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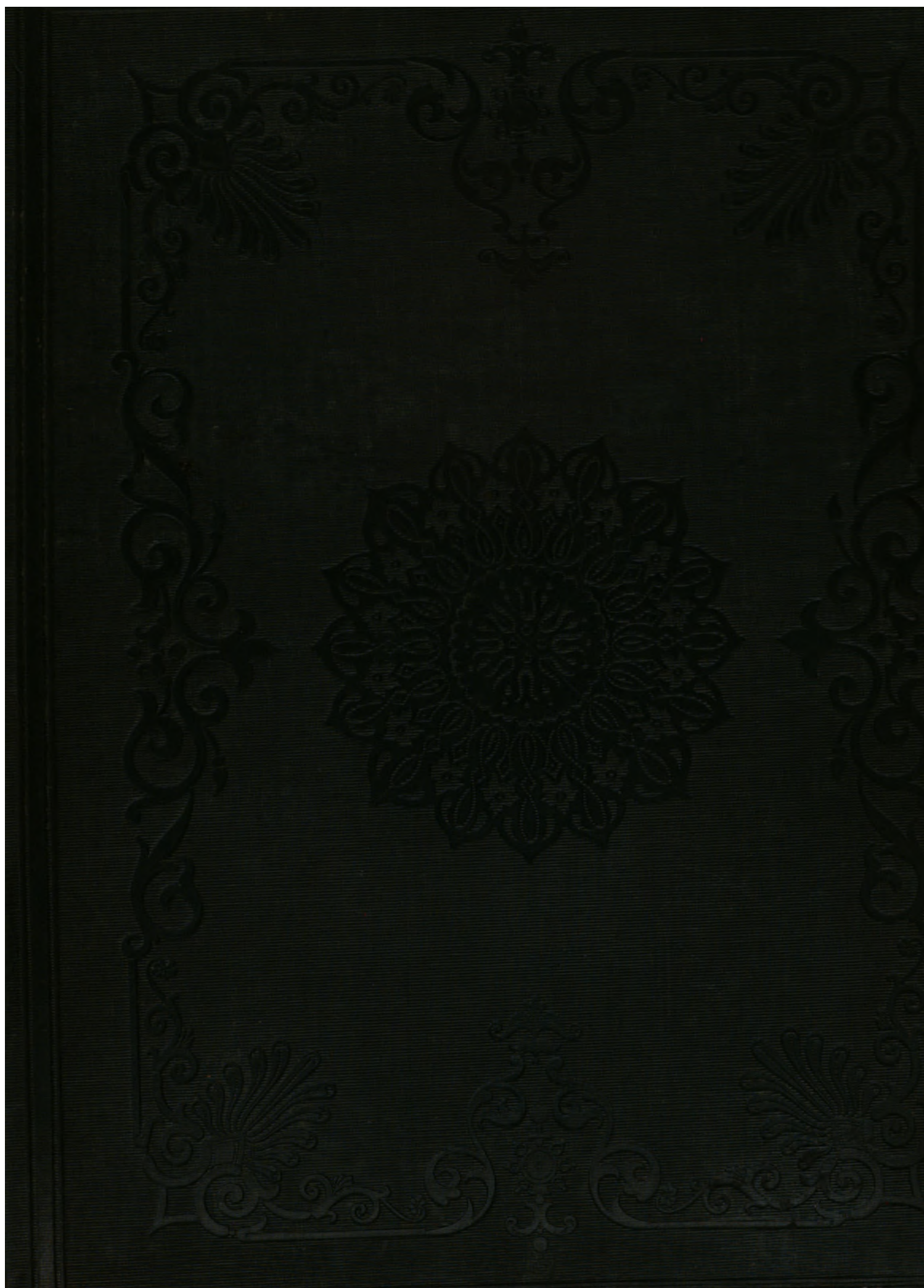
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Johnson d. 988

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PRACTICAL PERSPECTIVE;
OR, AN
EASY METHOD
OF REPRESENTING
NATURAL OBJECTS,
ACCORDING TO
THE RULES OF ART.
APPLIED AND EXEMPLIFIED IN ALL THE VARIETY OF CASES; AS
LANDSCAPES, GARDENS, AND BUILDINGS,
THEIR APPENDAGES, PARTS, AND FURNITURE;
WITH
RULES FOR THE PROPORTION AND POSITION
OF FIGURES,
IN DRAUGHT AND RELIEVO:
ALSO
THE MANNER OF CONDUCTING THE SHADOWS,
PRODUCED EITHER BY NATURAL OR ARTIFICIAL LUMINARIES:
AND PRACTICAL METHODS OF DRAWING AFTER NATURE, WHEN THE PROCESS OF RULES
ARE NOT UNDERSTOOD.
A WORK HIGHLY NECESSARY
FOR PAINTERS,
ENGRAVERS, | EMBROIDERERS, | JEWELLERS,
ARCHITECTS, | STATUARIES, | TAPESTRY-WORKERS,
AND OTHERS CONCERNED IN DESIGNING.
ILLUSTRATED WITH ONE HUNDRED AND FIFTY COPPER-PLATES.

WRITTEN IN FRENCH BY A JESUIT OF PARIS.
Translated by E. CHAMBERS, F.R.S. Author of *Cyclopædia*, or an Universal Dictionary of Arts and Sciences.

SEVENTH EDITION.
To which is prefixed, the THEORY OF PERSPECTIVE, by JAMES HODGSON, F.R.S.
*If you would proceed immediately to the PRACTICE of PERSPECTIVE, without engaging in the Intricacies of the
THEORY, the JESUIT'S PERSPECTIVE will answer your Purpose.*
WOLFIIUS IN ELEMENT. MATHES. Tom. II. p. 1018.

London:
PRINTED, BY ASSIGNMENT OF Messrs. BOWLES & CARVER,
FOR SHERWOOD, GILBERT, AND PIPER, PATERNOSTER ROW.



THE

P R E F A C E.

THE Art of PERSPECTIVE is most elegant and agreeable: It affords great entertainment to men of leifure, and is the very foul of painting; without which a PAINTER can never be a master in his profeflion. It is this muft conduct him in the difpofitions, heights, and proportions of his figures, buildings, and other objects. It is this muft fhew him what colours are to be deep or faint, vivid or dull; where each is to be applied; what parts to be highly finished, and what flightly touched; where light is to be beftowed, and where diminifhed. In a word, it is this begins and compleats the painting. Without the affiftance of PERSPECTIVE, the beft master muft make as many faults as ftrokes; efpecially in buildings with their enrichments. In which particulars I find fome reputable painters fo greatly defective, that this has been one confiderable motive to my undertaking the following work: Wherein their errors will be fhewn, without naming the authors; and novices instructed how to avoid the like. The moft confummate master is tied to the ftrict obfervation of thefe rules, on pain of pleafing none but the ignorant: And an indifferent painter may be told this to his comfort, that if he make himfelf a thorough master of them, he will be able to do wonders.

The ENGRAVER in copper can no more excel without PERSPECTIVE, than the painter; as having every thing to exprefs with the graver that the other performs with his pencil. From PERSPECTIVE he muft learn where to lean heavily, and where lightly.

on his graver; what strokes must be sunk deep, and what softened. And his occasion for this art is more important, as his pieces multiply to a much greater degree than those of the painter; and, if artfully performed, will spread his praise more: But, if otherwise, his failing will be the more notorious, and each print be a monument of the author's ignorance.

The SCULPTOR and STATUARY must here learn the heights both for the high, low, and middle sight; the slopes and inclinations of buildings, and other bodies; the angle for the point of sight; and the proportions and dimensions of all objects, near and remote.

By the same art the ARCHITECT must learn how to make his designs intelligible in a little compass: How to raise one part, and leave the other in its plan, to shew the whole conduct and effect of his work. By the way, having mentioned architecture, I must observe of how much consequence it is, for such as practise PERSPECTIVE, to understand the fundamental rules of that science; the finest pieces of PERSPECTIVE being those of great and magnificent buildings, raised according to the order of columns; the beauty whereof depends on their just measures and proportions, which must be represented with the greatest exactness, otherwise they will shock and offend the eye. Ignorance in these things is not excusable, considering with how much ease they may be learned in *Vitruvius*, *Vignola*, *Scamozzi*, and some others.

To know the orders of columns and their characters, is not enough: A draughts-man should likewise understand all the usual dimensions of buildings, and the several parts; as doors, windows, chimnies, &c. how to dispose them to receive the light to advantage, and that no part may appear maimed, useless, or ill supported, and that there be a symmetry and proportion running throughout the whole. Without such regulation, a piece of PERSPECTIVE, in which noble structures have a place, instead of pleasing the eye will offend it.

GOLDSMITHS,

GOLDSMITHS, EMBROIDERERS, TAPESTRY-MAKERS, ENAMELLERS, and even JOINERS, and others who have occasion to make designs, are under the strictest obligations to attain the knowledge of PERSPECTIVE, if they would be eminent in their professions.

Many who desired to improve themselves by the study of this art, have assured me, that they were discouraged by the great number of lines which most authors make use of to form, and find the places of their objects. Others have been deterred by numberless obscurities in the rules and operations, and often perplexed from the instructions not being immediately annexed to the figures. Now these complaints have warned me to be more clear and methodical in my instructions, and to place them fronting the copper-plates, so that the Reader may have both the rule and the example in his eye at once. Through the whole I have accommodated myself to the capacity of learners; not perplexing them with too many demonstrations, nor using any words but such as may be readily understood, at least in the definitions. With the same view I have followed the common custom of attributing qualities to certain things which really have them not. Thus, in considering distance, or removal, I have been forced to say, contrary to my own sentiment, that it is the Pupil which receives the rays from objects, as if they terminate therein; whereas it is past dispute, that vision is performed on the *Retina* at the bottom of the eye; and that the rays only pass through the pupil in the way thither: which, to some people, will appear a new language, and not easily to be conceived. However, being assured that such a piece of knowledge imported but little to the practice of PERSPECTIVE, I have attributed to the pupil what really belongs to the bottom of the eye, the proper place of vision, where the images of all objects are formed; though there are others who refer this to the crystalline. The Reader who requires farther satisfaction in this point, may consult *Aquillo Scheiner*, and *Des Cartes*.

Though I have strained every nerve to render the science easy, I do not doubt but there are several will find some difficulty at the

the beginning. But whoever can surmount the first difficulties, may rest assured he will easily understand and practise the remaining rules, provided he takes care to master one rule well before he turns over the leaf to another. The rules, in some measure, depend on each other: And a little trouble, at first, will be abundantly recompensed by the future ease accruing from it.

It will appear from the following table, that this work alone suffices to carry you through all the stages and degrees of PERSPECTIVE, and to perform every kind of draught; having recourse to the several rules, and collating them together, to furnish out the performance required. No doubt it must be agreeable to any one, who desires to produce a composition of his own, to find immediately rules that will answer his purpose: His satisfaction, assuredly, must far transcend that of barely copying the designs of others; and, in case he be obliged to copy any other, he will do it with much more ease and pleasure, when master of these rules, in which instructions are given for every thing that can occur. I take great pleasure in making new designs, and inventing new figures; which I should have made public, as my predecessors have done, but that I was willing every person should participate in the pleasure of composing from his own fancy; having furnished him with all the means requisite thereto. Such as chuse to decline that trouble, will meet with designs enough ready to their hand in *Marolois*, *Vredeman*, *Uriesse*, and others, who have shewn the politeness of their genius in this way.

So many fine performances, I doubt, have helped to render many of our painters too lazy to learn to do what they find ready done. All they aspire at is to copy them as well as they can; which were excusable, did they know how to do it with judgment: But their way is to copy without understanding the rules of proportion and beauty, or, in other words, the rules of PERSPECTIVE. And hence it is, that we have often as many different points in a painting, as there are objects, lines, and returns. Some of them will let you see the bottom of an object that should only shew the top; and others, rather
than

than be defective, will shew both. Others again, having several figures to shew in a painting, will make them all of the same height : Though sometimes they vouchsafe to dispense with that rule, and make those in the fore-part less than those behind, to give room, as they tell us, for the hind figures to be seen : Which is to overturn both art and nature at once.

As to the order of this work, I have divided it into five parts. In the FIRST are delivered a few definitions, demonstrations, and reasons, which need no great stock of mathematics to be understood, and yet give a deal of light into the subject. Thence I proceed to shew the nature of the point of sight, points of distance, accidental points, front point, and side point ; visual rays, diagonals, parallels, perpendiculars, and base line. The previous knowledge of which things is very necessary to the easy understanding the instructions that follow. In the SECOND PART * I give the methods of shortening and diminishing plans divers ways ; with several forms of pavements, which ordinarily serve for the foundations of Perspective Draughts. Having given sufficient instructions for putting all sorts of planes in PERSPECTIVE, I proceed, in the THIRD PART†, to the elevation of divers objects, beginning with the easiest, which are cubes, and other bodies of several sides or faces. These are followed by walls, doors, windows, ceilings, vaults, and stair-cases of divers forms ; all without ornaments, or mouldings, that the rules might be less perplexed with a number of lines which such enrichments would have rendered necessary. After shewing all the buildings in their simplicity and nakedness, I go on to furnish them with columns, cornices, and other ornaments, which add a majesty and grace. The houses all built to the roof, I shew how to put them in PERSPECTIVE with variety of coverings : Then proceed to the insides, and give rules for the furniture, moveables, &c. These are followed by instructions relating to streets, gardens, trees, walks ; which are pleasing objects, and render the draughts very entertaining. This part is closed with two or three contrivances for drawing after nature,

* See Page 19.

† See Page 42.

when the rules of PERSPECTIVE are not understood. In the FOURTH PART * is given the measures and proportions of figures, their postures, situation, and horizons, both for flat paintings and relievos. The FIFTH and LAST PART † considers natural shadows, whether projected by the sun, torch, candle, or lamp.

When the PERSPECTIVE of a building, garden, range of trees, palifade, or the like intermixed with figures, is intended, I would recommend it to you, to sketch out what relates to the PERSPECTIVE with a pencil in the first place; which done, you will proceed with more assurance to fix the heights of figures, and other circumstances.

One thing some people will find to censure in this work, namely, That the points of distance in all my figures are too near the point of sight. But if this be a fault, it is a voluntary one. For my design being to teach, it was necessary every thing should be shewn, and the reader led to see where so many lines were to terminate; otherwise he would have been left to his own conjectures. It is sufficient that I direct the learner to place them farther off; and even shew the laws and occasions thereof. Nor can it be supposed I should have scrupled making them more remote, had not other considerations prevailed with me: One of which was, to render the book as convenient, and cheap as possible. Had I followed the advice of some of my friends, I should only have given a single instruction in each leaf; which would have swelled the book to about thrice its bulk, without rendering it a whit the more intelligible.

Some people affect to conceal the names of the authors they have followed; and, as has been well observed of a certain one, pilfer from private persons what they give to the public. For my own share, I confess, that having proposed to write a little treatise of PERSPECTIVE, I was willing to see as many authors as I could on the same subject; nor made any scruple of borrowing from any of them what I found to

* See Page 122.

† See Page 129.

my purpose, with an intention of making an open restitution of all my private thefts to the Public. The first writer of any account is *George Reich*, in the Tenth Chapter of his works. The next, *Victor*, a canon of *Toul*, who gives us a number of good figures, but is too sparing in his instructions. After him comes *Albert Durer*, who has left us some rules and principles, in the Fourth Book of his *Geometry*. Then *J. Cousin*, who has an express Treatise on the Art of PERSPECTIVE, wherein are many valuable things. After these come *Dan Barbaro*, *Vignola*, *Serlio*, *Du Cerceau*, *Sirigaty*, *Solomon de Caus*, *Marolois*, *Vredement*, *Uriesse*, *Guidus Ubaldus*, *Pietro*, *Acolty*, the *Sieur de Vaulizard*, the *Sieur Desargues*, and lately *Father Nicéron*, a *Minim*: All whom I have read one after another, and not without admiring their great and happy industry in the service of the Public; esteeming it sufficient honour for me to imitate what they have done, and to be the unknown copyist of their works. Besides those already recited, there are many others whom I have never seen; which multitudes of authors must be allowed an argument of the great esteem the art has always been in, as well as the superior regard paid to it by the present age. On this consideration, I cannot doubt but the following work will be favourably received; especially as it brings along with it several new rules and instructions, for putting in PERSPECTIVE any of the objects our senses are ordinarily conversant about; and, by consequence, of truly performing whatever relates to that Art.



B

A TABLE

A
T A B L E

DIRECTING TO

THE SEVERAL PARTS AND MEMBERS WHEREOF ANY
PERSPECTIVE DRAUGHT IS TO CONSIST.

PERSPECTIVE must begin with plans, and, of course, with such as are the most simple and easy ; among which is the square, or cube. The method of making the plan is shewn in page 19, and that of its elevation in page 44, 49. If an angular view be required, its plan is given in page 20, and its elevation in page 50.

To raise the walls of a house, or the palisades of a garden, &c. see the plans and elevations, page 51, 52.

Such as require the inside of a hall, or chamber, in a front view, must take the same page 52 for the walls ; the following page for the doors ; page 54 for the windows ; and page 77 for the chimney. The pavement they will find in page 31, 32, 33, and 34. The ceiling is shewn in page 55, 56, 57, and 58. If a door is to be open, you have your instructions in page 53, and the page following gives a window or casement open. The same rules are to be observed when there are two or three stories over each other, as in page 76. To ascend to these stories, stair-cases are furnished in page 82, 83, and 84.

Houses viewed on the inside, are usually seen furnished with moveables ; most kinds whereof are shewn in page 96—103. The proportions of figures to be placed therein are found in page 122, 123, 124, 125.

To shew the inside of a church, the plan must be put in perspective, according to the instructions in page 37, or 41. The walls to be raised, from page 51. The windows are constructed by the same rules as the arches of page 62, or 54. Pillars and pilasters are to be taken from page 48. Columns from 87. A vault, or vaults, from page 68—72. And a dome, or cupola, from page 74, 75. To enrich it with cornices, mouldings, and other ornaments, have recourse to page 88—92. For altars, to page 104.

For outsidés of buildings : The doors and windows are performed as in the insides, see page 53, 54, and 106. When raised to

*A Cube viewed
in Front, and
Angle-wise.*

Walls and Palisades.

Inside of a Room.

The Walls. Doors.

*Windows. Chimney. Pavement.
Ceiling.*

Stair-case.

Moveables.

Inside of a Church.

Windows.

Pilasters.

Columns.

Vault.

Dome.

Cornices and

Mouldings.

Altars.

Outsidés of

Buildings.

to the proper height, the method of roofing and covering them will be found in page 107, 108. And if a cornice or other ornaments be required, you have them in page 88—92. Arched galleries, both within and without side, are shewn in page 63, 66, and 67.

If a whole street be required, you must multiply the houses on either side, as in page 109. When houses are made pretty deep within the draught, see page 110. In large squares, &c. a pyramid may be erected, as in page 144. Or some statue, figure, or a pedestal, as in page 91, and 124.

When a building is to be viewed by the angle, you may take its plan from page 19, 30, and 111. and manage the elevation as taught in page 50, and 111. which give rules for doors and windows therein.

Gardens in perspective are exceeding agreeable. Their plans are to be made as in page 35, 38, or 113. If arbours be required, you are supplied from page 60, or 61. If palisades, look to page 51, and 52. And if you prefer a grove, thicket, or walk planted with trees, page 112 furnishes variety of each. If fountains, or *jets d'eau* be wanted, page 29 gives a bason, and its elevation is performed as in page 73. For squares, or beds, see page 35, or 38. For polygons, 45, or 46. For placing statues, or figures in a garden, take the measures from page 122, or 125. For grotto's, or niches, see page 74. For an ascent out of one garden into another, you have divers forms of steps in page 78, 79, 80, 81. In fine, you are at liberty to chuse whatever pleases your fancy, and may range them all in the same piece, provided you avoid confusion, and observe the due symmetry and proportions.

If you would have open shops, without any fixtures, you are furnished in page 55. If you require them fitted up with drawers, boxes, &c. look to page 95, and 105.

Amphitheatres were anciently of more use in paintings than at present, for which reason I have chose to omit them: And yet shift might be made, by taking the plan in page 29, and adding more circles, according to the number of stories intended. To raise the stories, you are to use the line of elevation in page 75.

For fortifications, you have the method of diminishing their plans in page 39, and the method of raising them in page 114.

To give the shadows to bodies of all kinds, both those occasioned by the sun, candle, and torch, is shewn from page 129, to the end of the book.

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THE

THE
THEORY OF PERSPECTIVE.

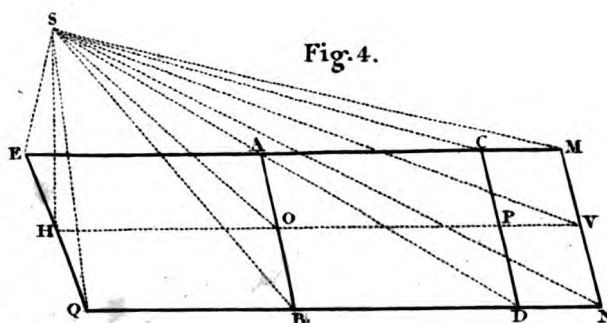
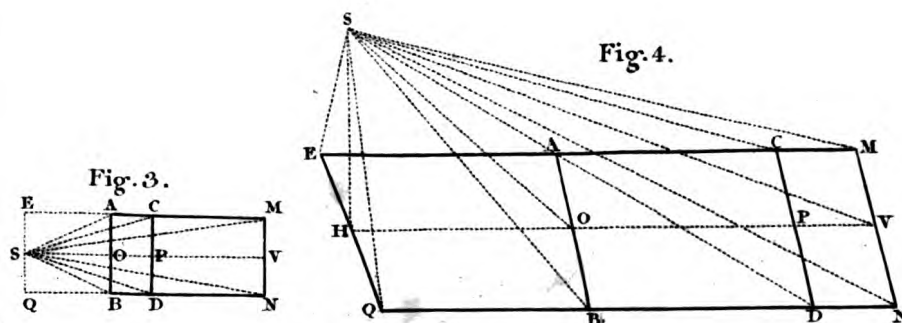
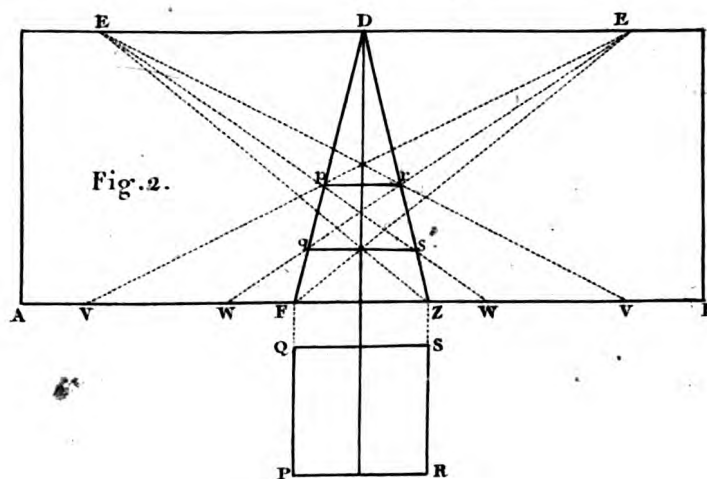
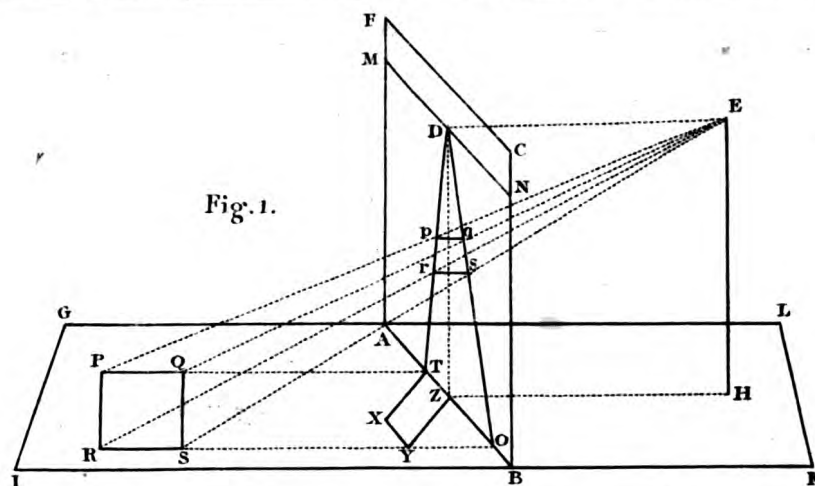
By JAMES HODGSON, F. R. S.

ILLUSTRATED WITH FOUR COPPER-PLATES.

DEFINITIONS.

1. **P**ERSPECTIVE is the art of describing on a plain surface the true representation or appearance of any given object, as seen from one determinate point for any given distance and height of the eye.
2. The perspective table, or plane, is that surface whereon the picture of the object is formed, according to the rules of perspective, as *A B C F*. See *Fig. 1*.
3. The geometrical or ground plane is that surface whereon the perspective table is supposed to stand, as *G I K L*.
4. The height of the eye is equal to the length of a perpendicular let fall from it to the ground plane, as *E H*.
5. The distance of the eye from the picture is equal to the length of a perpendicular drawn from the eye to the perspective table, as *E D*.
6. The common section of the perspective table with the ground plane is called the ground line or section, as *A B*.
7. The horizontal line is a line in the perspective table or picture, parallel to the section or ground line, and of the height of the eye above it, as *M D N*.
8. The principal ray is the line drawn from the eye perpendicular to the table, and is therefore equal to the distance of the eye from the table, as *E D*.
9. The distance of any point in the ground plane from the table is a perpendicular drawn from that point to the ground line or section, as *Q T*.
10. Direct parallel lines are such as cut the ground line or section at right angles, as *Q T* and *S O*.
11. Oblique parallel lines are such as cut the ground line or section at oblique angles, as *X T* and *Y Z*.

12. Transverse



12. Transverse parallel lines are those lines which cut the direct parallel lines at right angles, as P R and Q S.

13. Radial lines, or visual rays, are such as run up from points on the ground line, and unite in some certain point in the horizontal line, namely, either in the point of sight or in an accidental point, as D T, D Z, D O.

14. The point of sight is that point in the picture, which is found by drawing a perpendicular from the eye to the perspective table or picture, in which all the direct rays concur, as the point D.

15. The accidental point is that point in the picture, where lines that fall obliquely on the ground line or section, but parallel amongst themselves, unite or concur as the direct rays do in the visual point, as the point E. *See Fig. 2.*

16. The point of distance E is a point in the horizontal line of the table or picture removed as far distant from the visual point D in the 2d figure, as the eye at E in the first figure is distant from the table or picture A B C F, namely, D E.

17. The point of incidence is a point in the ground line or section, where a perpendicular let fall from any point in the geometrical plane intersects it, as the point, T or Z. *See Fig. 1.*

18. The perspective of any point is that point in the picture, where the visual ray drawn from the eye at E to any point, as P, in the geometrical or ground plane, intersects the picture or table, as the point p.

19. The perspective of a line is the common section of the table or picture, and the imaginary plane formed by an infinite number of rays flowing from the eye at E, and falling upon every point of the line R S to be represented, as the line r s.

20. The perspective of any plane figure is the section of the cone or pyramid of rays, whose vertex is the eye, and basis the figure proposed, made by the plane of the table or picture.

21. The perspective of any solid upon the table or picture is the aggregate of the perspective of all the planes whereof the solid is composed.

22. The optic angle, under which any object appears, is formed by two lines drawn from the centre of the eye, to the two extremities of the object, and here it is to be noted, that the most convenient distance of the eye, from the Extremities of the object should be nearly equal to the longest dimension of the object, whether breadth or height.

For as the beauty of perspective depends upon the point of distance, so the eye ought never to be placed too near the object, nor too far from it, but at a convenient distance ; and never nearer to the object than one half of the largest dimension, for in this situation the visual angle will be a right angle or 90 degrees ; and as this is the largest angle that the eye can well discover at one cast, so if it be made less than 45 degrees, the object will be too much contracted, and the visual angle will be so small that the returns in buildings would not be distinguished, and the whole would appear confused, and therefore when the visual angle is about 60 degrees, which agrees with the above mentioned limitation, then the object is seen with the utmost advantage, and consequently in all perspective designs they ought to come as near this situation as possible.

C

23. When

23. When the projection of any object is made on a plane parallel to the horizon by rays parallel and perpendicular to the same plane, the representation of the object in this case is called the *Ichnography* of the figure proposed, whence the base, bottom or platform, whereon a body or building is erected, is called the ichnography of that building, so that to project the ichnographic representation of any building is to draw the exact ground plot of the same building; thus the geometric ichnography of a column is a circle, of a pedestal is a square, &c.

24. When the projection is made on a plane perpendicular to the horizon by rays parallel and perpendicular to the plane upon which the object is represented, the representation in this case is called the *Orthography* of the figure proposed; thus the upright front of any building or object is called the orthography of that object or building, so that to draw the orthographic representation of any object or building, is to draw the exact front of the object or building as it really is and appears to be.

25. But when the representation or projection of any object is made by rays flowing from the several parts of the object, as the front, top or bottom, side or sides, and uniting in one point where the eye is supposed to be placed, the Representation of this object (upon a plane placed before the eye standing at right angles to the line drawn from the eye perpendicular to the object, and) formed by the intersection of the several rays with this plane, is called the *Schenography* of that object, so that to draw the schenographic projection or representation of any object, is to draw the projection or representation of the several parts of that object, as they will appear to the eye situated at a convenient distance from the object upon a plane placed perpendicular to the horizon, and in a proper situation to receive the object; and how this is to be done, is the proper business of PERSPECTIVE.

AXIOMS.

1. The common intersection of two planes is a right line.
2. If two right lines meet in a point, a plane may pass through them both.
3. If two or more right lines are parallel to each other, they will all be in the same plane; that is, if a plane pass through any two of these, it will pass through all the rest.
4. If two or more parallel lines are cut by another right line, there may be a plane that will pass through them all.
5. If two parallel planes are intersected by another plane, their intersections will be parallel to each other.
6. Lines parallel to the same right line, or to parallel lines, are parallel one to another; conceive the same of parallel planes.
7. Every point in any right line is in any plane that line is in.
8. A space seen under a less angle appears less, and the same space seen under a bigger angle appears bigger, and consequently spaces seen under equal angles are equal amongst themselves.

Note. In this *Axiom* we suppose the spaces viewed stand at right angles to the axis or principal ray issuing directly from the eye, or, which is the same thing, that they are parallel to the perspective table, for in other cases, where the diameter of the object is inclined to the table, it will not hold good.

THEOREM I.

THEOREM I.

If the eye be placed any where between two parallel right lines, the farther these lines are produced from the sight, the nearer they will seem to approach each other. See Fig. 3.

Let S represent the seat of the eye, EM and QN the two given parallel lines, and SV the axis or principal ray, through the points A , C , and M , draw the lines AB , CD , and MN , perpendicular to the principal ray SV , and these lines will be parallel and equal to each other. Also from S , the point of sight, let the rays SA , SB , SC , SD , SM , SN , be drawn.

Demonstration. Because the right angled triangles SQB , SQD , have the perpendicular SQ common to them both, but have the base QD of the triangle SQD , greater than the base QB of the triangle SQB , therefore the angle SDQ of the triangle SQD , will be less than the angle SBQ of the triangle SQB ; consequently the angle PSD , which is equal to SDQ , will be less than the angle OSB , which is equal to SBQ , and consequently the double of the angle PSD , or the angle CSD , will be less than the double of the angle OSB , or the angle ASB , wherefore the line CD , will appear less than AB , by the 8th axiom, and consequently the points C , and D , of the parallels EM , and QN , will appear to the eye placed at S , nearer than the points A and B of the same parallels EM , and QN . After the same manner it may be proved that the line MN , which is placed farther off from the eye at S , than the line CD , will appear less than CD , and consequently the points M , and N , will seem to approach nearer to each other than the points C and D , which are nearer, and that the same line MN , being placed at a greater distance than SV , from the point of sight, will appear lesser, and consequently the points M , and N , in the last Situation will seem to approach nearer to each other than in the present situation, and thus successively, till at last the line MN will appear indefinitely small, and the Points M and N will seem to come together.

Let us now suppose the eye, see *Figure* the 4th, placed above the plane passing through the given parallels, and let EM and QN be the parallels themselves.

From H , the middle point of the line EQ , erect the perpendicular HS , equal to the height of the eye above the plane, then will S be the place of the eye; from the point S draw the rays SE , SQ , SA , SB , &c. Now because the angles SEA , and SQB are right angles, the hypotenuses, or rays SA , and SB , will be longer than the perpendiculars SE , and SQ ; and inasmuch as both triangles have the sides SE , and SQ , equal to each other, it follows that the angle QSE will be greater than the angle BSA , and consequently the line AB will appear less than the line EQ , by axiom the 8th, and the points A , and B , will seem to be nearer to each other than the points E and Q , and by the same way of reasoning it will follow, that the angle DSB will be less than the angle BSA , consequently the line CD , will appear less than the line AB , and the Points C , and D , will seem to come nearer to each other than the

points A, and B, &c. which was to be demonstrated: And the same consequences will follow if we suppose the point S placed below the given plane of parallels.

Let us now imagine a plane, as E M N Q, to pass through the parallels E M, and Q N, it is manifest that to the eye placed in the plane itself, or above or below it, as in *Figure* the 4th, the two extremities M and N, which are farthest from the eye, will appear the nearest to each other, and the farther they are produced the nearer they will approach, till at last, being indefinitely produced, they will seem to meet in a point, and the distance will vanish.

And the same consequence will follow in whatsoever situation the plane is placed, whether it be perpendicular to the horizon, or parallel to it, or inclined to it at any given angle.

Hence we see why rows of trees, of columns, of pilasters, why walls and the sides of buildings contract themselves and seem to grow narrower and narrower the farther they are extended from the eye.

Hence we see the reason why floors and pavements of buildings seem to rise upwards towards the eye of the spectator, as is very visible in long rooms or galleries, and why the ceilings seem to sink gradually downwards towards the eye, whilst the sides of the same building seem to come closer and closer, that the right Side seems to approach towards the left, and at the same time the left Side seem to approach towards the right Side, each dimension growing lesser and lesser, and approaching nearer and nearer, the longer the room is, till at last, if the length be indefinite, they will all vanish into the visual point.

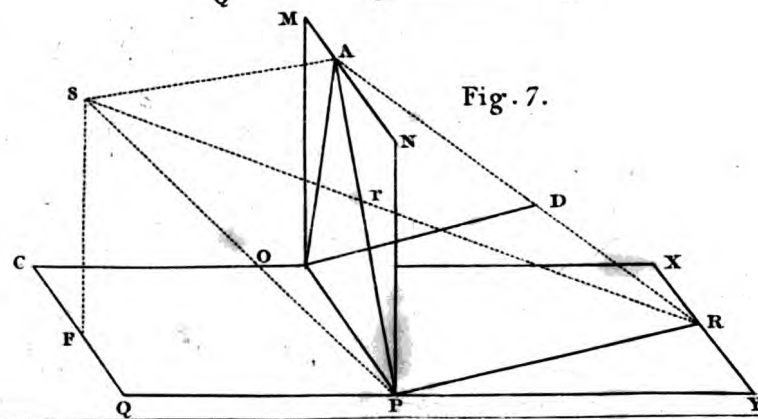
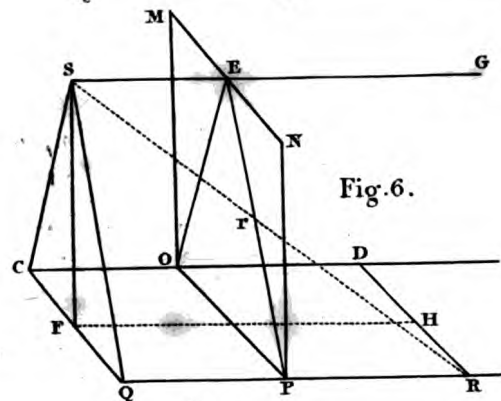
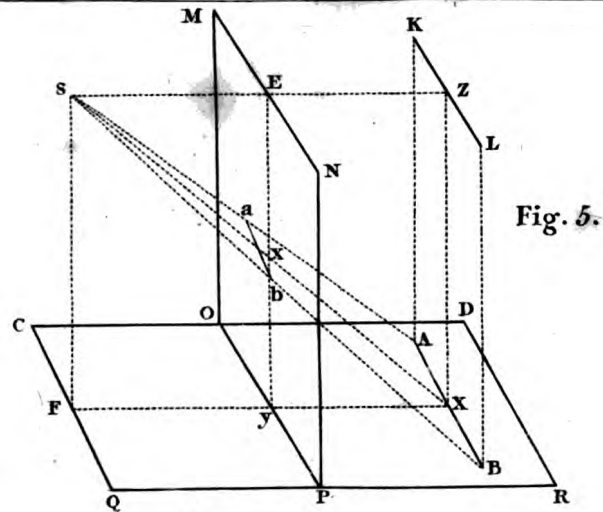
Hence we see the reason why the horizon appears higher than really it is, and that the convex surface of the sea, to an eye placed upon it, appears curved and protuberant, and different from what it really is itself. And,

Hence we see also the reason why statues and pictures placed at a considerable height above the eye, also why ornaments placed upon the tops of churches or other public buildings appear so much smaller than really they are, as well in breadth as in height, and hence are drawn rules for giving them their due proportion of magnitude, according to the several stations allotted them, also for portraits drawn upon upon ceilings or set up at any considerable height, and for a great variety of appearances too many here to enumerate.

Now inasmuch as the visible magnitude of the lines A O, C P, M V, see *Figure* the 3d, or their doubles, namely the lines A B, C D, M N, are as the tangents of the optic angles, A S O, C S P, M S V, to the several radii S O, S P, S V; or to their several distances from the eye, it follows that the visible magnitude of any object increases or decreases in its various approaches to or removes from the eye in a reciprocal proportion to its several distances from it: And hence,

The visible magnitude of any body being given, and its distance from the spectator, the true magnitude of the same body may be found; and on the contrary, the true or real magnitude of the object being given, its visible magnitude at any given distance may be determined; and hence we are taught to find of what magnitude any object ought to be made to appear of a given bigness at a given distance.

These



These laws extend to objects that are placed above or below the eye, as well as to objects that are placed upon the same horizontal plane with the eye, provided they be placed at the same distance from the eye; but if they are erected perpendicularly over the plane, their altitudes must be increased in the proportion of the difference of the tangent of the angle of elevation, and the tangent of the same angle of elevation increased by the optic angle of the figure when viewed upon the horizontal surface, and consequently the higher any object is placed above the eye, the greater will be the difference between the tangents of the several angles of elevation, and the tangents of the same angles of elevation increased by the horizontal optic angle of the figure, and consequently the greater must the real magnitude of the object be made to appear of the same bigness as if it was placed upon the same horizontal plane with the eye.

THEOREM II.

If any line in the object be parallel to the ground Line, its perspective in the picture will be parallel to the ground Line also.

Let $MNOP$, see *Figure* the 5th, be the picture or perspective table, S the place of the eye, and AB , parallel to the ground Line OP , the line to be drawn in perspective.

From S , the place of the eye, to the extremities A and B of the line AB let the visual rays SA , SB be drawn to cut the perspective table in the points a and b . If these points a and b be joined together by the right line ab , I say this line ab in the table, which is the perspective of the line AB the given object, will be parallel to the ground Line OP .

Imagine a plane as $KABL$, to pass through the line AB , and to stand at right angles to the plane $CDRQ$, now because the lines ab , and AB , are the common interfections of the parallel planes $MNOP$, and $ABKL$, by the visual plane SAB , they will be parallel by the 5th axiom, but AB is parallel to the ground Line OP by hypothesis, therefore its perspective ab in the table will be parallel to the ground Line also, by the 6th axiom, which was to be proved; And inasmuch as the same consequence will follow in whatsoever place of the plane $CDQR$, the line AB is seated, provided it be parallel to the ground Line AB , or at whatsoever distance from the eye the plane $CDRQ$ is fixed, it follows that all lines that are parallel to the ground Line of any picture will, when drawn in perspective, be parallel to each other and to the ground Line also. Again, because the triangles Sab and SAB are similar, SX , will be to Sx , as AB to ab , but SX , is to Sx , as SZ to SE ; therefore, by a similitude of ratios, ab will be to AB as SE is to SZ , that is, the length of the perspective line in any picture is to the length of its original line, as the distance of the eye from the picture or perspective table to the distance of the eye from the plane of the original object.

THEOREM III.

The perspective of any line, that is perpendicular to the ground Line in the original plane, will, when drawn on the perspective table, run up into the point of sight.

Let

Let S , see *Figure* the 6th, be the place of the eye, $MNOP$ the perspective table, MN the horizontal line, E the visual point, OP the ground Line, and PR the given right line cutting the ground Line OP at right angles in the point of incidence, P , I say, if from P , the point of incidence, to E , the visual point, the line EP be drawn in the picture, the perspective of every point R in the given line PR will be found somewhere in the line EP in the picture.

Produce the lines SE and RP to G and Q , and draw the line SQ .

Because SG and QR are parallel, and the line EP intersects them both in the points E and P , they will all be in the same plane $SQRG$ by the 4th axiom; and because the point of sight S , and the point R will be always found in this plane, the perspective of the point R will always be found in the common intersection of this plane $SQRG$, and the plane of the perspective table $MNOP$ that is in the line EP , and consequently in the point r , where the ray SR drawn from the eye at S to the given point R in the line PR intersects the line EP drawn from the point of sight E , to the point of incidence P , and consequently if the point R were placed in the point P , the point P will be the perspective at the point R , and the farther the point R is removed from the point P , the higher will its perspective r be in the table, and the nearer will it approach to the visual point E , till at last, being removed at an indefinite distance from the point of Incidence P , it will be projected in the visual point E , and consequently the line EP in the picture will be the perspective of the right line PR , drawn perpendicular to the ground Line OP in the original plane, and indefinitely produced; which was to be proved.

After the same manner it may be proved that any other right line, as OD , indefinitely produced, that cuts the ground Line at right angles, will be represented in the perspective table by the line EO , drawn from the point of sight E in the table to O , the point of incidence or point where the line OD cuts the ground Line.

Whence it follows, that all straight lines in the original plane, that cut the ground Line at right angles, will, when drawn upon the perspective table, meet or intersect each other in the point of sight.

THEOREM IV.

The perspective of any line in the original plane, that cuts the ground Line at oblique or unequal angles, will be found in that right line that is drawn from the point of incidence P , to the point A in the horizontal line of the table, which is found by drawing a line, as SA , from the eye at S , parallel to the original line PR , till it intersect the horizontal line of the table MN . See Fig. 7.

Because the lines SA and PR are parallel by hypothesis, and AP intersects them in the points A and P , they will all be found in the same plane $SAPR$ by the 4th axiom, and consequently the perspective of the point R will be found in the table in the point r , where the ray SR shall intersect the line AP , the common intersection of the plane $SAPR$, and the perspective table $MNOP$, and if the line PR be indefinitely produced from the point of incidence P , that is,

is, if the point R be removed at an indefinite distance from the point P, its perspective will be in the point of the table at A, that is, the line A P will be the perspective appearance upon the table of the line P R produced indefinitely.

After the same manner it may be proved, that any other straight line, as OD, indefinitely produced will be projected on the perspective table into the right line A O, drawn from the point of incidence O to the point found A, whence it follows, that all straight lines that fall obliquely on the ground Line, yet if they be parallel amongst themselves, they will all unite or intersect each other in some point in the horizontal line, and that point is called the *accidental* point; and to find it,

From the eye point S, draw a line parallel to the original line upon the horizontal table, and where this line cuts the horizontal line it will give the accidental point.

Hence it follows, that if the eye be placed any where in the line A S, produced from A towards S, as far as you please, the same converging lines on the table, will be the perspectives of the same parallels in the ground Plane, and hence innumerable points of sight may be assigned for viewing the same picture, and hence we have a solution of that perspective paradox. That the same representation of any original object will be projected on the table in the same lines, though the eye should change its place and distance.

This proposition is of very great use, and therefore ought to be thoroughly understood, it being the main and principal foundation of all the practice in perspective and indeed the preceding or third *theorem* is nothing but a particular case of this general proposition. Though I have given it a place by itself for order's sake, since when the lines on the original plane fall at right angles upon the ground Line, the point of concurrence of these rays will be found by drawing a line from the eye perpendicular to the picture, and this will necessarily give the point of sight to which all the lines, that fall perpendicularly upon the ground Line on the original plane must necessarily tend; as has been proved in the third *Theorem*.

And inasmuch as the line drawn from the eye to the point of distance upon the perspective table must necessarily form an angle of 45 degrees, with the principal ray or the horizontal line, the containing sides of the right angle being equal, it follows that the diagonals of all squares, one of whose sides is parallel to the picture, and all other lines that form an angle of 45 degrees with the ground Line, will have the point of distance upon the table for their point of concurrence; and where, if produced upon the table, they will all centre.

THEOREM V.

The projection or perspective of any line, that is perpendicular to the horizontal or ground Plane, will, on the picture or perspective table, be perpendicular to the ground Line.

Let M N O P, in *Fig. 8.* represent the perspective table, C D K Q the horizontal or ground Plane, S the place of the eye, and A B the line to be projected,

jected, which in the present case is supposed to be perpendicular to the horizontal plane $CDKQ$: imagine the plane $RTZX$ to pass through the line AB , and to be parallel to the picture $MNOP$; now because SBA is another plane intersecting the two former planes, their common sections, or the lines AB , ab , will be parallel to each other by the 5th axiom, but AB is perpendicular to the horizontal line XZ , therefore ab , if produced to G , will be perpendicular to the ground Line OP , which is parallel to the line XZ , the ground Line of the plane $RTZX$. w. w. d.

And since the same consequence will follow if the line AB be set upon any other point in the horizontal table, it follows that the perspective representation of all lines, that on the ground Plane are erected perpendicularly, will when projected on the perspective table be perpendicular to the ground Line and parallel to each other. And inasmuch as the line ab is to the line AB , as Sb is to SB , that is, as SE is to SL , it follows that ab , the perspective of AB , is to its original AB , as SE , the distance of the eye from the perspective table, to SL , the distance of the eye from the plane of the original object.

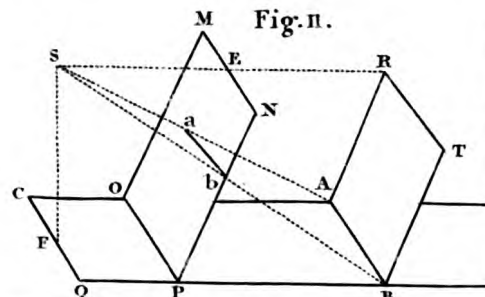
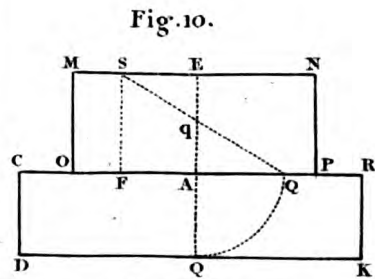
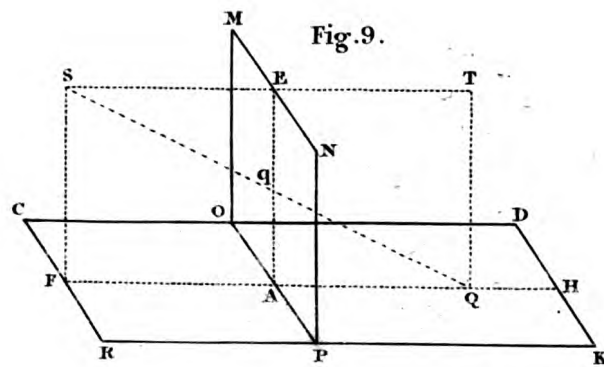
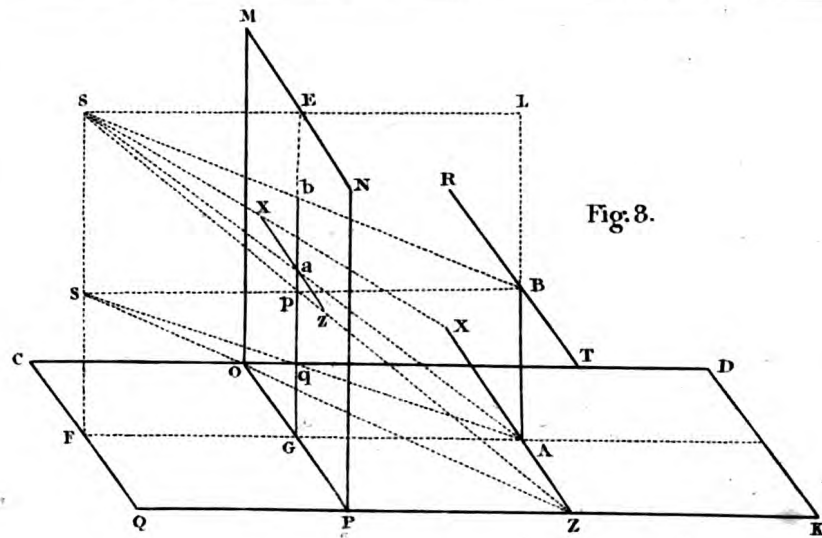
Again, through the point a in the picture, the perspective of the point A in the ground Plane, draw xz parallel to the ground Line OP , to cut the rays SX , SZ , in the points x and z , then will xz in the picture be the perspective of the line XZ on the ground Plane, and because, by the similitude of the triangles sax and SAX , it will be as AX is to ax , so is SA to sa , and so is SE to SL , and so is aE to aS , and so is ab to AB ; whence it follows that xa is to XA , as ab is to AB , that is, any perpendicular on the ground Plane is to its perspective in the picture, as any parallel on the ground Plane is to its perspective in the same picture, supposing the Perpendicular and Parallel at the same distance from the picture; whence it follows, that if the Perpendicular and the Parallel are both of the same length, their perspectives in the picture will be of the same length also. And this is a property of no small use in the practice of perspective; for the length of any original parallel or perpendicular being known, it will be easy, by the help of a sector to give any part of a scenographic projection its due dimensions in any situation upon the table.

