cases of natural shadows, A and A' must be on the (HL), determined by the angle at (DP), and the length of AL or A' L', we shall treat of in the next part.
PART V.

ON INCLINED PLANES.

122. We will now treat of (VP's) for inclined planes, which we passed over before as too complicated to enter upon at that early part of the explanation.

123. Having recourse to our primary rules, and treating at once of inclined perspective (parallel being only a particular case of inclined), referring to Pl. VI., suppose ABCD to be the ground plan of a roof, the gable ends of which are perpendicular planes over AB and CD, as in the accompanying figure. The vertical planes will evidently, as we have already demonstrated, meet in infinity (as they are parallel), and must have a straight line for their intersection, which must be vertical, since the planes are so.

124. Hence, to find the point in which A e and D f meet on the plate of glass, we must suppose a line drawn from (DP), parallel to A e, to meet the glass. This line must be in a plane drawn vertically over the line (DP) (VP₁), and will therefore meet the glass in a line drawn vertically from this point (VP₁); and therefore the length of this perpendicular line only is wanted, to give the (VP) for all lines parallel to A e or D f.

125. The length will, as we should expect, be determined by the angle of inclination; and it is evident that if we draw a line from (DW₁) (on the glass in practice) inclined to the (HL), at an angle equal to that made by
the supposed line from DP and the line (DP) (VP^1), it will meet the line drawn from (VP^1) (vertically) in the same point as the supposed line from (DP). A very little consideration will make this apparent, for (VP^1) (DW^1) is made equal to (VP^1) (DP), and therefore the two triangles are equal in every respect.

126. Hence, to apply it practically, Pl. VIII. Draw (VP) (VP), [(VP) meaning the vanishing point for the inclined plane,] perpendicular to the HL, and make the angle (VP) (DW) (VP) equal to the angle at A of the object, (VP) thus determined is the vanishing point for all lines parallel to AB.

127. When we have to apply the theory to parallel perspective, the perpendicular must evidently coincide with the (PL), being drawn from S, the only (VP) for horizontal lines in the same perpendicular planes as the inclined ones, see Pl. IV.; and we must determine the height of the line by taking the proper angle at the (DW). The principle is not new, and very simple after proceeding thus far.

128. We can now easily determine the position of L in Pl. X. figs. 2 and 3; for having found A, join A (DP), and bring down this line on the (HL), as if we were constructing a new framework, considering A as a new (VP), and the point thus found as a new (DW); make the proper angle at this point as before, and L is determined. Explanation would, we think, be superfluous, as it is only a particular case of inclined planes, the plane of the shadow being the inclined plane.
PART VI.

ON ARTIFICES.

129. The student having now attained to a knowledge of the orthodox way of drawing any common rectangular solid, simply placed, we will show how the working may sometimes be simplified, (merely by the application of the fundamental rule, viz., that all parallel lines, not in planes facing the spectator, go to one point,) a multiplicity of lines being avoided, and in many cases accuracy being more easily attained.

130. In Pl. III. fig. 1, we obtained the height of the line $e\, h$, by finding $f$, and drawing $f\, g$ the full height (here two inches), and joining $S\, g$; but a simpler way would have been to have drawn $b\, k$ two inches high, and then joined $k$ (DW). See also Pl. V. fig. 4.

131. Another simple way would have been, Pl. III. fig. 1, to have drawn $e\, m$ and made $e\, h$ four times as long as $e\, m$; for since the plane $h\, e\, m$ is parallel to the plane $g\, f\, c$, and they both face the spectator, the corresponding lines preserve their proportions to each other; but $f\, g$ is four times the length of $f\, d$, therefore $e\, h$ is four times as long as $e\, m$.

132. The lines $AC$ and $EG$, in Pl. V. fig. 4, must evidently go to the same point on the (HL), being horizontal and parallel. In this case, where the lines (AD) and (AB) are equal, and the object in parallel perspective, the lines $AC$ and $EG$ go to the (DW); but in Pl. IV. the lines FC and LM, if drawn and produced, would, being parallel and horizontal, meet in a point on the (HL), though not in the (DW), LP not being equal to (PM).
133. The same theory can of course be applied to inclined perspective; it is merely an application of the fundamental rule, and often of great use.

134. Again, it often happens that when we want to find the point of intersection of the diagonals of a square (as ABCD, in Pl. V. fig. 4), the square is so nearly on a level with the eye, that it is extremely difficult to do so by the ordinary method. But then, supposing ABCD had been almost on a level with the (HL), we might, by finding the point k, and drawing BD and k L, find L with great accuracy, whereas it would be extremely difficult to find it accurately by drawing AC and BD; the advantages of and correctness of this method must be apparent.