Again, if from any point S , in the line SF , considered as the place of the eye, rays, as SpB , SqA be drawn to the extremities of the perpendicular AB , because AB is to pq , as SB is to Sp , that is, as SB is to Sb , that is, as AB is to ab , it follows that pq , and ab are equal: wherefore the distance of the object and the eye from the table, continuing the same, the perspectives of the same perpendiculars are equal to each other, whether the eye be placed at a greater or less height above the horizon.

PROBLEM I.

To find the seat in the perspective table of any given point in the original or ground Plane, the height of the eye, its distance from the picture, and the distance of the original point from the table, being given.

Let $MNOP$, See Fig. 9. represent the table, S , the place of the eye, SF its height above the ground Plane $CDKR$, SE its distance from the picture, Q the



Q the original point in the horizontal plane CDKR, and AQ its distance from the perspective table.

From S, draw the line SE parallel to the horizon or perpendicular to the table, to cut the table in the point E, the visual point in the table, and from Q, draw the line QA perpendicular to the picture MNOP, to cut the ground Line in the point A, the point of incidence. Now if a plane as TSFQ, be imagined to pass through the lines, ST, FQ, it will cut the perspective table in the line EA, their common intersection; and in this line of the table will the perspective of the point Q be found, and consequently in the point q the intersection of the diagonal SQ drawn from S, the point of sight, to Q, the given point on the ground Plane. Let us now imagine the plane of the perspective table to revolve about the line EA, the common intersection of the two planes till it coincide with the plane STQF, as in *Fig. 10.* then will the point Q in the horizontal table coincide with the point Q in the ground Line, the point S or seat of the eye, in the plane SFQT, will coincide with the point S in the horizontal line of the perspective table, and at the same distance from the visual point E as it was from the perspective table: In *Fig. 9.* in the like manner, the distance of the point Q, in the ground Line OP, will be as far distant from its point of incidence A, as it was in the horizontal plane from the same point A, for by this revolution of the plane of the perspective table, the points S and Q revolve about the centres E and A, and consequently always keep the same distance from them, but the line EA, the common intersection of the two planes MNOP, and STQF becoming now the axis about which the plane of the table revolves, remains the same immoveable, and consequently the seat of the point Q in the perspective table, remains in the same place as at first before the plane was supposed to revolve, and is therefore the true perspective place upon the table: which being allowed, we shall have this general rule.

For finding the seat in the perspective table of any point in the horizontal table, (See *Fig. 10.*) Namely,

1. From Q, the given point in the horizontal table, draw the line QA perpendicular to the ground Line, to cut in the point of incidence A.
2. Set off the distance AQ, of the point Q, in the horizontal Plane, from the ground Line OP, from its point of incidence A in the same ground Line, to Q.
3. From E, the point of sight, to A, the point of incidence, draw the ray EA, and from S, the point of distance, to the point Q in the ground Line last found, draw the diagonal SQ, and where this intersects the ray EA, last drawn, as in the point q, it will give the perspective in the table, of the given point Q in the ground Plane.

Now as every line is bounded by points, and every surface by lines, and every solid by surfaces; hence we are taught how to draw the representation of any given object upon the perspective table. And indeed the laws here laid down and demonstrated are so general, that whosoever understands them readily will see the reason of every step taken in drawing the scenographic representation of any original object upon any vertical perspective table.

D

THEOREM

THEOREM VI.

If the perspective table be inclined to the plane of the horizon at any given angle, the perspective of any original line, that is parallel to the ground Line, will in the perspective table, be parallel to the ground Line also.

Let $MNOP$, in *Fig. 11*, represent the perspective table, inclined to the horizontal plane $CABQ$, at an angle equal to MOA ; let S be the place of the eye, and AB a line parallel to the ground Line PO , whose perspective is to be drawn; from S , the eye, let the visual rays SA , SB , be drawn to the extremities A and B of the given line AB , to cut the perspective table in the points a and b ; now if these points a and b are connected together by a right line ab , I say, this right line ab , which is the perspective of the original line AB , will be parallel to the ground Line OP .

Imagine a plane, as $RABT$, to pass through the given line AB , and to be parallel to the plane of the table $MNOP$.

Now because the lines ab , and AB , are the common intersections of the parallel planes $MNOP$, and $RABT$, by the visual plane SAB , they will be parallel to each other by the 5th axiom; but the original line AB is parallel to the ground Line OP , by hypothesis, therefore ab , its perspective in the table, will be parallel to the same ground Line OP also, by the 6th axiom. *w. w. d.*

Hence it follows that all lines whatsoever that upon the ground Plane are parallel to the ground Line, their perspectives upon the picture will be parallel to the ground Line, and to each other also.

THEOREM VII.

*In any inclined plane, the perspective of any line in the original plane, that being produced, will cut the ground Line at oblique angles, will be found in the right line that is drawn from the point of incidence P , See *Fig. 12.* to the point A , in the horizontal line of the table, which is found by drawing a line as SA , from the seat of the eye at S parallel to the original line PR , till it intersect the horizontal line of the table MN .*

Because the lines SA , and PR , are parallel by hypothesis, and AP a right line intersecting them both, therefore a plane as $SPRA$ will pass through them all, and therefore the perspective of the point R will be found in the table in the point r , the intersection of the diagonal SR , with the line AP , the common intersection of the plane of the table $MNOP$, and the plane $ASPR$; consequently, wheresoever the point R be taken, in the right line PR , its perspective will be found somewhere in the line AP , and consequently the line AP , in the table, will be the perspective of the line PR indefinitely produced; so that in whatsoever part of the horizontal plane the line PR be taken, provided it always forms the same angle with the ground Line, its perspective upon the table will be always found in that right line which connects its point of incidence P on the ground Line, with its accidental point A , in the horizontal line.

If

If the line PR cuts the ground Line at right angles, its parallel SA will intersect the table in the point of sight E upon the table; wherefore in inclined planes, as well as vertical planes, as all lines that are perpendicular to the ground Line in the horizontal plane, when drawn on the perspective table, do run up and unite in the point of sight, so all other lines in the ground Plane that cut the ground Line when produced at unequal angles, will if they are parallel to each other, when projected on the perspective table, run up and unite in one common point; whence it follows, that the height of the eye, and its distance from the inclined plane being known or given, the perspective representation of any original ground Plane is drawn on the inclined table by the same method, and after the same manner as it is done upon vertical tables. Let it therefore be required in

PROBLEM II.

To find the length of the principal ray intercepted between the point of sight, and the ground Line; or, which is the same thing, the height of the eye in the inclined table, and its distance from the table, the perpendicular height of the eye above the horizon, and the inclination of the perspective table, being given.

Let OP , see Fig. 13. represent the ground Line, FQC a line drawn at right angles to it, S the seat of the eye, SF its perpendicular height above the ground Plane, and QE the inclined plane forming an angle with the horizontal plane equal to the angle EQC .

From Q , the point of incidence of the line EQ , in the ground Line, draw AQ perpendicular to the ground Line, and through S , the seat of the eye, draw SAE , parallel to the line FC , to intersect the line QE in E ; then will E be the point of sight in the inclined plane, QE the height of the eye, and SE the space between the visual point E and the point of distance S , whence the perspective of any ground plot may be drawn on that plane.

THEOREM VIII.

In any inclined plane, as $MNOP$, see Fig. 14, if from E , the point of sight, through the point b , where the base FB , of the eye's perpendicular height SF , cuts the ground Line of the table, a line as Eb , be drawn, and produced till it cut SF , the line drawn from the eye at S , perpendicular to the horizontal plane $CQOP$, produced downwards in the point D , I say, the perspective of every line perpendicular to the horizontal plane, will be found in that right line in the table that is drawn from the point D through the point of incidence made by a perpendicular drawn from the base of the elevated line on the horizontal plane to the ground Line of the inclined table.

Let $MNOP$ be the inclined perspective table, OP its ground Line where it intersects the ground Plane $CR TQ$, S the seat of the eye, SF its perpendicular height, E the point of sight in the table, AB a line perpendicular to the ground Plane, whose point of incidence b , is coincident with the foot

b of the principal ray $E b$ drawn on the table ; now if the lines $S F$ and $E b$ are produced till they intersect each other in the point D , I say, that if from this point D , through any other point of incidence, as x , in the ground Line, a right line as $D x z$ be drawn, the perspective of the line $Z X$ erected perpendicularly over the horizontal plane, whose point of incidence in the ground Line is x , shall be found in this line $z x$ in the table.

Because the lines $S F D$ and $A B W$ are parallel by hypothesis, a plane as $S A B W D F$ will pass through them, and because the eye is seated in this plane in the point S , the perspective of the line $A B$ will be found upon the table in the line $E D$, the common intersection of the two planes, which line produced must necessarily cut the perpendicular $S F$, produced downwards in the point D , since they all lie in the same plane $S Y W D$.

Now if from this point D , a line as $D x$ be drawn through x , the point of incidence of the line $Z X$, erected perpendicular over the horizontal plane $C R T Q$, I say, the perspective of this line $Z X$ will be found in the line $D z x$.

For because the lines $S D$ and $Z X$ are parallel by hypothesis, a plane as $S Z X D$ will pass through them both ; and because the eye is seated in this plane at S , the perspective of the line $Z X$ will be found on the table in the line $x z$, the common intersection of the two planes, which being produced, must necessarily cut the line $S D$ in the point D , the intersection of the same line $S D$ with the plane of the inclined table produced, whence the perspectives of the lines $A B$ and $Z X$ on the table, will be the lines $a w$, and $z q$, intercepted between the rays $S A$, $S B$, $S X$, and $S Z$ flowing from the eye to the top and bottom of the given perpendiculars $A B$, and $Z X$.

And after the same manner may the perspective of any other line elevated perpendicularly over the horizontal plane be drawn on the table.

For if we imagine a plane to pass through the line $S D$, perpendicular to the horizontal plane indefinitely extended, and at the same time conceive this plane to revolve about the line $S D$ as an axis, it will during the course of this revolution, pass through every line that stands perpendicular to the horizontal plane, and the successive intersections of this plane with the plane of the table will be the successive perspectives of the several perpendiculars it shall happen to pass through ; and as all these lines must necessarily centre in the immoveable point D , as being common to every situation of the revolving plane, it must necessarily follow, the eye remaining also immoveable, that the perspective of every line that is perpendicular to the ground Plane, will be found in that line in the table which is produced by drawing a line from this point D , through the point of incidence in the ground Line, made by a perpendicular drawn from the base of the given elevated line to the ground Line of the inclined table ; which was to be demonstrated.

Hence and from the rules demonstrated in *theorem 6* and *7*, the practice of drawing the perspective of objects of any kind upon inclined tables is easily deduced.

By viewing the figure, it is evident that the greater the inclination of the plane, the lesser will be the angle $S D E$, and the farther will the point D be removed from the horizontal plane $C R T Q$, till at last when the plane becomes

comes vertical the point of intersection D vanishes, and the lines $E b D$ and $S F D$ become parallel, whence, as has been proved in the 5th *theorem*, it follows that all lines that are perpendicular to the horizontal plane will, when projected on the table, be perpendicular to the ground Line also.

Again, the farther the point of sight S , is removed from the table, the greater will be the distance of the point of intersection D from the horizontal plane $C R T Q$, till at last the eye being supposed at an infinite distance, the line $S F D$ will be removed at an infinite distance from the picture, also the point of intersection D will vanish, and the elevation of all lines perpendicular to the horizontal plane will become perpendiculars to the horizontal plane of the table, which is the foundation upon which the *Military* or *Bird's perspective* is founded.

Again, the lesser the inclination of the table $M N O P$, the nearer does the point of intersection D approach to the point F in the horizontal table, the foot of the eye's perpendicular, till at last when the inclined plane $M N O P$, coincides with the horizontal table $C R T Q$, the angle of incidence vanishes, and the point of concurrence D coincides with the point F ; whence it follows,

That in all horizontal or optical projections, the perspective of every line that is erected perpendicularly over the horizontal table, will be found in that line of the table which is produced by drawing a line from the foot of the eye perpendicular through the base of the elevated line; whence it follows, that the perspective of all lines that stand perpendicular upon the horizontal plane, will, if produced, unite or centre in one common point, namely, the point where a line let fall perpendicularly shall intersect the horizontal table.

THEOREM IX.

If the plane of any original figure be parallel to the table, its perspective will be similar to its original, alike, and alike situated.

Let S , see *Fig. 15*, be the seat of the eye, $M N O P$ the table, $H I K L$ the plane of the original figure $A B C D$.

I say, if the planes $M N O P$ and $H I K L$ are parallel, the perspective appearance $a b c d$ upon the table shall be similar to its original $A B C D$.

For from S , the point of sight, draw the rays $S a A$, $S b B$, $S c C$, and $S d D$.

Because the planes $M N O P$, and $H I K L$, are parallel, $S A B$ is a visual plane intersecting them, therefore the common intersections $a b$, and $A B$ will be parallel, therefore $A B$ will be to $a b$ as $S B$ is to $S b$: And again, because $S B C$ is a visual plane intersecting the same parallel planes, therefore their common intersections, namely the lines $B C$ and $b c$ will be parallel, therefore $B C$ will be to $b c$, as the same ray $S B$ is to the ray $S b$, wherefore by equality of ratios $a b$ will be to $b c$ as $A B$ is to $B C$; after the same manner it may be proved that $b c$ is to $c d$, as $B C$ is to $C D$, and $c d$ is to $d a$, as $C D$ is to $D A$, whence the perspective figure $a b c d$ is similar to its original $A B C D$; which was to be proved: Whence it follows, that the optical or horizontal

horizontal perspective of all plane figures that are parallel to the table, will be similar to their originals ; that is, that the perspective of square figures parallel to the horizontal or perspective table, will on the table be square, also the perspectives of circles will be circles, of hexagons will be hexagons, &c.

Whence and from the last corollary of the preceding *theorem*, the reasons of all the appearances in horizontal perspective are manifest, and as all shadows are nothing else but horizontal projections of the several objects, the candle or luminous body supplying the place of the eye ; hence it follows that every horizontal projection of any object elevated above the plane, is the projection of the shadow of the same object, and consequently the rules given for forming of one will serve for forming the other. And inasmuch as the immense distance of the sun is infinite with regard to any terrestrial object, hence it is that the rays that flow from the sun to form the solar shadow are supposed to be parallel; and hence it is that every orthographic perspective of any object elevated above the plane of the horizon, is the projection of the shadow of the same body, and consequently in drawing of one, you draw the other also ; and these several shadows, when drawn upon the scenographic table according to the rules of scenographic projection, will exhibit upon the same table the shadows of all objects drawn upon the picture.

Again, inasmuch as the practice of horizontal perspective proceeds after the same manner as does the practice of scenographic projections, so in *problem* the first, page xxiv,

If we suppose the eye in *figure* 10th in S, the point of distance in that case, and F Q to be the distance of the eye from the given object, the demonstration for one will hold good for the other, and consequently, in proving the operation in one, you prove the operation in the other also.

Though my principal view in this tract has been to render the demonstrations plain and concise, and the number of *Theorems* as few as possible, yet at the same time I have endeavoured to make them so general, that I may venture to say there is scarce any operation made use of in the practice of the several kinds of *Perspective*, but what may be accounted for by some one or other of the preceding laws : This, together with the following treatise, which I look upon as one of the best practical books that has appeared in the *English* language, will, I hope, make the whole as compleat and useful a piece as can be comprised in a volume of this size.



PRACTICAL

PRACTICAL PERSPECTIVE,

P A R T I.

SHEWING THE

DEFINITIONS AND PRINCIPLES,

OF

PERSPECTIVE.

Definitions, Names, and Terms of the Points, Lines and Figures used in the following Work.

A POINT is that which is conceived to have no parts ; such as A, *Fig. 1.* There are three kinds of points used in perspective, called *points of sight or view*, *points of distance*, and *contingent or accidental points*.

A LINE is a length without breadth ; such is A B, *Fig. 2.* There are five principal lines used in perspective, namely, 1. The *line of the base*, called also the *line of the plane*, or the *terrestrial line*, as C D, *Fig. 3.* 2d. The *perpendicular* or *plumb line*, which, falling on another, makes the angles * on either side equal : such angles are said to be *right* ones, and the line so falling on the other called a *perpendicular* thereto. Thus, in *Fig. 3.* A B and E F, falling on C D, and making right angles in B and G. is a perpendicular thereto. 3. The *parallel lines*, which, being continued on the same plane to infinity, never meet ; as the lines N and O, *Fig. 6.* The *horizontal line* is no more than a line drawn parallel to the *terrestrial lines* ; as shall be shewn in its place. 4. The *diagonal line*, which is that drawn across a figure, from one angle to another ; such is K L, *Fig. 10.* 5. The *occult line*, which is either drawn in dots or dry, and is supposed not to appear when the work is finished ; such is O N, *Fig. 2.*

A RIGHT ANGLE we have already said to be that formed by a perpendicular. It is here represented apart, by E F G, *Fig. 4.* to shew what it is the more distinctly. There are two other kinds of angles, which comprise all those that are not right ones : the first, called *obtuse*, are such as are greater than a right angle : as H L M, *Fig. 5.* The other, *acute*, are less than a right angle ; such is H I K in the same figure.

A TERM is the extremity or bounds of any thing : thus the points A and B, *Fig. 2.* are the terms of the line A B.

A FIGURE is comprehended under one or more terms ; thus 7, 8, 9, 13, &c. are *figures*.

A SQUARE has its four sides equal, and its four angles right ; such is A B C D, *Fig. 7.*

A PARALLELOGRAM, or long square, has its four angles right, but not its sides equal ; such is C D E F, *Fig. 8.*

AN EQUILATERAL TRIANGLE consists of three equal sides ; as G H I, *Fig. 9.*

THE SECTION OR INTERSECTION of two lines is when they run across, or cut each other in a point, as in *Fig. 11.* where A B and C D cut or *intersect* in E.

A CURVE LINE is that which goes indirectly, or about, from one point to another ; such is L M, *Fig. 12.*

A CIRCLE is a plain figure, comprehended under one single line, called the *circumference*, to which all lines drawn from the centre are equal ; such is B C D, in *Fig. 13.* And the point A in the middle thereof is called the *centre*.

THE DIAMETER of a circle is a right line B C, passing through the center A, and dividing the circle into two equal parts.

A RADIUS is any right line drawn from the centre of a circle to its circumference, as the line A D.

AN ARCH is any part of the circumference, as B D C.

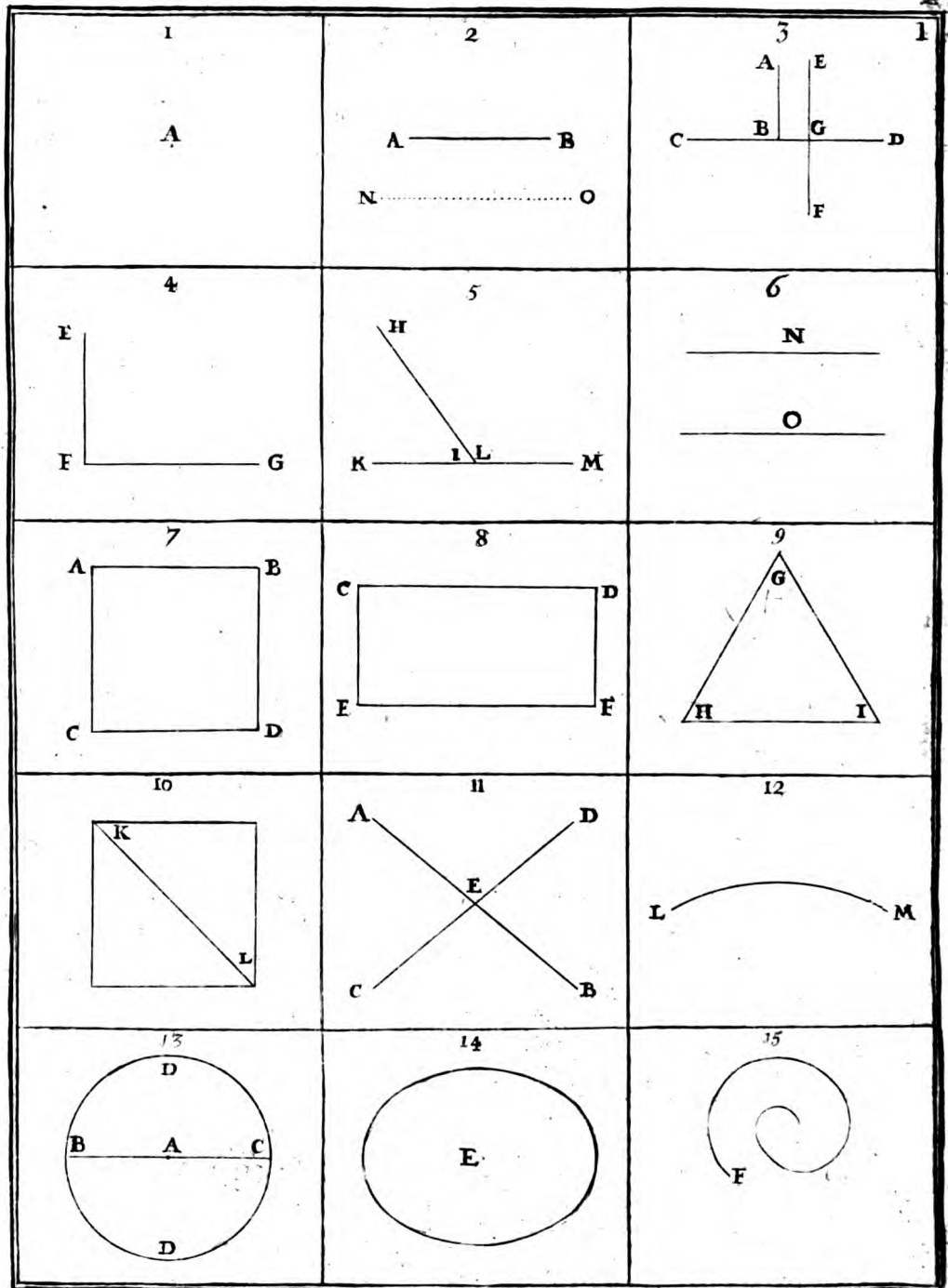
THE CHORD of an arch is a right line drawn from one end of an arch to the other ; as B C is the chord of the arch B D C, and B D is the chord of the arch B D.

Every **ARCH** of a circle is measured by its chord ; thus B D is the measure of the arch B D, and B C, the greatest of all chords, measures the arch B D C.

AN OVAL, or **ELLIPSIS**, is an oblong figure, comprehended under one crooked, regular, but not circular, line ; such is E, *Fig. 14.*

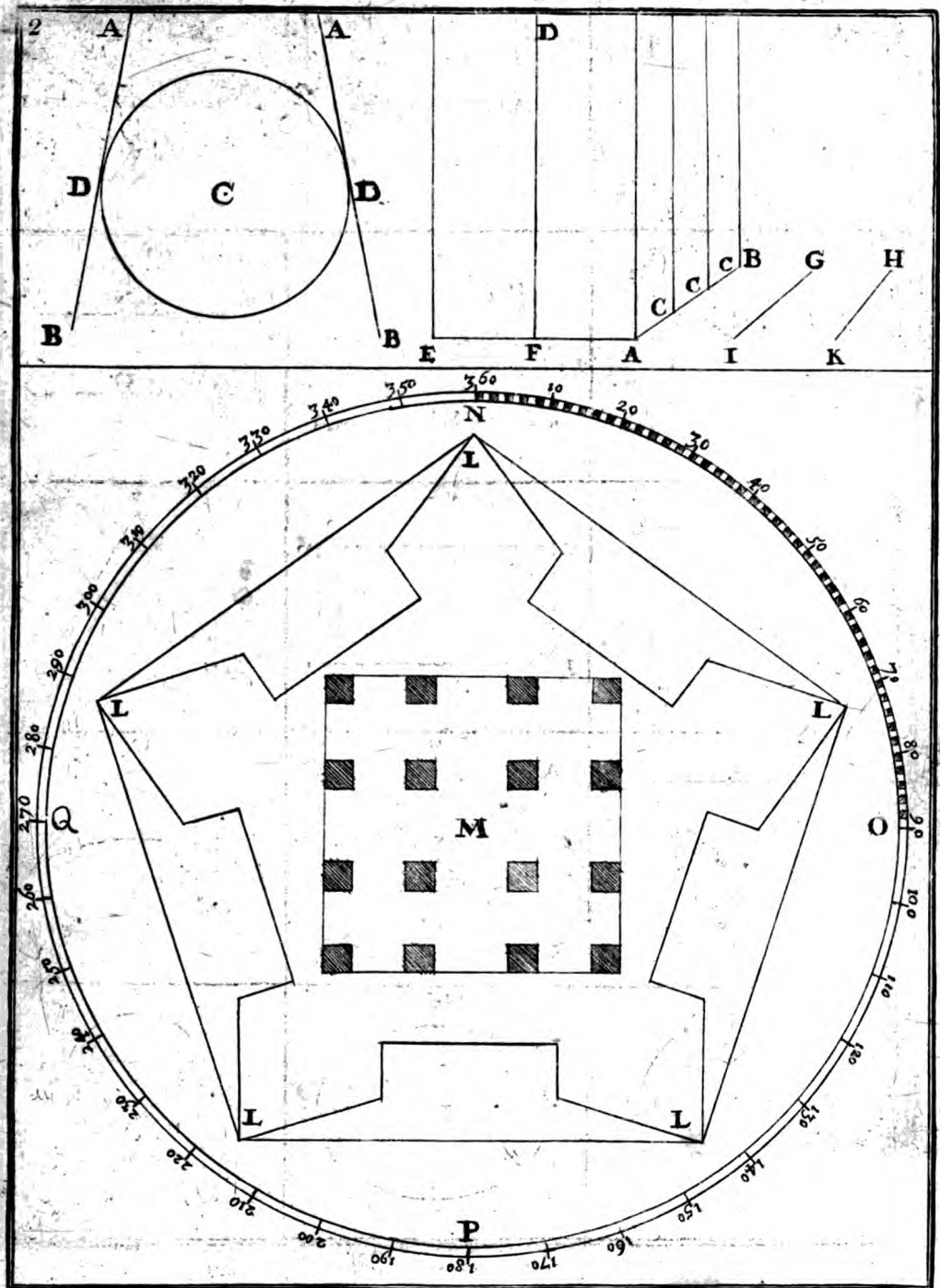
A SPIRAL, or **VOLUTE**, is a line found by a revolution about one or two centres ; such is F, *Fig. 15.*

* An angle, the aperture or inclination of two right lines meeting in the same plane, is usually expressed by three letters ; the middle letter shews the angle, and the other two the lines that make the angle ; as in *Fig. 5.* H L M is the obtuse angle L, and H I K. is the acute angle L.



E

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SEQUEL of the Definitions, Names, and Terms.

A TANGENT is a line, which being produced only touches or razes an object, figure, or line, without cutting it; thus the lines *A B* are *tangents* to the circle *C*, in the points *D D*. I here add too kinds of lines, which have the same denominations as the former, and yet have different effects, on account of the point of view: for the angle *E A B* is to be esteemed a right angle, and all the lines *C C C*, &c. to be esteemed as perpendiculars to the plane, as *D F* is; and the lines *A B*, *G I*, and *H K*, as perpendiculars to the terrestrial line. All the lines drawn to the point of sight, whether from above or below, or from either side, are called *RAYS*, or *VISUAL RAYS*.

A PLAN, ICHNOGRAPHY, or GROUND-PLAT, is a first draught or design of a work, representing the traces or paths of its foundation on the ground, so as to exhibit the extent, division, and distribution of its various parts, in their several magnitudes and proportions, respectively, at one view. This is what I have represented in *L* and *M*.

A POLYGON is a figure containing several angles; as *L*.

A DEGREE is a small arch or portion of a circle. Every circle is supposed to contain 360 degrees, and an arch is estimated by the number of those degrees it takes up. Thus *N O* is an arch of 90 degrees. Astronomers subdivide each degree into 60 minutes, and each minute into 60 seconds, &c. But such subdivision has no place here. It is enough we know that degrees are those little divisions in the circle *N O P Q*, whereby all angles are measured. To know their quantity, an arch is described, having its centre in the point of the angle. From them we derive an easy method of making all sorts of polygons, namely, by dividing 360 by the number of angles the figures are to consist of. Thus, for instance, if I would make a square, divide 360 by 4, the quotient is 90, which gives the right angle *N M O*: and so for the rest. Such as are unacquainted with arithmetic, will find geometrical methods of doing the same in *plate IV*.

Methods of describing the Lines and Figures.

1. **T**O raise perpendiculars : If it be in the middle of a line that a perpendicular is required, open the compasses to more than half the length of the line, and setting one foot in the point A, *Fig. 1.* with the other strike little arches both above and below, as F and F : Do the like at the point E, and the two intersections of those arches will give a perpendicular to the line A E.

2. *If the line be at the top or bottom of a draught or paper*, so that arches cannot be struck both above and underneath, divide the line into two, to get the point G, *Fig. 2.* and from the two extremes of the line, make arches intersecting each other in H ; then draw a line from H to G.

3. *To raise a perpendicular at the end of a line*, as at the point I of the line I K, *Fig. 3.* there are divers methods : The first is that already delivered. But where room is wanting, one leg of the compasses is to be set in the point I, and with the other a large portion of a circle L M is to be struck, and the compasses, thus open, to be set on the point M, and with the other leg the circle to be cut in the point N, half the arch M N being set off from M towards O, gives the right angle O I K. Or, without seeking for half the arch M N, from the point N, describe an arch P Q ; then, laying a ruler over the points M and N, draw a line, cutting the arch P Q in the point P, and raise a line from I to P ; which is the perpendicular required.

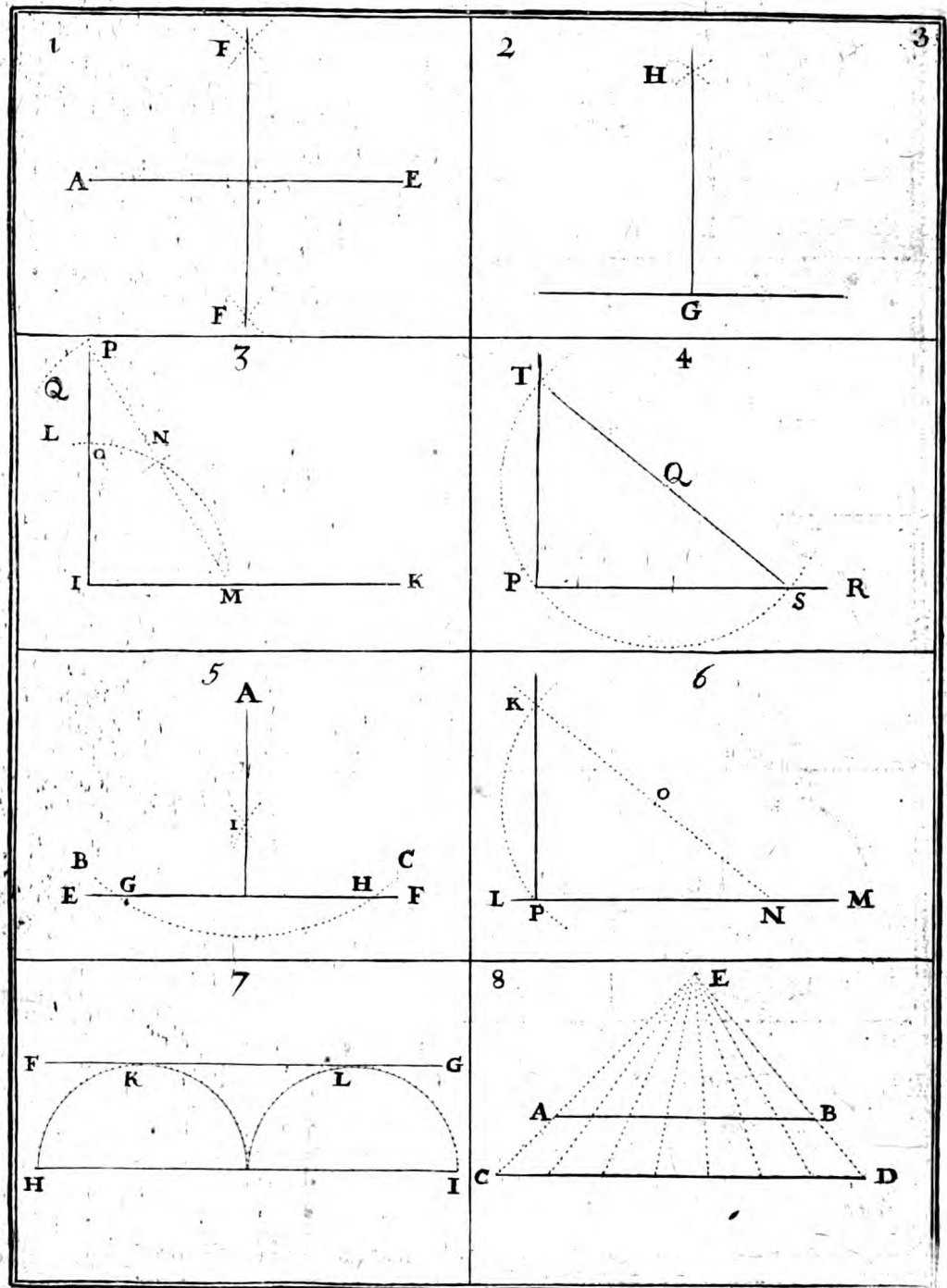
4. *Or thus* : If you would raise a perpendicular from the point P, *Fig. 4.* take a point at pleasure over the line P S, as the point Q, and from this point describe a circle passing through the point P, and cutting the line P S in some place, as S ; then from S draw a line through Q to the circumference of the circle T, and the point T gives the extreme of the perpendicular T P. A just square shortens all these operations.

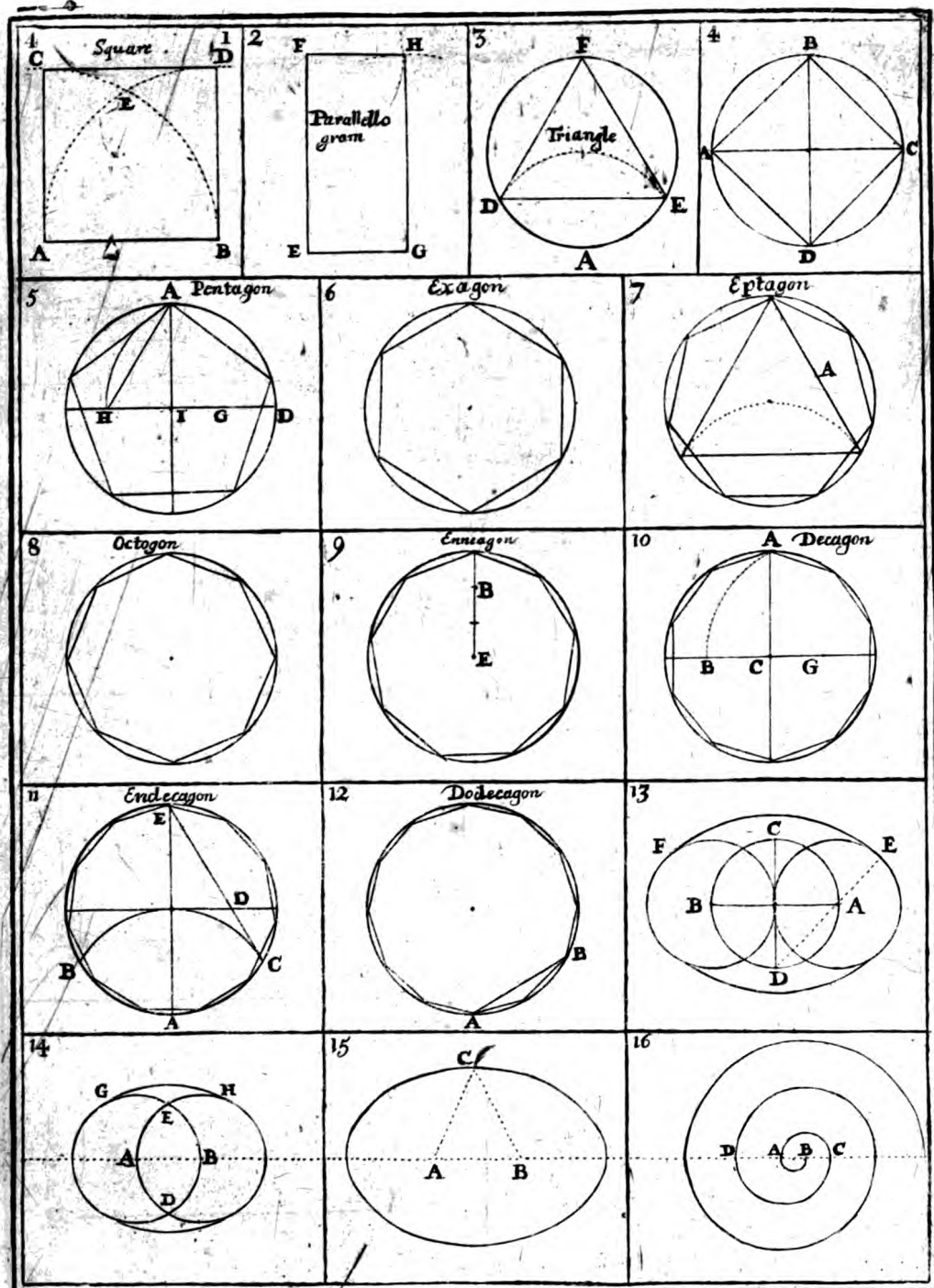
5. *To let fall a perpendicular from a given point* : From the point, as A, *Fig. 5.* describe the arch B C, cutting the given line E F in the points G H, from which points describe two little arches above or below, cutting each other in the point I ; then from the point A let fall a line through I to the line E F, and it will be the perpendicular of the given point.

6. *From a point given at the end of a line, to let fall a perpendicular* : Suppose the given point K, and the line L M, *Fig. 6.* from K draw a traverse line at pleasure, cutting the line L M in some point, as N ; divide the line K N into two equal parts, and from the middle point O, draw an arch through K ; and from the point P, where the arch intersects the line L M, draw the perpendicular K P.

7. *A parallel line*, if truly drawn, will be a tangent to semi-circles drawn from points assumed in the other line : thus F G, *Fig. 7.* is parallel to H I, because it only touches or razes the semi-circles L and K.

8. *To divide a line into equal parts* : Suppose the line be A B, draw another parallel thereto, either above or below it, as C D ; and on this last, which is either to be greater or less than that to be divided, set off as many parts as A B is to be divided into, for example, into seven ; from the first and last of these divisions draw lines through the extremes of A B, intersecting each other in some point, as E ; from which point drawing lines to all the divisions of the line C D, the line A B will be divided into seven equal parts.





METHODS of Describing the Figures.

1. **A** Line as A B, Fig. 1. being given to form a square on, set one foot of the compasses in the point A, and extending the other the length A B, describe the arch B C; then from the point B describe another arch A D, intersecting the former in E, and from E set off half the arch E A, or E B outwardly, to D and C; to which points drawing lines from A, B, &c. the square is formed.

Or thus: upon the given line A B erect a perpendicular A C equal to A B; then, taking the length A B in your compasses, set one foot in B, and with the other describe an arch: the like being done from the point C, the intersection of the two arches will be the point D, which gives the square A B C D.

2. To describe a parallelogram, or long square, on the term E, of the given line E F. Erect a perpendicular either greater or less than the same, as E G; then taking E G in your compasses, set one foot in F, and with the other describe an arch; take also E F in your compasses, and setting one foot in G, describe a second arch, cutting the former in H: this will give you the parallelogram required.

Of Circular Polygons, which are Figures of several angles inscribed in circles.

3. To describe an equilateral triangle: The compasses being open to the radius of the circle, set one foot in the point A, describe the arch D E, and draw a right line D E, which will be the side of the triangle D E F.

4. For a square, draw two diameters at right angles, and join their extremes; thus you will have the square A B C D.

5. For a pentagon, or five-angle, draw two diameters, and take D G, half the semi-diameter D I, and from the point G, with the interval G A, describe the arch A H; the chord of which is the side of the pentagon.

6. For the Hexagon, or Six-Angle, the semi-diameter is the side of the hexagon.

7. For the Heptagon, or Sept-Angle, take half a side of the equilateral triangle.

8. For the Octagon, or Eight-Angle, take half a quadrant of the circle.

9. For the Enneagon, or Nine-Angle, take two thirds of the semi-diameter for the side; as E B.

10. For the Decagon, or Ten-Angle, divide the semi-diameter into two in the point G, and from G, with the interval G A, describe an arch A B; the part of the diameter B C will be the side of the decagon.

11. For the Undecagon, or Eleven-Angle, draw two diameters at right angles, and from the point A, with the interval of a semi-diameter, describe an arch B C; then from the point of intersection C, draw a line to E; the portion C D will be the side of the undecagon.

12. Dodecagon, or Twelve-Angle, divide the arch of a hexagon, A B, into two equal parts; the chord of the moiety will be the side.

13. An Oval is formed divers ways; in all which the figure is either a compound of several portions of circles, or it is one line drawn from two centres. The most usual methods are these: having described a circle, and drawn two diameters therein, as A B C D, from the points A B we draw two other circles equal with the first; then from the point D we draw a line through the centre of the last circle to the circumference E: this done, setting one foot of the compasses in D, and with the other taking the interval E, we describe an arch E F. The like being done on the other side, the oval is formed.

14. For a rounder Oval, draw a single line, and from A, as a centre, describe a circle, the intersection whereof with the right line in the point B, will be the centre of another circle. Now, to form the oval, take in your compasses the whole diameter of one of the circles, as from A to F, and in one of the intersections of the circles, as D, setting one foot of the compasses, with the other draw the arch G H: the like do from the point E.

15. Otherwise we have an easier and more useful manner of describing ovals than any of the preceding ones; the same rule serving for all forms, long, narrow, broad, short, &c. thus: set two nails or pins in a right line A B, to serve as a centre, and about these tie a thread of the length and width of the oval required, as A B C; hold the thread tight with a pen or pencil, and turn it about till you arrive where you began. If you require it a long one, set the centres the farther apart; and observe the contrary for a short one; for if the nails stand close together, the figure will be a circle.

16. For a Spiral, or Volute, take two points in a line A B; the points to serve, one after another, as centres, For instance, having drawn the semi-circle A B, set one foot of the compasses in B, and open the other to the length B A, and describe a semi-circle A C; then setting one foot in A, take the interval A C, and draw the semi-circle C D; and this continuing as long as you please, still shifting centres. Vignola gives us another method.

Of the VISUAL RAYS.

*I*F an object be a single point, it sends only one visual ray to the centre of the eye ; and that ray is called the *axis*, or *central ray*, as being the most vivid of all rays : such is A B.

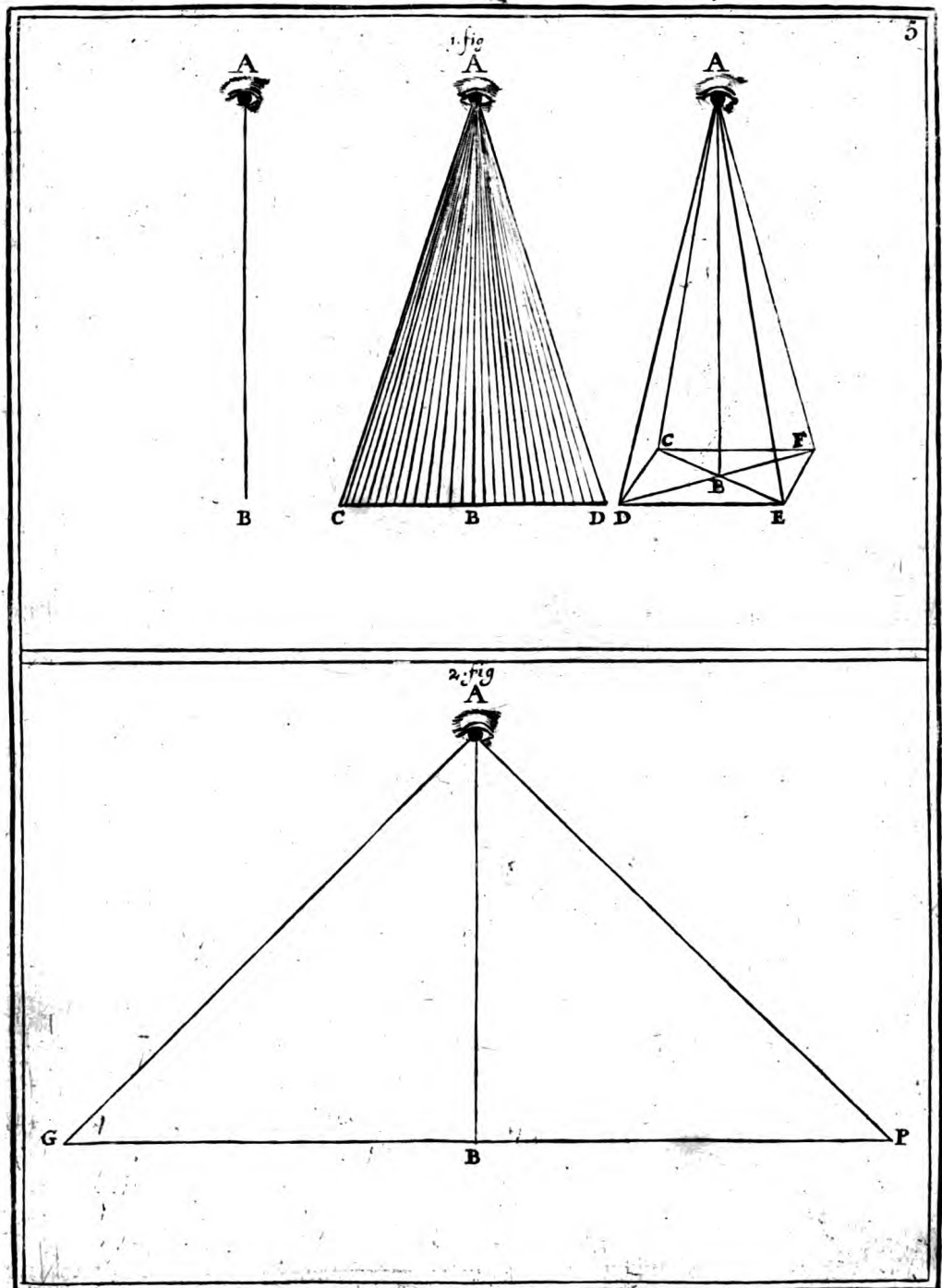
If the object be a right line, the visual rays form a triangle, as C A D, whose base is the line C D, and sides the two extreme rays A D and A C ; A B is the central ray. If the line was seen end-wise, it would appear as a point.

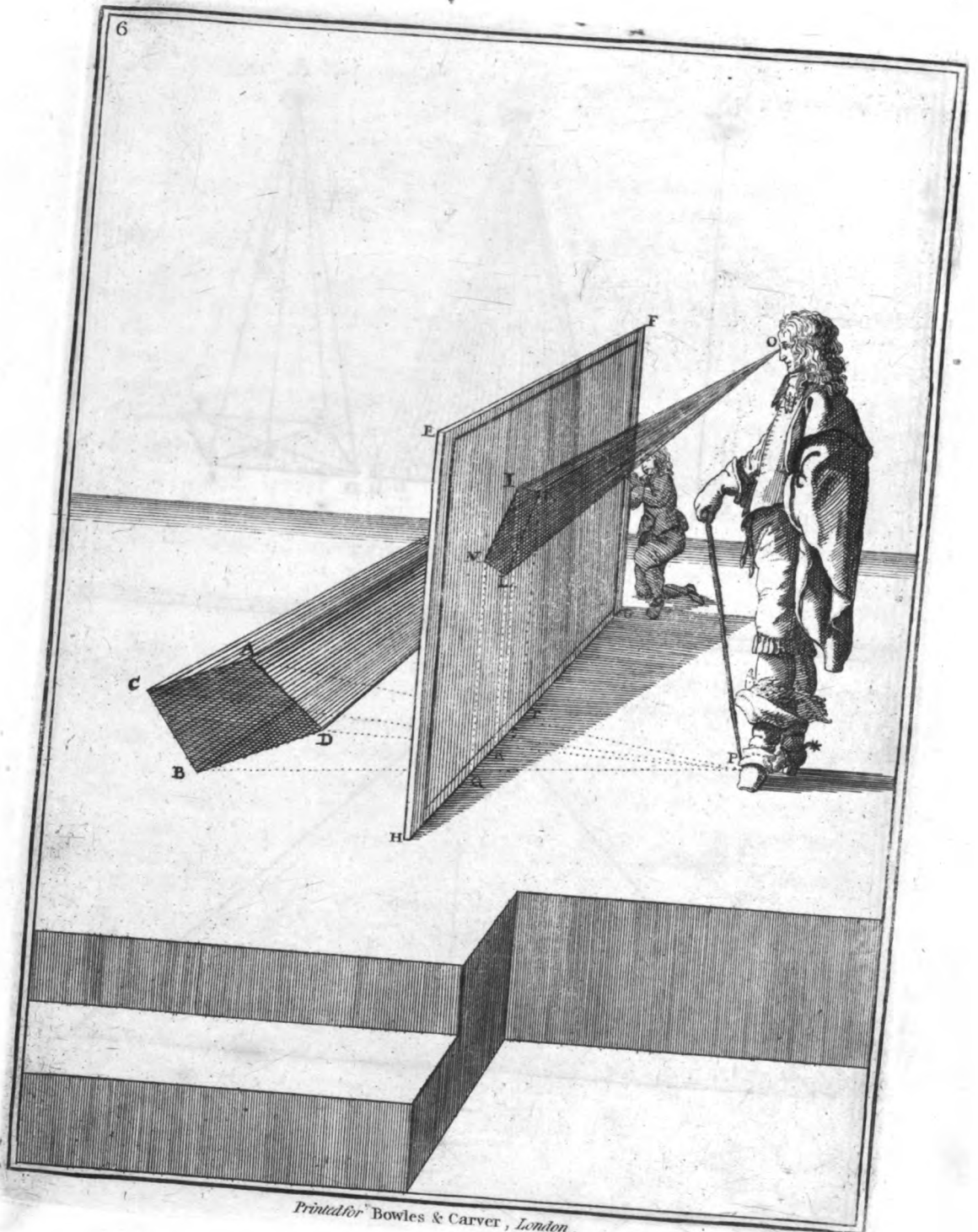
If the object be a surface, whether plane or spherical, the visual rays will make a pyramid, whose basis is the object C D E F, and its vertex the eye A. The rest of the pyramid consists of visual rays ; of which the central A B is the strongest, the others growing weaker, as they are removed farther therefrom, though they still retain a competent strength, till they make a right angled triangle. Such as go beyond this, become so feeble, that they appear very confusedly, so that to have distinct vision, the extreme under which an object is comprehended, must, at most, subtend a right angle in the eye. If the surface was viewed edge-wise, it would appear no more than a line.

Why a Piece of Perspective is seen better with one Eye than with two.

Some hold that all objects appear better with one than both eyes ; alleging, that the sight is rendered more penetrating by the visual rays of the shut eye being determined to the other ; inasmuch as all powers become more vigorous when united, than when dispersed. Accordingly, say they, one of the eyes being closed, the whole visive virtue before diffused through both, is now supposed to be collected into one ; and this reinforcement must necessarily render it stronger, more piercing, &c. than both.

Be this as it will, it is certain, we see a piece of perspective with one eye better than with both. The reason is, that the central ray, in this case, is directed to the point of sight where all the radials of the piece unite and centre, which is what shews a picture in its highest perfection. It is for this reason that we do not say, *the points of the eyes*, but, *the point of the eye*, as insinuating, that perspective is most pleasing when viewed by a single eye.





First DEFINITION.

PERSPECTIVE is the art of representing objects seen through some transparent medium, which the visual rays penetrate in passing from the several points of the object to the eye. Accordingly, whatever is seen through any thing, as through air, water, clouds, glass, and the like, may be said to be seen in *Perspective*. And since we see nothing but through those mediums, it is certain all we see is in perspective.

The end of perspective is to exhibit objects upon a plane, situate between the eye and them, for example, on the plane E F G H, to represent the objects A B C D, in the points I K L M.

The better to conceive this, suppose an object A B C D on the ground, and a spectator's eye in O, if a transparent body E F G H be placed between the two, the intersections of the visual rays with the perpendiculars Q R S T, will give the figure I K L M, such as the object appears on that plane. Perspective, therefore, consists altogether in the intersections of lines: whence it is, that *Marolois* always calls any thing put in perspective, the *appearance of the section*; since the plane E F G H cuts the visual pyramid A C B D and O, and gives I K L M for its section.

The reason of these sections is, that one single line determines nothing; but there are two required to cut one another, to give a point. Now, as it is evident, that between our eye and an object there is always a right line, or ray, that can never be wanting: but to get the other, which is to cut it, it is necessary we conceive, that from our foot as a centre, there are a number of lines or rays, continually flowing to the angles of the objects we see; as from P to the angles A B C D: all which rays being cut by some transparent plane, as E F G H the rays P B, P A, P C, P D, which before were horizontal, are now erected, and become perpendicular: P B, for instance, becoming Q M, P D becoming R L, &c. For if they continued horizontal, the visual rays would never intersect them, till they both met in the object itself. It is for this reason we always suppose a plane, which, reflecting the rays, gives them an occasion of intersecting, and so of finding the points to form the appearances of objects.

Second DEFINITION.

ICHNOGRAPHY is the plan of any work, on the view of it, cut off by a plane parallel to the horizon, just at the base or bottom of it. A geometrical plan, as that in page 2, exhibits the various parts in their just proportions, and their different magnitudes may be ascertained by the use of a scale. A perspective plan is one conducted and exhibited by degradations and diminutions according to the rules of perspective; thus ABCD is the *Ichnography*, or perspective plan, of a square body.

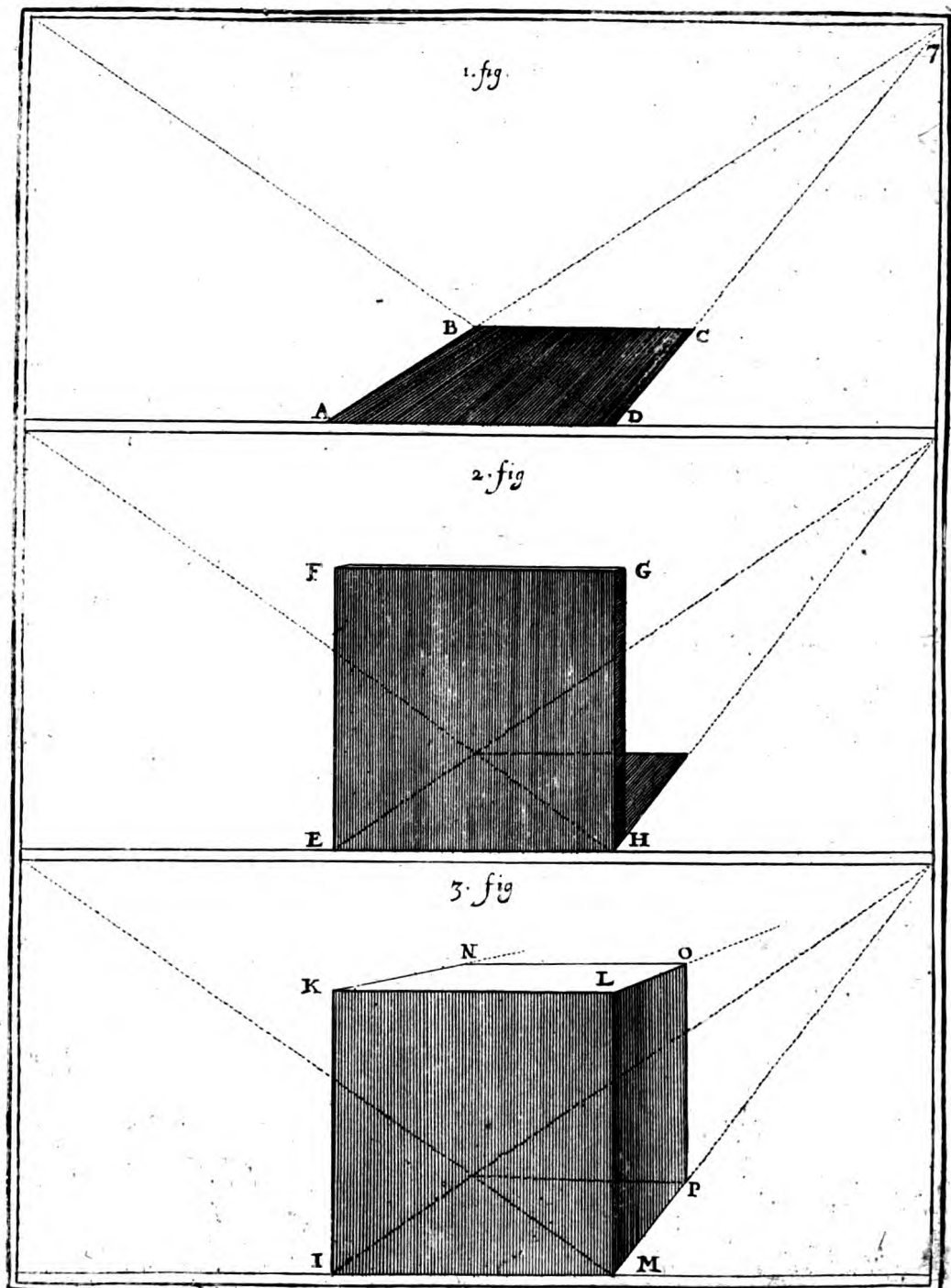
Third DEFINITION.

ORTHOGRAPHY is the delineation of the front or fore-side of an object, as an house or a cube, &c. Or the elevation of any object, as a house, or a cube, &c. directly opposite to the eye. Thus EFGH is the *orthography*, or fore-part of a cube. As the *ichnography* represents the plan, the *orthography* represents the side opposite to the eye.

Fourth DEFINITION.

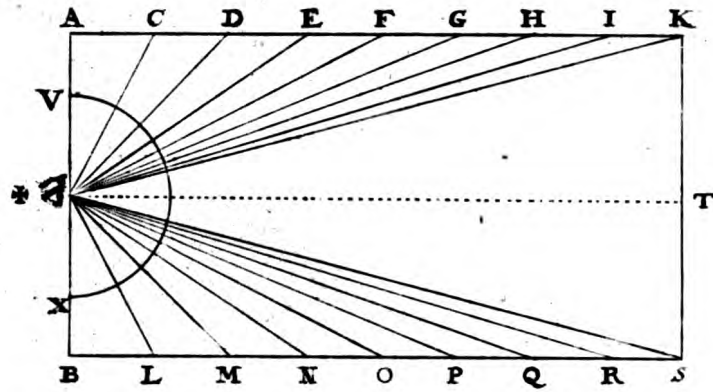
SCENOGRAPHY exhibits the object quite raised, and perfect, in the front, top, and that side which is visible from the situation of the spectator's eye. Thus IKLMNOP is a *Scenography*, or perfect cube. This is the whole object compleat, and comprehends the plan and front as parts.

The sum of what has been defined is, the *Ichnography* of a building, &c. represents the plan or ground-work of the building. The *Orthography*, the front or fore-right plane. And the *Scenography*, the whole building, front, sides, height and all. Preferring the more familiar terms, for the future, I shall call the *Ichnography* **PLAN**, the *Orthography* **FRONT**, and the *Scenography* **ELEVATION**.

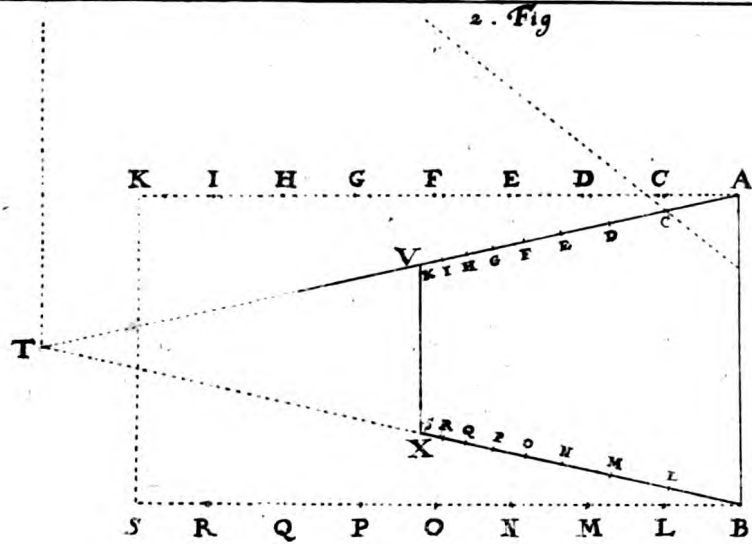


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1. Fig.



2. Fig.



Why Objects appear the nearer each other, as they are more remote from the Eye.

THIS figure may help to solve a question of some difficulty. Suppose a spectator's eye in the middle of a line at $+$, it is evident, that if it would see the two extremes thereof, A and B, it must take in a semi-circle V X, whose centre is in the eye itself, and whose central ray is the line $+T$. By taking in this semi-circle, it will perceive the objects on either side, and in such manner, as that those farthest off from A will appear to approach towards the centre T, and those on the side B seem to approach likewise.

Now it is asked, whence it is, that objects ranged on strait lines so wide asunder, should seem to approach and join each other, and that whether the ranges are situated side-wise, or one over the other?

The answer is in few words. All objects appear under the visual angle they subtend at the eye. Now, be they columns, trees, animals, or any other things placed on the side A, K the remotest will seem to border on the centre T, by reason they are seen under an angle, or ray, that is near thereto. The ray $+K$, for instance, being much nearer the central ray T, than is the ray $+C$ or $+D$, of consequence must appear nearer to it. If the range of objects was prolonged, they would still approach nearer the central ray T, till such time as they seemed contiguous, and only to form one point therewith.

Now, in perspective, the sides A K and B S do not continue parallel, but become visual rays, which contract themselves till they intersect each other in the point of sight, and by that means give the diminutions of objects. Thus, for instance, in the second figure, the eye being at a distance capable of seeing the line A B; from the two angles A, B, arise two rays, which proceed to the point of sight T; which rays A T and B T receive the intersections the point of distance makes with the objects, which all the while contract themselves proportionably: as will be shewn in the description of diagonals and their sections. By such means the whole parallelograms A K B S, and all the objects on either side become reduced into the narrow compass AV, B X: and if the eye were more remote, that space would be still smaller, since the farther an object is off, the smaller it appears, as will be made appear in the following page.

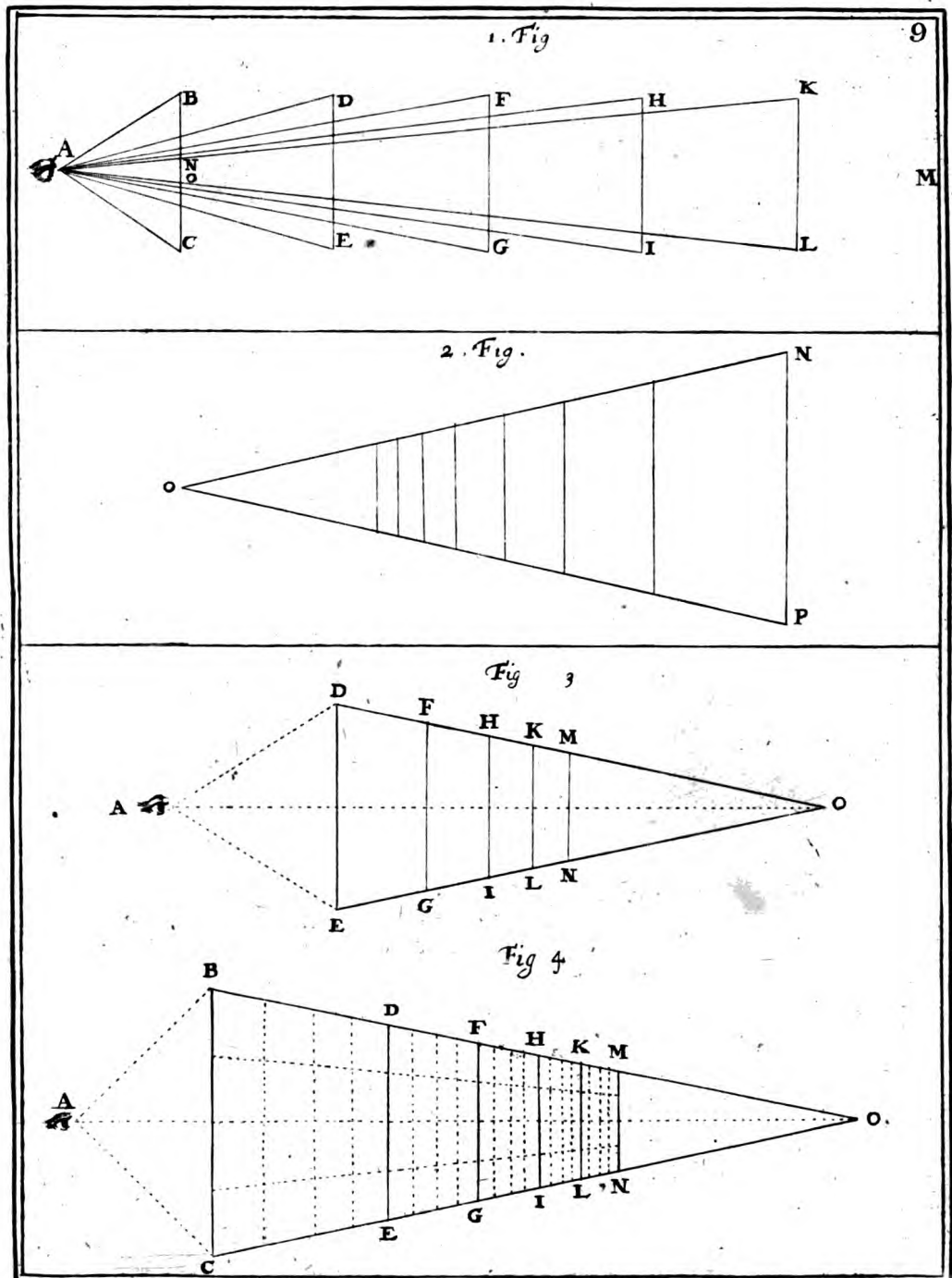
Why Objects appear the smaller as they are at the greater Distance.

I HAVE already observed, that objects appear large or small according to the angle wherein they are seen, and that this angle is taken at the eye, where two rays drawn from the two extreme points of an object meet. The eye A, for instance, viewing the object B C, will draw the rays A B and A C, which give the angle B A C. But an object viewed under a greater angle appearing large, and another under a lesser angle, little; and among equal objects, those at the greatest distance appearing under the smallest angle, it consequently follows that in all perspectives the remotest objects must be made the smallest. To illustrate this by an example, if the eye be in A, the object B C, which is the nearest, will appear the biggest, because seen under the greatest angle; and the second, third, fourth and fifth objects, though of equal magnitude, will all appear smaller and smaller, inasmuch as the angles under which they are seen, diminish in proportion as the objects recede. If the eye were removed into M, K L would appear the largest; and B C, in this latter case, seem no bigger than N O.

The second figure is a sequel of what I have advanced. For, supposing the apparent magnitude of objects to be such as is the angle they are seen under, it follows, that if several lines be drawn between the sides of the same triangle, then will all of them appear equal. Thus, all the lines comprised between the sides O N, O P, of the triangle N O P, will appear equal to each other; and as objects comprehended under the same angle seem equal, so all comprehended under a greater angle, seem greater, and all under a smaller, smaller.

Thus much premised: if there be a number of columns, or pilasters, to be ranged in perspective on each side of a hall or church, they must of necessity be all made under the same angle, and all tend towards one common point in the horizon O, *fig* 3d. For instance, the eye being placed in A, viewing the first object D E; if from the points D, E; you draw the visual rays D O, E O, they will make the triangle D O E, which will include the columns D E, F G, H I, K L, M N, so as they will all appear equal in magnitude.

What has been said of the sides, is likewise to be understood of the ceilings and pavements; the diminutions of the angles of remote objects, placed either above or below, being governed by the same rule as those placed laterally. I need not therefore add any thing farther; unless, that care be taken there be as many squares or divisions between the remotest objects as between the nearest: for in that case, though distant objects be closer as they are farther from us, they will appear in some measure to preserve their distance; thus, in B C, D E, the interval between the four nearest columns, there are sixteen squares, and no fewer than sixteen between the four remotest K L, M N, *fig*. 4.



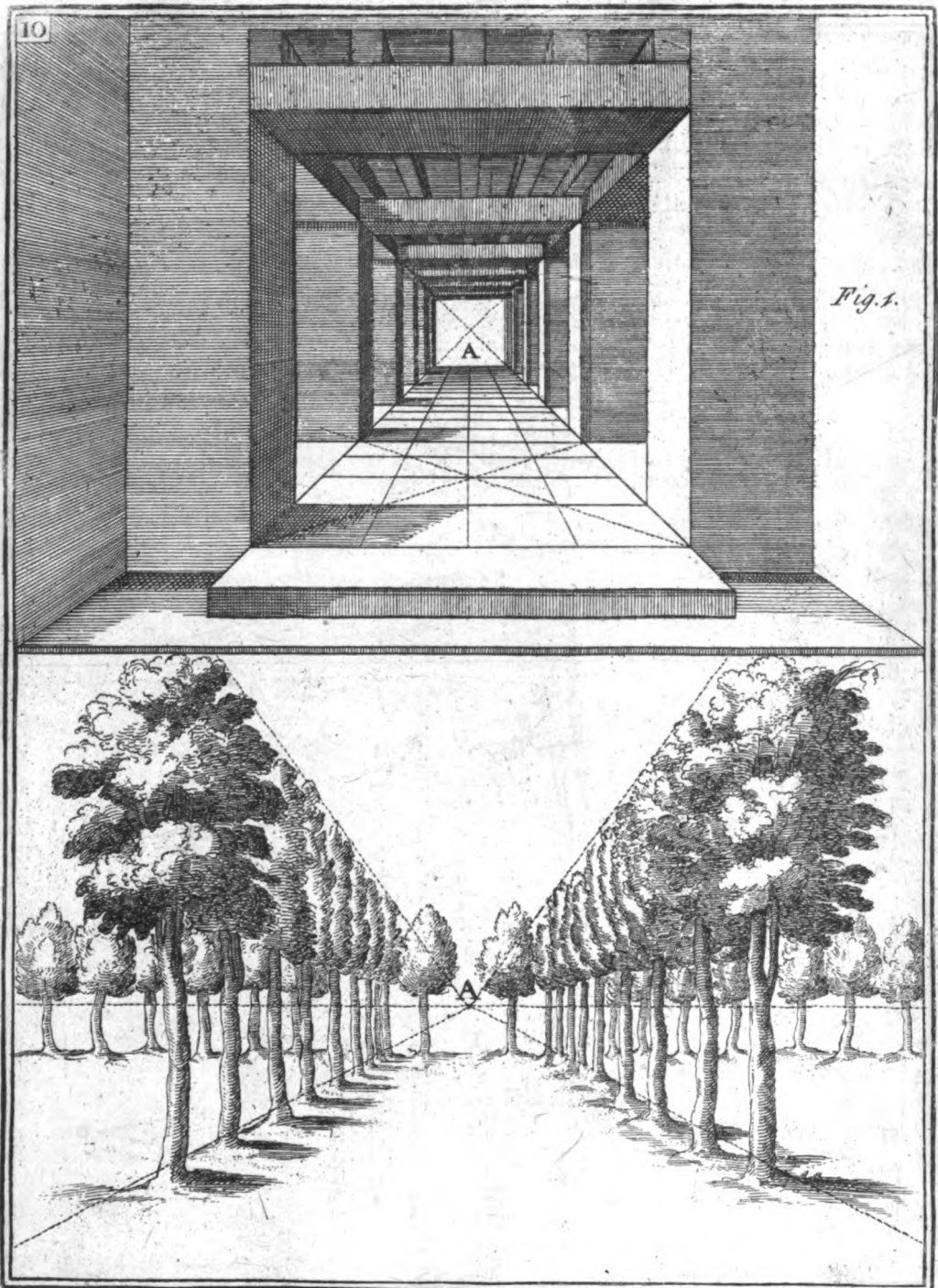


Fig. 1.

The Observations of the former page, applied to practice.

IT follows from what was said in the foregoing page, that if you join two triangles, as in the last figure but one, for the sides, and two others, of the last, for the top and bottom of an object, all four will terminate in one single point A, which is the point of sight, wherein all the visual rays meet. And this will give a proof of what I advanced, namely, that objects diminish as they remove; the lower objects rising, the upper falling, and the lateral closing or approaching nearer to each other. An example of all which you have in *Fig. I.* which exhibits, as it were, depths and distances falling back, and receding from us, though all the parts of the design are in fact equally near the eye, being all of them drawn on the same plain surface; but this ingenious effect is produced, and the appearance of a distant view procured, by comprehending and diminishing the objects within the triangles.

The trees in the lower figure being ranged by this rule, have the same effect as the columns, &c. The two rows are each of them comprehended within the side triangle, and diminish as they approach the point of sight A. The third or bottom triangle, is the earth between the trees, and the fourth or upper one, is the air; and thus an elegant design, highly entertaining the eye, is easily constructed.

I shall next shew, how you are to proceed in putting any plane body, or other figure, in perspective.

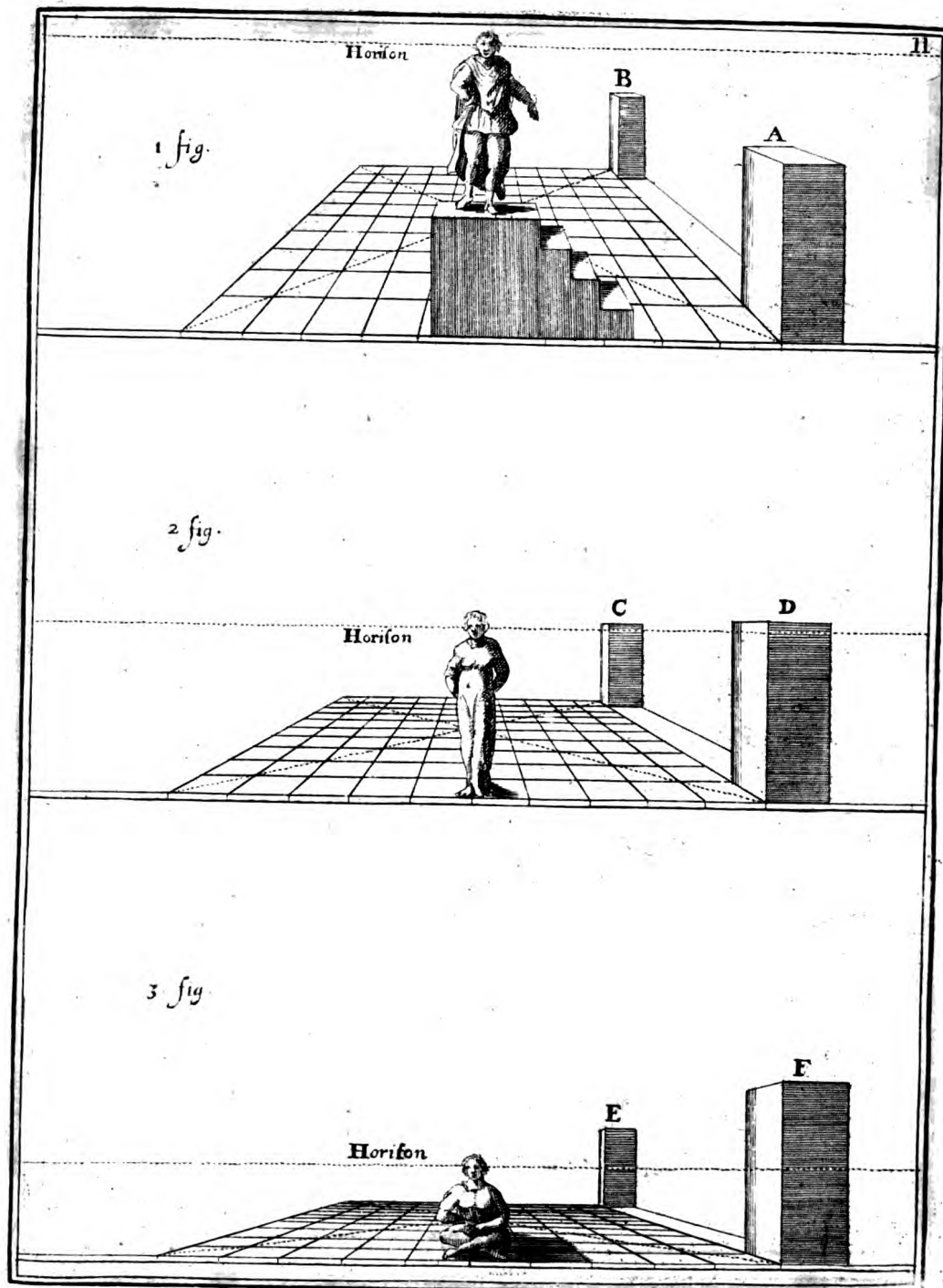
Of the HORIZON.

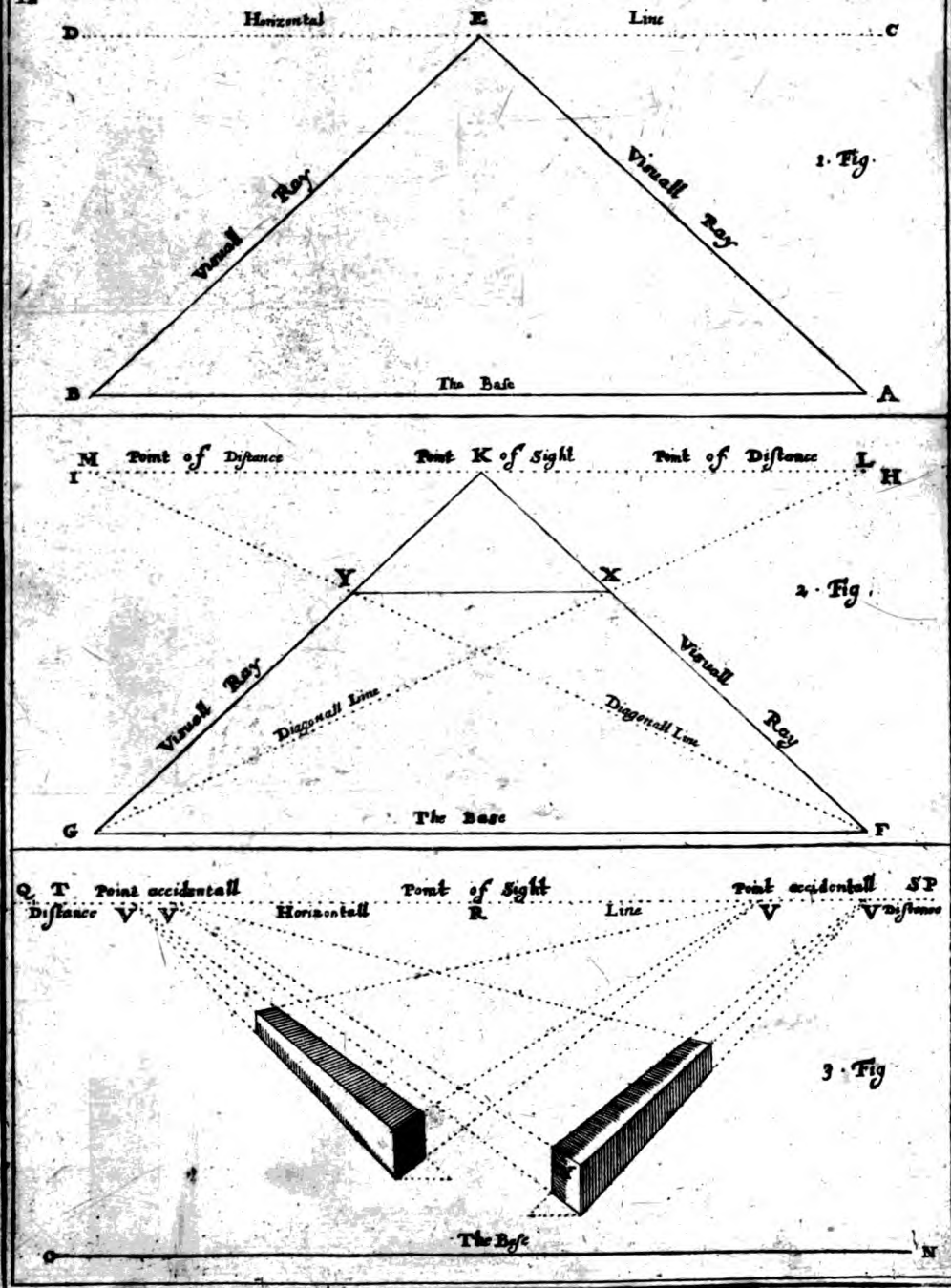
WHAT we call the HORIZON, in perspective, is only a line given us by the height of our eye. Thus, if we be raised on an eminence, as is the man in the first figure, our horizon will be high. If we stand only on the plane, as represented in the second figure, the horizon will be our own pitch. And if we be seated, as is the third, the horizon will be low. So that it is the horizon shews how high the eye is above the ground.

This, in effect, is the principal article in a picture, and that which directs and gives law to all the rest; both as to the slope and inclination of buildings, and to the measures and heights of the figures. This has occasioned a little dispute among our best painters; some of them assert, that all paintings should have their horizon in the work itself, and that perspective allows, where the painting is raised very high above the eye, that it have its particular horizon. Others do not allow of a second horizon, but always use the natural one, wherever the painting be placed; as imagining that the whole height and breadth before them is, as it were, one large painting, from which that which is raised above ought to take its measures. The respect I bear to the patrons of each opinion will not allow me to determine between them; especially, as several good authors have tolerated both. But if my own sentiments were asked, I should make no scruple to profess myself of the opinion of these latter, because every thing in the painting will thereby appear the more natural.

In this horizontal line are always found the points of sight and distance, and sometimes the contingent or accidental point. It is this line that terminates the view, and which, to our apprehension when at sea, or on a large plain, separates heaven from earth: it is always parallel to the bottom of the piece, or the plan the object is placed upon. Hence it appears, that nothing ought to be placed above the horizon, but what surpasses the height of the eye; and if an object be so high as that it surpasses this horizon, the plan of the same object must be placed below it. Thus, a tree or mountain may have its top above the horizon, but its bottom must be a good deal below it.

Whatever is below the horizon shews its top; but in objects ever so little above it, the top is invisible. Thus the two blocks A, B, placed on the ground of the first figure, shew their tops, by reason the horizon is over them; but in those of the second figure C, D, the top does not appear; and much less in those of the third figure: yet, in reality, they are all of the same height, so that it is the horizon makes all the difference.





Of the TERRESTRIAL LINE.

THE TERRESTRIAL LINE, BASE LINE, or LINE of the PLAN, is the bottom line of the drawing or plan. This is always parallel to the horizon, as is seen in *AB* of the first *Figure*, *FG* of the second, and *NO* of the third. It is the first line drawn for the plan of a place; and whereon all the measures are to be set, as will hereafter be shewn.

Of the POINT of SIGHT.

THE POINT of SIGHT is a point in the axis of the eye, or in the central ray, where the same is intersected by the horizon; or in other words, a point in the horizontal line where all the visual rays terminate. Thus the point *E* in the first figure is the point of sight in the horizon *CD*, wherein all the visual rays meet. It is called the *Point of the eye*, or *ocular Point*, because directly opposed to the eye of the person who is to view the piece. It is also called the principal point, or point of perspective.

Of the POINTS of DISTANCE.

PPOINT of DISTANCE, or POINTS of DISTANCE, is a point, or points (for there are sometimes two of them) placed on the horizontal line at equal distances on each side from the point of sight. They are thus denominated, by reason the spectator ought to be so far removed from the figure or painting, and the terrestrial line, as these points are from the point of sight. Thus *HI* being the horizon, and *K* the point of sight, *L* and *M* are points of distance, serving to give all the shortenings. Thus, for example, if from the extremes of *FG*, *Fig. 2d.* you draw two lines to the point *K*, and from the same points draw two lines to the points of distance *M* and *L*, where these two lines *GL* and *FM* cut the lines *FK* and *GK*, in the points *X* and *Y*, will be the line of depth, and the shortening of the square, whereof *FG* is the side and base. The lines drawn to the point of sight are all visual rays, and those to the points of distance, all diagonals.

Of the ACCIDENTAL POINTS.

CONTINGENT, or ACCIDENTAL POINTS, are certain points, wherein such objects as may be thrown negligently and without order, tend to terminate in the horizon. They are called accidental, because they are not drawn to the point of sight, nor the points of distance, but meet accidentally in the horizon as the situation of the objects happen. Thus, for instance, the two pieces of wood *X* and *Y* terminate in the points *V, V, V, V*, in the horizon *PQ*, not in the point of sight which is *R*, nor in the points of distance *S* and *T*. Indeed sometimes the objects are so ill disposed, that these points must be made out of the horizon, as I shall have occasion to shew hereafter. They serve particularly in the apertures of doors, windows, stair-cases, and the like.

Of the Point of the FRONT.

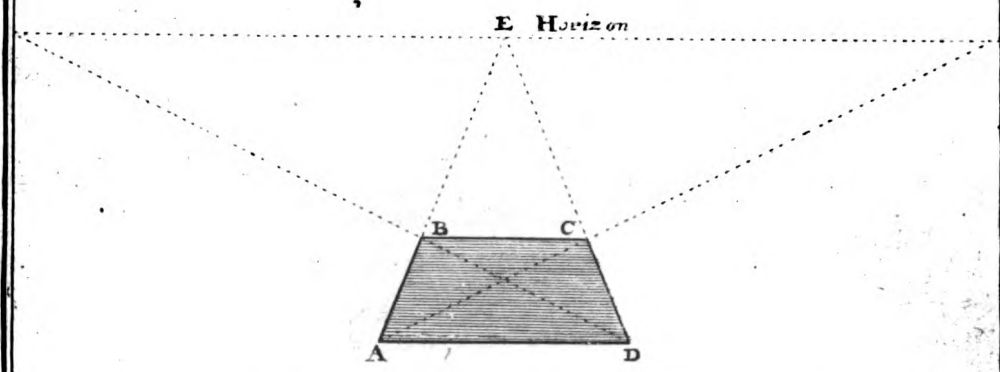
THE point of DIRECT VIEW, or of the FRONT, is when we have the object directly before us, and not more on one side than the other; in which case it only shews the fore-side, and, if it be below the horizon, a little of the top too, but nothing of the sides, unless the object be polygonous. Thus the plan A B C D is all in front, and, if it were raised, we should not see any thing of the sides A B, or C D, but only the front A D. The reason is, that the point of sight E, being directly opposite thereto, causes a diminution on each side: however it is only to be understood where an elevation is the object, that the front or forepart can only be seen, for, if it be a plan, it shews the whole, as A B C D.

Of the SIDE POINT..

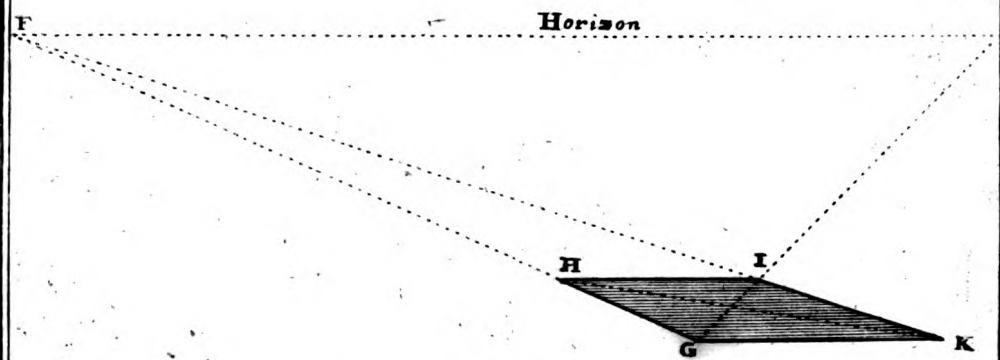
THE point of OBLIQUE VIEW, or of the SIDE, is when we see the object sideways, or askant. In viewing the object obliquely, it presents us two faces, or sides; and the point of sight, instead of being in the middle of the horizon, as in the former instance of the point of direct view, is now placed in the side of the horizontal line. For example, if the point of sight be in F, the object G H I K will appear athwart, and shew two faces, G K and G H; in which case it will be a side point. The practice is the same in the side points as in the front points; a point of sight, points of distance, &c. being laid down in the one as well as the other.

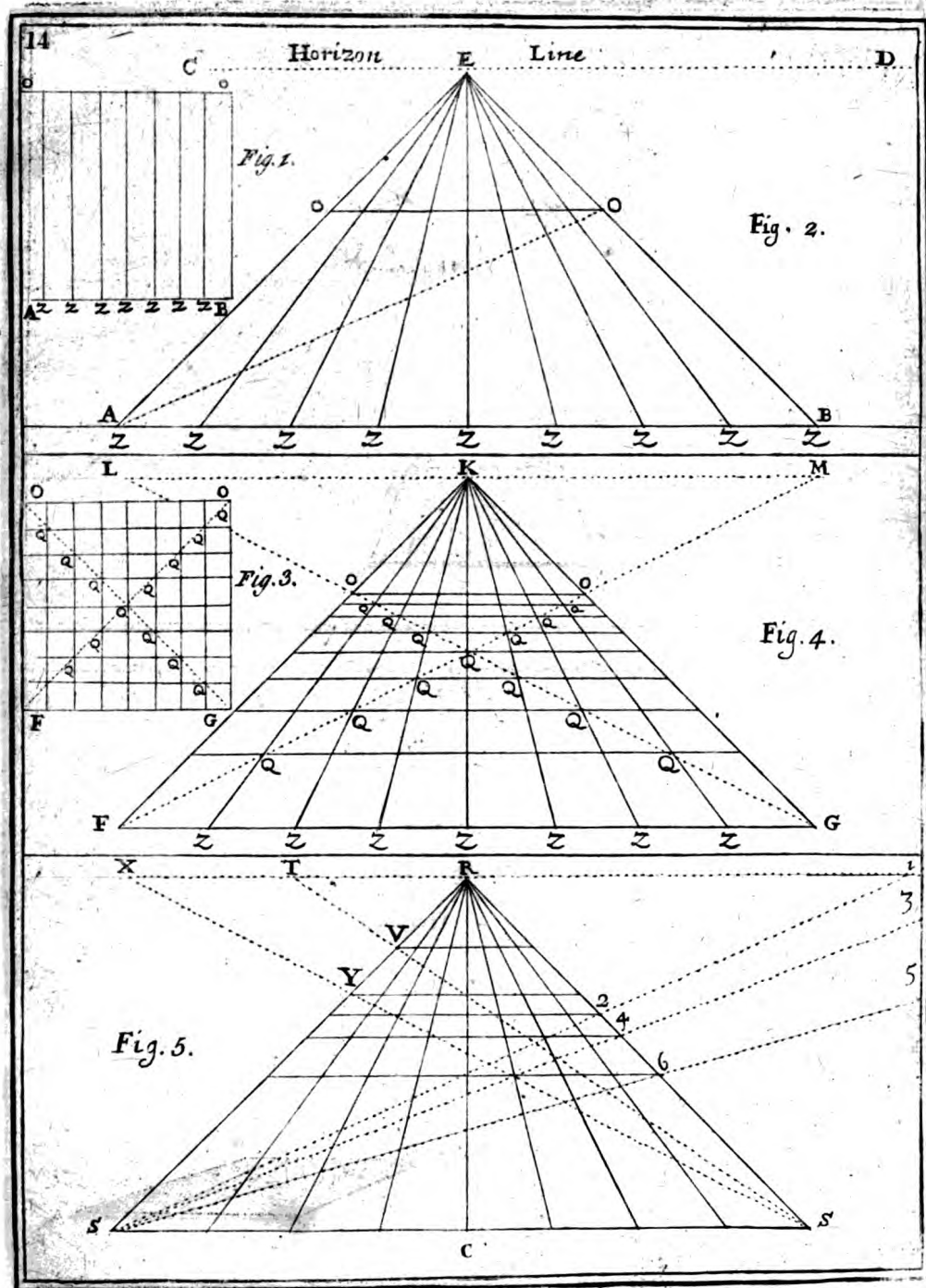
1. Fig.

15



2. Fig.





Of the VISUAL RAYS.

IT is an universal rule, that all the lines, which in a geometrical plan are perpendicular to the terrestrial line, be always drawn to the point of sight, when the same plan is to be put in perspective. Thus, in the little plan *AO, OB, Fig. 1.* *AB* is the terrestrial line, to which all the lines *ZZ, &c.* are perpendicular. But if the plan be to be thrown into perspective, and either a greater or a less line than that of the plan be pitched on, for example, the line *AB, Fig. 2.* which has the same number of divisions as the small one; from the several divisions *Z,* the lines are to be drawn directly to the point of sight *E.* Such lines are properly denominated radials or visual rays; and the last of them, the extremes, as being drawn from the extremities of the terrestrial line *AB.*

Of the DIAGONALS, or DIAMETRALS, and their SECTIONS.

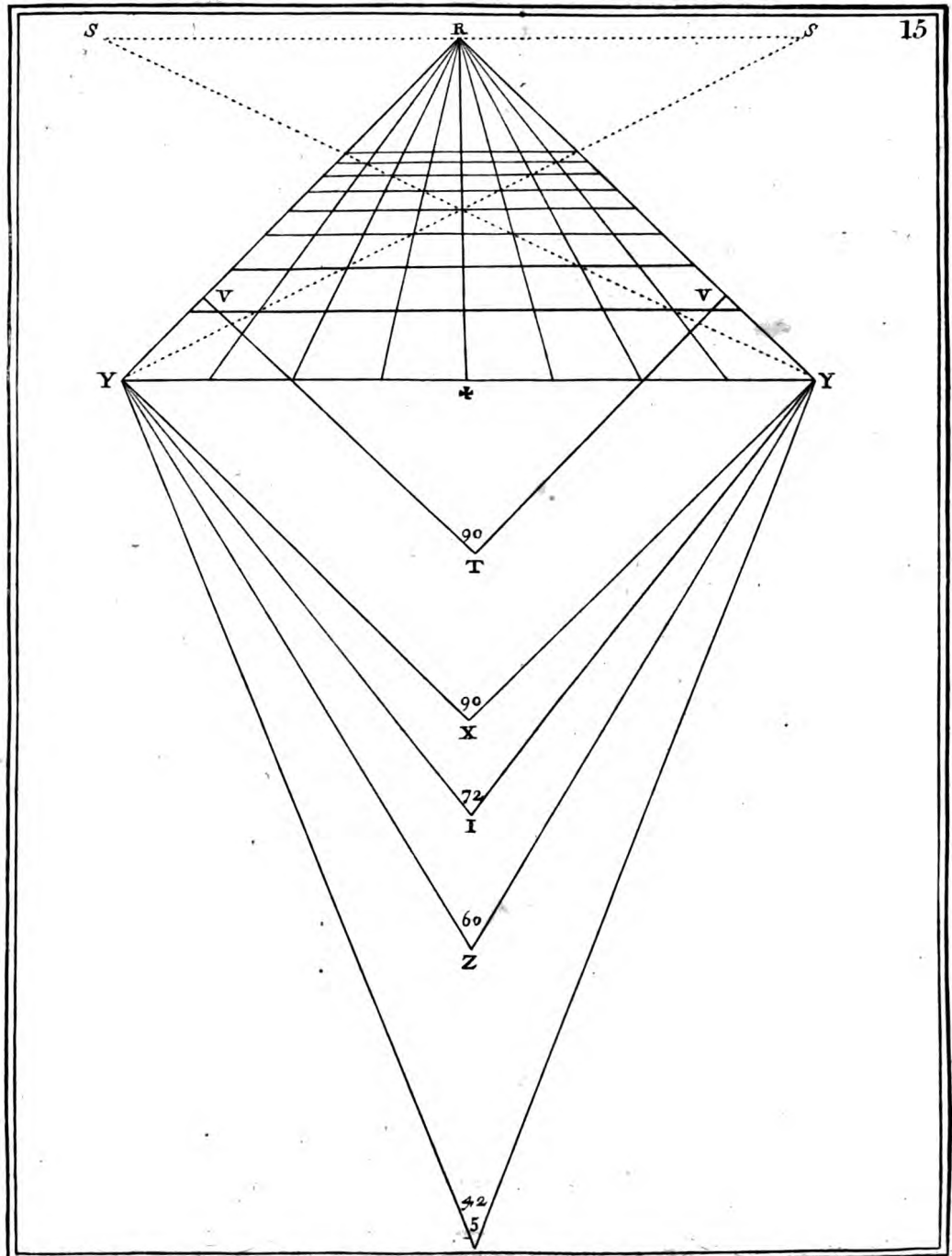
It is likewise a rule, that all the diagonals of the squares in a geometrical plan, be drawn to the point of distance when the plan is put into perspective. Thus, in the little plan *Fig. 3.* the diagonals, *GO* and *FO,* are drawn to the points of distance, when the same plan is exhibited in perspective, and thereby the shortenings or diminutions of the objects are procured. For example, if from the extremes of the base line *FG, Fig. 4.* lines be drawn to the points of distance *LM,* they will be diagonals; and where those lines intersect the extreme rays *FK* and *GK* in the points *O, O,* will be marked out the diminution of the square, whereof *FG* is the side. And where these diagonals cut the lines *Z, Z, &c.* in the points *Q, Q, &c.* parallels to the base line are to be drawn, which will give the diminution of all the squares, and the same number of sides as in the little plan. The more remote the points of distance are from the point of sight, the more the objects are diminished; hence the beauty of a perspective depends on fixing the points of distance, at a proper distance from the point of sight. On this account, I have added *Fig. 5.* with a diversity of intervals between the point of sight, and points of distance, to evince the truth of what is just now observed. Suppose then *R* to be the point of sight, and *RS, RS,* the extreme rays; if the point of distance be at *T,* it will cut the ray *SR* in the point *V,* which will give the diminution of the square, whereof *SS* is a side. But it would be ridiculous to see a square so extravagantly deep, occasioned from the point of distance *T* being so much too near the point of sight *R.* The least space in any-wise allowable, is for the point of distance to be removed from the point of sight, half the breadth of the whole draught or perspective; (such as is the distance of *X* from *R, viz.* equal to that from the central ray *C,* to *S;*) by reason such a distance makes a right angle at the spectator's eye. It would, however, be still more agreeable at *1,* the line in that case cutting the square at *2;* and it would be better yet at *3,* cutting the extreme ray at *4;* and best of all at *5;* being then remote enough, and making the square shorter at *6:* the reason thereof will be assigned in the next page.