135. We would here observe, that the student ought thoroughly to understand the reason of all these methods, or he may in applying them only become confused, and by forsaking the beaten path, involve himself in a maze.

136. Again, consulting Pl. V. fig. 1, it is often shorter to find one of the lines CA, and by that method determine Q, than to first find the angle at C and then make the proper angle at (DW), as we explained in Part V.

137. Again, in Pl. VIII., to find the height of EF, we have merely to take EF double the height of DE, instead of taking the original height of EF on the base line, and reducing it from that. EF is here two inches, and BD only one (i.e. originally); the reason is the same as that given for the artifice in Art. 131.

138. Again, to find the points by which the arch BPC is formed, we have taken them first between B and C, and then found them higher up by vertical lines; but we might just as easily have found them at once at the required height by making a new (BL) at the required elevation.

138. We will content ourselves with these few hints;
they are intended more to show the student that the orthodox methods may often, as occasion offers, be conveniently replaced by others, all equally true, and out of which he must learn to select the one most calculated to give accuracy, neatness, and celerity.

139. Before, however, we leave this part of the subject, we will observe that with respect to solids whose ground plan is not rectangular, we must pursue the same method of finding the (VP's). The angle at the point (DP), being made the same as the angle of the object; if however, the principles contained in Part I. be thoroughly understood, we confidently anticipate that the student will find no difficulty, whatever form may be presented to him. We would, however, here recommend the testing of all the artifices thoroughly, before any attempt to apply them practically, unless they at once appear axiomatical.

140. In our next part we shall give an extension of the system of (VP's) and (DW's) to any planes; and then conclude with a few practical remarks on the application of the rules to sketching from nature.
141. It may now be asked, is the horizontal plane the only one for which we are to have (VP's) and (DW's)?

The answer is—No—and we will proceed to show how the principles may be extended to vertical planes.

142. The same principles can with a little thought be applied to any planes, but the complexity of these cases is too great for any lengthened explanation—in fact, they are of so little practical use, if any, as to be regarded more in the light of problems, than anything else, as a simpler solution of the difficulty can in most cases be found.

143. Referring to Pl. XI. fig. 1. To draw the cube GAE set on one of its edges GB.

It is evident, that one of its edges being horizontal, must go as before to a point on the (HL), (VP₁), to this point the lines AF and DE, parallel to GB, also go.

144. Now the lines AD and AB, are in a perpendicular plane at right angles to BG, and AF, and must therefore go to points in a line drawn vertically to the (HL), and through a point on the (HL), to which horizontal lines at right angles to GB or AF would go; all this can be done as we have already shown in Part V. Having found the point (VP₁), and drawn the perpendicular line through it, we find the (VPI) for lines parallel to AD, by taking the
proper angle at \((DW^2)\), \(DAB\) being evidently a right angle, we must make the angle \((VPI^1)\), \((DW^2)\), \((VPI^2)\) also a right angle, the point \((VPI^1)\), being thus determined, is the \((VP)\) for all lines parallel to \(AB\).

145. But how are we to determine the length of \(AD\) and \(AB\)? It must evidently be diminished from the original length of one inch by some fixed rule, and the rationality of applying the same rules for finding and using \((DW’s)\) for vertical planes, which we did for the horizontal plane, must at once strike the student.

146. Following this theory we measure \((VPI^1)\) \((DW^1)\) equal to \((VPI^2)\), \((DW^2)\), and similarly for \((DW^1)\) find the points for determining the diminished width in the perpendicular plane, and proceed exactly in the same way as for a horizontal plane; making a new base line \(KL\), parallel to the vertical line \((VPI^1)\) \((VPI^2)\) which serves as a \((HL)\) for the new plane.

147. We must not however forget that in this plane, though the point \((VP^1)\) has many, it has not all the properties of a point of sight; and also, that

The new \((HL)\) is one, merely with the properties of a \(HL\) for that particular plane.

148. To find the length of \(AB\) and \(CD\), we measure one inch along the new base line, and use the new \((DW’s)\) in the same way as before.

149. We may extend this principle to any planes. In this plate fig. 1, we have another plane \(AFED\); we have already the \((VP’s)\), for this plane, viz. \((VP^2)\) and \((VPI^1)\), but here occurs a new difficulty, namely:—Where is the \((PL)\) to be? for of course the line so called, has in this case no immediate connexion with the point of sight. This question a little consideration will set at rest.