It may be demanded, why, throughout the course of this work, I have put the points of distance so near the point of sight, when they have so much better effect at a greater distance? The answer is, that the book not being intended to be viewed merely out of curiosity, but to instruct, it was necessary every circumstance should be seen, that the various methods of practice might be the better conceived. For this reason I have included as much of the several operations as possibly I might.

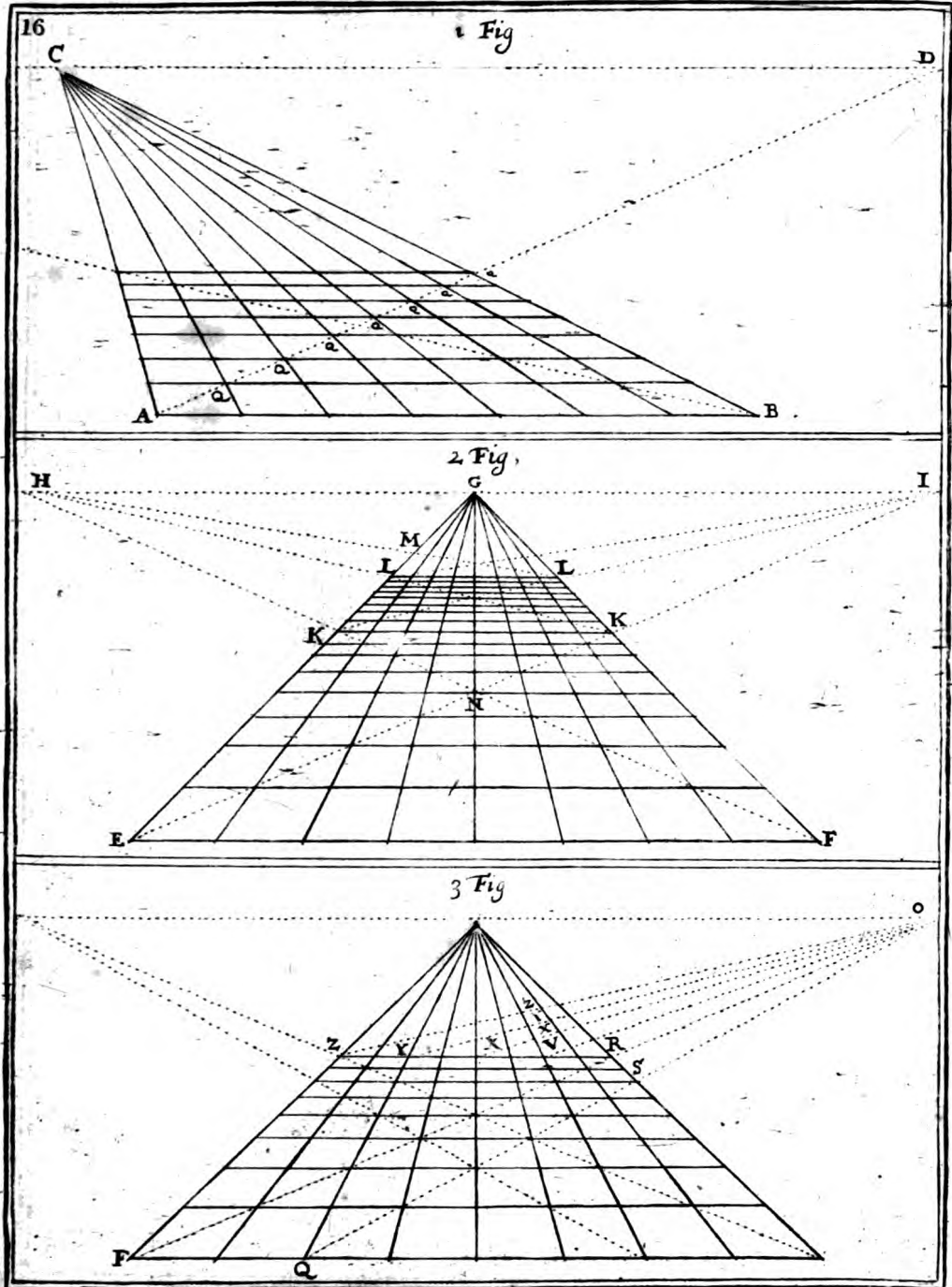
Of the DISTANCE, or REMOVAL.

I HAVE already observed, in speaking of the visual rays, page 5, that the eye cannot commodiously take in more of them, than are included in a right angle : that is, that the sight does not receive the forms of objects fully and distinctly, when the rays transmitted from their extreme points, extend beyond a right angle. The reason is the pupil being nearly in the centre of the eye, does not well admit more than a quadrant of a circle, so that whatever rays exceed that portion, are either not seen, or produce only a dim confused effect. On this account, objects are seen to greater advantage under an angle less than a right angle rather than greater ; for instance, two thirds of a right angle, or sixty degrees, but not less, because the rays, in such case, being so straitened become indistinct, the angle being little more than a point in the pupil. To shew this difference in figures. Suppose the plans and squares the same as in the last figure, and the spectator's eye at the distance of T from the terrestrial line ; the opposite figure demonstrates it would be necessary the angle should open much farther to see the extremes Y, Y. If it only opened to a right angle, the eye could not see all the figure, as T for instance could not see beyond the points V, V. Whence would arise a very faulty perspective, inasmuch as what would exhibit a square, will now only form a parallelogram. The nearest distance from the eye is in the point X, which is the just measure of a right angle comprehending the whole piece Y Y. If the distance be carried still farther back from the point of sight, it will be still more agreeable, as in I, where the angle will be only 72 degrees. If it be brought back as far as Z, it will be in perfection, inasmuch as the rays being now less dilated, have the more force, and exhibit objects with the greater vivacity. But I would never choose to go beyond five, for the reason already insinuated, that the angle then dwindles to a mere point. Too much care cannot be taken in the disposal of points of so much importance ; with regard to which it must be esteemed a certain rule, that the distance be at least equal to the space between the direct ray and the corner of the perspective. + R, for instance, is the direct ray and X + the least distance, which is equal to + Y. This measure being taken, must be set off each way from the point of sight to fix the points of distance, as here from R, to S, S ; or only one way, as in the following page, for a side point.

Thus much we learn from reasons that regard the eye ; but experience furnishes another nobler rule, which may be general too, provided it be used with judgment, namely, that having chose the place where the perspective is to be made, you are to determine from what quarter it is to be seen to the best advantage ; then taking the distance from this place to the terrestrial line, set off this interval, by a little scale, from the point of sight to the point of distance, provided it be not too remote. Which is a circumstance that will require some discretion, to avoid the inconvenience either of placing it too near, or too far off.



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OBSERVATION I. *Relating to the Side-point.*

THE rules for the front point, are not varied in drawing the points of the sides, they are both founded on the same cause, which always produces the like effects. *Fig. 1.* will sufficiently shew, that the method of practice for the side point, is the same as for that in front. Set off the division on the terrestrial line A B, and if the point of sight be supposed in C, and the point of distance in D, from the several points of division draw the rays to C, then draw the diagonal line A D, and you will have the interfections Q, Q, &c. which give the diminutions of the squares in the same manner as those in the preceding plates. The rest will be learnt from the following rules.

OBSERVATION II. *Of the Depths or Hollowings.*

A perspective may be sunk to any depth, by making new terrestrial lines and diagonals in the following method. For example, *Fig. 2.* from the terrestrial line E F, draw to the point of distance H I, the diagonals E I, F H, and where they intersect the visual rays E G and F G, in the points K, K, the diminution of the first square will be. Now, if we take this line K K for a new terrestrial line, and from its extremes K, K, draw diagonals to the points of distance; where these cut the same lines E G and F G, namely in the points L, L, will be the diminution of the second square, which will have as many divisions and squares as the first. Again, if we take this line L L, and repeat the same operation, we shall have the diminution of the third square in the point M. And if we begin again with this, we shall have a fourth; and so on, till we arrive at a point, which will be a length that will appear prodigious. By such means, it is easy either to sink the perspective plan deeper, or to shorten it. Thus, if you would have the depth, twice its width, proceed as already directed, by drawing new diagonals at K, K: and if you would have the depth but half the width, a line drawn at N, at the intersection of the diagonals, will give your request.

Since it is infallibly certain that as many visual rays as cut the diagonal line, so many squares of depths you have; it follows, as has been already hinted, that you may give the perspective what depth you please. For if, instead of drawing the diagonal from the ray F to the point of distance O, you draw it from Q, you will want two squares of the other diminished square R; and if you would have two squares more than the square R, draw a line from the same point O, cutting two rays, to V: if you desire four, take X; if six, Y; and if the intire square, Z: which is very easy, when well understood.

OBSERVATION III. *Of the Measures upon the Base.*

BY the base line alone, one may give any depth, and in any part of the perspective at pleasure, without the use of squares; which is a very expeditious way, though somewhat difficult to learn. I shall, however, endeavour to make it understood, because I shall make frequent use thereof. For an example, *Fig. 1.* Suppose B S the base line; the point of view A; and the points of distance D, E; if now you would make a plan of a cube, of which B C is the side, draw two occult, or dotted lines, from the extremes B C, to the points of sight. Then, to give the breadth, take the same measure B C, and set it off on the terrestrial line C F; and from F draw a line to the point of distance D; and where this line intersects the first ray C, in the point G, will be the diminution of the plan of the cube B H G C.

If you would place the cube farther towards the middle, take the measure B C, and transfer it on the base line to the distance required, as I K; and to attain the depth, set the same as you would have it on the base line, as L: from L measure the width, as L M; then from L and M draw occult lines to the point of distance D, and from the points N O, where those lines intersect the ray K, draw parallels to the terrestrial line, and you will have the square Q P O N in the situation you wanted.

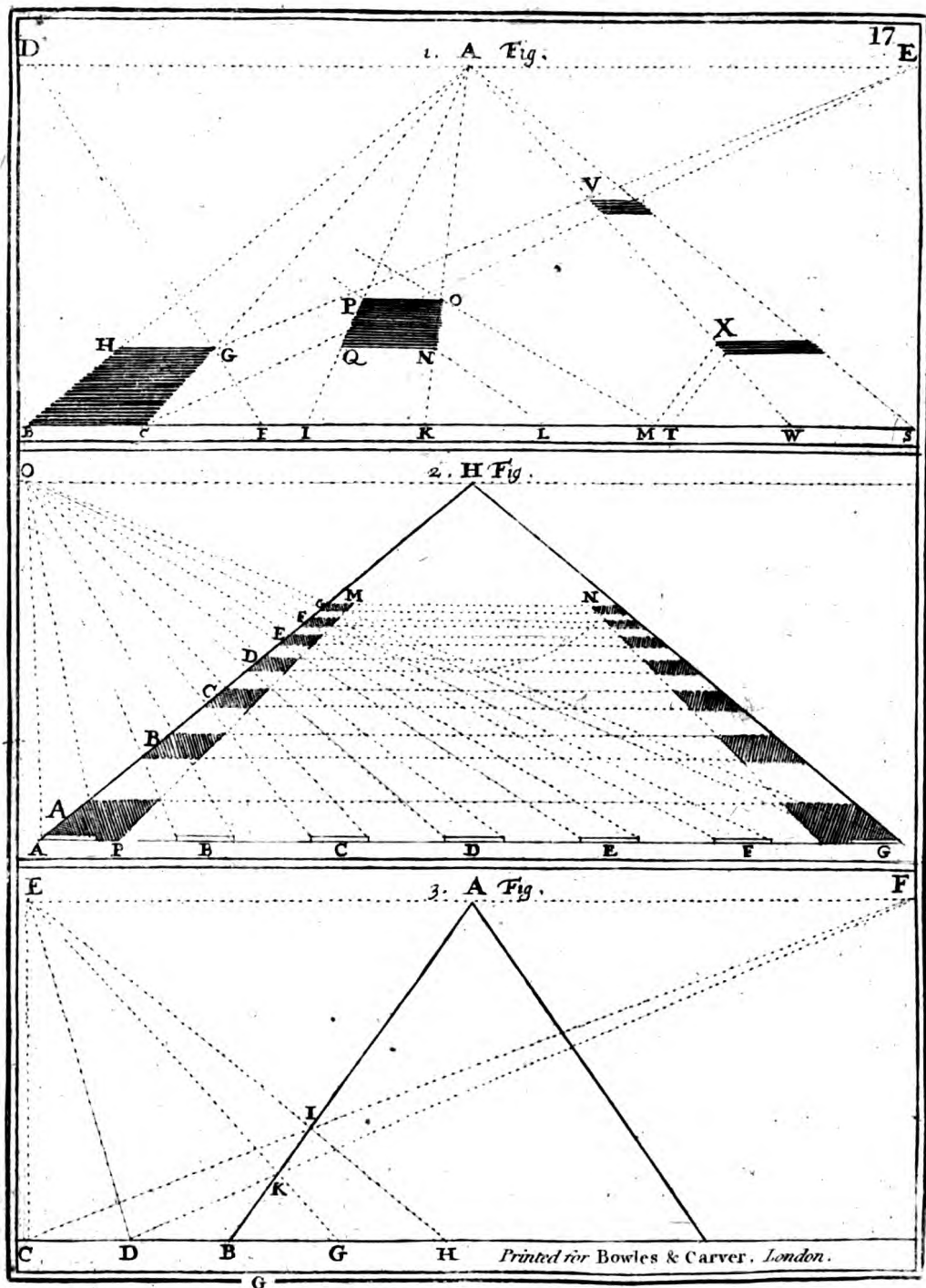
You may set the cube on the other side of the square, by transferring the measure of the side to W S on the base line, from whence draw the rays S A, W A, and perform the operation as already directed. The cube B H G C is here transferred to V, by lines drawn from the points C, D, to the point of distance E. The interval M T, intended for a border, is shewn in the narrow figure X, as being very near.

OBSERVATION IV. *Of the Base Line, and a single Point of Distance.*

SINCE the depths and widths may be procured by means of this base line, we need not give ourselves any farther trouble in the making of squares; as shall be shewn in this example. Suppose a row of trees, or columns, is to be projected on each side; on the base line lay down the place, and the distance between them, with their breadth or diameters, as A B C D E F G, then laying a ruler from the point of distance O, to each of the points A B C D E F G, the intersections it makes on the extreme visual ray A H, will be the bounds of the objects desired. To set them off on the other side, upon the ray G H; set one foot of your compasses on the point of sight H, and with the distance H G, strike an arch: The point wherein this cuts the ray G H, as in N, will be the corresponding bound. Thus N will be the same with M, and so of the rest; through which drawing parallels, you will have the breadths. And as for the length, make it at pleasure; setting it off from A, for instance, to P, and then from P drawing a line to H; and where this cuts the other parallels, will be formed the plan required: which you may make either round or square.

OBSERVATION V. *Not to deceive one's-self in the Measures.*

NEVER put any objects that are intended to be within the plan, on the side of the point of distance, where you are to draw lines for managing the depth. Thus, suppose A B the visual ray whereon the measures are to be marked; if you would produce the points C and D through the same, do not draw the lines from the point of distance E, but from that opposite thereto, F. Or if C and D were on the inside, as G and H are, you should not draw from the point F, but from E; by reason the line of intersection is found between the two. Consequently, the two will cut each other in the same points I, K.



OBSERVATION VI. *Of a single Point of Distance.*

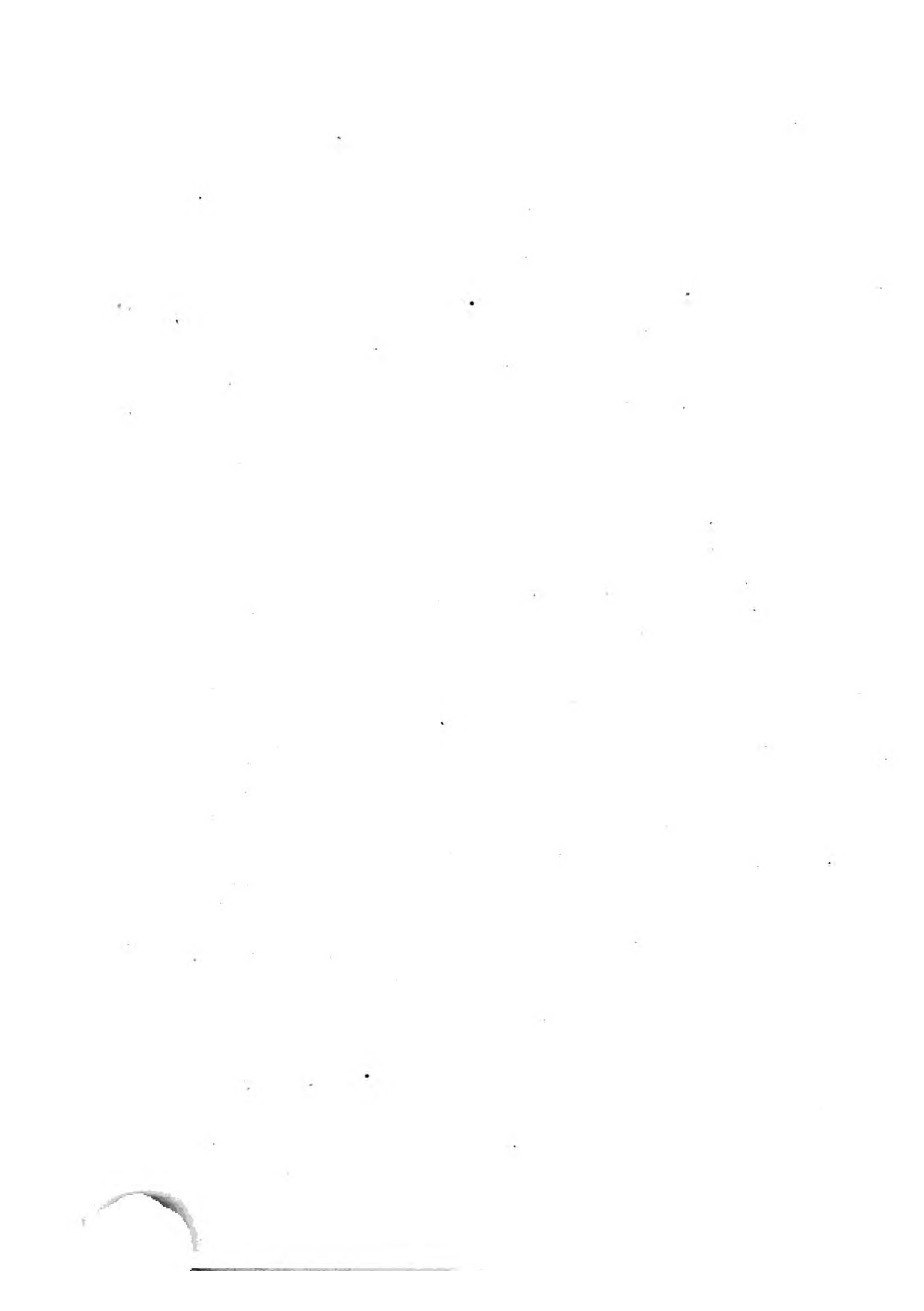
THE artist is sometimes so straitened for want of room on the place on which he exhibits his draught that it is impossible to make above one point of distance. On which occasion, such as have been always accustomed to two, find themselves at a loss. This I am now to recover him from, and to give him to understand how a single point suffices for the operation. Suppose, then, we have a pavement to make of square stones, and that we have already drawn all the visual rays to the point A; to get the diminutions of them, draw lines to the points of distance, the interfections whereof will give us points for parallels to be drawn through. But here being only one point of distance, namely B, draw the single diagonal stroke C B, to cut all the visual rays. Then mark the same interfections on the opposite rays, for the drawing of parallels. Set, as already directed, one foot of your compasses in the point A, and sweep the other through all the interfections, as I P. This however is only adviseable for what is to be viewed in front; another method is to be given for plans to be seen sidewise, viz. set one foot of your compasses on the base line, and with the other take the interfection you want to transfer, as D, and set it upon the perpendicular O E, marking the extent thereof, as F; then draw a line from D to F, and you will have the same as if there had been two points of distance. And so of all the other interfections.

OBSERVATION VII. *How to perform without making Use of the Diagonal.*

IF one would use the extreme ray G H for the line of interfection, the objects K L M N O must be set on the base line, and from them, lines are to be drawn to the point of distance I; which is here to be removed as far as possible that the diminution of the perspective may have the better effect. For if that point were too near the point of sight G, the objects would be too flat; I mean, for example, that a square would appear a parallelogram. Then from the point I draw lines to the several objects K L M N O, and mark the interfections thereof on the ray G H, and through these interfections draw parallels to the terrestrial line, as here P Q, &c. This method is not much in use, though some set a value on it.

OBSERVATION VIII. *Other methods of Shortening or Diminishing.*

IF you chance to be straitened for space on the plane you draw upon, and cannot remove the point of distance far enough; from the foot of the ray R S erect a perpendicular T S, which will receive the interfections, and give a greater diminution. And if you would have the diminutions still more, draw a slope line, as X, which by means of its inclination, will give the interfections still closer. Then, to draw the parallels, you have nothing to do but set off the line X or T on the foot of the ray, as in V; and from those points draw parallels to the terrestrial line.



PRACTICAL PERSPECTIVE,

PART II.

SHEWING THE

METHODS OF PUTTING PLANES

IN

PERSPECTIVE.

Of Planes viewed directly, or in Front.

FROM *Observation III.* and *IV.* page 17, as well as from the elevations that follow; it will appear that my intention is not to use geometrical plans, in order to the drawing of perspectives. That being a double labour; and there being scarce any Painter would give himself the trouble, seeing I teach him to do the same thing, by the use of the terrestrial line. But as there is no rule so general, but has its exception; so there are certain figures which cannot be put in perspective without the use of such plans. Beside, the confusion a person would be under, should a plane be given him to be exhibited in perspective, if he had not been instructed how to proceed. Therefore I am induced to give the following rules; which may suffice to shew how any plane that can be required, or even imagined, may be put in perspective.

1. *To shorten, or diminish a square*; as *A B C D*. From *A* and *B*, to the point of sight *E*, draw the lines *A E*, *B E*: and from the same angles *A* and *B* draw two diagonals *F B*, *A G*; and the points *H* and *I*, where they intersect the rays *A E* and *B E*, will give the square *A B C D*, diminished in *A H I B*. To do it without the geometrical plan; draw a line from *B* to *F*, or from *A* to *G*; or set off the line *A B* on the terrestrial line; as in *B K*: and from *K* draw another line to *F*: which will give the same intersection *I*, on the ray *B E*.

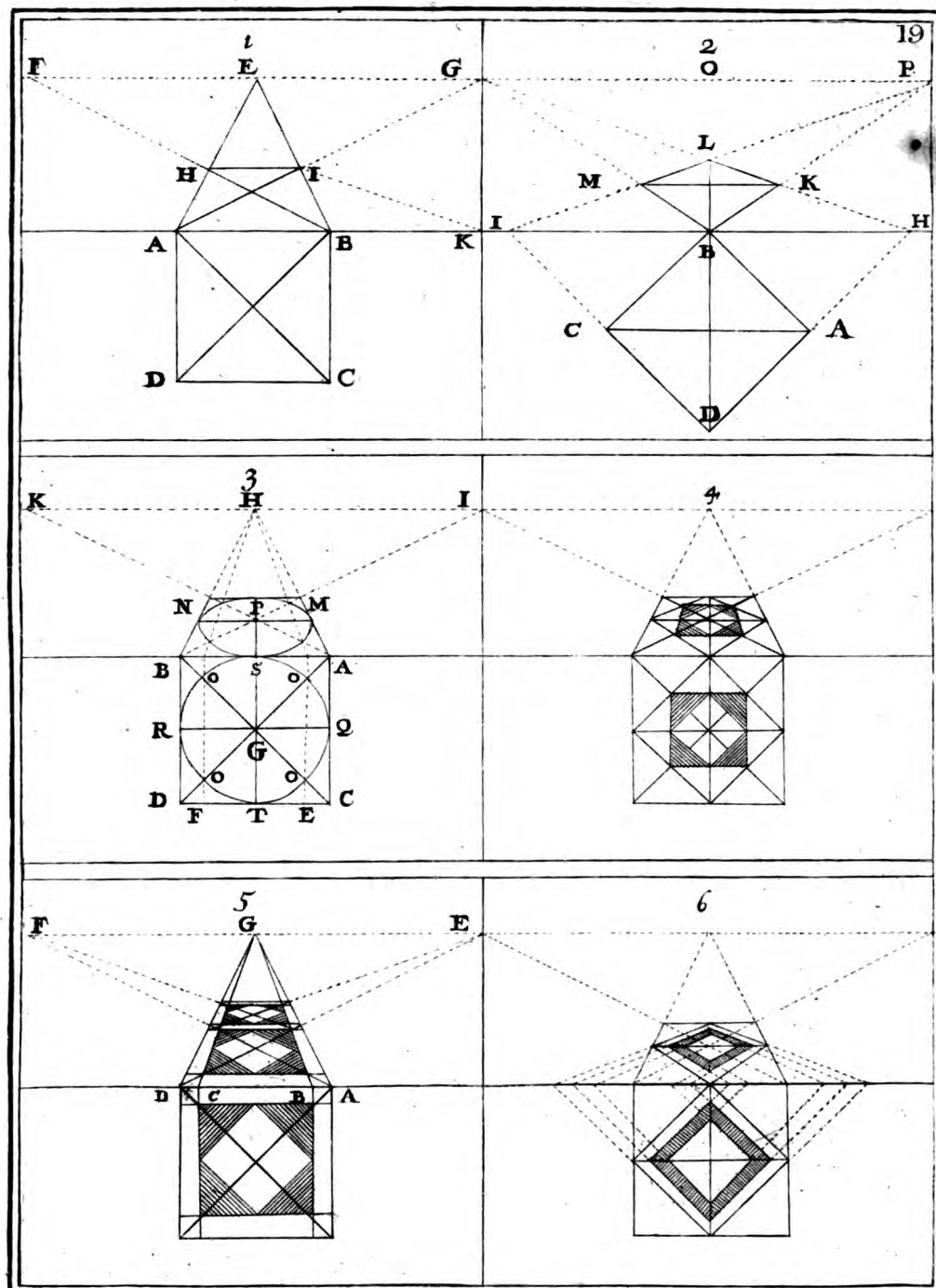
2. *To diminish a square viewed by the angle D*. Having described the plan *A B C D*, continue the sides *D A*, and *D C*, to cut the base line in *H*, and *I*: from the points *H*, and *I*, draw lines to the points of distance *G*, and *P*; and from the angle *B*, of the square which touches the base line, draw to the same points two others *B G*, and *B P*; their intersections being joined will give you the square *K L M B*. To do without the plan: set off the diagonal *D* each way from the middle point *B*; as to *H* and *I*, and draw the diagonals as before. But in either case no line is to be drawn from the point of sight, *O*.

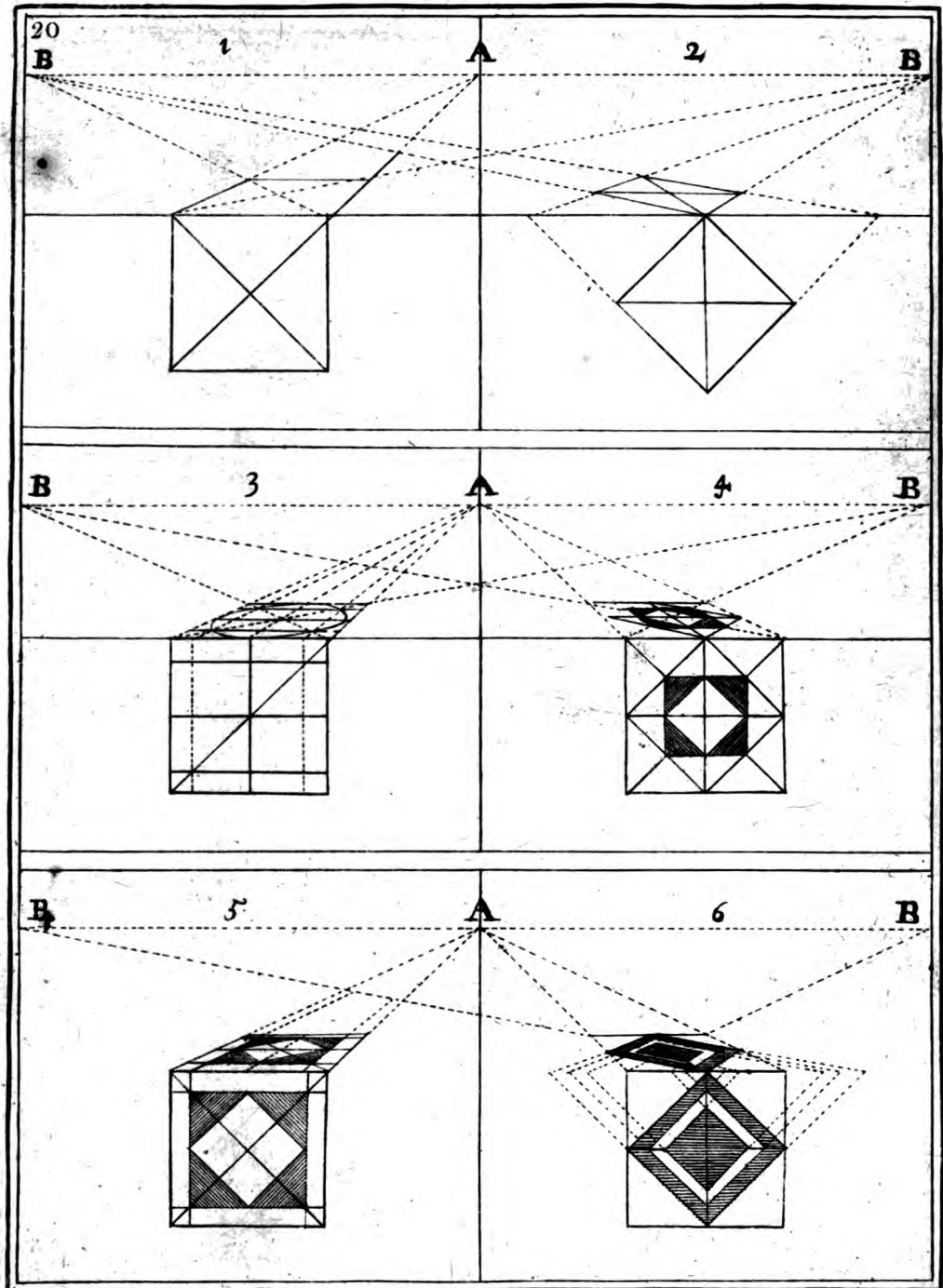
3. *To diminish a Circle*. Draw a diameter *S T*, perpendicular to the ground Line, and another *R Q* at right angles, which will divide the circle in four equal parts: a square *A B C D* described about the said circle, and drawing the diagonals *A D*, *B C*, will divide it into eight parts: from each of these points *O*, *O*, &c. draw perpendiculars to the ground-Line, and from each of their intersections with the said ground-Line, draw lines to the point of sight *H*; and where they are intersected by the diagonals *A K*, and *B I*, make points; the two last of which, *M N*, give the square, which is to be divided into four, by diagonals, intersecting each other in the point *P*. Lastly, from the extremes of this cross, draw curve lines through the said points, which will give the form of the circle in perspective. This method may serve for small circles; but for large ones we shall give another method, more exact.

4. This figure is a compound of the two first; which is all we need to say about it.

5. This too depends on the two first; only here is a lift, or border, going round, which the others have not. To put the lift in perspective: from the four rays *A B C D* draw lines to the point of sight *G*; and where the inner rays *B C* intersect the diagonals *A F* and *D E*, draw parallels to the base-line; and you will have your desire.

The sixth is the same as the second; except that it is surrounded with two borders.





*The perspective appearance of PLANS viewed obliquely,
or side-wise.*

THESE plans, being much the same with those already dispatched, are to be managed after the same manner. It would be losing time to repeat the method of operation how they are to be diminished in perspective; a bare inspection of the figures and lines sufficing to shew, that all the difference between these and the former, consists in the situation of the objects, which are here shewn laterally, and there in front.

All the AAA's are points of sight, and the BBB's points of distance. The side-point has been described, page 16th.

The Method to find the perspective Appearance of a
TRIANGLE.

TRIANGLES, according to the order of numbers, ought to precede squares; but, according to reason, they are to come after them in this work, as being more difficult to put in perspective. Not on account of the plan, which is easy enough, as only consisting of three lines joined together, but on account of the obliquity of its sides.

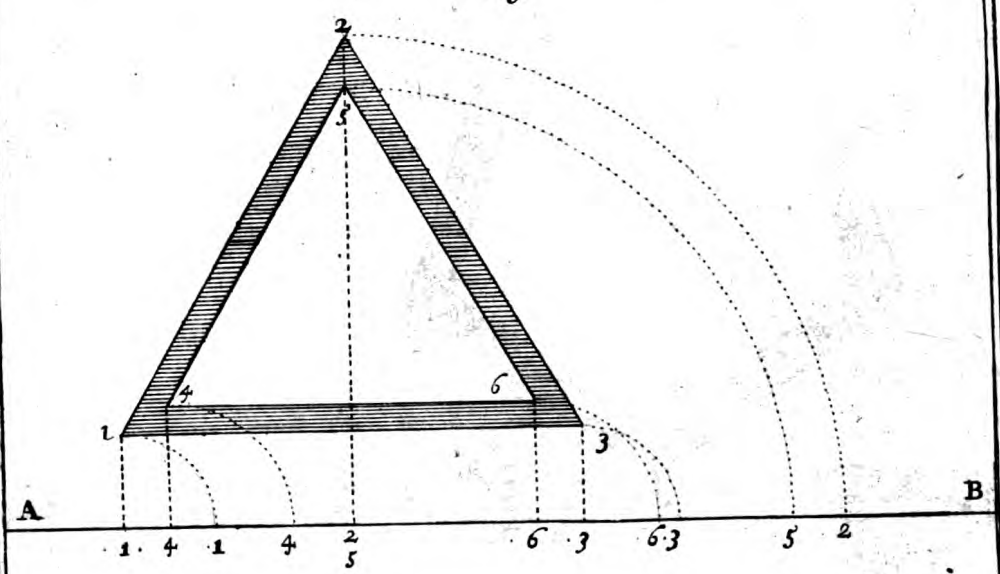
I come now to apply some of the observations, page 17th, relating to the measures on the base line *AB*: for, to exhibit this triangle in perspective, whose base 1. 3. is parallel to the fundamental line *AB*, from all the angles thereof, 1, 2, and 3, perpendiculars are to be drawn to *AB*. Then setting one foot of your compasses in the intersections, with the other set off the distances of the parts of the object from the terrestrial line, along the same line, by striking arches, as from 2 to 2, from 3 to 3, &c. This done, having drawn another base line in another place, as here under *EF*, transfer the measures from *AB* to *EF*, and to the point of sight *C* draw lines from the points 1, 2, 3, &c. Lastly, having pitched one point of distance *D*, draw lines thereto from the other points of depth, 1, 2, 3, &c. And between the intersections made by these with the visual rays, lines, being drawn, will give the triangle required.

If you would give it the lift or breadth, repeat the same over again for the several inner points thereof; only using other figures to prevent confusion; as, next to 1, 4; next 2, 5; 3, 6, &c. Then, drawing perpendiculars to the point *C*, and between the points where they intersect the others, draw lines as you see in the scheme.

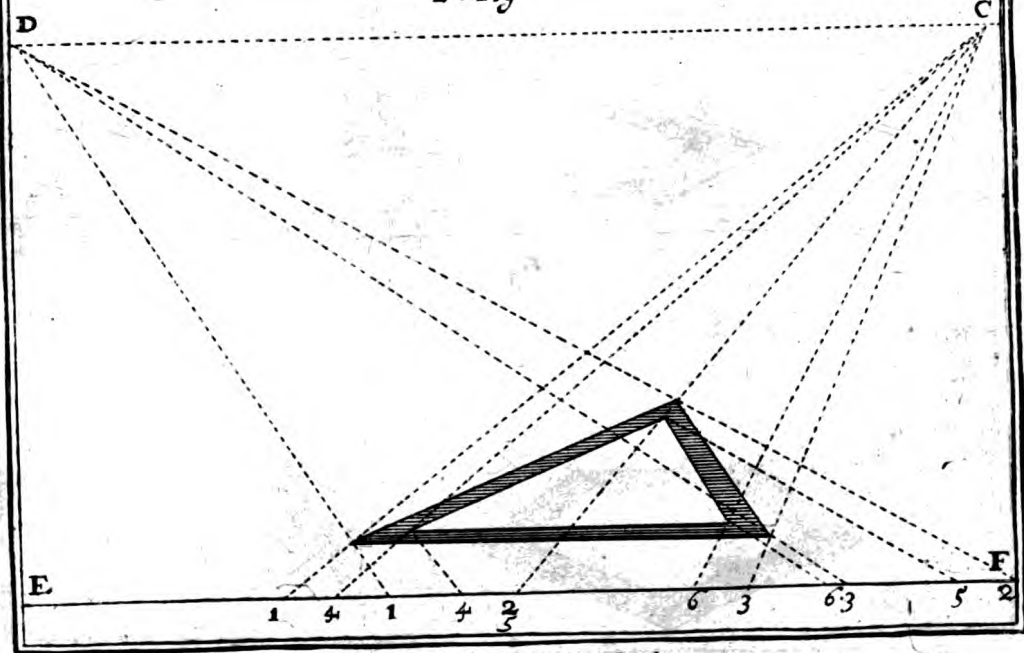
The equilateral triangle, such as that here described, is inscribed in a circle, that is a circle may be drawn about it, every side subtending 120 degrees.

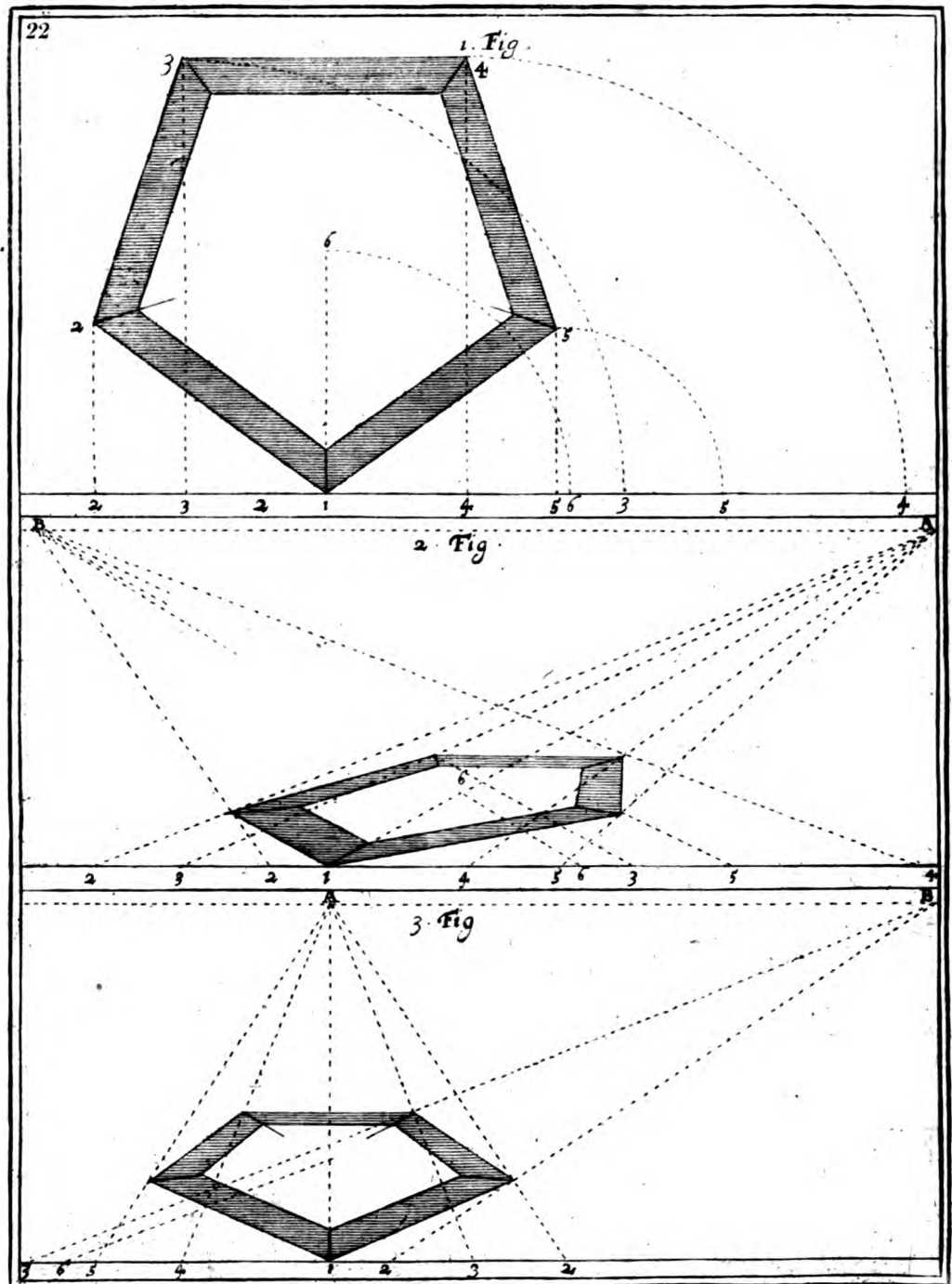
Note. The same operation will serve for all sorts of triangles.

1. Fig.



2. Fig.





To exhibit a PENTAGON, or figure of Five-Angles, in perspective.

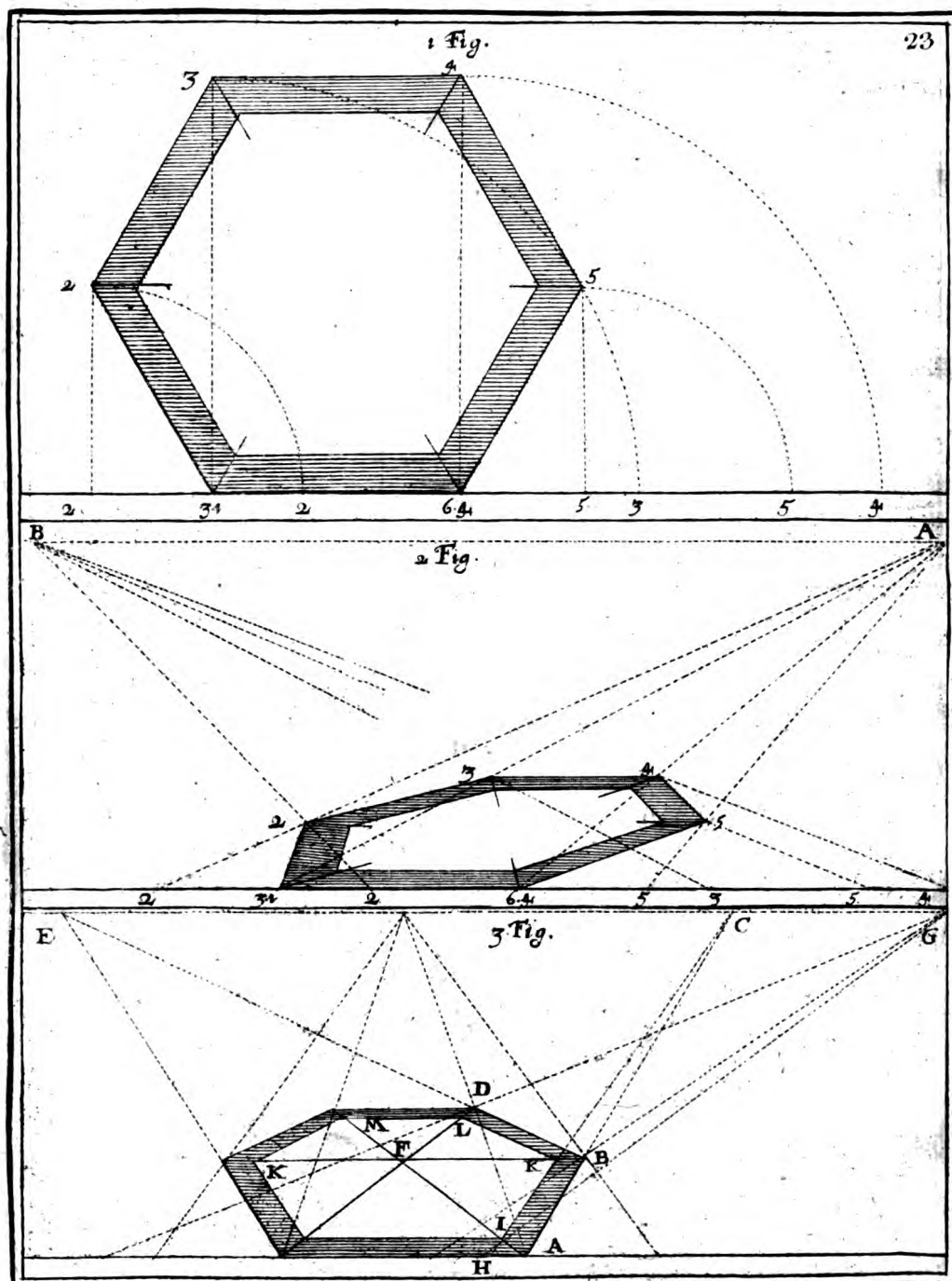
THE way to construct a pentagon is to describe a circle, and divide it into five equal parts, of seventy-two degrees each. Then, for putting it in perspective, the method is the same as has been shewn for the triangle, as will appear in viewing the figures and the lines of operation. The lift or breadth is added, because when I come to treat of elevations, instances will be given in objects that have broad edges. The exterior pentagon must be first compleated on the base line, and the inner one afterwards, by the same method of proceeding. The reader was instructed herein, in drawing the rim of the triangle in the former page. The point of sight, both of the front and side, is A; the point of distance B; the visual rays, which are the perpendiculars drawn from the angles of the plan to the base line, are drawn to the point of sight A; and the other rays that give the diminution, and the place of the angles, to the point of distance B. As 2 cuts the ray marked 2, which gives the angle 2, 4 gives the angle 4; and so of the others. All the rest is clear enough; regard, however, is to be had to one thing, that all the angles tend toward the centre 6; for this reason the centre is to be marked in the plans in perspective, as well as in the geometrical plans:

*To find the perspective Appearance of an HEXAGON,
or Figure of Six-Angles.*

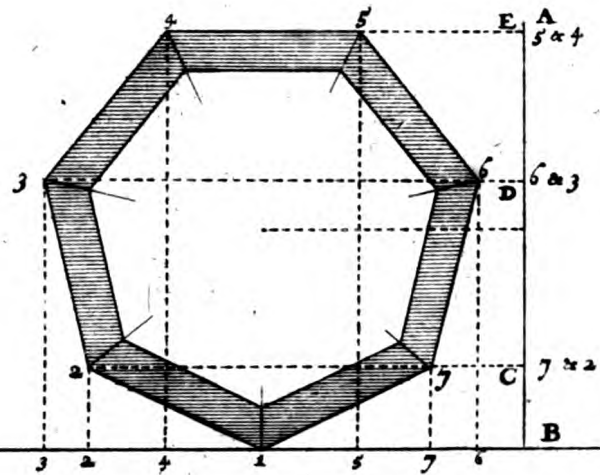
THE HEXAGON is a plane with six angles, and as many sides. If the sides be equal, it is a regular hexagon, and the easiest to describe of all the polygons, (figures of more than four sides and angles) by reason the same aperture of the compasses, which circumscribes it within a circle, is the measure of its sides, *viz.* 60 degrees each. In other words, the side of a hexagon is equal to the radius of a circle circumscribed about the same. As to the putting it in perspective, the method does not at all differ from that of the triangle, or pentagon; either when single, or with the lift or thickness, A is the point of sight, and B that of distance.

Since I have a good deal of room in this page, I think it not amiss to give a brief method of putting the lifts or thicknesses of all polygons, regular or irregular, in perspective. And the present hexagon shall serve for an example of this proposition. Suppose the exterior lines of the plan of *Fig. 3.* to be only laid down, and it were required to give it a lift or thickness within: to do this in perspective, lay your ruler along the sides, and make points in the horizon where it cuts the same; thus laying it along the side A B, it will cut the horizon in C; then laying it along B D, it will give the point E; and the like of the other sides. Before you proceed any farther, draw occult lines from the several angles through the centre F, which lines are to receive the interfections that give the diminutions. Such dispositions made, set the breadth of the band or lift on the base line, as A H, and draw the first breadth to the point of distance G, and where the line G H cuts I, will be the bound of the thickness of the first side, which is to determine for all the rest. For from this point a line is to be drawn to the point corresponding to this side C, and the interfection of this line with K will give the diminution; from the point whereof drawing a line to the point E, corresponding to the line B D, you will have the diminution for the point L, which serves for the last side L M. Then transferring all the same measures to the other side, you will have the figure complete, by the formation of the inner hexagon.

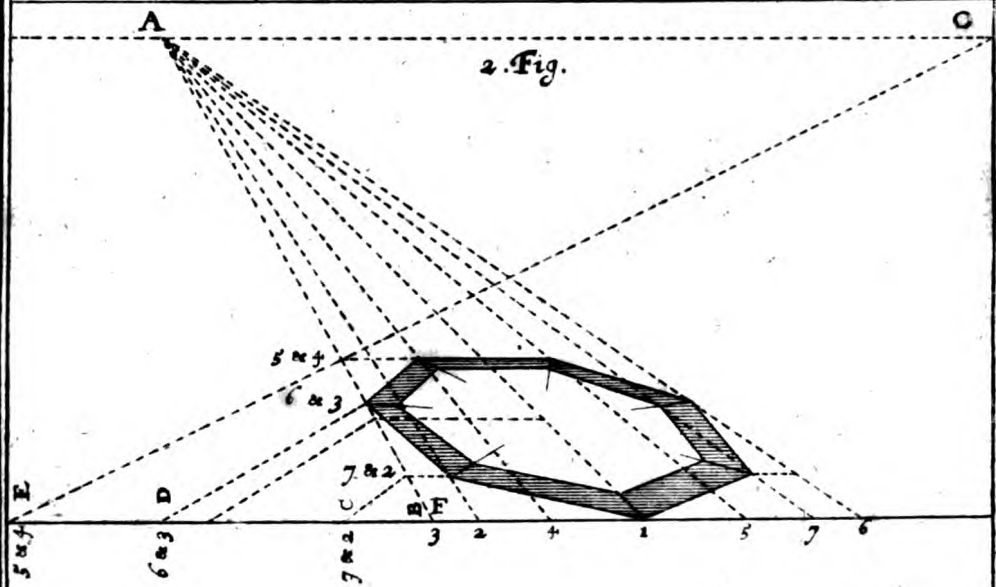
Hereafter we shall have occasion to give another method.



1 Fig.



2 Fig.



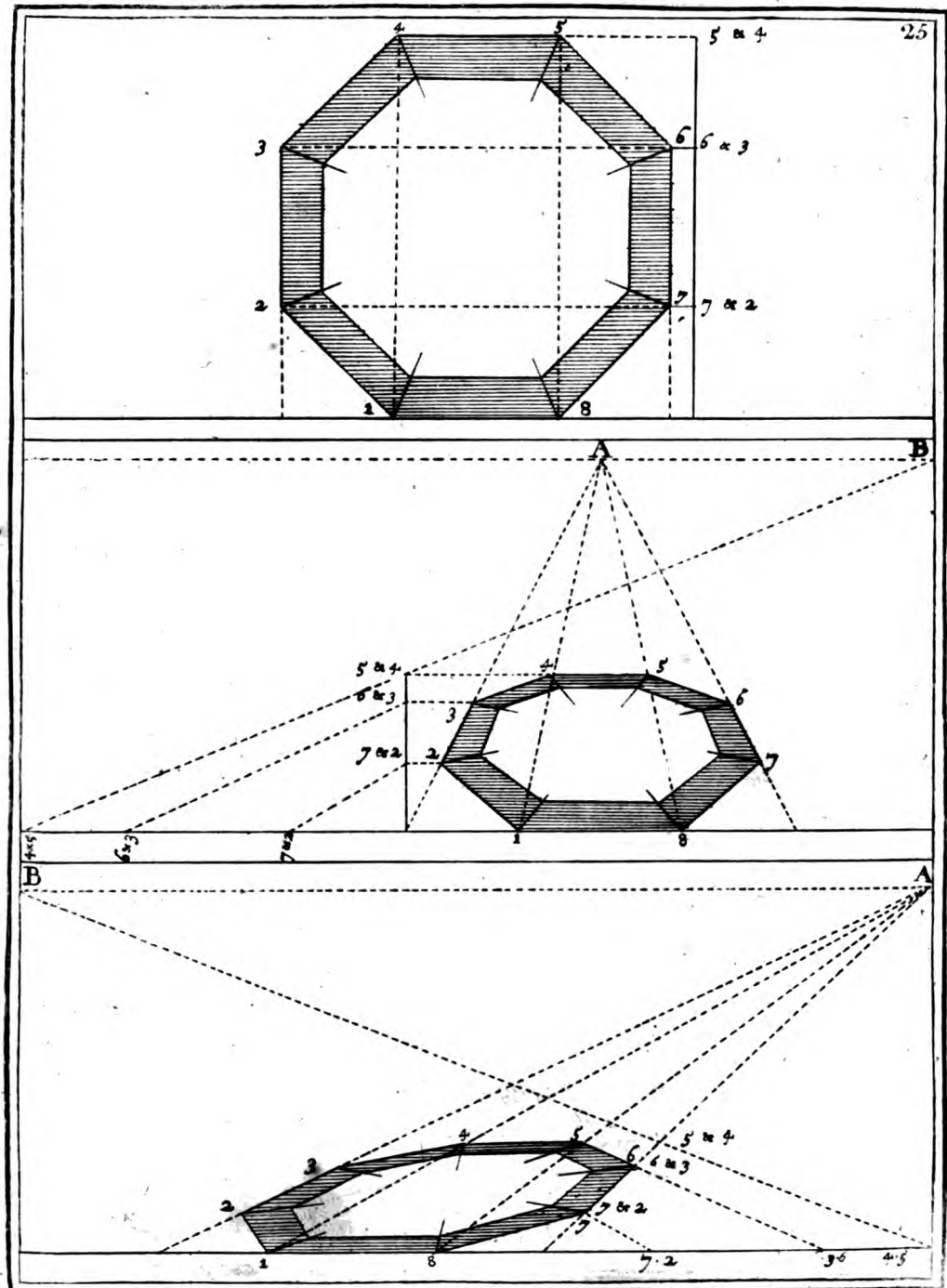
To exhibit the perspective appearance of the HEPTAGON, or figure, consisting of seven sides and seven angles.

THE HEPTAGON is formed within a circle, as the other polygons are ; in order to which the circle is divided into seven parts, each side subtending 51 deg. 25 min. and sometimes more. The method of putting it in perspective is the same with that of the preceding ones, as to the perpendiculars falling from the angles to the base line, which are all drawn to the point of view A ; but as to the diminution, and the lines that give the points of the angles, it is different, and rather according to the seventh *Observation*, page 18 ; though I do not absolutely approve that, as thinking the eighth *Observation* the better. But to condescend to such as do use it, and shew them that it does not diminish enough.

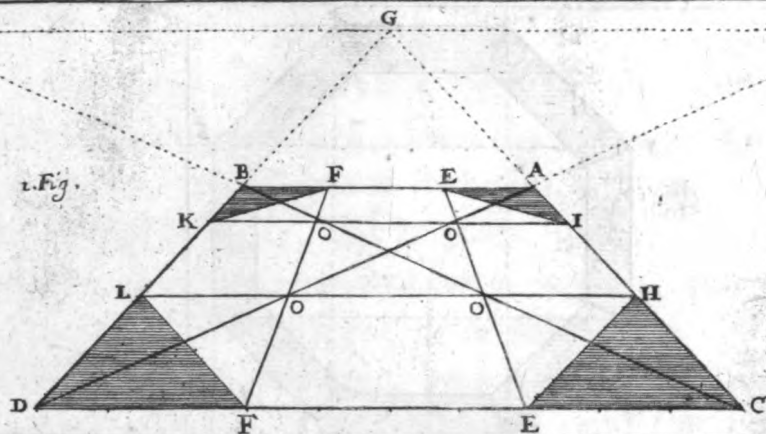
Having drawn perpendiculars from the angles of the plan to the terrestrial line, as in the preceding cases, a perpendicular is to be made on one side, as AB, to receive the intersections of the parallels drawn through all the angles. Thus, the first angle being placed on the terrestrial line of 2 and 7, I draw a parallel through both, cutting the perpendicular in C. After the same manner, the angles 3 and 6 give the intersection D, and 4 and 5 the intersection E. This line AB, thus divided, must be set off the base line of the plan to be diminished, beginning to put the point B in F, as in the figure. Then making the other divisions CDE, and from these drawing lines to the point of distance O, from the intersections of the extreme ray draw parallels to the terrestrial line, and where these cut the rays that bear the numbers of the angles, points are to be made, which, being joined by right lines, will give the figure desired. As to the thickness, or lift, it is to be made after one of the preceding manners.

*To exhibit the perspective Appearance of the OCTAGON, or
Figure of Eight Angles.*

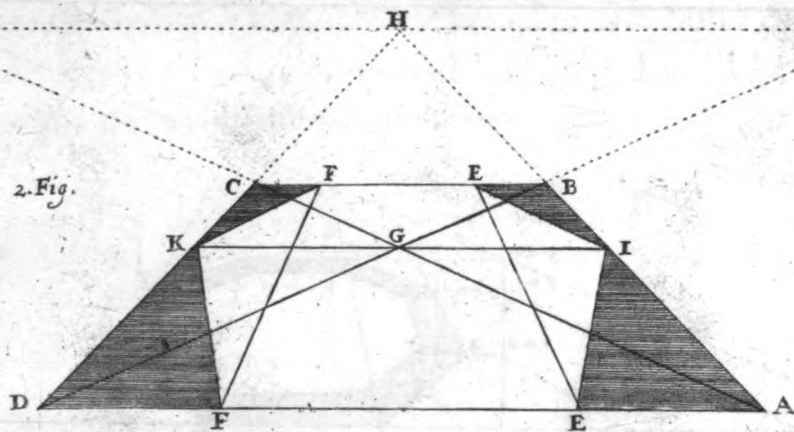
THE octagon is formed of a circle divided into eight parts, of forty-five degrees each, from the divisions whereof, lines being drawn, will form an octagon, that is, a figure composed of eight angles, and as many sides. The rules already delivered, shew abundantly how it is to be put in perspective, whether for a front or a side view. I shall only observe here, that the front plan is to be diminished according to *Observation VIII.* page 18, and the side plan according to the VIIth *Observation* in the same page. The point of view is A, and that of distance B. The rest is too obvious to need an explanation.



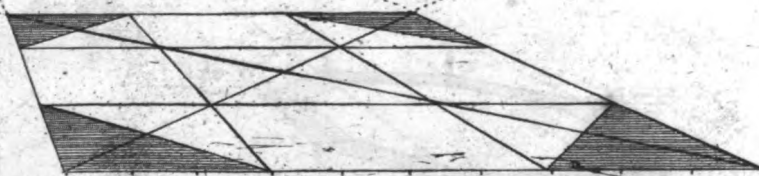
1. Fig.



2. Fig.



3. Fig.



Another Method for exhibiting the OCTAGON in perspective.

THIS method of conducting the OCTAGON, was invented by *Serlio*. The practice is thus : having found a square A B C D the ordinary way, divide the base line C D into ten parts, and, leaving three on each hand, from the third of either side E and F, draw lines to the points of sight, G; and through the interfections of those lines with the diagonals O, O, draw parallels to the terrestrial line, cutting the sides of the square in the points H, I, K, L : then joining the points E H, I E, F K, L F, by lines, you will have an octagon, as in the preceding figure.

To find the perspective appearance of the HEXAGON. or figure of Six-Angles, by the above method.

THE same *Serlio* has contrived a like way of managing the HEXAGON. Suppose, as above, a square A B C D, and the base line A D divided into four parts, from one of which, on either side E and F, draw lines to the point of sight H ; then through the intersection of the diagonals, which is the middle of the square G, draw a parallel to the base line, cutting the sides of the square in I K ; lastly, drawing lines through these points E, I, E, and F, K, F, there will be found a hexagon.

I shall say nothing of the octagon, *Fig. 3.* viewed sidewise ; since, as it has been so often repeated, the method is the same as for that viewed in front, *Fig. 1.* the operation is plain and simple, the lines drawn at *Fig. 3.* shew it at the first inspection.

Of the Double OCTAGON, or the method of adding breadth or thickness to an octagon, by the operation of the circumscribed square.

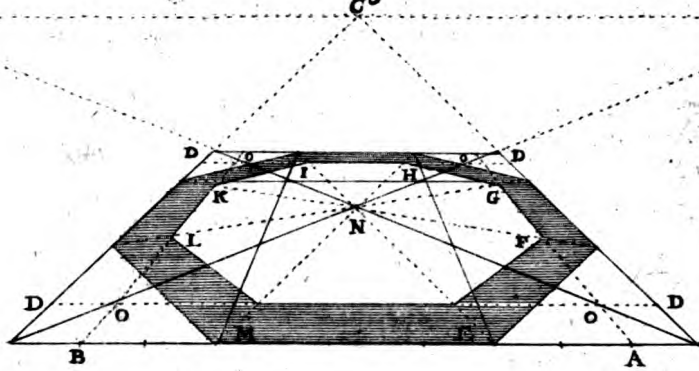
SUPPOSING a single octagon already made, if it is required to have it double, or to give it a thickness, or lift, proceed thus. Set the breadth or thickness you are willing to give it, within the square which circumscribes the octagon, as here at A B; and from these points draw lines to the point of sight C; and where these lines cut the diagonals, as in O, O, draw parallels D D, which will form a sort of band within the square; lastly, draw occult lines from angle to angle, intersecting each other in N; and where they cut the lines of the inner square, namely, in the points E, F, G, H, I, K, L, M, will be the bounds of the inner octagon.

Of the Double HEXAGON.

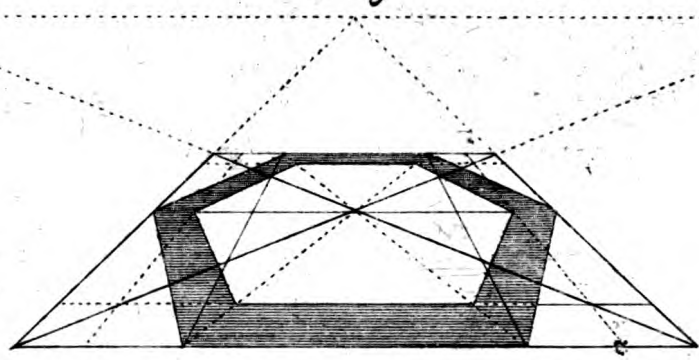
AN hexagon circumscribed with a square, will receive a lift, or inner hexagon, by the same method of operation. It would be needless to repeat particulars, since the figure will clear any doubts that may arise.

The octagon viewed sidewise, is managed precisely as that viewed in front; the point of sight is A, and that of distance B.

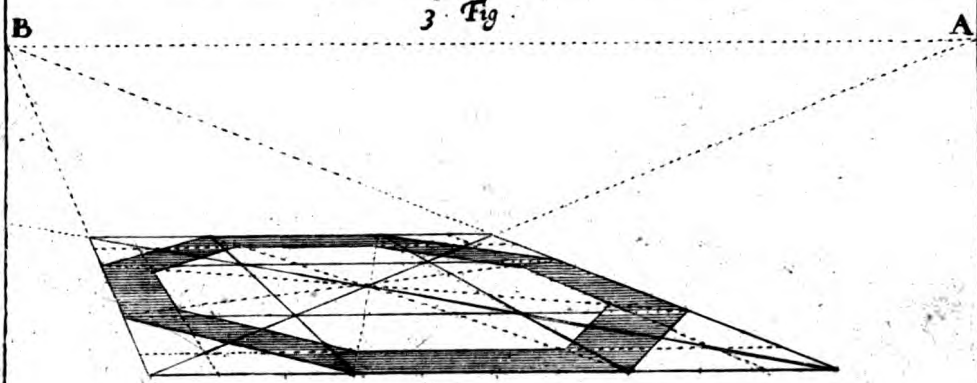
1 Fig

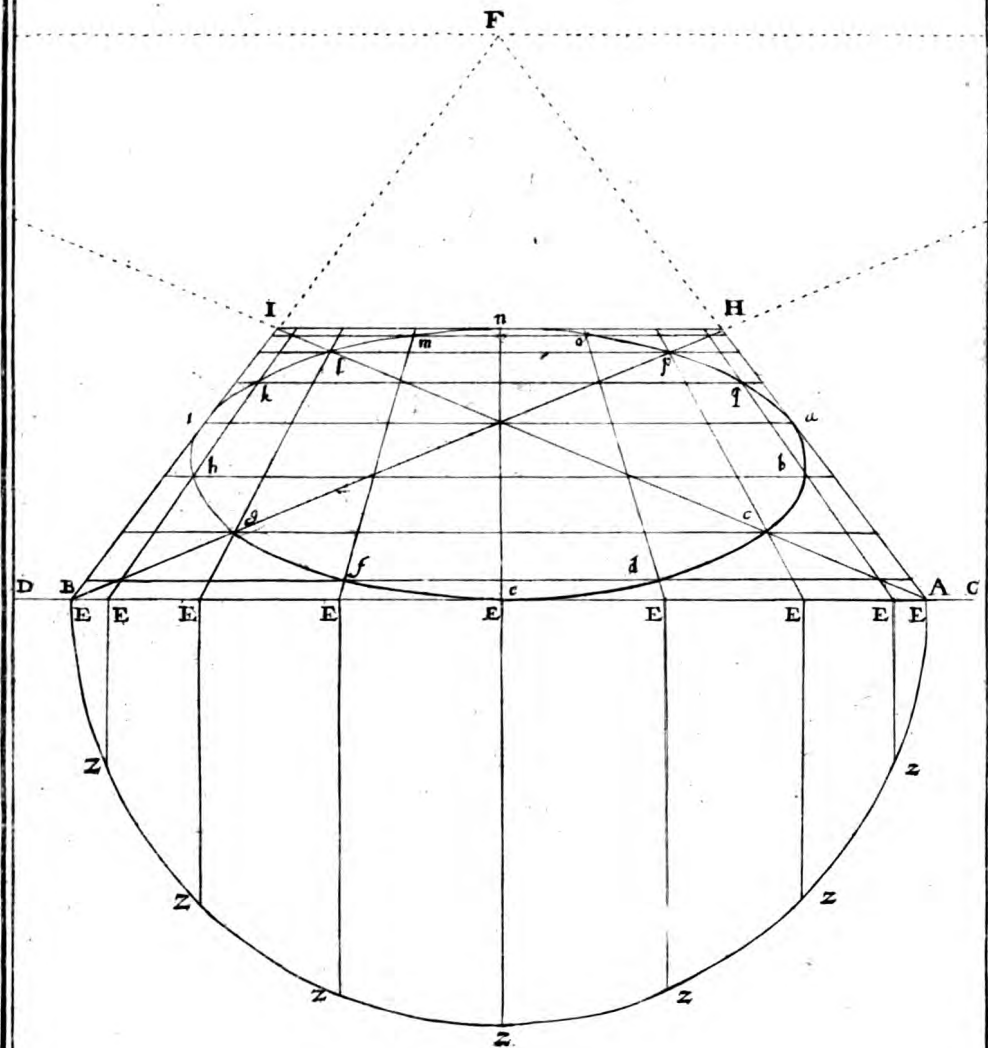


2 Fig



3 Fig





To exhibit the perspective of a CIRCLE.

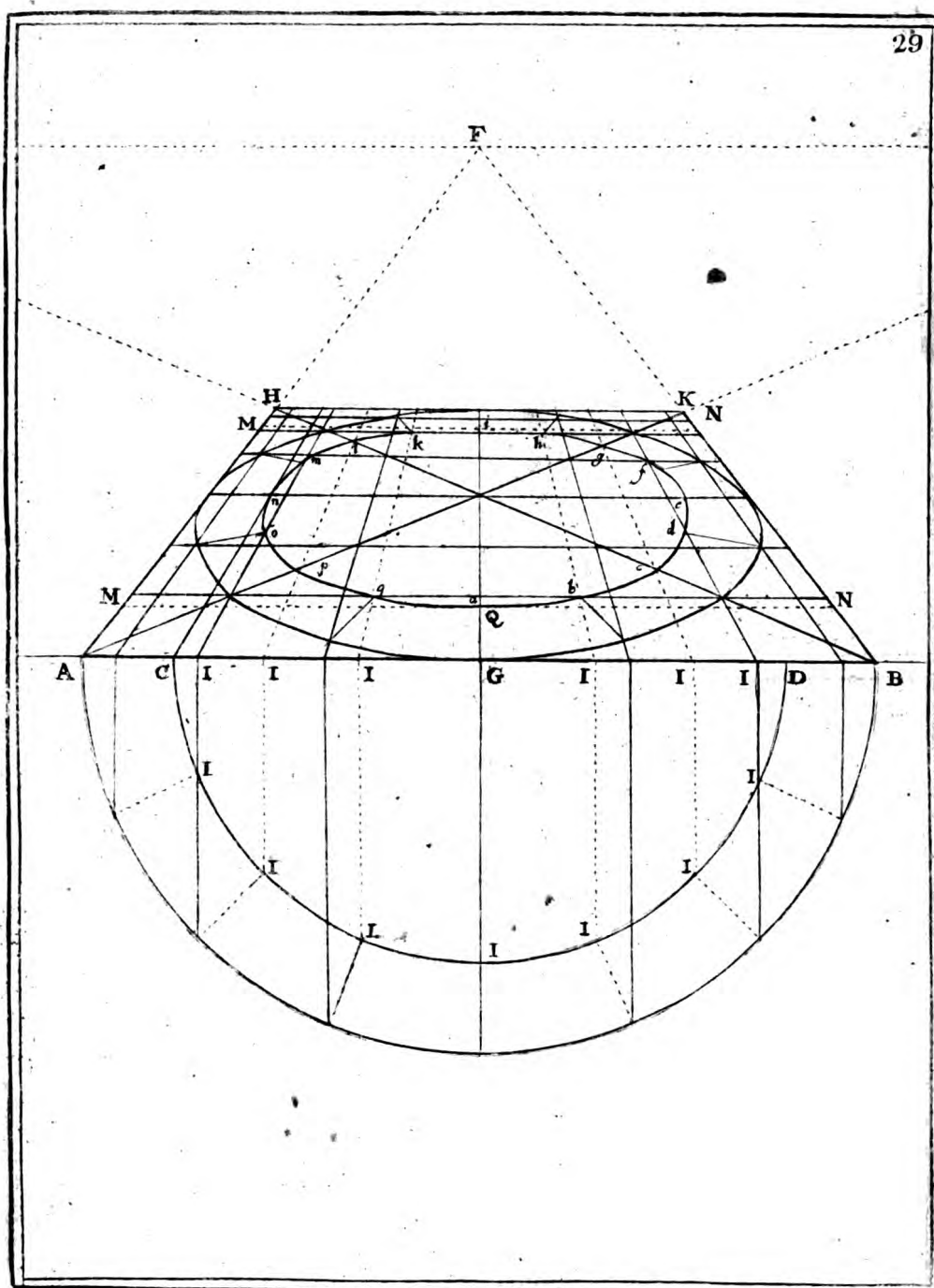
IF the circle be small, you are directed, page 19, to an easy method of projecting it, by circumscribing a square about it. If the circle be large, take the following method, which *Serlio* has directed. Set one foot of your compasses in the middle of the fundamental line, with the other describe the semi-circle *A Z B*, divide its periphery or circumference into any number of equal parts at pleasure. You will see in the process, that the more of these divisions, the easier it will be to form the circular lines, from the junction of which the circle receives its appearance. The semi-circle *A Z B* is here divided into eight parts, which is the usual practice. From the several divisions *Z Z*, &c. perpendiculars are raised to the base line in the points *E E*, &c. this done, the two diagonals are to be drawn to the points of distance, which are here removed beyond the compass of the plate, but which are to be supposed, as usual, in the horizon. Thus you get a square *A H I B*; and this square thus formed, draw lines or rays from all the points *E* towards the point of sight, as far as the line *H I*, and through the intersections of those lines with the diagonals, draw parallels; then, beginning in the middle of one of the sides of the square to make a point, as *a*, connect it by a circular line with the opposite angle *b*, and proceeding thus with arches from angle to angle, according to the direction of diagonals through the points *a b c d e f g h i k l m n o p q*, you will have your circle in perspective.

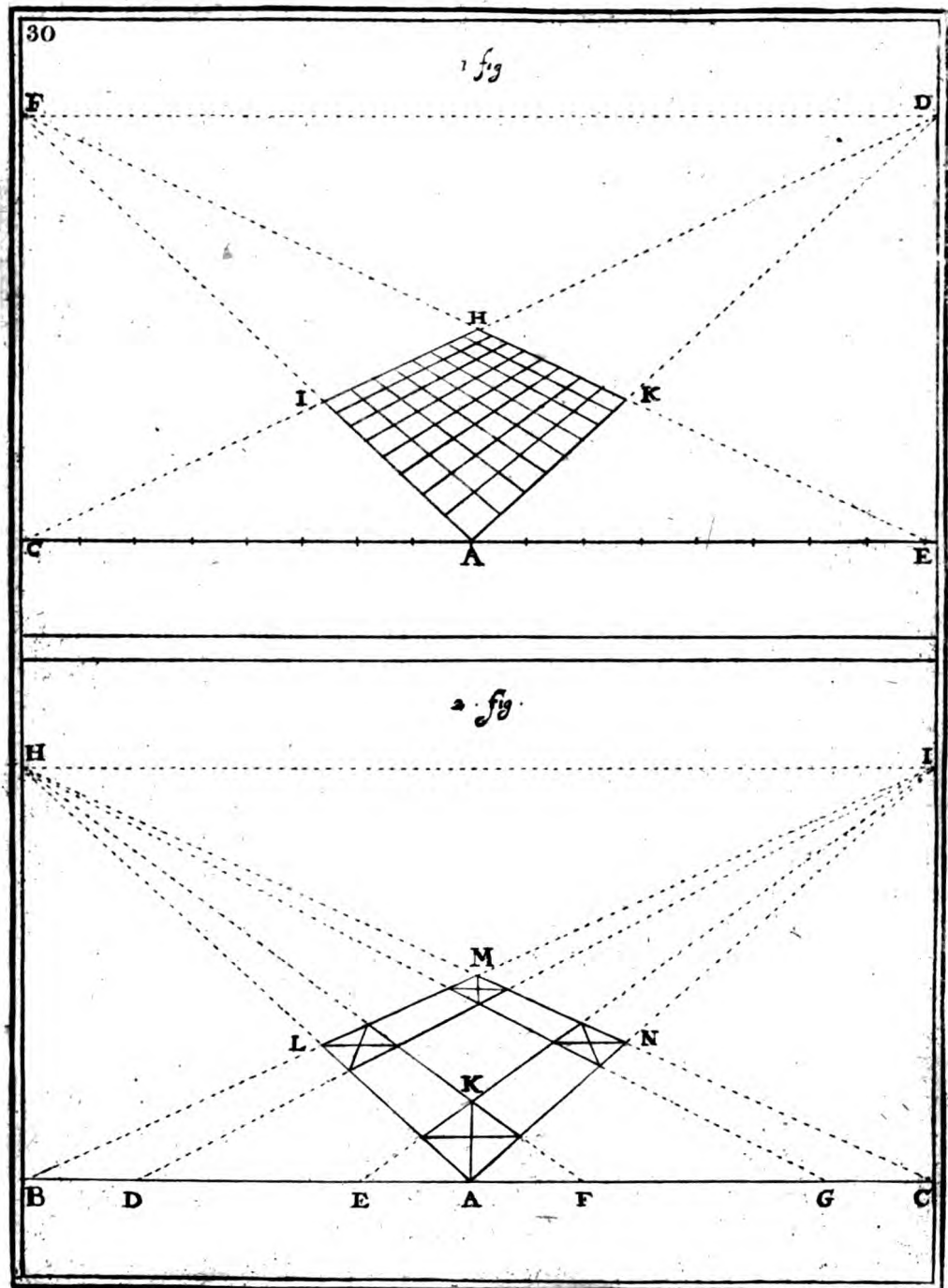
By this method, it is apparent how any curvilinear figure may be projected on a plane, and therefore how necessary it is, to have this rule of the projection of the circle very familiar, because of the frequent use hereof in columns, vaults, arches, apertures of doors, windows, &c.

To exhibit the appearance of a Double CIRCLE.

THE outer circle is supposed the same that I have just now been describing ; and it is required to give it a thickness, or lift, by making another within-side thereof. Thus, give it any breadth at pleasure, as, for example, A C : from G the centre of the outer semi-circle, describe the inner one C D, which you are farther to divide, like the great one. These divisions are easily procured, by drawing lines from the divisions of the great semi-circle to the centre G ; the intersections of those lines with the inner semi-circle at I I I I, &c. are the points of its divisions. From these points raise perpendiculars to the base line A B, and, to prevent confusion, let these last lines be dotted. This done, proceed by drawing lines from the new points C I I I I D on the base line, towards the point of sight F, as far as the line H K, and through their intersections with the diagonals draw the two parallel dotted lines M N, which will give the breadth the circle is to have at G Q, and its further diminution. Lastly, draw lines from all the angles on which the great circle is produced, towards the centre, and the points wherein they intersect the dotted lines *a b c d e f g h i k l m n o p q*, will be the points, which, connected with curve lines, will form the inner circle's circumference.

A person who should desire a plan of three, four, five, or six circles in perspective, must lay them all down in the geometrical plan after the same manner as the second semi-circle is done in this example, and then observe the same method of process.





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To exhibit the appearance of the PLAN of a Square viewed Angle-wise.

IF it be required to draw a square, viewed by an angle directly opposite to the eye, there is nothing more requisite than to set off the diagonal of it upon the base line; as here AC is equal to the diagonal of the geometrical plan of the square to be projected. Then from the points A and C to draw two lines to the point of distance D, then to set off the measure of the line AC on the base line towards AE, and from EA to draw lines to the point of distance F, and the three intersections of the lines HIK will be the bounds of the square desired, viz. AIHK.

When such a plan is to be divided into several parts, lay down the number or divisions required between the points C and A, and the same number on the other side AE; and from all these points draw lines to the points of distance; as in the present figure, which has eight squares on each side, and sixty-four in all.

If in the same plan, thus viewed by the angle, instead of the divisions in the first figure, it were required to have little plans in the four corners, as four lodges, columns, trees, or other objects, set the width of each on the base line, as BD, EA, on the nearest side, AF, GC, on the other side; from which points drawing lines to the points of distance HI, their intersections will give the four plans KLMN required.

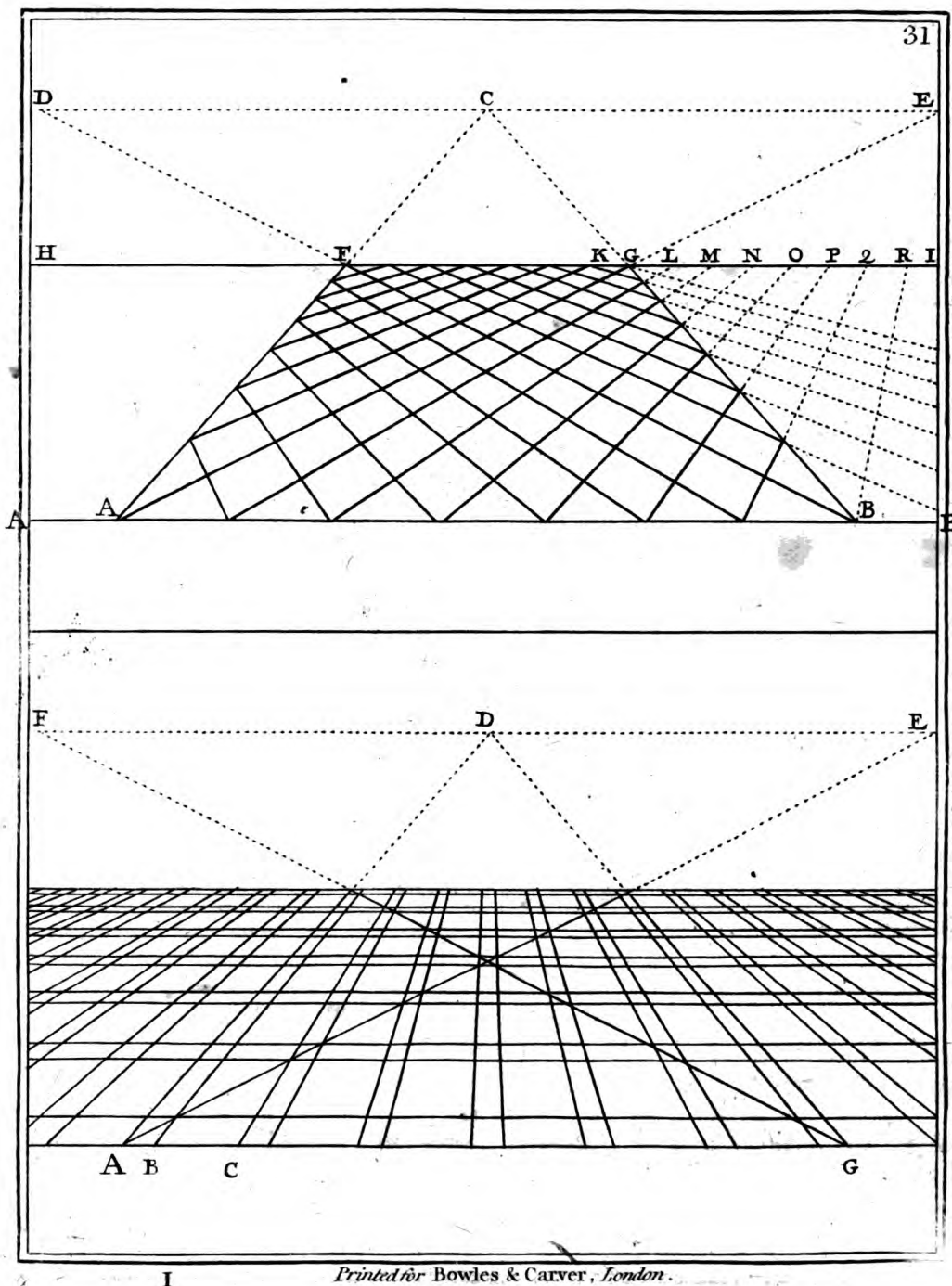
*To exhibit the perspective of a Pavement of SQUARE STONES,
viewed by the Angles.*

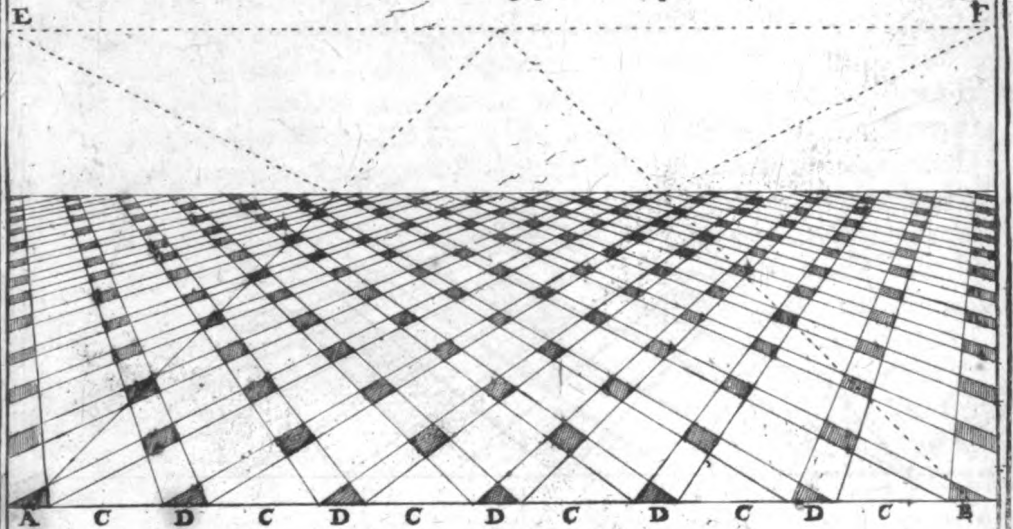
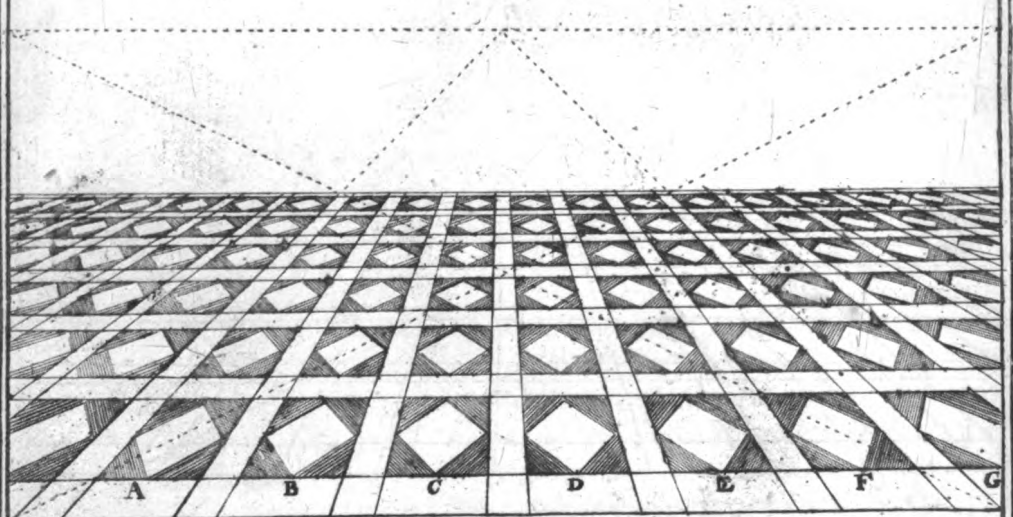
NOW we are about places viewed angle-wise, it may not be amiss to shew how the pavement of a hall, church, or other place, is to be conducted. Having drawn the horizon parallel to the terrestrial line A B, the point of sight C, and the points of distance D and E, divide the base into as many parts as you would have squares; then draw lines from the extremities thereof A and B, to the point of sight C, and from the same points A and B, draw two diagonals to the points of distance D E, the points of intersection F G will give the square of the hall, and through them the line of depth H I is to be drawn. Then draw lines from all the divisions of the base line A C and B C, to the points of distance D and E, and between the rays A C and B C, you will have your desire; as appears from the figure. But here arises a difficulty, namely, how to fill the vacant space B B and G I, A A and H F with the same squares; for it is supposed the base line cannot be prolonged any farther. On such occasion, take the measure of one of the squares, as G K, on the line F G, and set it off on the same line H I as often as it will go, and you will have the points L M N O P Q and R, through which drawing lines to the point of distance, you will have the same squares as before; such are those here marked with dots. The same method of setting off the measures on the line of depth, will be exemplified in other pavements hereafter.

*To exhibit the perspective of a Pavement of SQUARES
encompassed with a List or Fillet.*

THE method of managing this second pavement with a band around it, is the same with that of single squares viewed in front; I shall therefore decline to waste any time in teaching it, since I have already given so many figures thereof. It may be proper, however, to add, that the base line is to be divided into unequal parts, as A, B and C, because of the fillets, and lines to be drawn from all these divisions to the point of sight D, and through the points where these are intersected by the diagonals A E, and G F, parallels to the base line are to be drawn. By this very plain operation will be produced the appearance of the pavement shewn in the opposite figure.

3 of this



1. *fig.*2. *fig.*

To exhibit the perspective appearance of Pavements viewed angle-wise, encompassed with a band or fillet.

FOR such kind of PAVEMENT, the base line AB is to be divided into unequal parts, the largest whereof are to be for the squares, and the smaller for the band or fillet ; and from all these divisions, lines are to be drawn to the points of distance E F, as has been already directed in single squares.

To exhibit the perspective Appearance of Pavements of Squares viewed in front, encompassed with bands, or fillets, whose squares are divided by the angle.

FOR this fourth kind of pavement, the same method is to be taken as in the second, by setting the measures of the first range of squares and fillets on the base line, and from those points to draw the lines according to former directions. Then to make the inner squares which are seen angle-wise, nothing more is required than to bisect the lowest side of each square of the first range, and from those points, as A, B, C, D, E, F, G, draw lines to the two points of distance, and their intersections with one another will produce the several inner squares or lozenges throughout the plan.

To exhibit a pavement of Squares viewed angle-wise, with chains of Squares seen in front.

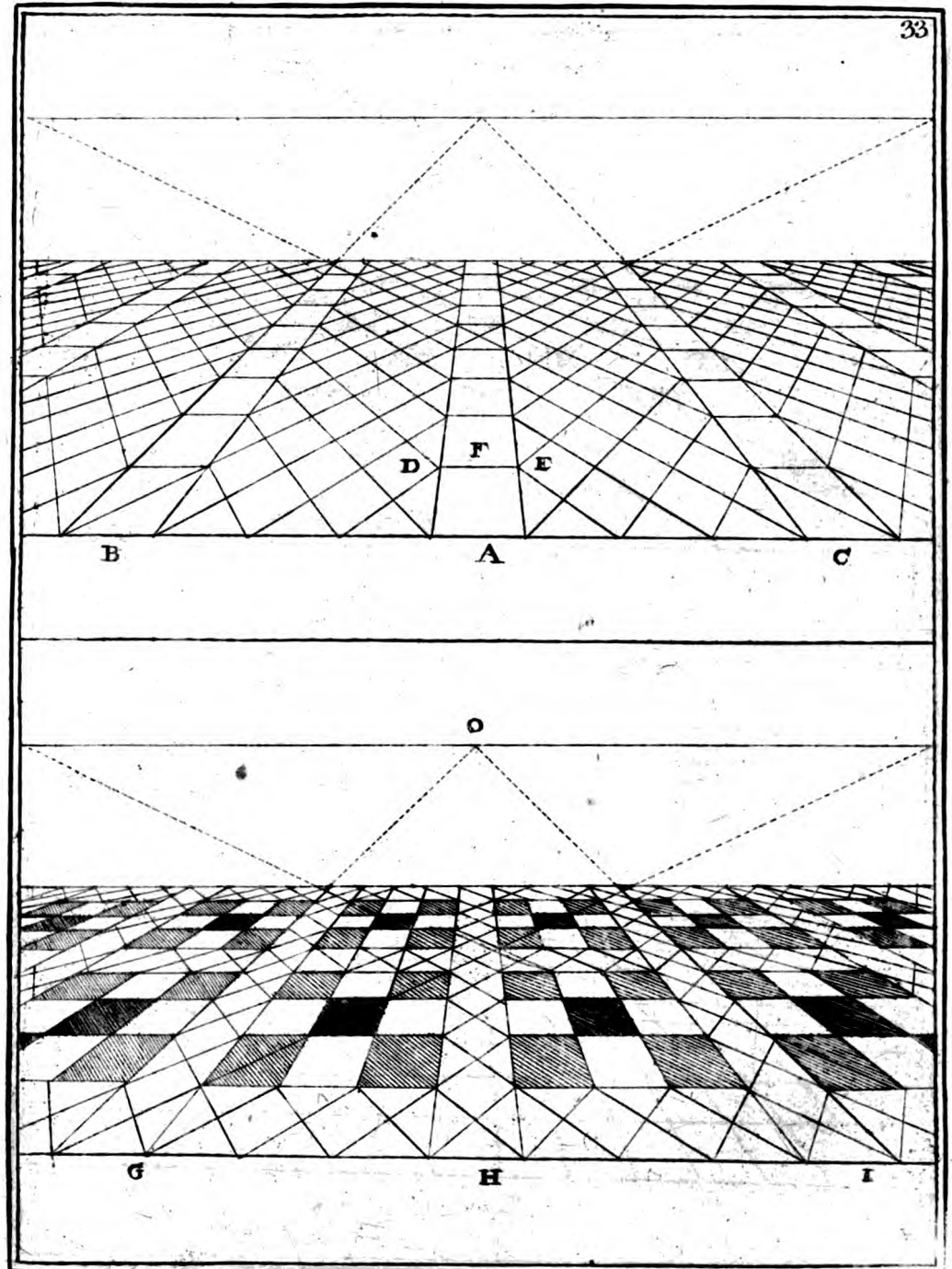
I SHALL suppose the perspective, or diminution of the square, by drawing the line of depth, to be already done, that I may save the trouble of too frequent repetitions in the ensuing pavements.

To manage this fifth sort of pavement, divide the base line into equal parts, to answer the number of squares, and from the points of the squares to be divided in front, as A B C, draw lines directly to the point of sight, and from the points of those to be seen obliquely, draw lines to the points of distance, but without marking them through the chains. After all the squares which are thus viewed by the angle are drawn, the squares of the chains will be easily formed by parallels from the opposite angles of the oblique squares on either side. As for example, from the angle D and E draw the parallel line F, and so for all the rest, as is shewn by the figure. Care is still to be taken, that there be always the same number of squares between the chains; as here we have three between A B. The measures on the base line, rightly laid down, will prevent any error of that kind.