150. The lines \(AB, FG\). are perpendicular to this plane,
and meet in the point (VPI*); therefore the perpendicular line for this plane, must also pass through the same point, and it must also be perpendicular in reality to the line which serves as the (HL) of the plane, viz. (VP*) (VPI*), hence we have only to draw a line (PL) vertical to that line, and making a right angle at N on this line, by means of two lines from the (VP’s) for the plane, we have a new system of points for this plane, finding the (DW’s) as before, and drawing a new base line for it, parallel to its horizontal line; similarly for the plane AFGB.

151. It is evident that from the complexity of the case, it would be much more difficult practically to construct the framework (so to speak), than in planes more simply placed. But having found the (VP’s) for one object we can construct the framework and use the points thus obtained, to draw other objects similarly situated.

152. But the theory is to be looked on more in the light of a problem calculated to open the mind to the universal application of the rules contained in Parts. I and II. than as of much practical use in itself.

153. We will now refer to that important point in drawing, viz., the limits of the picture.

154. And first we will endeavour to show the necessity of limits being assigned, by exhibiting an absurdity arising from a neglect of it. Consulting fig. 2, we have taken a line A (VP) the end placed on the base line at A, i.e. touching the glass; we want to cut off from this line a length equal to AB, to do this we (proceeding as before) join (DW) B, crossing the line (VP) A in b, and A b is according to our former rules the diminished length of the line whose original length was AB. But by measurement A b is found to be actually longer than AB. Here, then, is an absurdity, and how does it arise?
155. It is evident that as long as the point A is taken between the two (DW's) no absurdity can arise, and for perspective drawings, this is perhaps enough; but strictly speaking—

156. We cannot take in at one glance, a picture larger than a circle, whose diameter is half the distance we stand from it. To take notice of any other object we must alter the direction in which we look, and therefore the position of the plate of glass which is always supposed to face us, and in short our whole system of points. In fact we begin a new picture—a different view.

157. If we keep to this we shall never find any absurdity creeping into our drawings, and we may, as we observed, generally go a little beyond these limits, without falling into manifest error in a problematical drawing. In the previous plates, we have always avoided absurdities, though we have not often paid strict attention to this rule. Perspective drawings are called forced when we take in too large a field.

158. A reference to Pl. XI. fig. 2, where the circle is drawn, will show the student, the great importance of a knowledge of this rule.

159. In sketching from nature, a panoramic effect is often produced by extending the field of view and disregarding this rule: and all must have observed the distortion produced in drawing a room, at one end of which the spectator stands,—it cannot in such cases be avoided. (See remarks in Articles 8 and 9).

160. When sketching from nature, the student cannot be supposed to know the exact proportions of every building and object, but it is always of service to mark the point of sight, as being the height of the (HL), in sea pieces, of course, the boundary of the sea in the distance,
for otherwise we might make men appear tall enough to
look in at the top windows of houses, &c.

161. Again, in drawing buildings that are not far dis-
tant, we should, having drawn one line as carefully as we
can, on one inclined side, continue it in imagination till it
crosses the imaginary (HL), mark this place with a point,
and we have at once the (VP) for all lines parallel to the
first. This will at once determine the direction of all
those lines, a thing most difficult to determine accurately
(if not impossible) by the eye alone.

162. The diminished width of objects must generally be
determined by the eye, the different proportions being
supposed unknown: but having determined the width of
the inclined side of a house in this way, if we have to put
the gable end of a roof on that side, we can find the middle
point accurately by intersection, as shown in Pl. IV. In
drawing houses placed on hills of different heights, the
use of the (HL) is at once apparent, as we know at once
that all horizontal lines above this line, slope down to it,
and vice versa.

163. With one more observation on the use of perspec-
tive, as applied to sketching, we will conclude. In sketch-
ing from nature, buildings in particular, with the sun
shining brightly on them, if we have not time to finish the
drawing on the spot, how are we to put in the shadows
correctly from memory, without a knowledge of the rules
by which they can be drawn? Otherwise we might (as we
have actually seen done) make the shadows of a row
of houses, of different heights, all the same length.

164. But it is unnecessary to multiply instances, for it
must be evident to all how much more likely a person ign-
Orant of the rules is to make a mistake, than one who
possesses a sound knowledge of them; at least the latter
has this advantage, that having made mistakes, he can not only detect, but correct them, and endeavour to avoid them in future; and in this world of imperfections, what more can be done by any one.

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