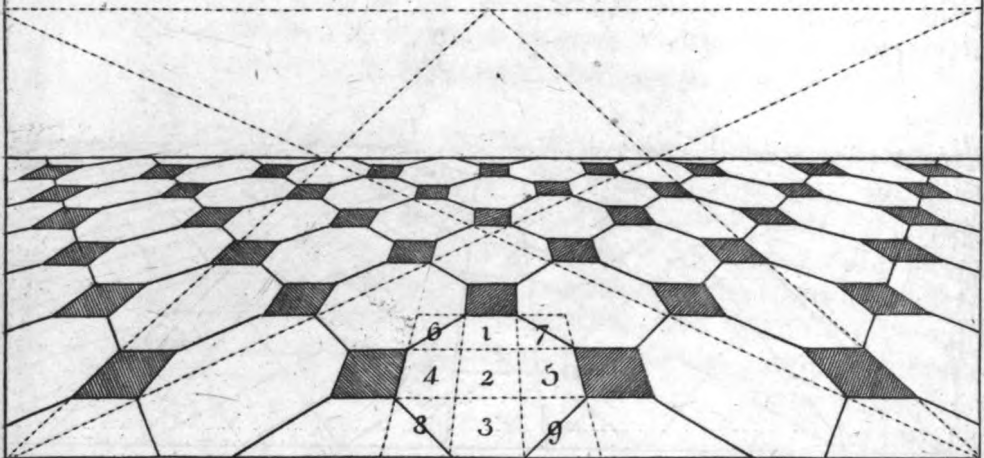
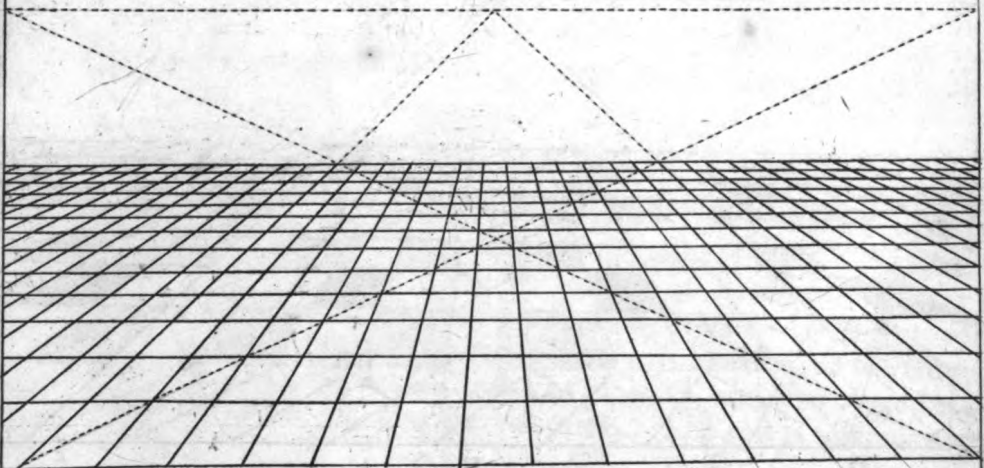


To exhibit a pavement of Squares in front, with chains of Squares angle-wise.

THIS sixth sort of pavement is performed much after the manner of the preceding, by dividing the base line into equal parts, according to the number of squares, and from the points of divisions drawing lines to the point of sight, to form the bands or chains G H I; yet somewhat more in it, care being taken to make the crosses there is, of the same breadth as the others that tend to the point of sight O, and that there be the same number of squares between the vacuities. The rest is obvious enough,



34

2 fig*2 fig**Printed for Bowles & Carver, London.*

To exhibit a pavement of Octagons intermixed with Squares.

I SHOULD never have done, was I to give all the varieties of pavements : invention would find endless employment in their construction. This seventh instance is obvious enough ; all I add it for, is to open the mind, and furnish occasion for the contriving of others. All that is required to produce this kind of pavement, is to divide the base line into a number of parts equal to the number of squares to be formed, as has been already directed. Of which squares a certain number is to be taken, as here nine, five whereof are full, and the rest only halves ; the full ones give the inside of the figure 1 2 3 4 5, and the diagonals of the rest, 6 7 8 9, give the sides : the rest is evident.

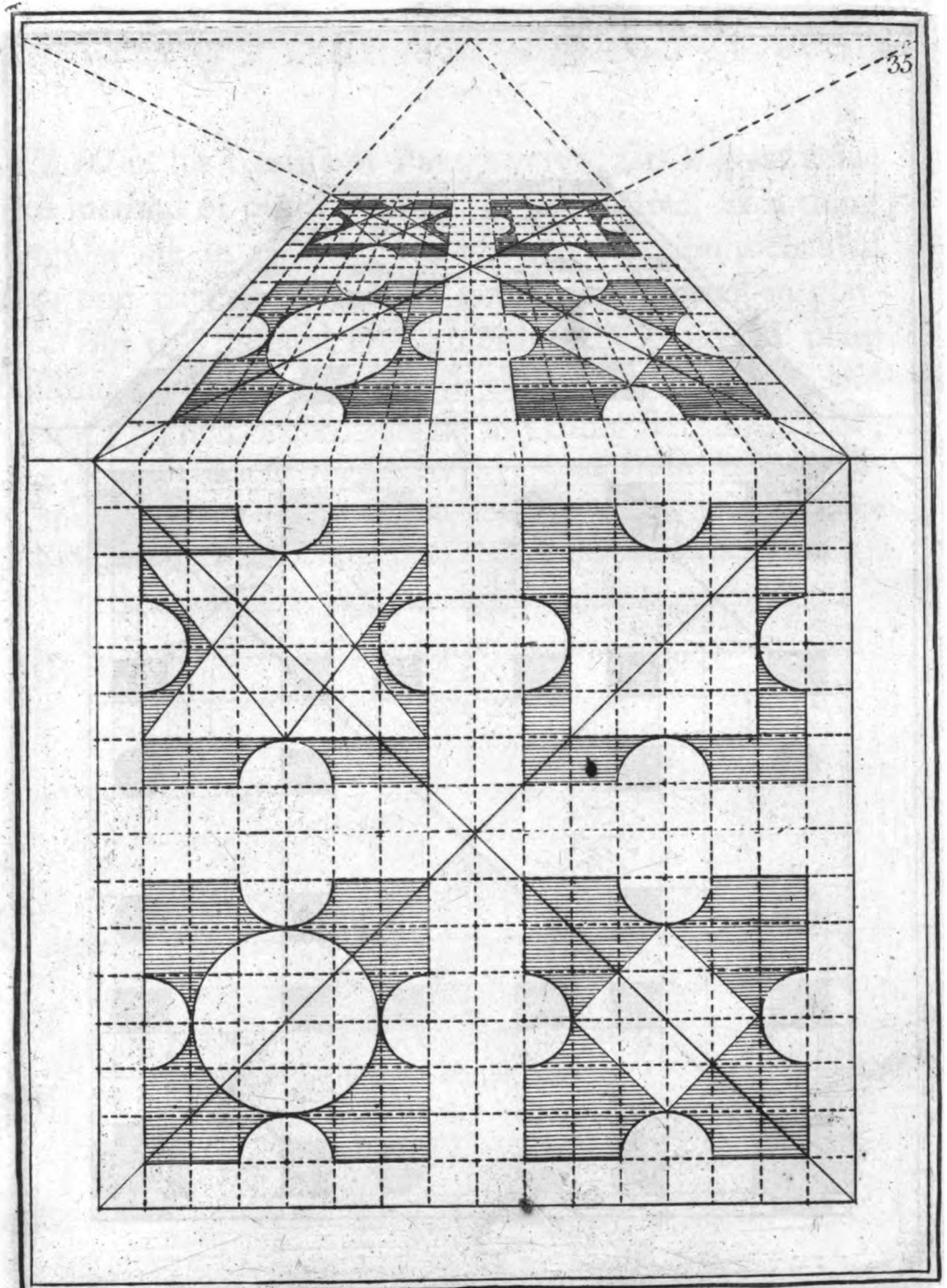
To exhibit a pavement of single Squares viewed in front.

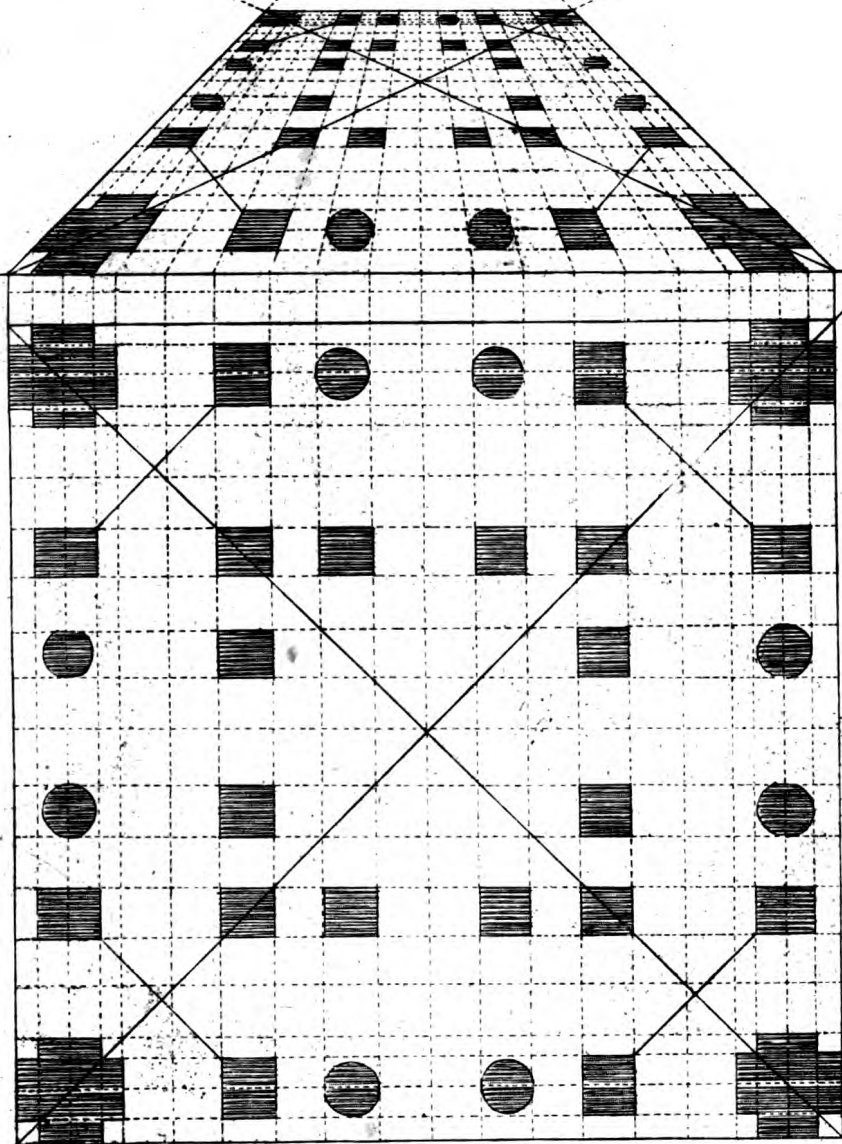
THIS form I have put the last, not as being the most difficult, for in reality it is the easiest of all, and the very beginning of perspective, but to intimate that it is the most useful and necessary ; the others being seldom added but by way of ornament, and this serving as the foundation whereon any solid is to be raised, and the elevated parts made appear. As will be shewn hereafter.

Plan of a GARDEN in perspective.

WHAT we have been observing, is confirmed by this plan, which shews with what facility the projection is made by the foregoing rules. For, drawing lines from all the divisions on the base line to the point of sight, the diagonals will give the depth of the whole plan, and the diminution of all the little squares. Lastly, marking the walks, borders, and figures of the geometrical plan in the corresponding square of the projected plane, the whole parterre will be found in perspective.

Let the plan given you to put in perspective, be of what sort soever, the readiest way will be to draw a square about it, and divide that into several lesser squares. For after the grand square, with all the lesser ones, are projected by the ordinary rules, you have nothing farther to do, but take care that every part is comprised in the same number of little squares in the diminished plan as in the geometrical one, and the figure of the one will be exactly found in the other.





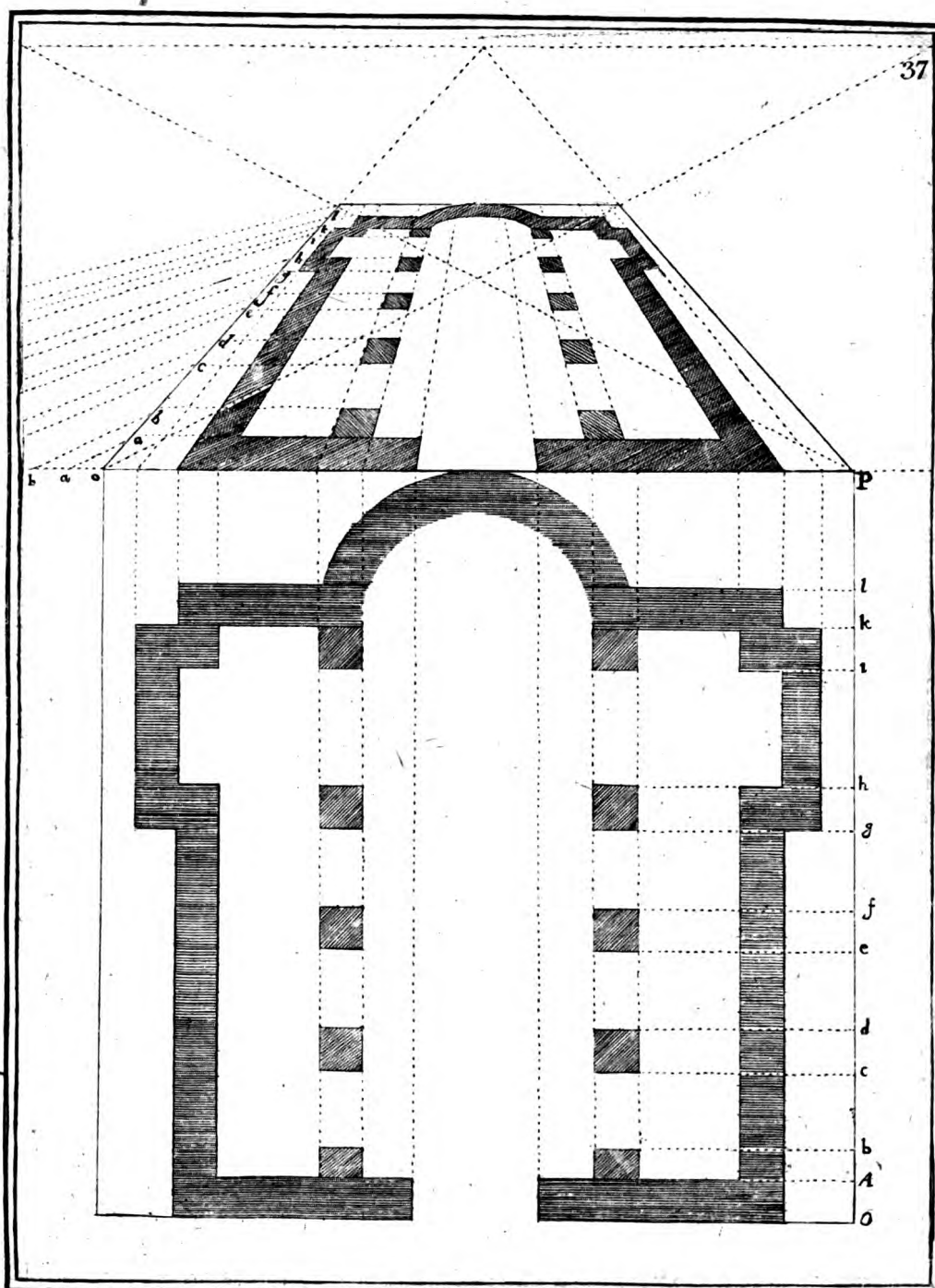
Plan of a BUILDING in perspective.

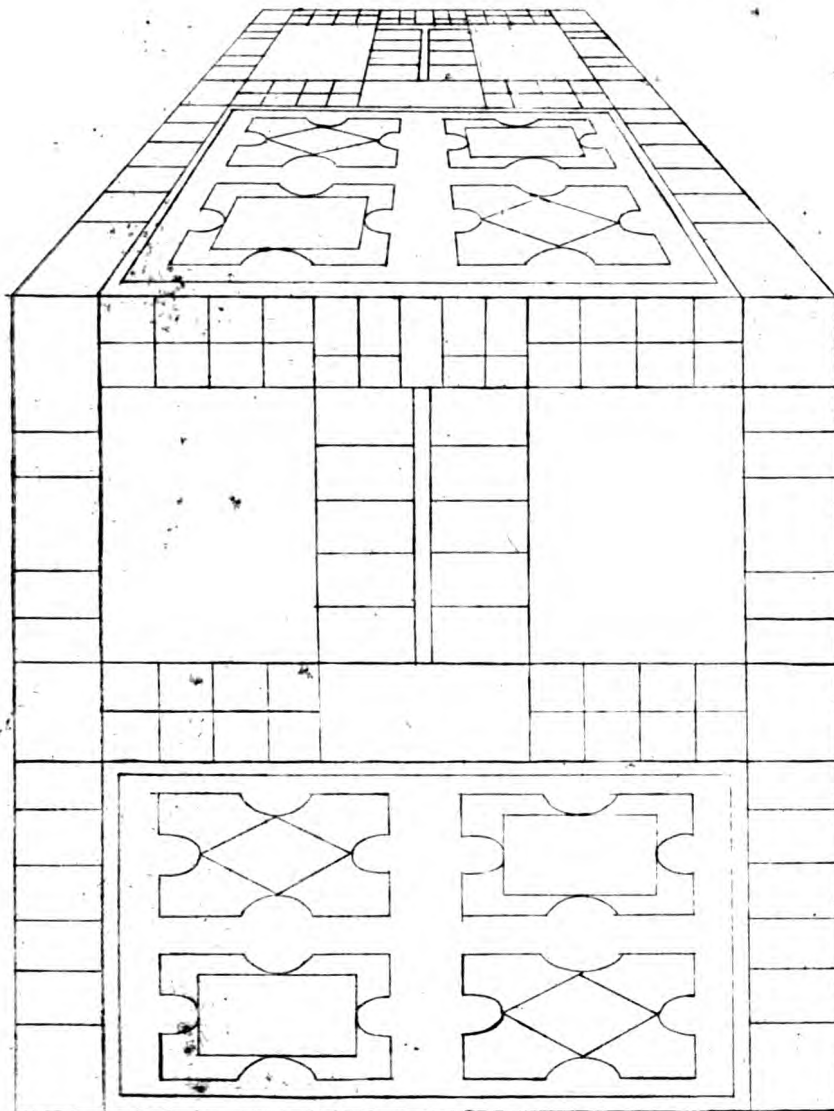
SERLIO in his treatise of PERSPECTIVE, sets a great value on this method of putting planes in perspective, as a thing of singular use in architecture, whereby a person is enabled to shew one part of a building raised, and the rest in platform. But this method for exhibiting the projected plans of buildings, being the same with that I have already laid down for a garden, I need not say any thing farther thereof; the figure is sufficient for the rest. And from this one figure measures are easily taken for any other, either more easy, or difficult ones.

Plan of a CHURCH, in perspective.

THIS plan is conducted according to *Observation VII.* page 18. That is, all the sides perpendicular to the base line, as are here the places of the walls and pilasters, are drawn to the base line, and from that line to the point of sight; and all the other sides parallel to the base line, as are here the breadths, &c. drawn to a line on one side, O P, which thus shews the points *a b c d e f g h i k l*. These points transferred hence upon the base line as *a b*, &c. and lines drawn from them to the points of distance, their intersections with the extreme ray, give points for drawing parallels through, exhibiting the diminution of every thing; as shewn by *a, b, c*, &c.

This method of diminishing on the extreme ray is practised by many; and yet such as would take my advice, should let it alone, and rather follow the method directed in *Observation VIII.* where a perpendicular is raised on the end of the base to receive the intersections, and to obviate the defect of the present method, which does not diminish enough, unless where the points of distance are very remote: for in that case, the effect is the same as in the other methods.



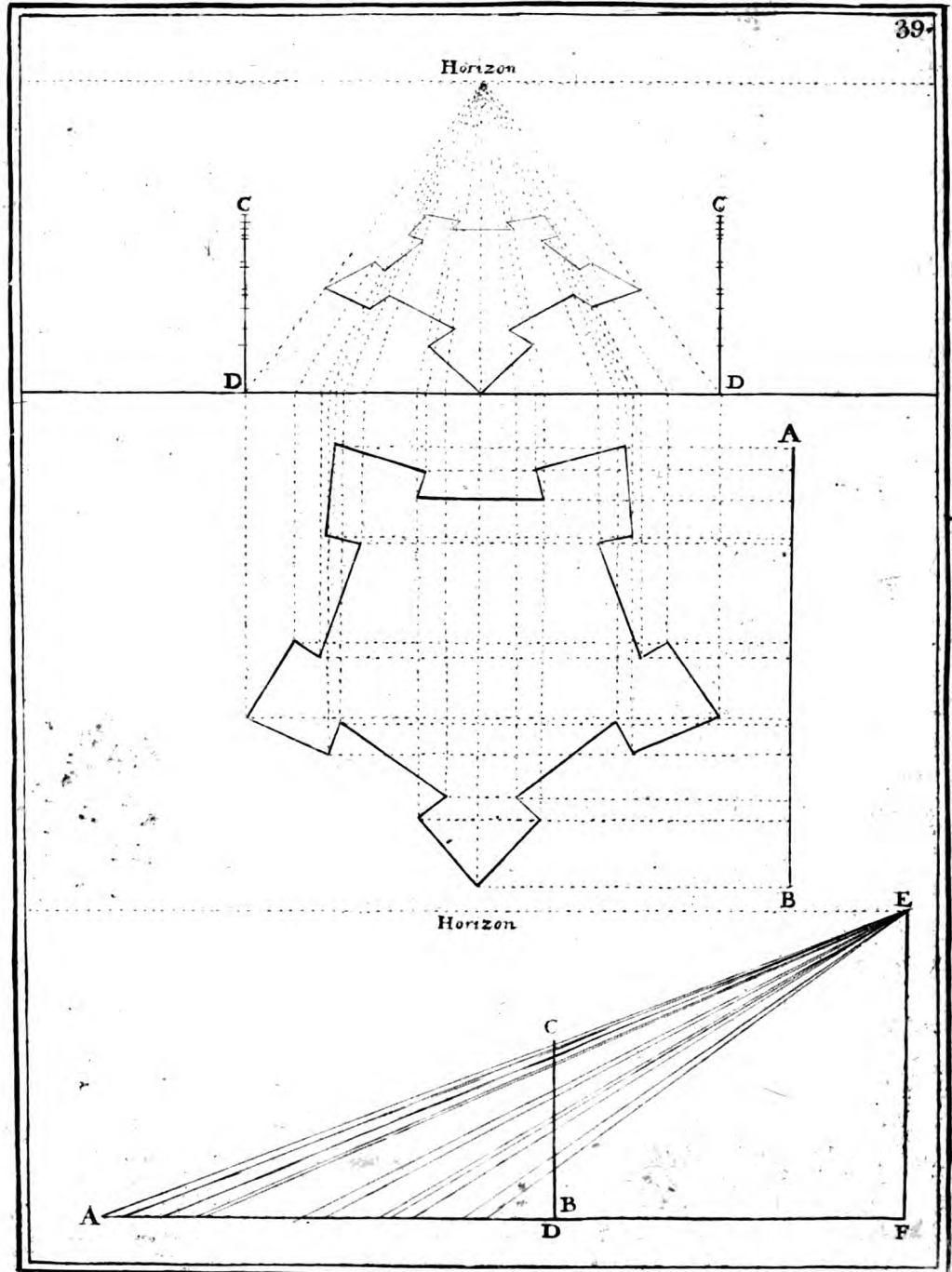


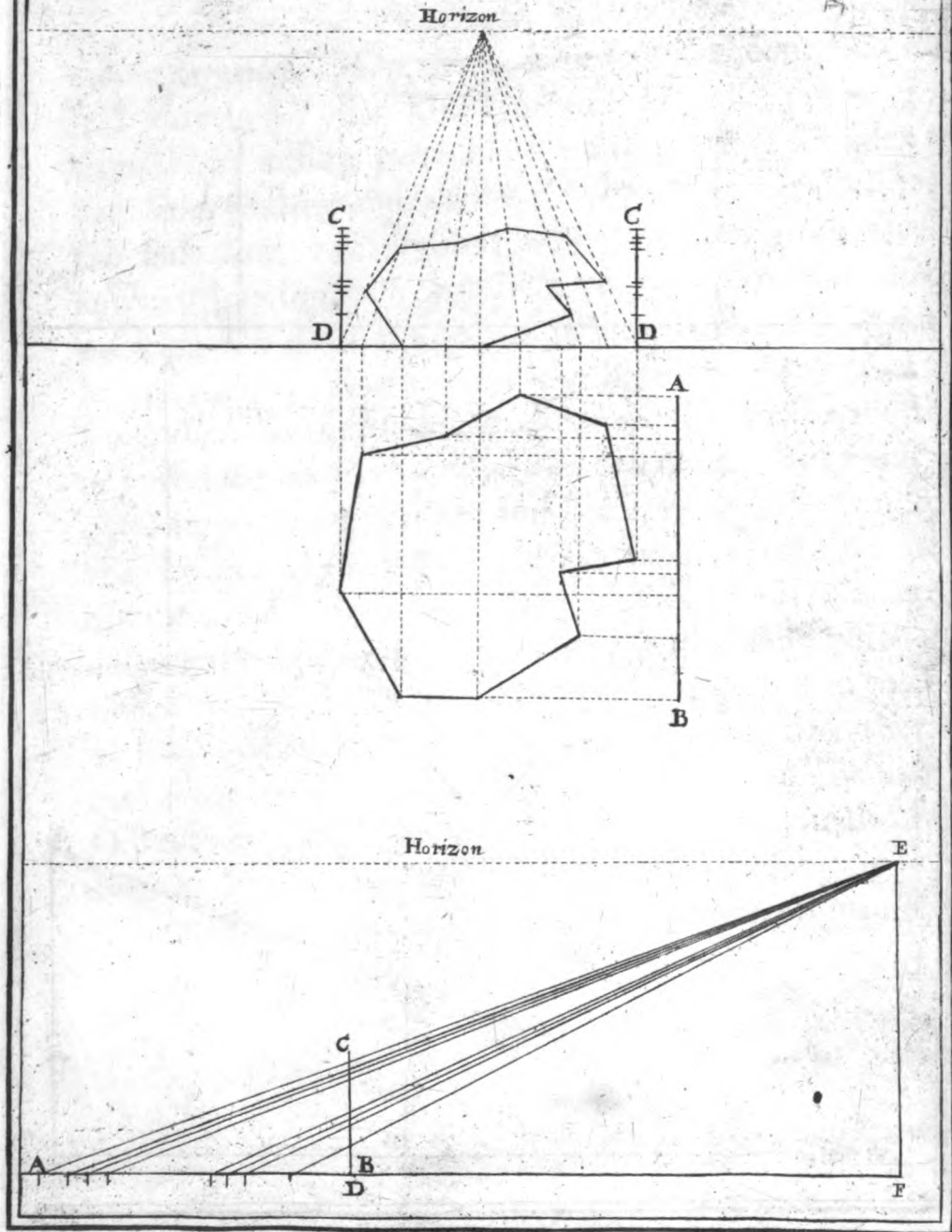
PLAN *of a House with a Garden.*

THE method of putting this plan in perspective, is the same with that of the garden alone ; so that what is there said may suffice for both. My design in putting it here, is to shew, that one may diminish all sorts of plans, whether consisting of equal or unequal parts.

Plan of a FORTIFICATION in perspective.

TO put a FORTIFICATION, or other plans of the like kind in perspective, the VIIth and VIIIth *Observations*, page 18, are to be used. The same in effect is the method already laid down for the CHURCH and HOUSE, pages 37, 38, namely, by raising perpendiculars from all the angles to the base line, and producing rays from their intersections with the base line, to the point of sight; and from the same angles drawing the parallels to the terrestrial line, and marking the divisions on a side line, A B. These divisions being transferred thence to the base line, and lines drawn from them to the point of distance, we shall have the line of intersections C D. But, because there is not room on the plate to put it on the base line, I have added it underneath the figure, as in A B. Lastly, having fixed the point of distance in E; draw lines thence to all the divisions of A B, cutting the line of intersection C D in so many parts; which line, C D, with its divisions, is to be transferred to the bottom of the extreme ray, in the perspective plan, or rather set on each side, as D D; and from all the points of the lines D C, D C, draw parallels, or only mock-points, on the ray proceeding from the angle of the plan belonging thereto. Which points, connected by lines, give the figure required.





An irregular Plan and Figure in Perspective.

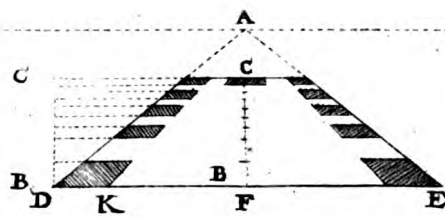
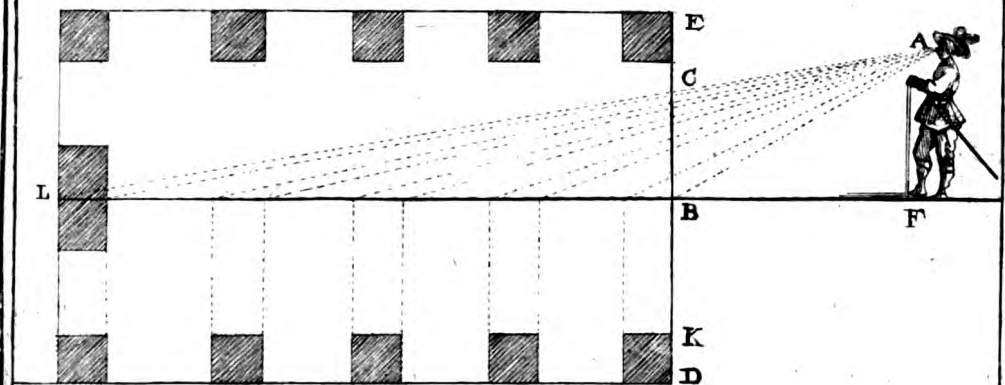
WHOEVER can perform what is directed under the last article, will find no difficulty in projecting any other figure, that being the most intricate of all kinds of plans in perspective. It was judged, however, proper to add some irregular form, which might appear at first sight to be difficult, in order to shew that these rules are adapted to all the variety of possible figures, and that every form and shape, in whatever view or aspect it is to be seen, may easily be projected in perspective.

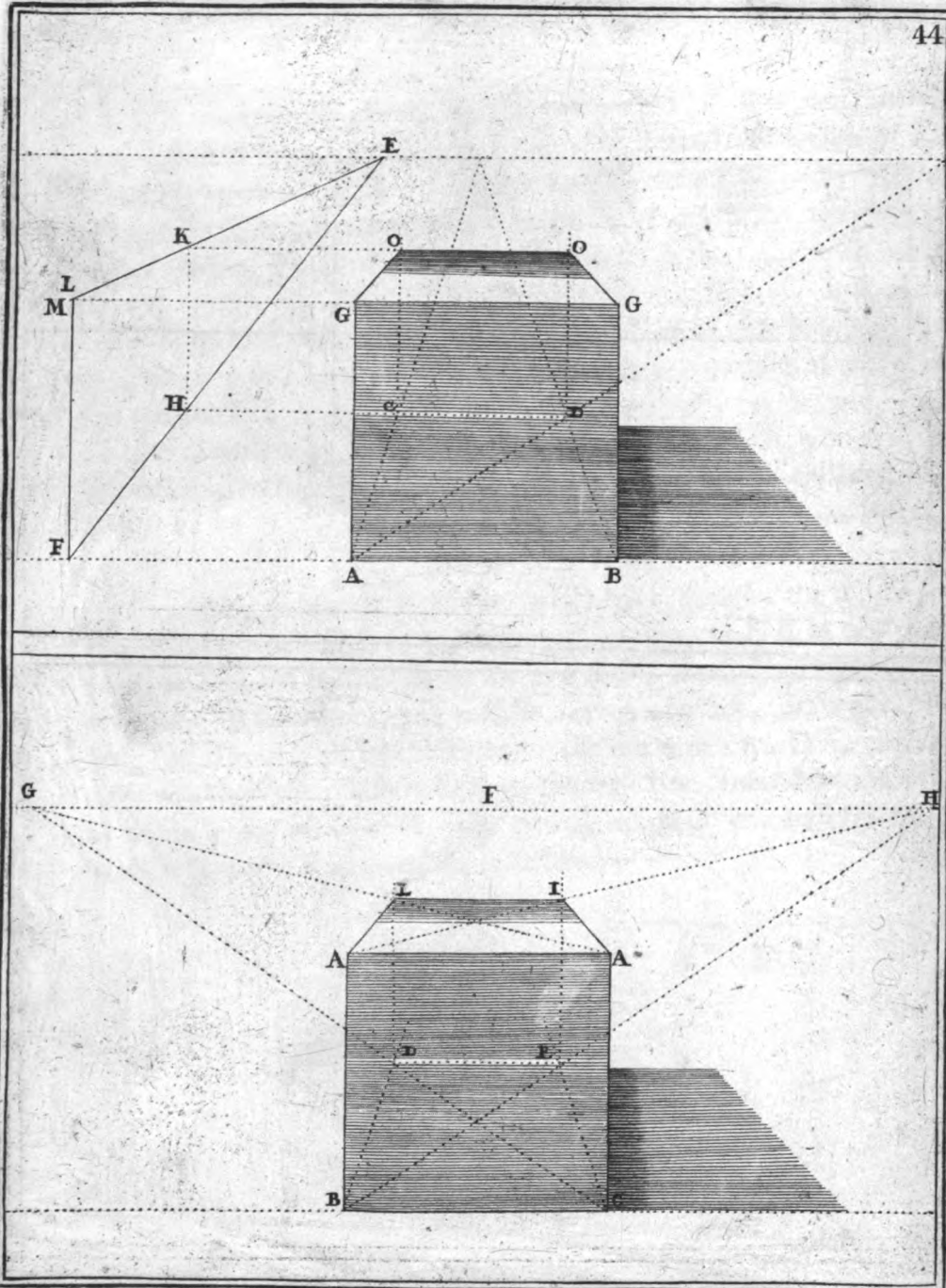
The lines in this plate are marked as in the former: to repeat the operation is needless.

Another plan of a CHURCH, in Perspective.

THE manner of projecting the perspective of this plan, should seem very different from what I have hitherto delivered, by reason of its different disposition ; but that I own is a thing done designedly, to shew that though there be diverse ways and manners of operation, they are all reducible to one. For this projection, in effect, is the same with what I have already prescribed for fortifications, irregular figures, and other plans, with only this difference, that the parallels to the base line are there marked on a side line, and here, on a line in the middle of the plan. But the same effect is produced from each method ; for drawing lines from all the divisions of the middle line *BL* to the eye *A*, you will have the line of intersection *BC*, which is upon what may be called the base line *DE*.

To put the geometrical plan in perspective, transfer the whole length of the terrestrial line *DE* to any place at pleasure, as *DE* in the perspective plan, and set off the height of the eye *AF* ; then, putting the line of intersection *BC* either in the middle, or on one side, draw parallels to the base line through all its divisions to the extreme rays *DA*, *EA*, and set the breadth of the pilasters *DK* on the base line ; then drawing a line from *K* to the point of sight *A*, the points wherein it intersects the parallel lines will be the widths of the pilasters.





PRACTICAL PERSPECTIVE,

P A R T I I I .

RULES FOR ELEVATIONS.

Preliminary instructions *necessary to the following methods.*

THE reader is by this time sufficiently instructed in what relates to Ichnography and Planigraphy, considered as the foundations of Orthography and Scenography.

Orthography, I have already defined to be the elevation of the fore-right plane or front of any object, the elevation of the face or front, &c. and Scenography the elevation of all the parts. See the DEFINITIONS, page 7.

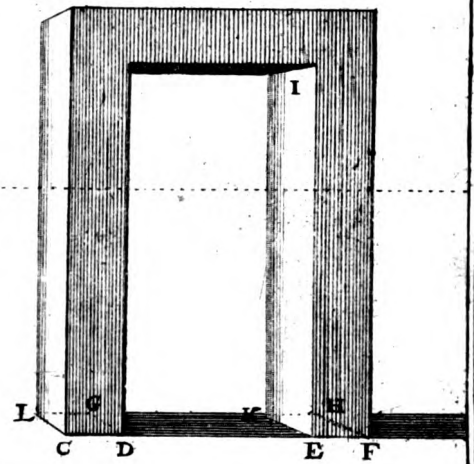
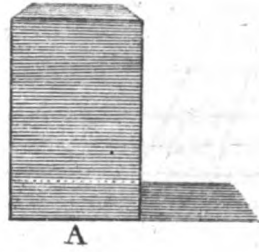
To make myself more intelligible to such as are not versed in the use of those words, I purpose, as already promised, for the future to call Ichnography the *Plan*; the Orthography, the *Upright* or *Elevation* of the front; and Scenography, the *Elevation* of the whole.

Here it is to be observed, that elevations never give the eye all the angles of the plan, and that the quantity of sides, or angles which appear to the eye, depends on the aspect or view the object is taken in. Thus, if it be viewed in front, as the figure A, it will only shew one side, though the plan hath four. If it be viewed by the angle, it will shew two, as B; but never more, in whatever view it be taken. I speak of squares: for as to objects of many sides, they may shew three, four, five, and more.

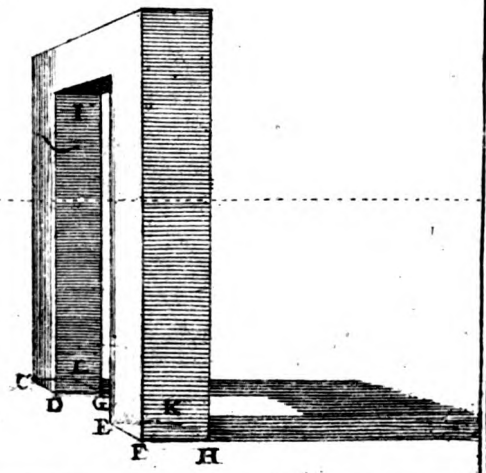
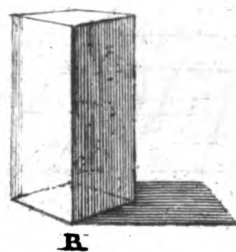
When objects decline ever so little from the point of view, they are seen by the angle, and of consequence must shew two sides. And still the farther they are removed from the point of sight, the more of the side they shew; thus the side K E shews more of itself than C L, though their thickness be equal.

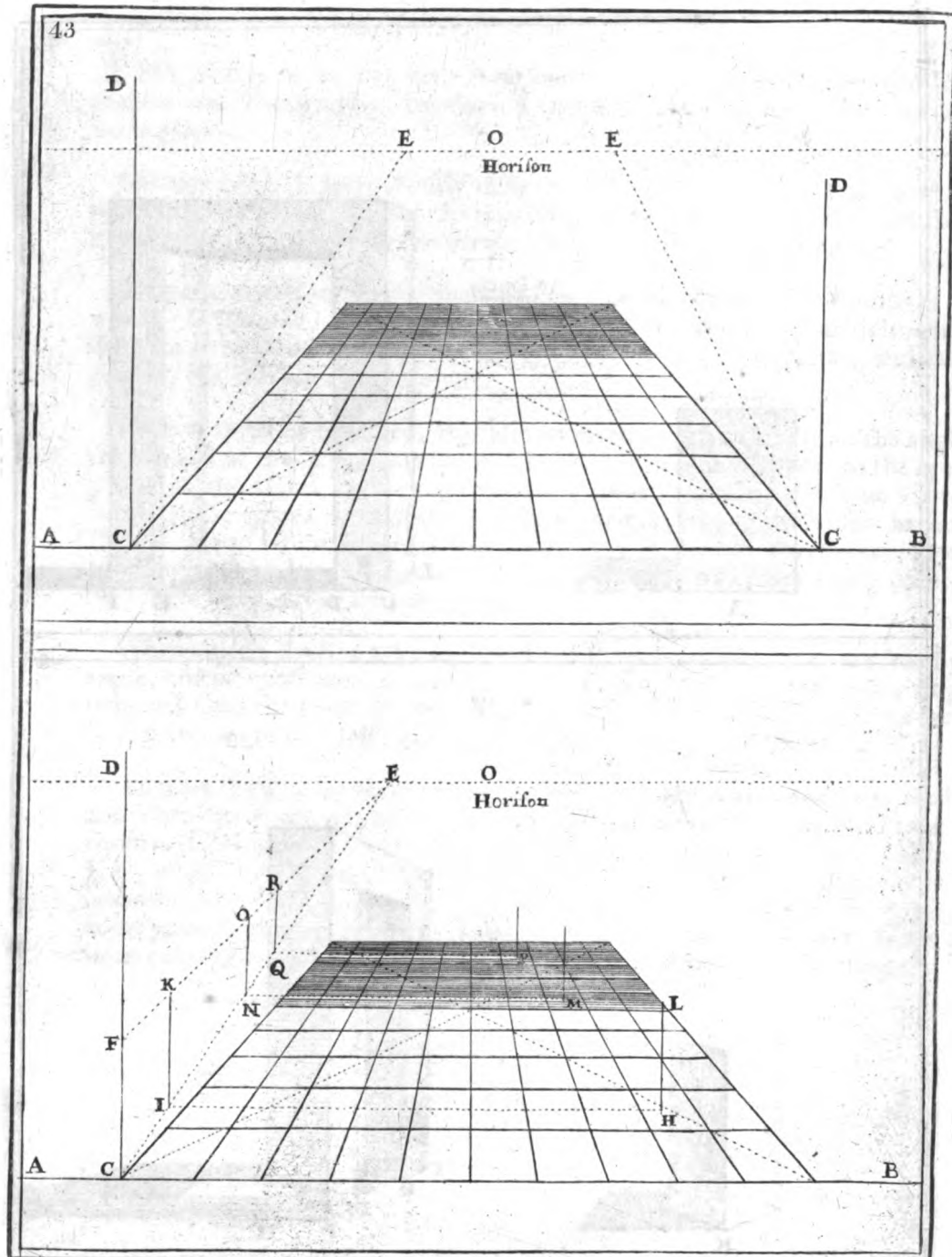
Another thing to be observed is, that the lines which are parallel to the horizon when the object is viewed in front, as C D E F of the door in *Fig. 1.* become a visual ray when the same object is viewed a little obliquely. Thus C D E F, which in the upper figure stands in front, becomes a visual ray in that underneath. And, on the contrary, the lines which are rays in the upper, become parallel to the base in the under. As to perpendiculars, they always continue perpendiculars in whatever view the projected bodies are exhibited.

1. fig.



2. fig.





Of the Line of ELEVATION, serving to give the Heights of all Kinds of Objects in all Parts of the Plan.

THE use of this line is of the last importance, infomuch, that whoever is perfectly master thereof, will scarce meet with any difficulty in raising any kind of elevation.

As in the putting planes in perspective we made use of the base line; so in elevations, another line is to be used to direct us, and carry the proper heights to all the objects to be raised.

This *line of elevation* must be perpendicular to the base line A B, which is always the first line of the plan, and that next the eye, and of consequence the fittest to carry the measures to the several objects in the plan. On this account the line of elevation C D is raised perpendicularly on A B, as the other lines in the plan should be. Infomuch, that it is to be remembered as a rule, that whenever, in the course of this work, mention is made of perpendiculars, it is to be understood of perpendiculars to the base.

Since this line of elevation is to receive and give the heights of all objects to be raised on the plan, it must have the same horizon with the plan. Therefore, from the foot of this line (which is placed either on the right or left) a line is to be drawn to some part of the horizon, though what part does not matter, the effect being the same in all. In this figure, the line of elevation is C D, and from C the line is drawn to the point of the horizon in E; or it might be drawn to the point of sight, if one pleased. I have here put the line of elevation on either side, and the point different in each, to shew that it will answer any where.

If from the point H, which is in the plan of the second figure, you would raise a line of two feet height, set two equal parts on the line of elevation, which you hold equivalent each to one foot, such is here C F; and from C drawing a line to the point E, you will have an elevation of two feet between the two lines C and F.

Now, to give the same height of two feet to a line raised from the point H, from H draw an occult line parallel to the base line, till it meet the line CE in the point I; then from the point I erect a perpendicular I K; this will be the height of the line required, which is to be taken hence in the compasses, and set off from H to L.

If a line likewise two feet high were required to be drawn from the point M, the same operation being repeated, you will have the perpendicular N O, which will be the height required from M. Lastly, performing the same for the point P, you will have the perpendicular Q R for the height of a line of two feet from the point P.

The same rule will give a height of 3, 4, 5, 10 or 20 feet; all required being to set such heights on the line of elevation, from those heights to draw lines to the point in the horizon, as E, and to proceed with the rest as above.

To exhibit the ELEVATION of a Cube in Perspective.

HAVING projected the plan according to the preceding rules, and raised the line of elevation as FL , set off the height of the cube thereon, namely FM , and from the points F and M draw lines to the point of elevation E . From the several angles of the plan $ABCD$, draw parallels to the base line, till they meet with the line FE , and from the points of intersection F and H , erect perpendiculars FM and HK ; then taking those measures in your compasses, set them perpendicularly upon the angles of the plan; thus, taking the height FM , set it on the two perpendiculars raised from A and B , which will give you AG and BG ; then taking the height HK , set it on perpendiculars raised from C and D , which will give you CO , DO ; lastly, joining the right lines GO , OG , the cube will be raised.

Or, if you draw parallels to the base line from M and K , their points of intersection with the perpendiculars AG , BG , CO , DO , will be the altitude of the cube, and those points connected by straight lines will complete its figure.

For the elevation of any figure whatever, always draw lines from the several angles of its plan, parallel to the base line, till they cut the line drawn from the foot of the line of elevation, and proceed in all respects as directed for the cube, and you will find there is no figure however difficult and irregularly formed, but will be thus brought into its perspective. Example of which I shall give in the polygons following.

The second figure is another cube, raised after a somewhat different manner from the first. The process I shall describe in few words, being nothing contemptible.

Having dispatched the plan the ordinary way, from the several angles thereof, $BCDE$, erect perpendiculars; and on the first of them, BC , set off the given height of the cube, namely BA , CA ; then from the points A draw lines to the point of sight F , or to the points of distance GH , and the points I and L , wherein they intersect the perpendiculars of the angles D and E , will give the line of depth, and the top of the cube perfectly raised.

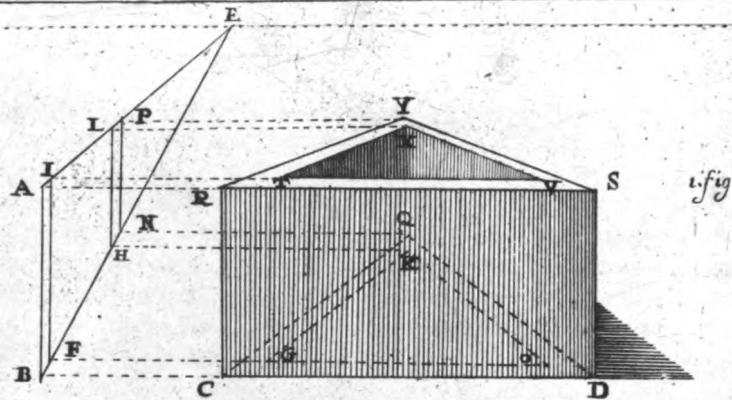
This latter method is much less universal than the former, which has always been in use among the oldest authors; yet has it some advantages which I shall have occasion to touch upon hereafter.

1. The first part of the paper is devoted to the study of the properties of the function $f(x)$ defined by the equation

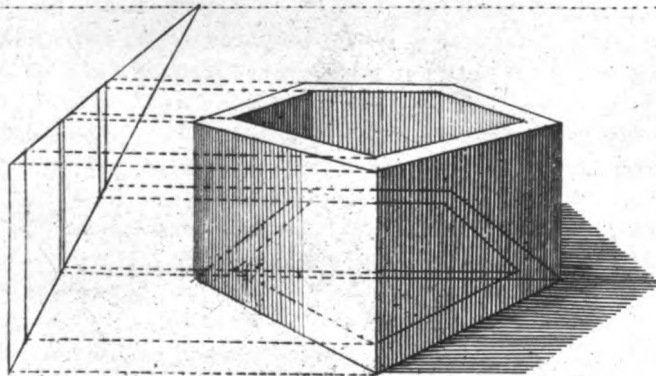
$$f(x) = \int_0^x \frac{1}{1+t^2} dt$$

2. The second part of the paper is devoted to the study of the properties of the function $f(x)$ defined by the equation

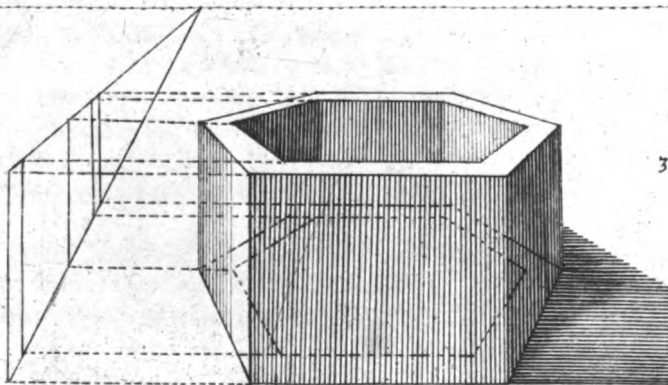
$$f(x) = \int_0^x \frac{1}{1+t^2} dt$$



1. fig



2. fig



3. fig

To find the Elevation of a TRIANGLE.

INOW proceed to shew with how much ease all kinds of figures may be raised in perspective. Of these, polygons, or figures of many sides, are the most difficult. I shall therefore choose to exemplify in these; and, to observe some order, will begin with the most simple, the TRIANGLE.

Having formed the plan, as already directed, page 21, where is shewn the method of drawing it with a ledge or list; the line of Elevation, as just now intimated, must be set on one side, and of any height at pleasure, for example B A, which we suppose to be three feet; then from all the angles of the plan drawing parallel lines, parallel to the base line, to the line B E, and from the points of intersection erecting perpendiculars between the lines A E and B E, set off all their heights upon the several angles, whence the parallels proceed. The height A B for instance, on the angles C and D, which will give C R and D S, the height N P on the angle Q, which will give Q Y. Then for the inner angles, set F I on G and O which will give G T and O V, and N L set on K will give K K. Lastly, connecting the points R, S and Y, and again the points T, V and X, by right lines, you will have the triangle in its proper thickness, &c.

By drawing lines parallel to the base line, from the points A I L P, the points of their intersection with the perpendiculars raised from the angles of the plan, will give the angles of its elevation.

To exhibit a PENTAGON, or Five-angle, in perspective.

THE PENTAGON, I have said, is a figure with five sides, and as many angles; and have directed the method of forming its projection, page 22. As to the making its elevation, I should lose time to describe it, the figure hereto annexed, with the lines drawn from its angles, and from the perpendiculars of its altitude, shewing abundantly that its method is the same with that of the cube and triangle.

To exhibit the elevation of an HEXAGON, or Six-angle, in perspective.

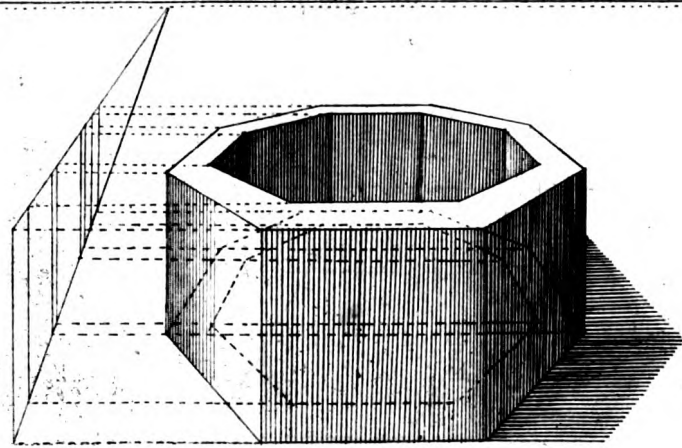
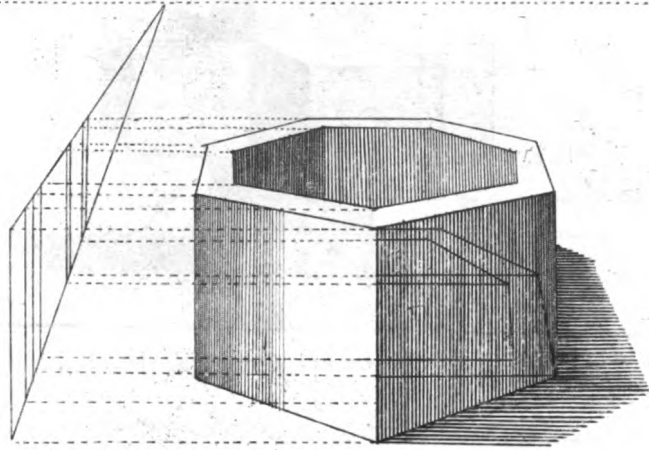
THE HEXAGON is a figure with six angles, and as many sides or faces, as already observed, pages 23, and 27, where I have given its diminution. The method of raising it is obvious enough from the figure.

The HEPTAGON, or Seven-Angle, *in* perspective:

THE HEPTAGON is a figure with seven sides and angles ; the manner of describing it, and of putting its plan in perspective, I have already given in page 24. Its elevation is performed after the same manner as that of the triangle, as appears from *Fig. I.*

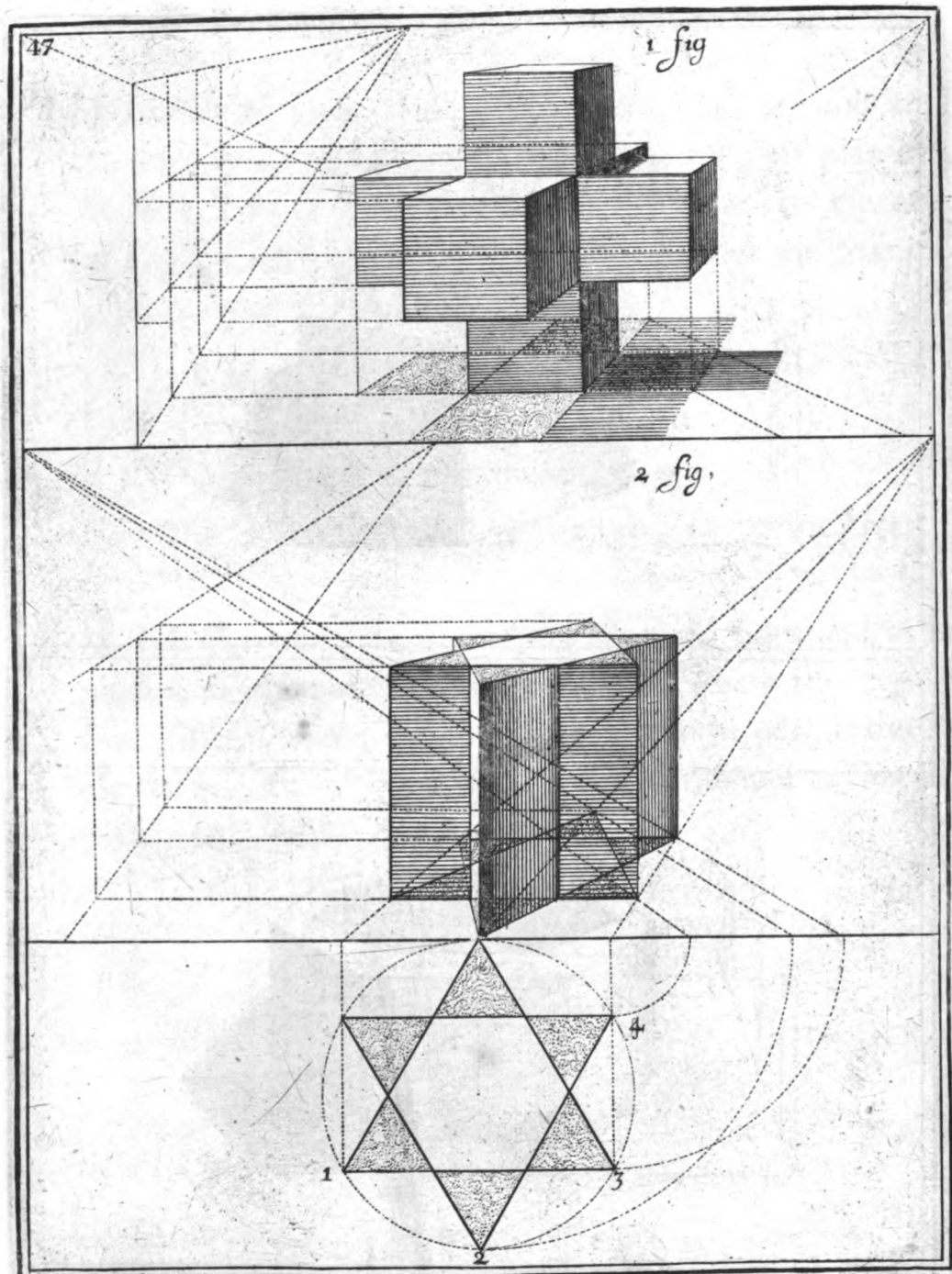
The OCTAGON, or Eight-Angle, *in* perspective.

THE OCTAGON is a figure with eight sides and as many angles, as represented in pages 25, 26, where the reader will find different ways of putting the plan in perspective. Its elevation is to be procured in the same manner as that of the preceding object.



I.

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A Double Cross in perspective.

THIS and the following figure I add from the *Sieur de Maralois*, who has given them a place in his works according to the method I have already laid down. The truth is, it would be somewhat difficult to put them in perspective any other way, by reason of the multiplicity of their angles; but in this method all is easy, by only raising the heights from all the angles of the plan, &c. as already observed of polygons, and is evident from the figure.

A Stone fluted, or channeled star-wise, in perspective.

NOT having given the plan of this figure among the other plans, I have judged proper to add it underneath. The geometrical plan is easily made, as being only a circle whose periphery is divided into six parts and the divisions joined by right lines, leaving a point between each two; as, for example, between 1 and 3, leaving 2; and from 2 to 4, leaving 3; and so of the other. The rest is obvious from the second figure.

To exhibit PILASTERS in perspective.

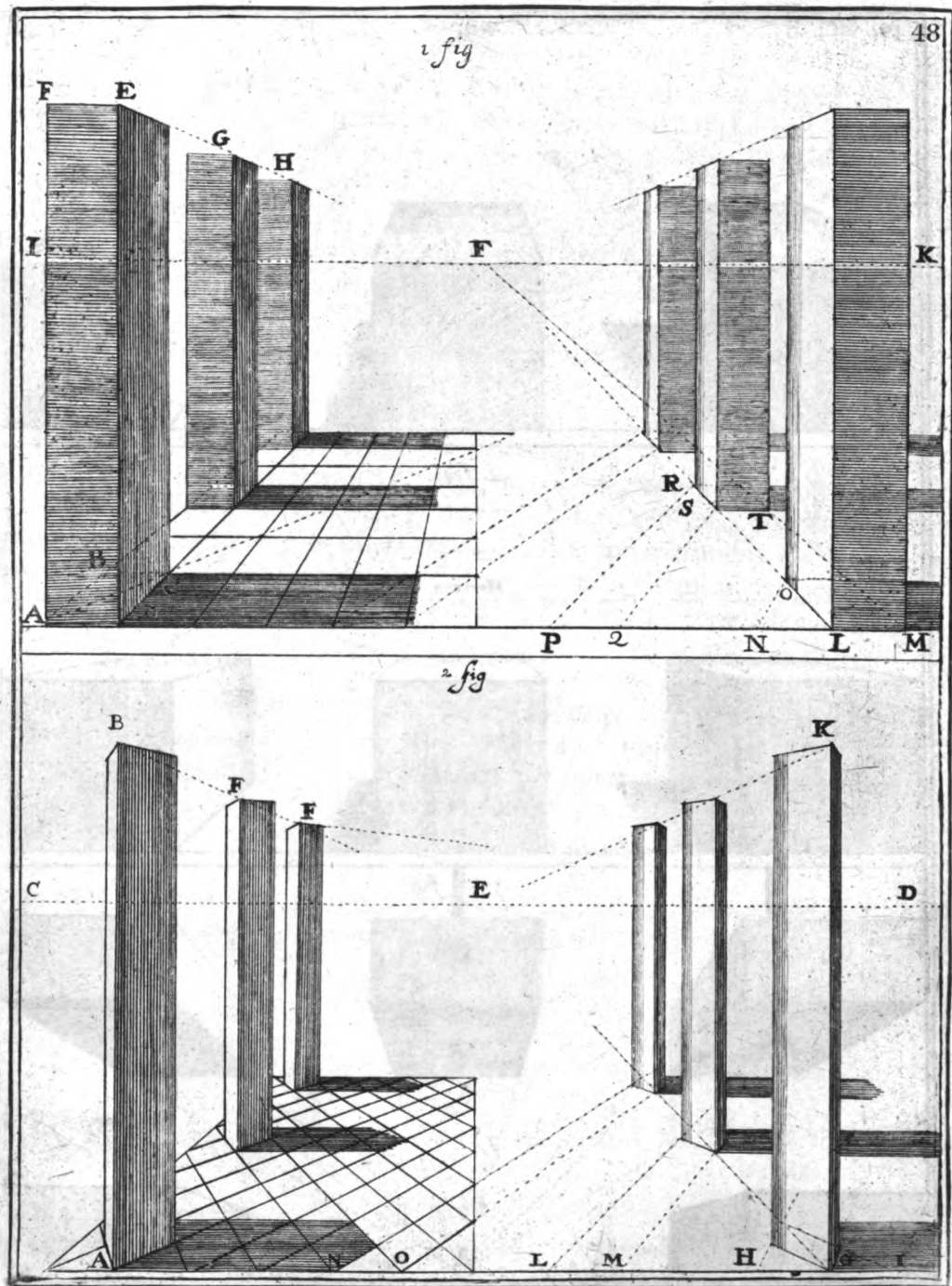
IN the raising of columns, pilasters, walls, or the like objects, which are to be of the same height, there is no need of a line of elevation; it is sufficient to proceed as in the second method for the cube, page 44, that is, having raised perpendiculars from the angles of the plan, as here from A B C D of *Fig. 1.* set the height desired on the first or second perpendiculars, as A F or D E; then drawing a line from E to the point of sight F, to this line all the perpendiculars from the angles from the inner side of the pilasters are to be raised. In which case, the pilasters G and H will have equal altitudes to the first.

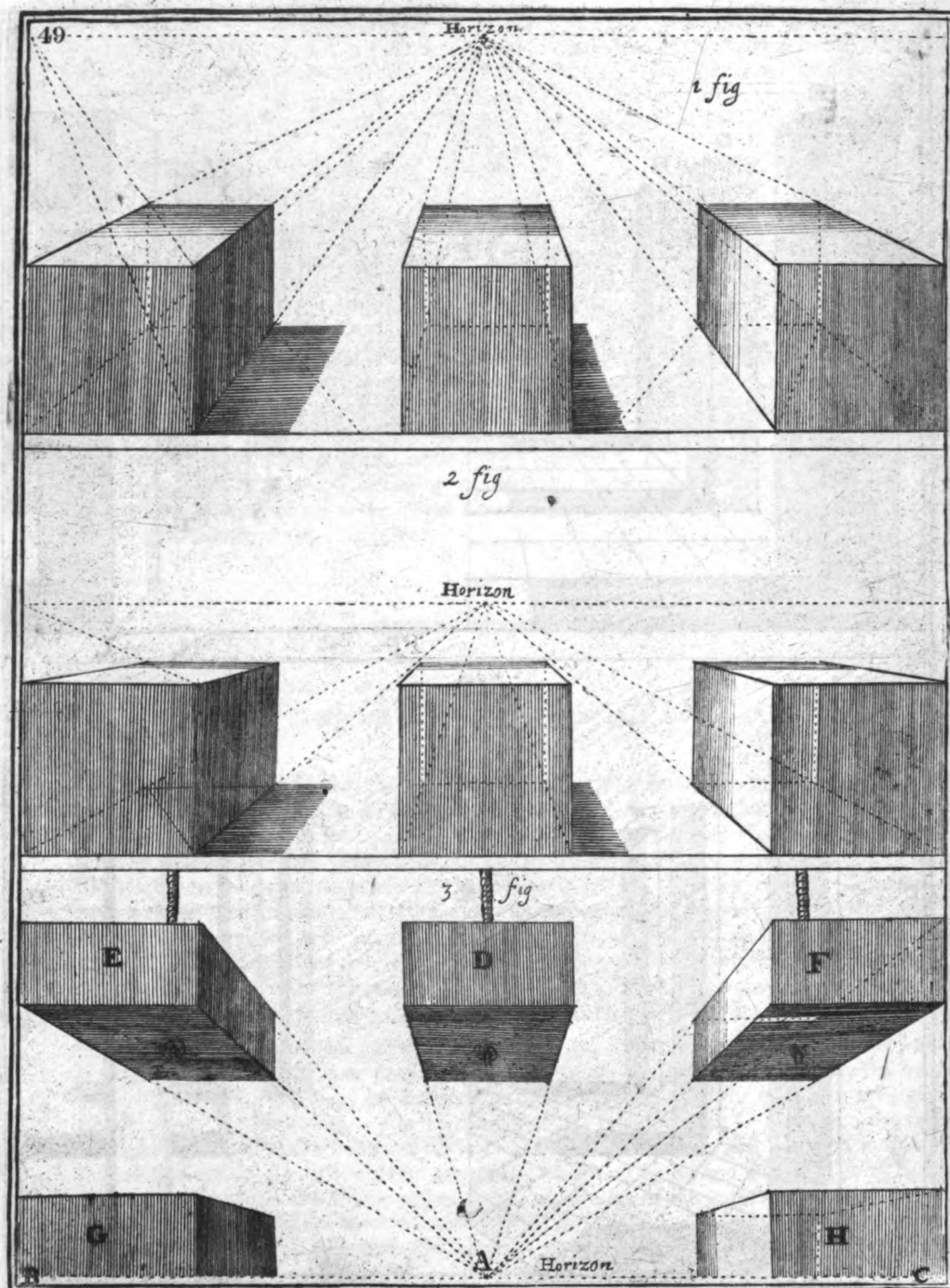
If one choose not to make use of squares in the plan, the measures must be laid on the base line, and rays be drawn thence to the point of sight F, and other rays for the diminutions to the point of distance K. Thus, for example, L M being a side of a pilaster, rays are to be drawn from the two points thereof, L and M, to the point of sight F, for the breadths of all the pilasters: and for the depth of each, as they are intended to be square, the distance L M is to be taken and set off from L to N; then drawing a line to K, it will give the depth of the pilaster in O: lastly, from the points L M O erect perpendiculars, and proceed as above directed. If you would have the width of two pilasters between one and another, set them accordingly on the base line, and after making the depth of the second pilaster equal to the first, as here P Q, from the two points P Q draw lines to the point of distance K, which will give the points R S on the ray L; and from S draw another short parallel S T, cutting the ray M F; lastly, from the three points R, S and T, erecting perpendiculars, proceed as in the former case. A third and fourth pilaster, &c. are to be added after the same manner, still observing the same measures on the base line as in the first figure.

To exhibit PILASTERS viewed by the angle.

IHAVE already observed, page 17, that the plan of squares is formed by drawing lines from the divisions of the base line to the point of distance. As to the elevations, the method is the same with that just described. For having set the height A B on the first perpendicular, lines must be drawn from the point B to the points of distance C D, which will intersect and give the heights of the other perpendiculars raised on each side. Then giving the distances required between the two pilasters, which are two squares, raise the second; and by the same rule the third. Their heights will be found by drawing a visual ray from the point B to the point of sight E, the intersections whereof with the first perpendiculars in the points F and F, as also the intersections of other lines from F and F to the points of distance C and D with the other perpendiculars, will give the heights required, as in the first pilaster.

These pilasters which are raised without plans, must have their measures on the base line, as if they were to have the same breadth with those viewed in front. Accordingly, the breadth G H must be marked, and a ray be drawn from G to the point of sight E, which will give all the middle points, or diameters. Then setting the same breadth from G to I, from the three points G H I draw lines to the points of distance C D, which form the first plan. On this plan erect perpendiculars, on the first whereof set off the height, as G K, and from the point K draw lines to the points of distance, which will give the shortenings of the perpendiculars of each side. For the second pilaster, do the same with the points L and M: and for the third, with the points N O. The rest is evident from the figure.





Effect of the Difference of HORIZONS.

THE higher a person is raised above an object, the more he sees of the upper part thereof ; of consequence the lower he is, the less he sees ; and if he be underneath it, he only sees the bottom part, and nothing of the top.

The first proposition is evident from *Fig. 1.* the second from *Fig. 2.* and the third from the last.

The first and second cubes are formed after the manner already delivered. The third are also produced by the same rules, though they may appear somewhat more difficult, by reason the object is seen over head ; but inverting the paper, or painting, and drawing lines to the point of sight A, and points of distance B and C, as in the former methods, you will have the same facility in exhibiting them. I say nothing of objects viewed side-wise, as having so often repeated, that the method is the same as those in front. To render the practice of putting them in perspective more easy, I have added in the next plate two figures, the one a bare outline, the other shadowed farther.

Before we quit this third figure, it is to be observed, that the lowness of the horizon is the reason we see the bottoms of objects, as D E F, whereas of the two others, G H, placed in the horizon, neither top nor bottom can be seen. Not the top, by reason of the lowness of the horizon ; nor the bottom, because they are the horizon itself.

There are abundance of painters faulty in this point, inconsiderately shewing the tops of objects, even where the horizon is very low.

Elevation of Objects viewed by the Angle.

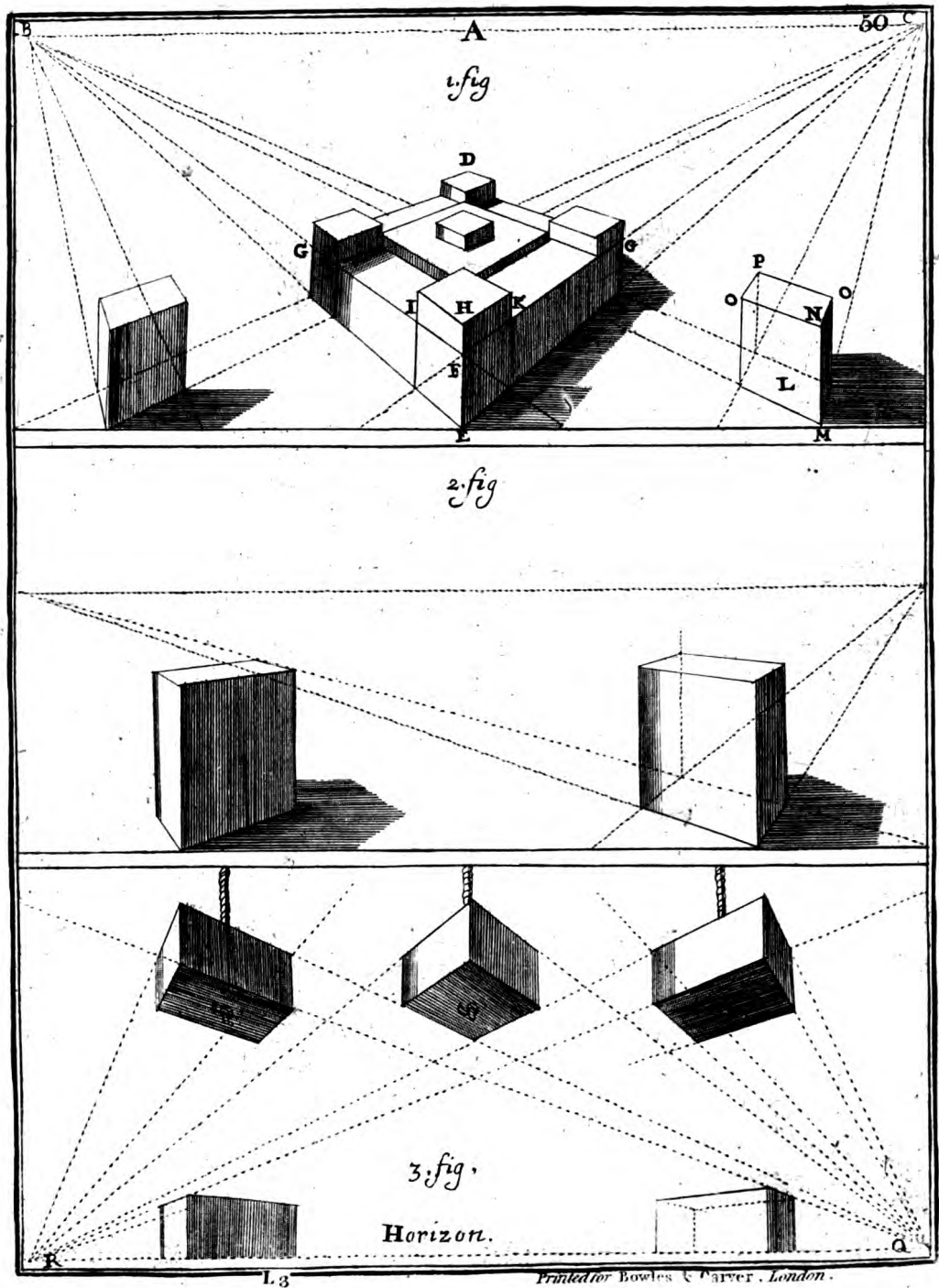
I HAVE shewn in pages 19, 20, that in the projection of oblique plans, the lines are always to be drawn to the point of distance, not to the point of sight, unless for finding the diameter. The same rule is to be observed in raising the elevations, as is evident from the first figures, all the lines whereof are drawn towards the points of distance B and C, and none of them to the point of sight A.

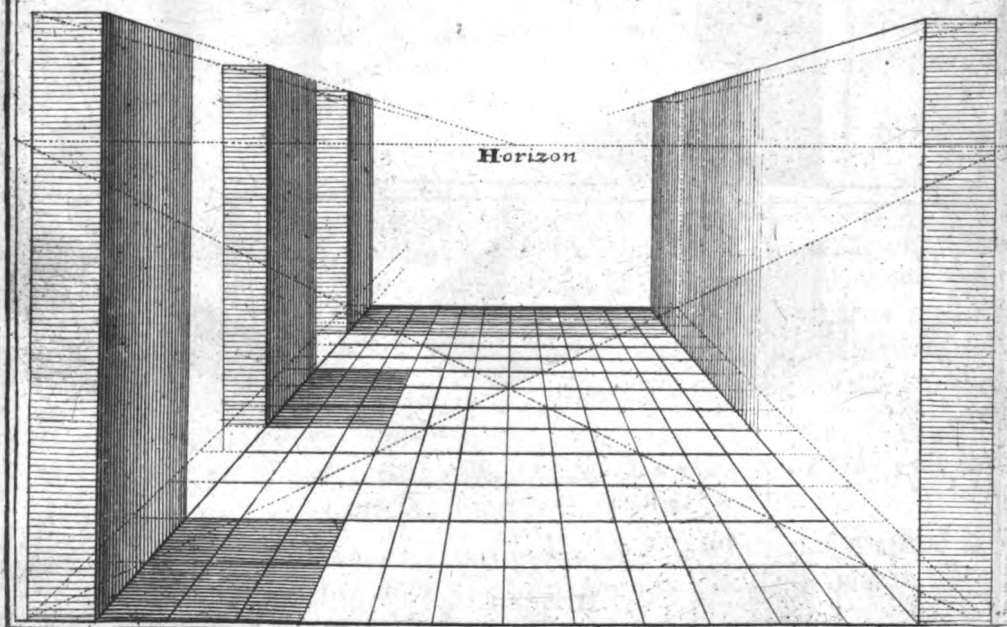
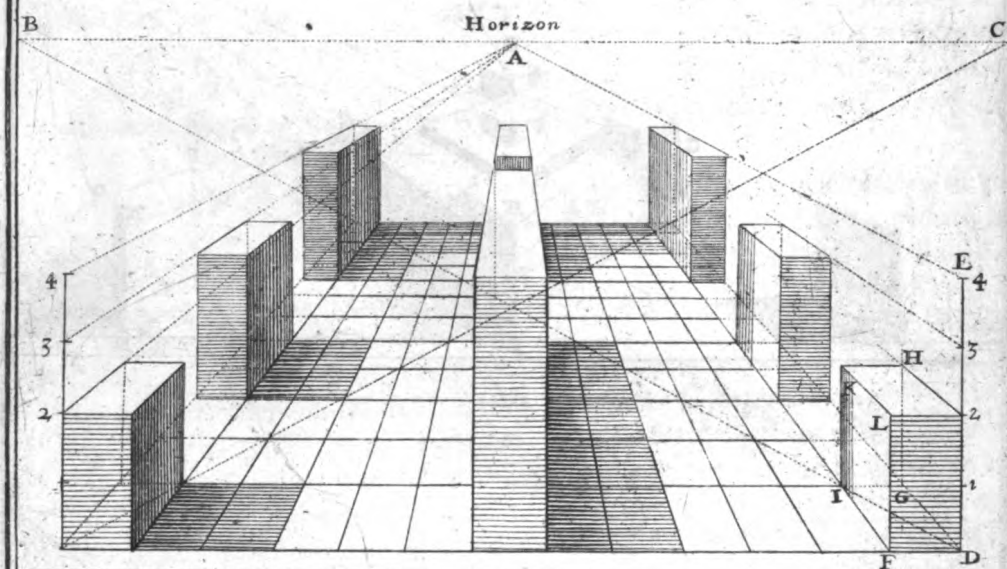
The first figure D shews that though there be a multiplicity of parts in any object seen angle-wise, they are all to be drawn to the points of distance B and C. To perform the operation, the rule is this ; having projected a plan, and raised occult perpendiculars, as already directed, set the given height on the first angle, as E F, and from F draw lines to the points of distance B C, for the heights of the second and third angles, in the points of intersection G G, then from G G draw lines to B and C, and you will have the fourth angle of the platform. The other lesser pieces are raised after the same manner, namely, by setting the heights on the first perpendicular, as from F to H ; and from H drawing lines to the points C and B, as before done from the point F. By such means you will have the heights of all the angles, and the points I and K will give the thicknesses of all the lesser pieces, and the platform of the middle, by still continuing to draw lines to the points B and C. The rest is evident from the figure, which may serve for a castle defended with four square towers, or for a palace cantoned with four pavilions.

The two other objects on each side the great one are seen side-wise ; the manner of drawing them is in all respects like those viewed in front. Thus, raising perpendiculars from all the angles of the plan L, and giving the necessary height to the first of them, as M N, and drawing a line from the point N to the points of distance B C, you will have the second and third angles in the points of intersection O O ; then drawing lines from O to the points B C, you will have the fourth angle, which is the elevation of the whole. This is according to the first method : the second would have given the same.

The second figure underneath is produced the same way ; all the difference is, that in this the horizon is somewhat lower.

The third shews the bottom of the objects ; but the method is still the same as in those that shew the tops, the lines being drawn to the points of distance Q R in the horizontal line.





To raise objects of any heights, and remove them to any distance at pleasure.

SUPPOSE it be required to have an object two feet high, one foot broad, and one foot deep; and another three feet high, one foot broad, two feet deep, and two feet distant from the first object; and another a foot broad, five feet deep, four feet high, and three feet distant from the middle object; your method of proceeding will be thus. Having formed a plan of squares, supposed each equivalent to one foot, by means of the points of sight A, and distance B C, from the first angle D erect a perpendicular according to the second method, page 48, which perpendicular is to carry the proper measures to all the objects, as here D E, wherein the measure D F, is set four times, by reason the highest object is not to exceed four feet. From the several angles of the first square F I G D erect occult perpendiculars; and having set the proper measure, namely two feet, on the first of them, D, from the point 2 draw a line to the point of sight A, and it will cut the perpendicular of the angle G in the point H, through which a line is to be drawn parallel to the base, cutting the perpendicular of the angle I in K, and another parallel to be drawn through the point 2, cutting the perpendicular of the angle F in the point L; then connecting the four points H K L and 2, by right lines, you will have the first object. Now as you would have a space of two feet between the first and second object, two squares are to be left vacant between them; and on the first angles of the third, perpendiculars are to be raised, and the same operation performed as to the first object, with this difference, that the height of the second is to be taken from the third point of the line D E, by reason it is to be three feet high, and that it must take up two squares, since it is to be two feet deep. Between this second and the third object the space of three squares is to be left, by reason there is to be three feet distance from the one to the other. From the first angles of the fourth square perpendiculars are to be raised as for the first object, and five squares farther, another perpendicular for the line of the depth, and the bound of the five feet, which is the depth of this third object. The fourth point of the line D E gives its height, four feet, by cutting the perpendiculars, as in the first object. The objects on the other side are raised in the same manner, and on the same proportions as these; but the wall in the middle is of an equal height every where, namely, three feet, with an aperture of four feet in the middle.

In the second figure are three walls of equal height; whereof that in the middle is a square deeper than the two extreme ones. Between each is an aperture of the three feet, for doors or windows. On the other side is a continued wall fourteen feet long, and of an height answerable to the rest. The method of elevating all these, is the same with those above. What we call a wall may likewise serve for a hedge, palisade, &c. of a garden.

Of WALLS viewed in Front.

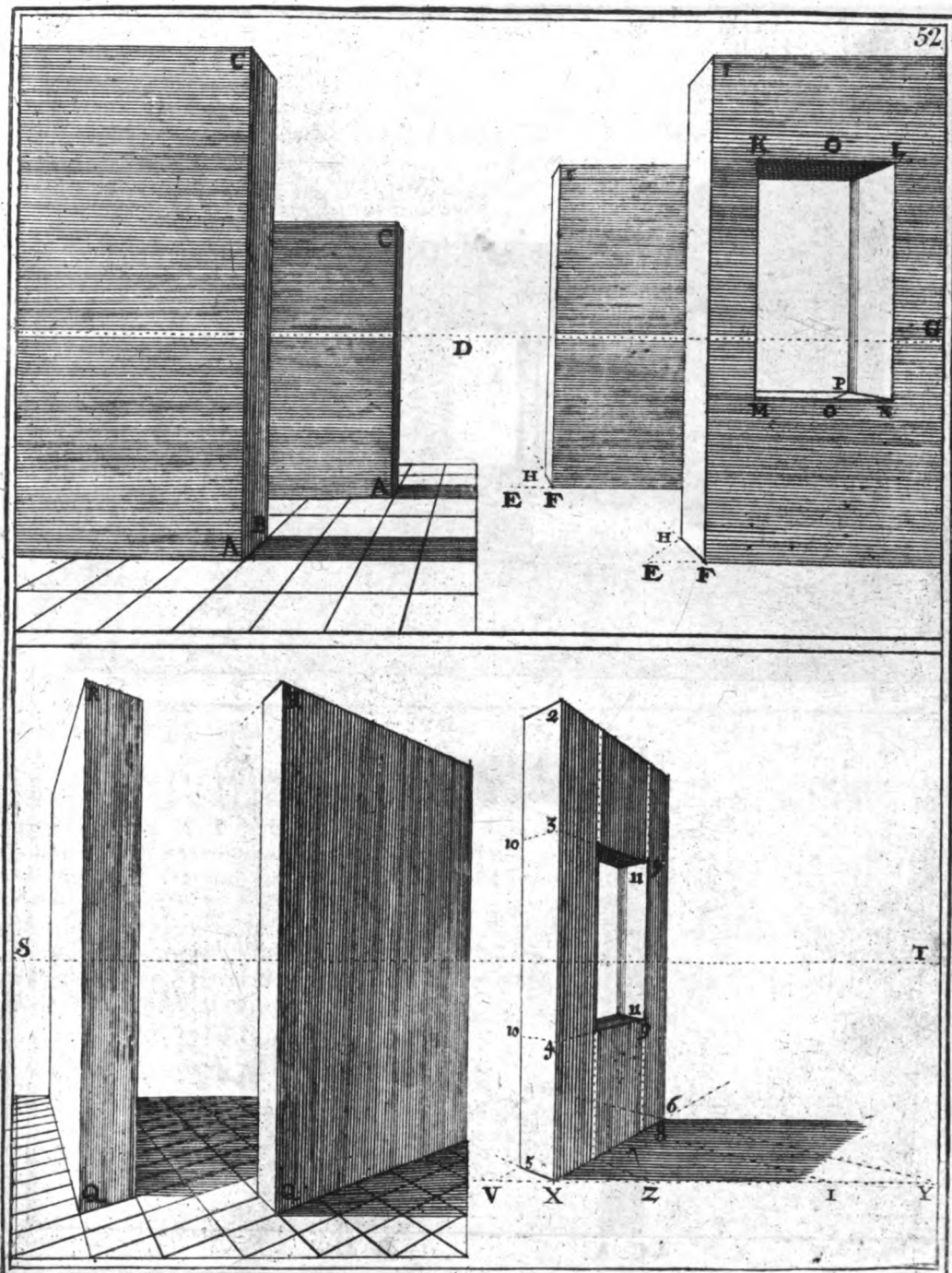
FROM what has been said one may raise walls of all kinds in any oblique views; and though the same method may serve for the same walls viewed in front, I have thought proper to add this figure on two accounts: *1st*, by reason it is not always that plans are made, and on such occasion a person would be a little to seek for the thickneses. *2^{dly}*, To give the thickneses to gates and windows, which might occur in such walls.

To make walls parallel to the base line, or the horizon, on a plan, one may give them any length at pleasure on the parallels to the horizon. To adjust their breadth, you may take that of a square, from the angles whereof A B, you are to erect perpendiculars to any height, as C; from C draw a ray to the point of sight D, and C D will give the diminution of the wall.

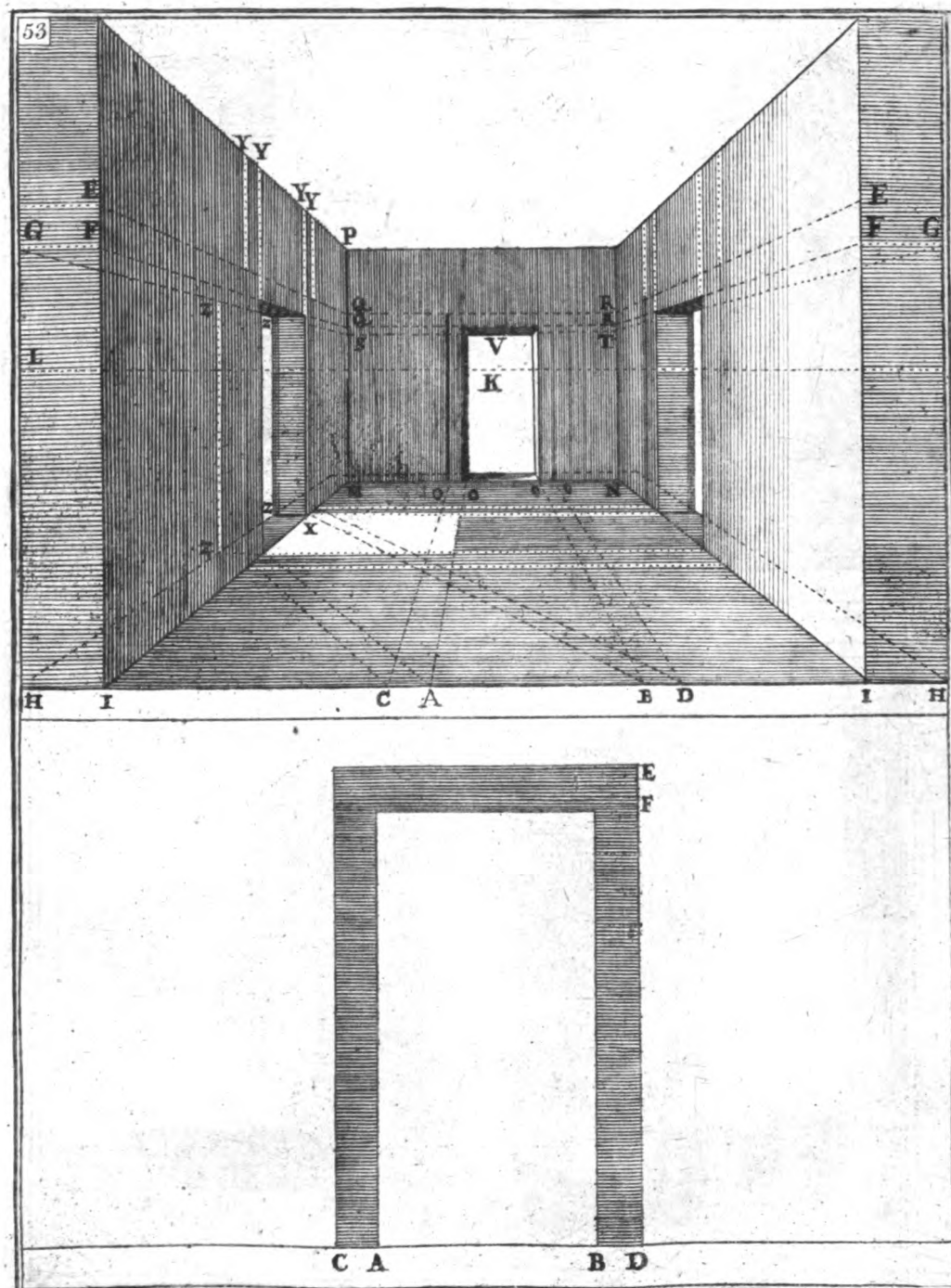
When there is no plan, the thicknes of the wall, as E F, is to be set on a parallel to the base line in the first corner of the wall: then from F a line is to be drawn to the point of sight D, and from E, another to the point of distance G; and from the intersection of the two in the point H, a perpendicular to be raised, and another from the point F. Then the height of the wall F I is to be taken, and from I a line to be drawn to the point of sight D, the intersection whereof with the perpendicular H, will give the diminution of the wall. For the length, you may give it at pleasure on the first parallel E F. For the doors and windows, in the same walls, mark the width and height as here K L M N, and set the thicknes required on a parallel, either above or below the doors or windows, in the corner next the point of distance, as here N O or L O; lastly, from the points L and N draw lines to the point of sight D, and from the points O to the point of distance G, and from the intersections of those lines in P, &c. draw the thickneses.

Other WALLS viewed by the Angle.

WHEN the wall is to be raised on a plan, you have nothing to do but erect perpendiculars from the angles already determined, and to mark the heights on the perpendicular from the angle next you, as on the line Q R; and from the point R, to draw lines to the points of distance S T; the intersections those lines make, with the perpendiculars raised from the angles of the plan, will give the length and thicknes of the wall. If you have no plan, set the measures both of the breadth and depth of doors and windows on the base line, as in this example, V X is the breadth, X Y the depth, and Z I the height of a window; then from all these points draw lines to the points of distance S T; first from X, which is the ray of the base; then from V, a little occult line cutting the ray X S in the point 5, which is the thicknes of the wall. As to the depth, the ray Y S will give it by its intersecting with X T in the point 6; and Z I will give the breadth of the windows in the points 7, 8; from which points X, 5, 6, 7, 8, perpendiculars being raised, and the height 2 being set on the first of them X, and from the point 2 drawing lines to the points S T, the intersections with the perpendiculars will give the height of them all. From the height of the window, marked 3, 4, draw lines to T, and where these intersect the perpendiculars 7, 8, lines are to be drawn; and from the corners 9 to S, for the depth 10, draw lines to T, and from the point of intersection 11, draw a perpendicular. This may also serve for a palisade as well as a wall.



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To place a Door in any part of a Wall at pleasure.

A WALL being raised one, two, or three feet thick, on the points H I, and carried on of the same height, as already directed; in order to place a door in any part thereof, observe the following method. Suppose the door required is to be three feet wide, and all its dimensions to correspond with that of the lower figure. To place this door in the middle of the end wall, set the breadth on the base line, as here in A B, and on the side of A and B set the breadth of the frame, or band, D and C, and from A B C and D draw lines to the point of sight K; and where they cut the parallel M N in the points O O, &c. erect perpendiculars of any heights at pleasure. Thus is the width of the door procured. For its height, D F E is to be transferred from the door underneath to the corner of the wall I, and lines to be drawn from the points F E to K; and where they intersect the perpendicular M P in the point Q, draw Q R parallel to M N, which will give the height of the door, and the band or frame at top. Its thickness, or depth, will be the same with that of the wall, which is G F. And if from G you draw a line from the point of sight K, it will cut the perpendicular M P in the point S, through which drawing S T parallel to Q R, you will have the thickness of the door V.

To make a door in a side-wall, the instructions given in page 17. are to be well remembered; importing, that all the measures are to be put on the base line; and, that lines being drawn from these measures to the point of distance, will give all the diminutions desired. For an example, a door four feet broad is desired in a chamber. Set off four equal distances from I to C, and draw lines from the dimensions of the door C A and B D to the point of distance L; where the ray I M intersects those lines, erect perpendiculars X Y, which will give the breadth of the door. For its height, draw lines from the point E and F to the point of sight K, and the intersections with the perpendiculars will give the height. As to the thickness of the top and bottom, draw the thickness of the wall, G H and F I, to the point of sight K; then drawing a little parallel to the terrestrial line, through the lower corner of the door X, and another through the upper corner, you will have X Z, the thickness of the top and bottom, to be joined by a perpendicular, as you see in the figure.

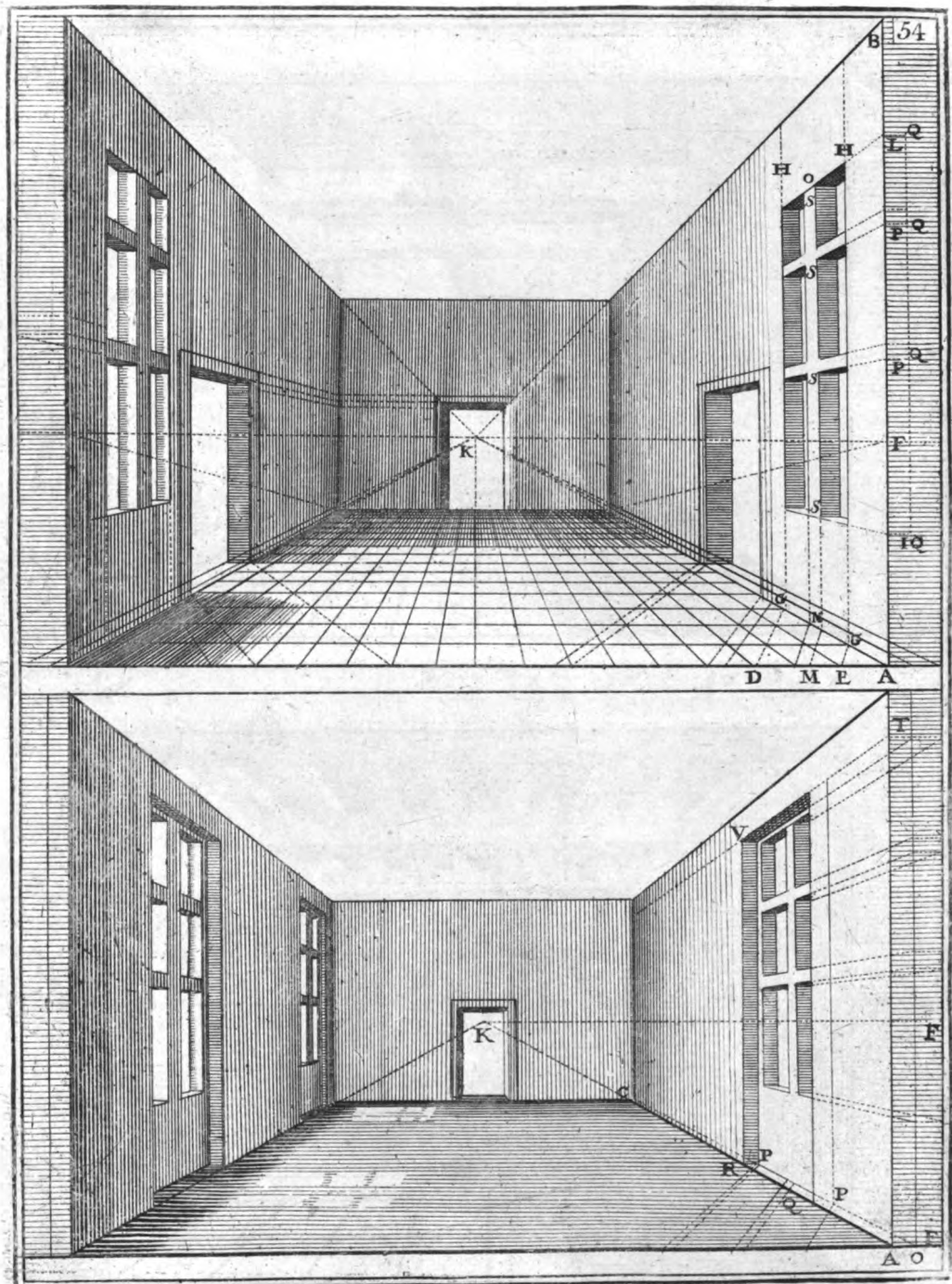
If you would have a door on the other side, you have nothing to do but draw parallels to the baseline from the point X to the ray I N, and then raise them as already directed. The rest is the same as on the other side. The gate is not here represented in the middle; it is designedly placed elsewhere, to obviate the error of such as without any other measures, draw two diagonals through their painting, though of ever so great a size, and make all their objects equally distant from the intersection of those lines, that is, from the middle of the painting. So that, on their principle, a body should always be mounted to shew their work in all its advantage; which is a palpable oversight. For though painting should be forty feet high, and it should be placed on the ground to be seen, the horizon should never be above five feet high, but rather less than more; whereas in their way the horizon should be twenty feet high.

To draw WINDOWS in perspective.

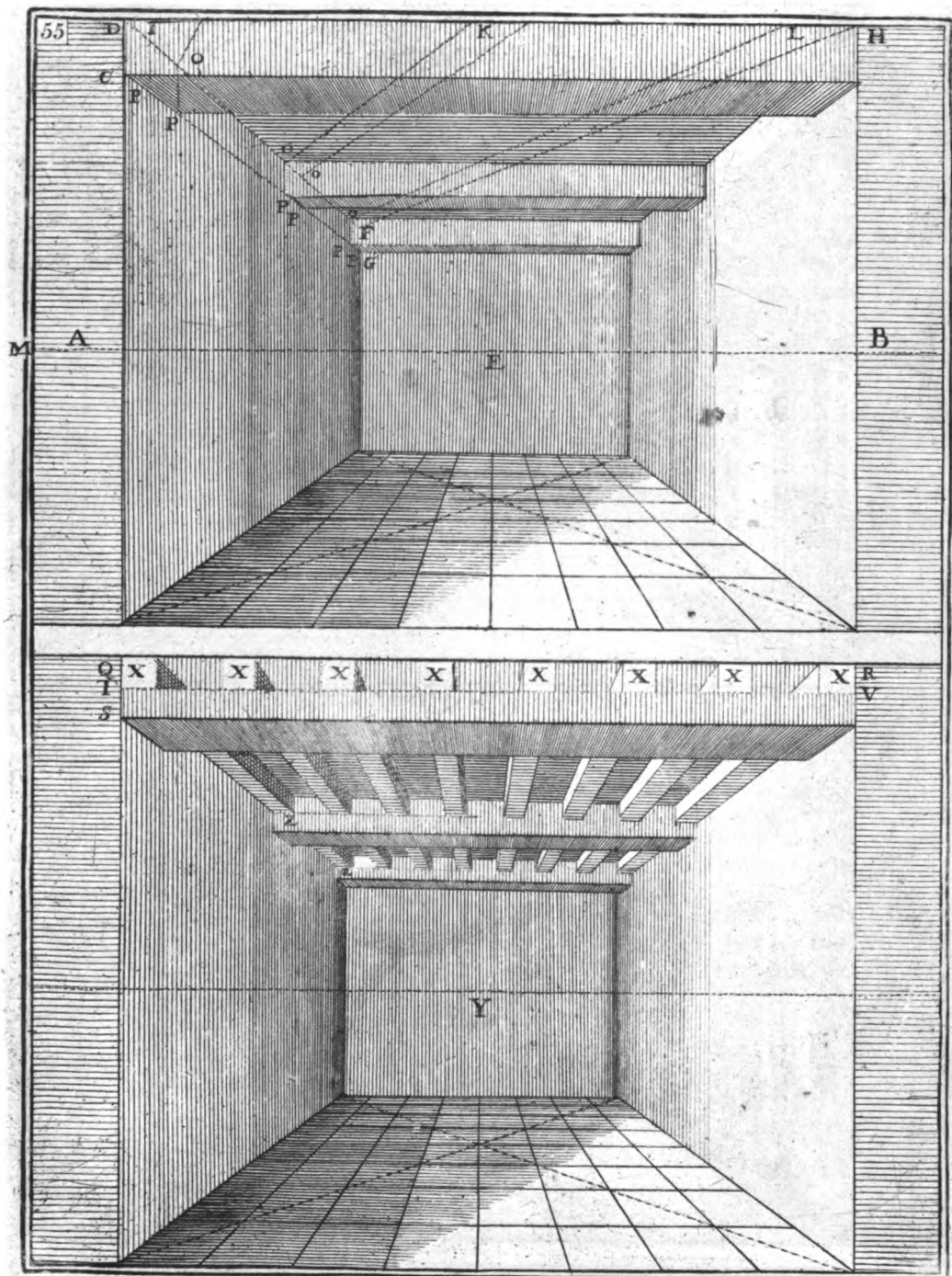
THE method of describing a window is perfectly the same with that of a door; therefore by learning to make a single and double cros, you are a master of windows. Suppose now it be required to make a window in the wall AB , of any breadth at pleasure, lay down its breadth on the base line, as DE , and from the points D and E draw lines to the point of distance F , and from the intersections GG , of those lines with AK , erect perpendiculars GH , GH giving the width of the window, which is here only two squares, or panes. As to the height, it is usually raised as near the ceiling as may be, but the breast part should not be above three feet and an half; this measure therefore is to be set on the perpendicular AB , as from A to I , and drawing a line from I to K , where that line intersects the perpendiculars GH , will be the breast-part. After the like manner drawing a line from L , the top of the window, to the point of sight K , its intersection with GH , will be the top of the window; by which means we shall have a long square, or parallelogram, to which a cros being added, will form a window. To make this cros, the space DE must be divided into two equal parts, each being about half a foot; then drawing this breadth M to the point of distance F , and from the intersections thereof with the ray AK , erect perpendiculars NO for the upright post, or stancher in the middle of the window. As to the cros pieces, you may add as many as you please, only observing that their thickness must be equal to that of the upright piece; therefore taking the measure M , set it off upon the perpendicular AB , as is P , and drawing lines from P to K , the points wherein they intersect the perpendiculars GA , GH will give the cros bars, and of consequence the window is finished. For its thickness, it is here only to be half that of the wall; to accommodate which, occult lines must be drawn from the point Q to K , and little parallels to the base being drawn from the corners of the window S , the point wherein they cut the line QK will give the thickness required.

This window ranges even with the wall on the inside, which is not very usual, windows being now frequently made with embrasures, or niches entering into the wall a foot, or less.

The method is precisely the same in both, only that instead of taking the intersections on the line ACK , they must here be taken in another line, re-entering into the wall as much as the window is made to re-enter, as appears from the lower figure, where the ray OK receives the measures laid on the base-line; and that all the rest must be drawn to the point of distance F , as in the former case, taking the thickness of the window between the perpendicular O , and the other F , which is the last. Lastly, when the window is finished, on the ray OK , and from the breadth of the wall OF , raise the perpendicular A , and draw it to the point K ; then from the lower corner of the window, in the points PP , draw a little parallel cutting AK in Q , which will give the thickness of the wall, covering the window a little, and shewing the thickness RP ; then from the point R erecting the perpendicular RV , cutting the ray TK in E : which will be the thickness of the top of the window. From the measures here laid down, one may make as many as one pleases, still observing the same order.



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Of CIELINGS.

IN forming perspective representations, there are many instances in which we must observe a method, somewhat analogous to the order practised by masons in raising a building from the ground. The pavement, or ground-work, is their foundation, whereon they raise walls, which they pierce in as many places as they please for doors and windows.

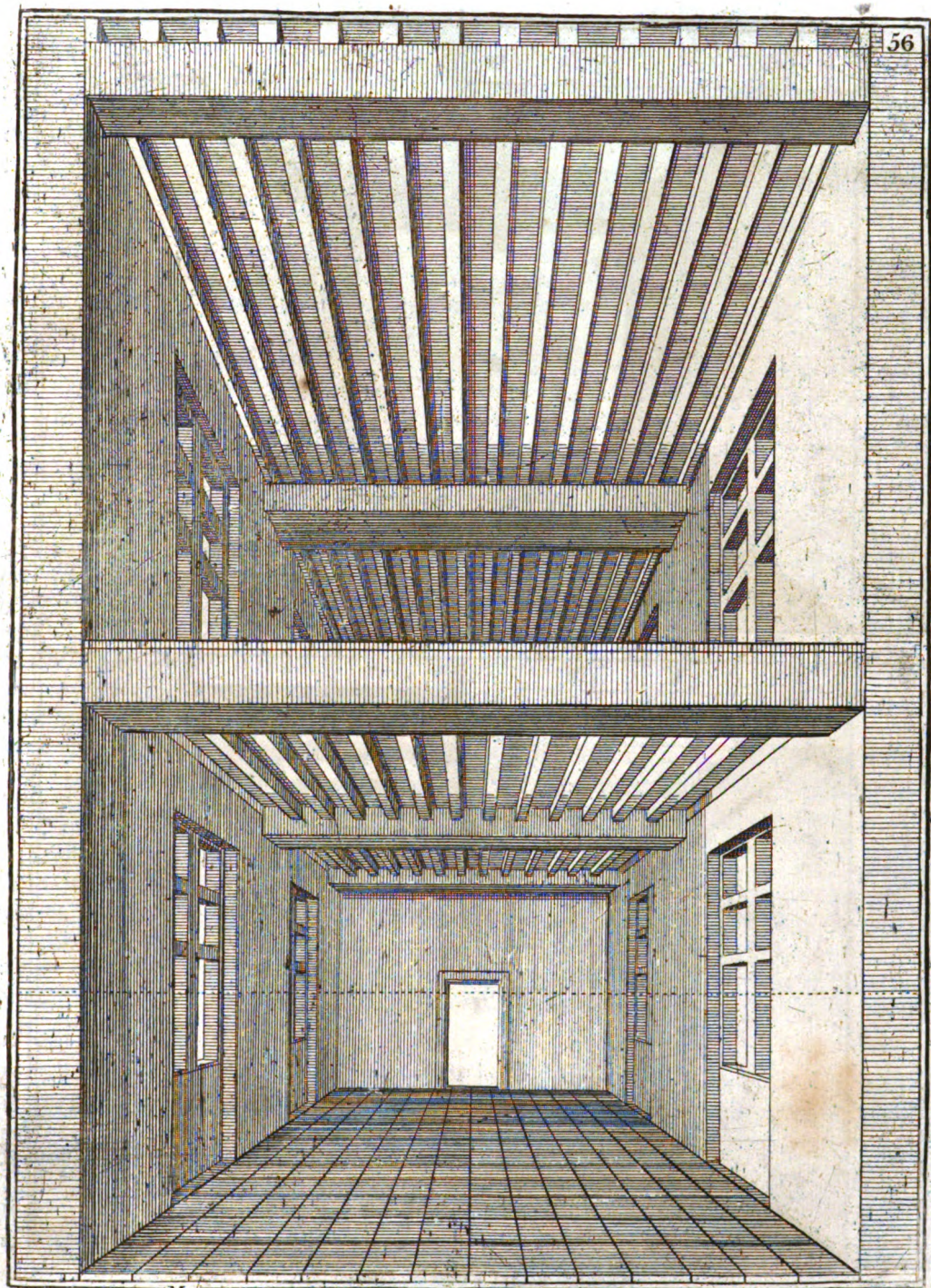
Suppose the walls A B raised, on which beams are to be laid, and over them joists or quarters. Having measured the square of one of the joists (which we here suppose a foot) it is to be carried to the top of the wall, as C D, and from the points C and D occult lines to be drawn to the point of sight E, which will give the rays C G D F. The same measure C D is likewise to be set on a parallel to the horizon D H, on which line the measures of all the intended joists are to be disposed, as will be shewn presently when I come to direct the drawing them. The measures of three joists are here placed at I, K, L; then drawing lines from all these measures to the point of distance M, and from the intersections with the line D F, in the points O O, &c. letting fall perpendiculars, cutting the rays C G in the points P, P, &c. and lastly, drawing parallels to the horizon through the points O and P, you will have the beams, or girders, orderly laid: as in the first figure.

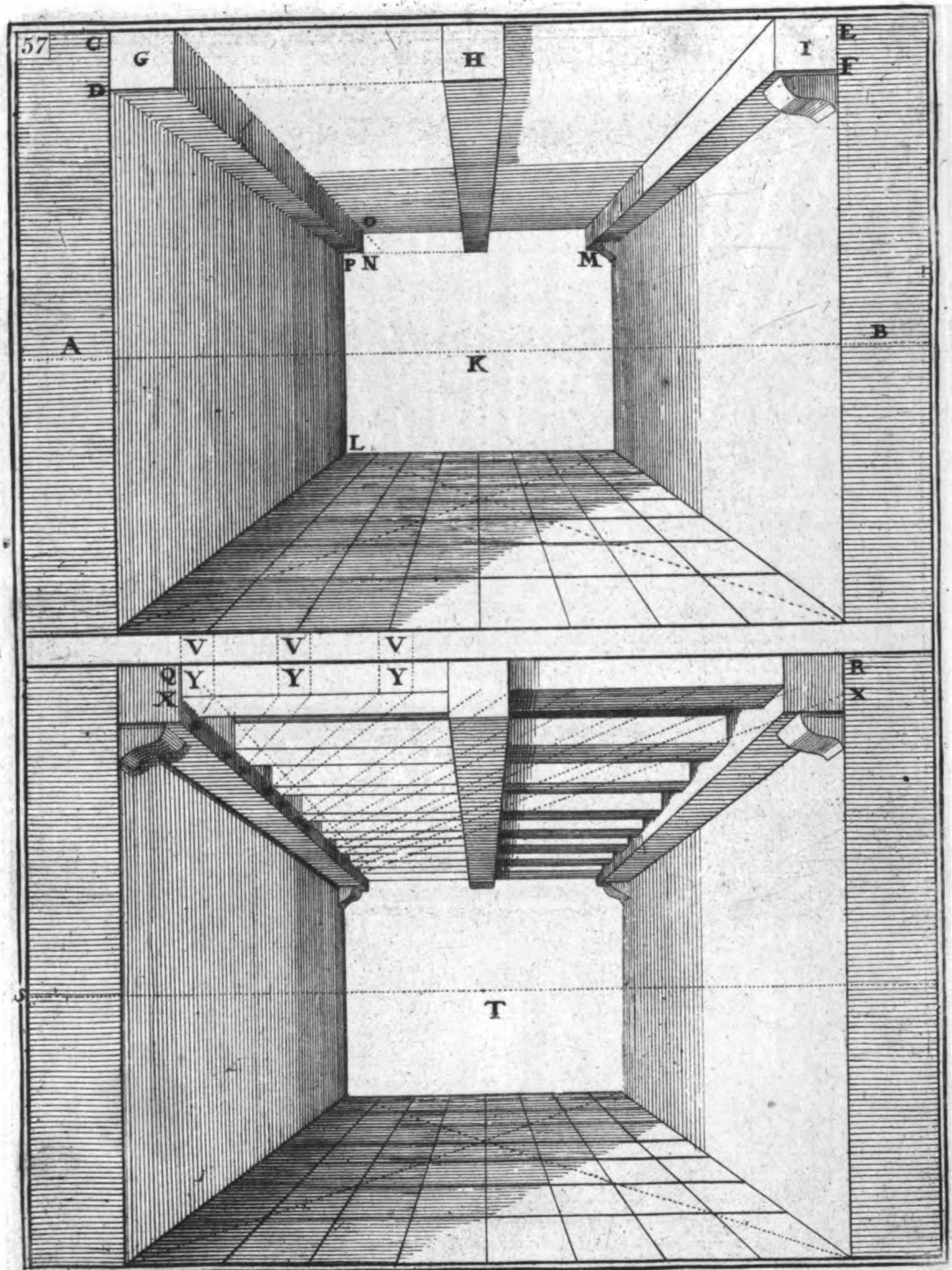
Now, to lay the joists upon the beams, or, more properly, to mortise them there, the line Q R, *Fig. 2.* is to serve as a base line whereon to lay the joists in such number, and at such distance from each other, as shall be judged expedient; the rule being usually to be twice their thickness apart from each other. To mortise them, take their thickness within that of the beam Q S, such as Q T, and draw an occult line T V; then between Q R, and T V, range the joists X, X, &c. and from all their angles that are visible, draw lines to the point of sight Y. And that they may not exceed the half of the further beams, from the middle of the first, which is the point T, draw an occult line to the point of sight Y, which will cut the other two beams in the middle of their depth, in the point Z; lastly, from the point Z draw parallels to the horizon, which terminating the lines drawn from the angles of X X X, &c. to the point of sight, will shew the joists mortised in those beams answerable to the others, in drawing lines from the joists to the point of sight. If you do not care to take so much pains, set the joists Z on the line Q R, as they are underneath; then draw lines boldly from one beam to another, from all the angles of X X, &c. to the point Y, and you will have what you require.

The CIELINGS of two Stories, shewn in Perspective.

THIS FIGURE is only added to shew the effect of the method just now laid down ; wherein it is observable, the number of stories does not render the practice at all the more difficult.

The joists are not mortised in the beams of the upper story, as they are in the lower.





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Another Disposition of CIELINGS in Perspective.

THIS method is performed in all respects like that just described, only that the disposition of the members and pieces that compose the cieling is to be changed; that is, the beams are laid long-wise, tending towards the point of sight, and the joists across, which is the reverse of the former.

Suppose the walls *A B*; on these, or on consoles jutting out from them, set the thickness of the beam *C D*, and through the points *C* and *D* draw parallels to the horizon *C E* and *D F*, between which you may put any number of beams at pleasure, in the manner that three are placed in this figure, namely *G H* and *I*, from all which, lines are to be drawn to the point of sight *K*; then through the point *P*, wherein *D P* intersects the perpendicular *L P*, draw a line parallel to the horizon *P M*, this will be the bound of all the other rays, as *G N*, *I M*, &c. lastly, from the point *N* erect a perpendicular *N O*: and so of the rest. Thus much for the beams.

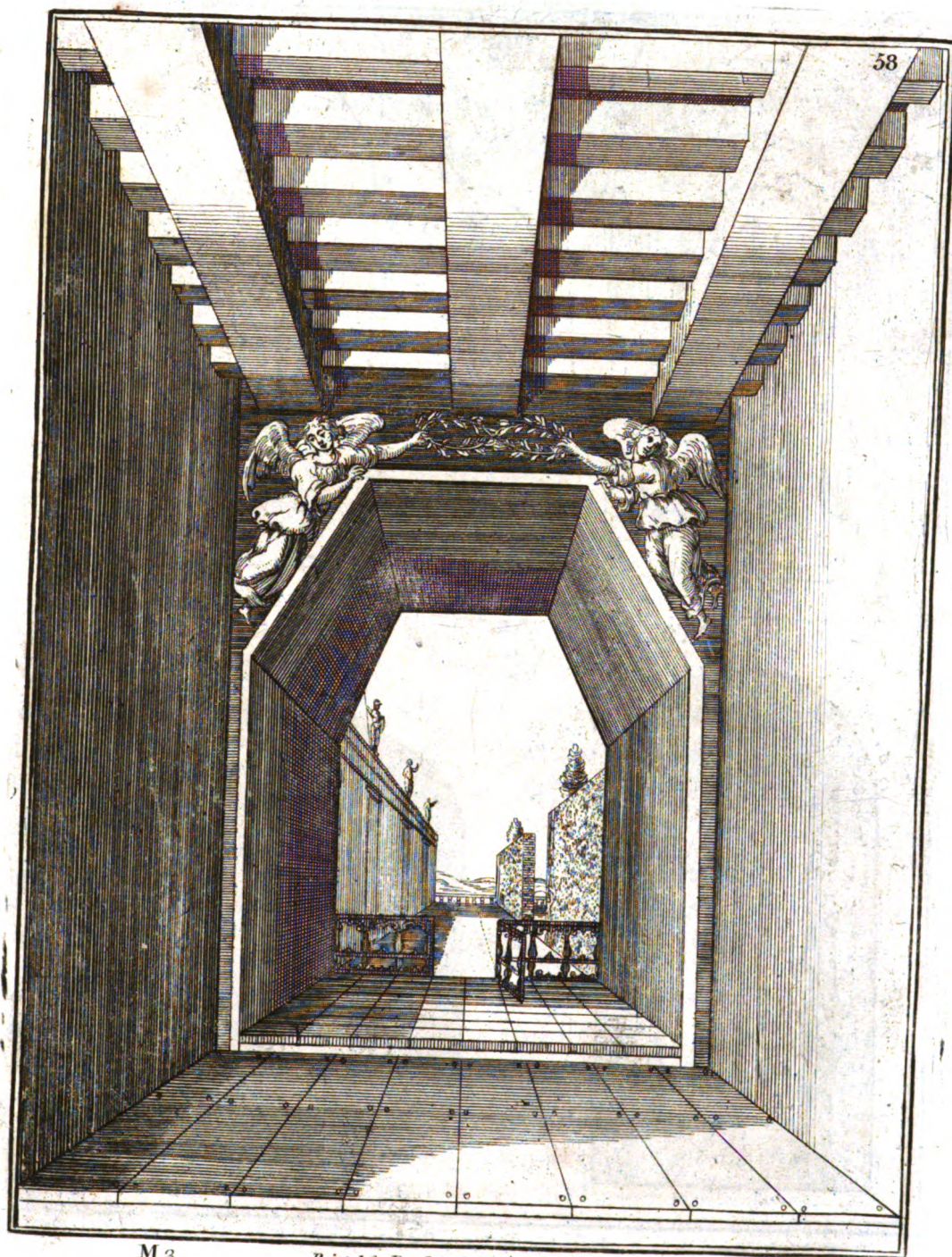
To lay the joists across the beams, set their thickness on the line *Q R*, as *V V V*, *Fig. 2.* and from the extremes of *V* draw lines to the point of distance *S*; and through the points of intersection with the ray *Q T* draw parallels to the horizon, as far as the beam of the other side. If you would mortaise them in the beams, take the thickness of the rafters within the beam, as *Q X*; and from *X* draw a parallel to the base line, as far as the other side *X X*; and between the two lines *Q R* and *X X* set the divisions *V V*, &c. which will form *Y Y*, &c. And from all the points *Y* drawing lines to the point of distance *S*, you will have the thicknesses of the bottom and sides given by the intersections with the ray *X T* in the points *Z Z*, &c. through which drawing parallels to the horizon, the cielings will be finished; as in the second figure.

Thus it is that simple timber cielings are put in perspective. If, after these, or in lieu of these, you will have a handsome platform of painting, or enrichments of other kinds, the instructions given in page 35 for exhibiting the plan of a garden, are applicable to these purposes, for by making use of the line *Q R* for a base line, you will easily shew on the ceiling the perspective appearance of any design; and making use of the line *Q R* for a base line, you may do what you please therein.

As to floors and pavements, such full instructions have been given for them in pages 30, 31, 32, 33, and 34, as to make the operation for shewing them very familiar and easy, and to open the mind for inventing what variety of them it pleases. Thus far we have had to do with the rooms, as hall, chamber, or the like, the several parts whereof are sufficiently described: the moveables therein shall be shewn hereafter.

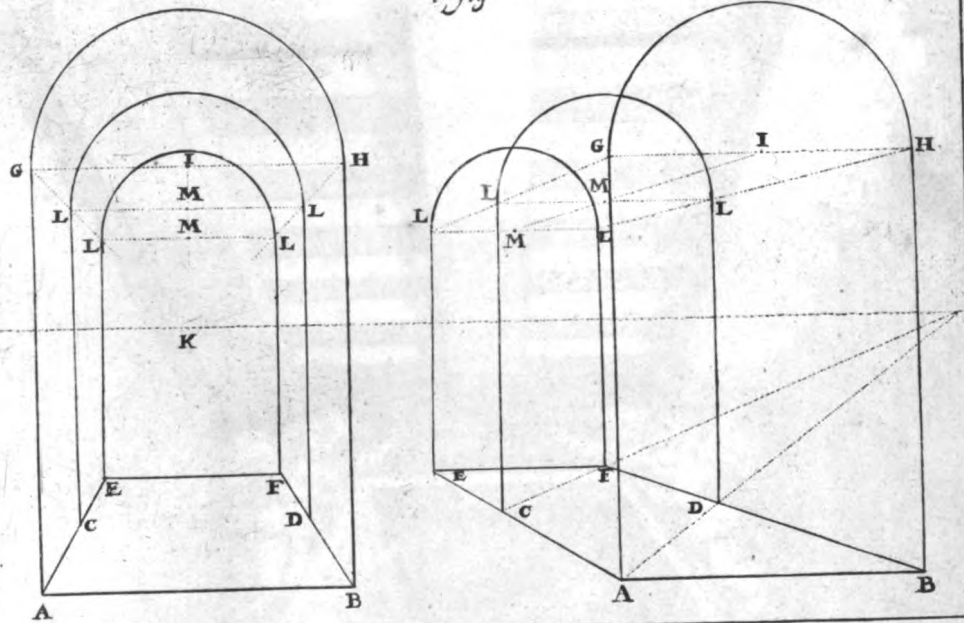
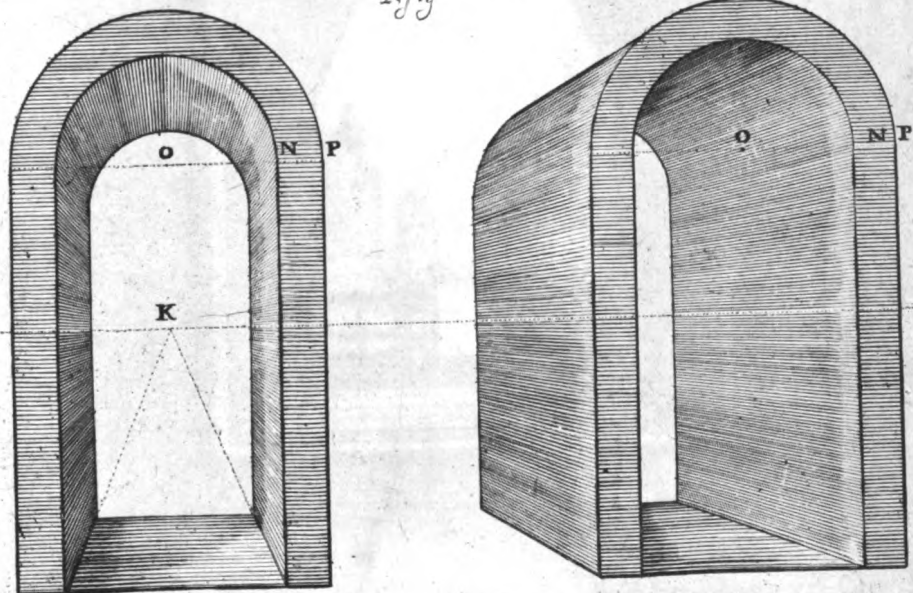
THIS figure shews the cieling just now described, distinct and clear of the lines where-with the former was embarrassed.

The construction of the gate shall be shewn hereafter.



M 3

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1. *fig*2. *fig*

To describe Circular GATES and ARCHES viewed directly in the front, or partly on the side.

HAVING given sufficient instructions for halls, chambers, windows, and *square* doors, or gates, we proceed to the practice of *round* ones.

Suppose then ABCDEF to be pilasters on a plan, in order to place arches thereon, divide the upper breadth G H into equal parts, in the point I, on which setting one leg of your compasses, with the other describe a semi-circle G H, for the first arch.

To make all the other arches of the same height and breadth, draw lines from the points G H to the point of sight K, and through the two points L, L, where those rays cut the perpendiculars C, D, draw parallels to G H. These parallels being divided into two, and semi-circles struck from them, as in the first, you will have the second and third arch. To find the middle of those parallels M, you have only to lay the ruler in the first centre I, and draw a line to K, which will cut them all precisely in the middle M M, and give the points for the semi-circles to be drawn from. The arches viewed in front, and those by the side, are all performed the same way ; as appears from the two first figures, and K is the point of sight both for the one and the other.

If it be required to make an edge, or band about them, of equal thickness, you are only to use one centre as O, from which the thicknesses N P of the lower figures are formed. The rest is all performed as already directed, by drawing lines to the point of sight K. The last figures shew how all kinds of simple vaults, only consisting of a semi-circle, are to be formed. As to the enrichment thereof, we shall have occasion to speak hereafter.

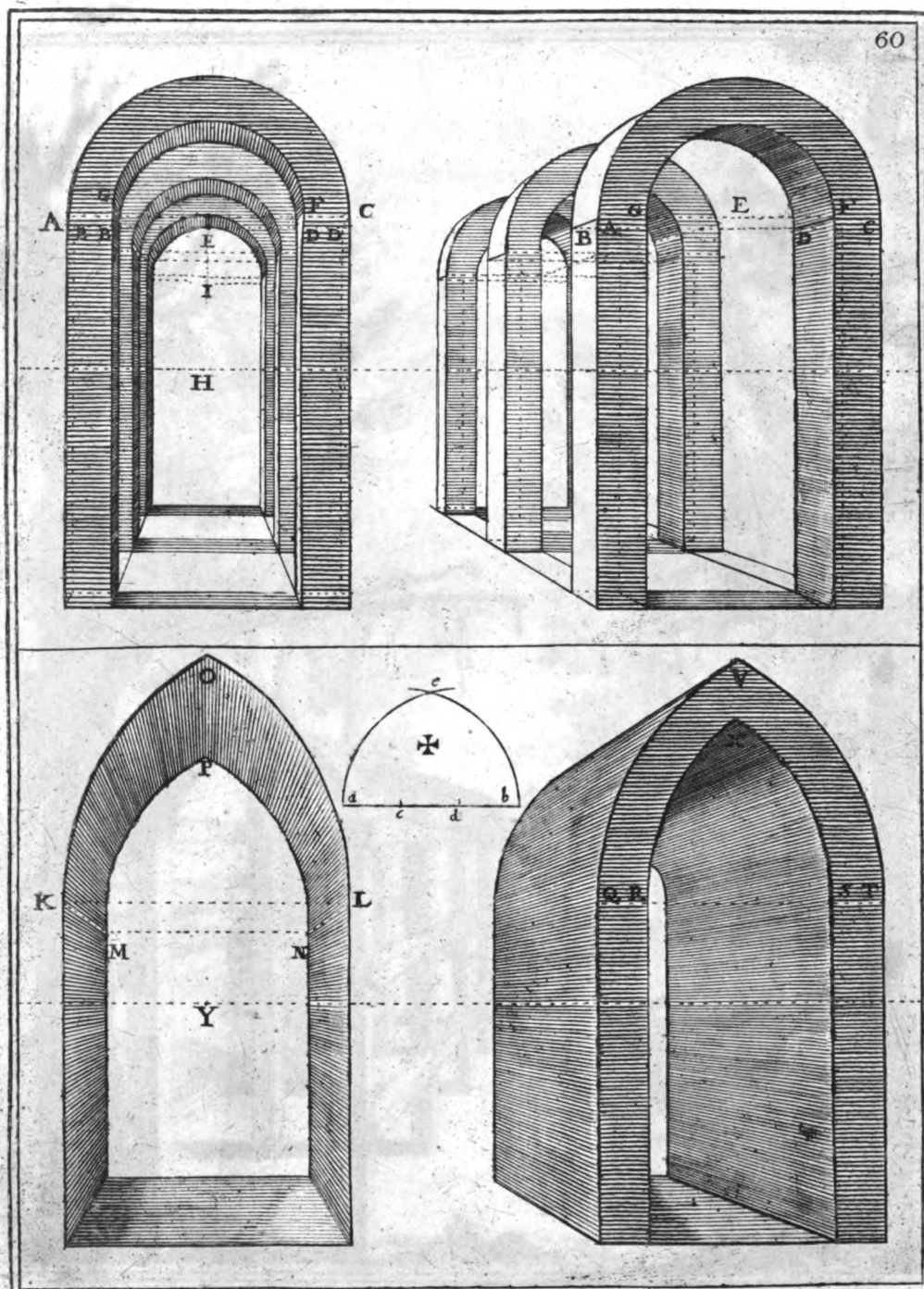
To describe Circular ARCHES over Pilasters, viewed as in the preceding plate.

THE out-line of the last plate readily directs how to perform this operation, the method being the same in both. In the present case there are a few more lines, but not any thing more of difficulty. For, drawing parallels to the base line over the tops of the several pilasters, and dividing the first of them into equal parts, from the middle E as a centre, describe the first semi-circle A C, without removing the compasses, from the same centre describe the band or thicknesse A G F C; lastly, from the centre E, drawing lines to the point of sight H, the ray E H will give the middle points of all the parallels for describing semi-circles over them all, from B D to the last, I. The method is the same for that in the side-view.

To describe the GOTHIC ARCH, or Arch in the third Point.

THE drawing of this is as easy as that of the circular arch. Having laid down the breadth K L, set one foot of your compasses in K, and directing the other to O, strike the arch L O; then removing your compasses to L, describe the arch K O, and you will have an arch *in the third point*, K O L. Do the same from M and N, and you will have the *second*, or *inner arch*, M P N. The second figure, *in the third point*, has a band or list all round it, which is described from the same centres: thus, for example, from the centre R the arches S X and T V are swept; and from the point S the arches Q V and R X. All the rest is drawn to the point of sight Y.

Another *third point*, or *terzo acuto*, is represented in the figure +; the diameter or chord whereof, *a b*, being divided into three equal parts, and one foot of the compasses set in one of the divisions, as *c*, and with the other the aperture *c b* taken, the arch *b e* is struck therewith; then removing the compasses to *d*, the arch *d a e* is struck, which is an arch in the *third point*, as well as the former; and either of them may be used at discretion. Those in old *Gothic* churches come nearest the former kind.





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Sequel of the former FIGURE.

WE here add an arbour of a garden, the performance whereof is in all respects the same as that of arches viewed in front.

Sequel of the foregoing RULES.

THE rules given in the two former pages, are applicable to a vast variety of designs. In this plate I shew one instance thereof in the perspective representation of an arbour, composed of five arches, of equal chords or diameters, and placed at equal distances behind each other. These are exhibited by the method laid down in pages 59 and 60.

*To describe, and put in Perspective, semi-circular Arches
and Doors.*

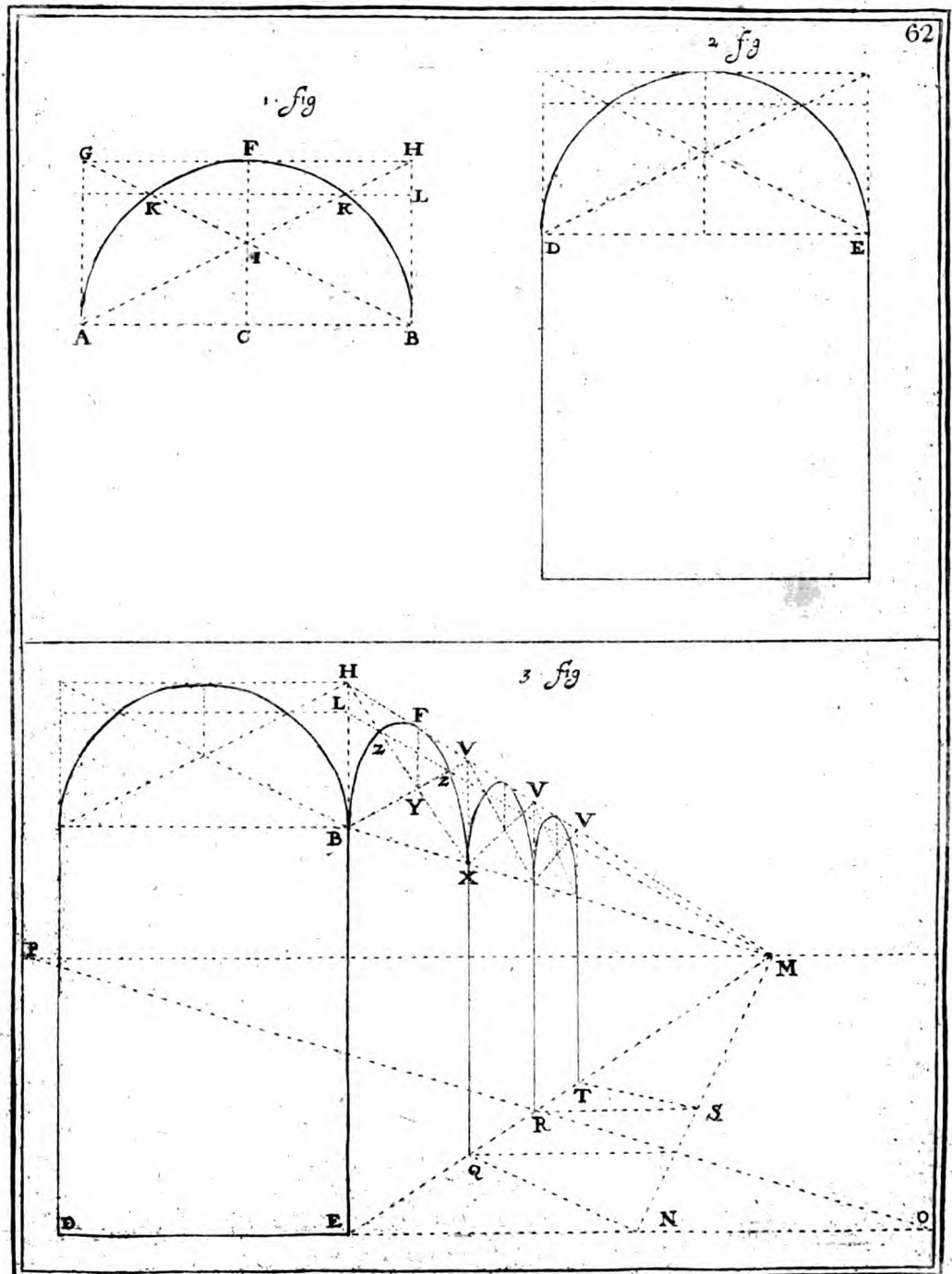
THE circle being somewhat difficult to put in perspective, requires a number of previous lines and points : to shew the method of procuring them is the design of *Fig. 1.* which ought to be well understood. To describe a semi-circle upon a diameter A B, there needs no more than to set one foot of your compasses in the middle thereof, in the point C, and with the other to sweep a crooked line from A to B. And thus is the semi-circle to be upon the elevation D E, *Fig. II.* for a circular gate or arch.

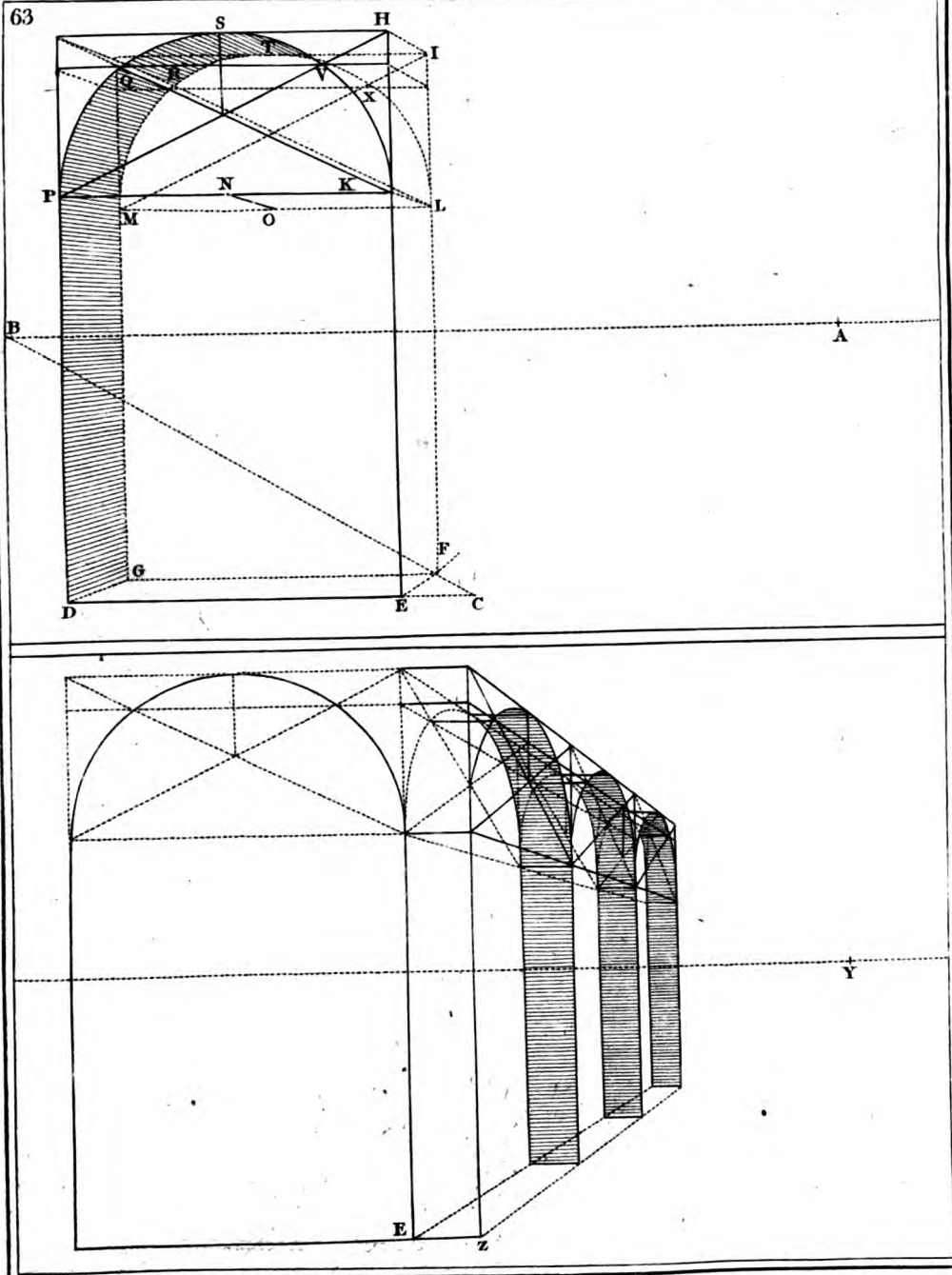
Now to put it in perspective, it is to be divided into any number of parts, and the more the better ; as already observed in page 28. and as I shall hereafter have occasion to shew, when giving directions for the exhibiting of cross vaults. The present semi-circle I shall only divide into four, and that by circumscribing it with a parallelogram, or long square, and drawing two diagonals intersecting each other in I, and the semi-circle in K K, and laying a ruler over C I, bisecting the arch in F ; lastly draw the line K K, cutting the parallelogram in L, which line L K is to be transferred to *Fig. III.* to put it in perspective.

First then draw a line from the angle E to the point of sight M, set off the measures of the diameter of the arch D F on the base line, as E N, N O, and from the point N draw a line to the point of distance P ; which cutting the ray E M in the point Q, E Q will be the width of the front arch D E in perspective. Then drawing a line from O to the point P, where it cuts the ray E M, in the point R, will be the width of the second arch. As there is no more room on the base line to take the third arch, a line must be drawn from N to the point of sight M ; and through the point R a parallel to the base lines R S. Now as R S is under the same angle with E N, it is the same breadth in its proper diminution, as has been already proved in the beginning of the book ; therefore drawing a line from S to the point of distance P, it will cut the ray E M in the point T, which gives the third arch.

Proceed then to raise perpendiculars V V, &c. from the three points Q R T, which intersecting the ray H M, will give the highest of the arches ; then from the ray B M, which gives the bottom of the semi-circle, draw diagonals B V, H X, which intersecting each other, give the place of the perpendicular Y F, that divides the arch into two ; and drawing the ray L M, it will cut the diagonals in two, and the arch in four ; lastly, connecting the points B Z, F Z X, with curve lines, you will have the first arch : and this method will give you infinite others. The same serves not only for arches and doors, but also for vaults, bridges, and other things that require the semi-circle ; for which reason it is that we decline speaking any thing farther of the two latter.

The same method may likewise serve for church windows, only one or two upright posts are to be added to fasten the glass to.





To describe, and put in perspective, double ARCHES and GATES, that is, such as shew their thickneses.

THE former page only shews the formation of the out-line: I therefore now proceed to the method of completing the same and exhibiting the breadths and thickneses of the arches, and their supporters, by only connecting the intersections of each by right lines: for example,

Having described the first line D E, and drawn lines from D and E to the point of sight A, set the breadth or thickness on the base line E C. From the point C draw a line to the point of distance B, and where it intersects the ray E A in the point F, draw the line G F parallel to the base line, which will cut the rays D A and E A in the points F G, and give the thickness required. Then from F G erect perpendiculars, and from H draw a line to the point of sight A, the intersection whereof with the perpendicular F I gives the height of that side. To find the chord or line of the centre of the inner semi-circle, draw a line from K, the extreme of the diameter of the semi-circle seen in front, to the point of sight A, which gives the point L, a parallel drawn through which will have the centre of the hinder semi-circle upon it, as N is the centre of that before. This line M L is to be divided into two equal parts, by drawing a line from N to A, through O. Then setting one leg of your compasses in O, with the other describe a semi-circle M L, to be divided like that in the preceding figure. Lastly, draw right lines from the divisions of the one to the other, that is, from the fore semi-circle to the hind one, to connect the two into one; as in the figure, M is joined to P Q, to R S, to T V, to X L, to K.

For circular arches, &c. viewed in front, as D E F G, there is no need of so many divisions, it being sufficient to find the line M L, in order for the describing of the semi-circle, which refers to the first N P Q; but I have made them designedly to avoid confounding the letters with the lines of the lower figure, where the arches are viewed obliquely, tending all towards the point of sight Y. Such arches would give their thickneses by repeating the operation already laid down for *Fig. I.* twice over, and joining the divisions of the one to the other, as already observed, and as is expressed in the present figure, to which having given the thickness E Z, I have drawn the line E in dots, and Z a full line, in order to avoid confusion, and to intimate, that whatever is done with dots, is not intended to be seen when the draught is finished.

Another METHOD of describing Circular Arches.

THE arches in front, which I have hitherto described, are all performed to the last exactness; but the process is a little long and tedious: I shall now add another, equally just, but much more expeditious.

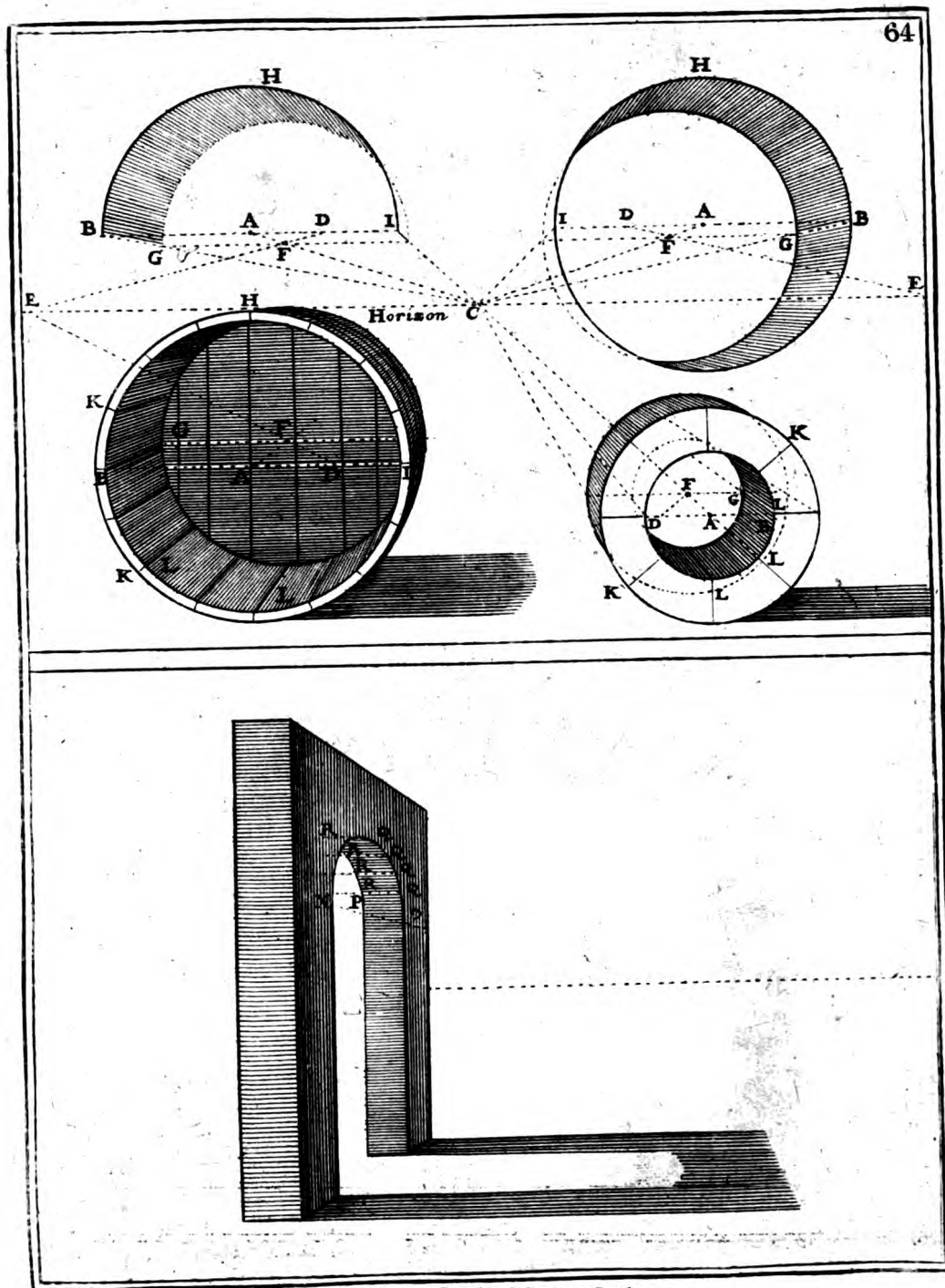
Having described a semi-circle, or a whole circle, B H I, from the centre A, from the same centre and the extreme of the diameter B, draw lines to the point of sight C; then setting the breadth, or thickness required, on the line B I, as here D A, from the point D draw a line to the point of distance E, and through F, the point where D E and A C intersect, draw a line parallel to the base, till it cut the ray B C in the point G; this done, setting one leg of your compasses in F, and in the other taking the distance G, describe a semi-circle, or circle, which will be the thickness of the arch, or sweep: as is seen in the four different figures, which are all performed by this easy process. All the lines K K, &c. in the third and fourth figures are to be drawn to the centre A, and the others, L, to the point of sight C. The same method may serve for circular windows built of stone, in which case the lines will represent the joints; as also for tons, vats, &c.

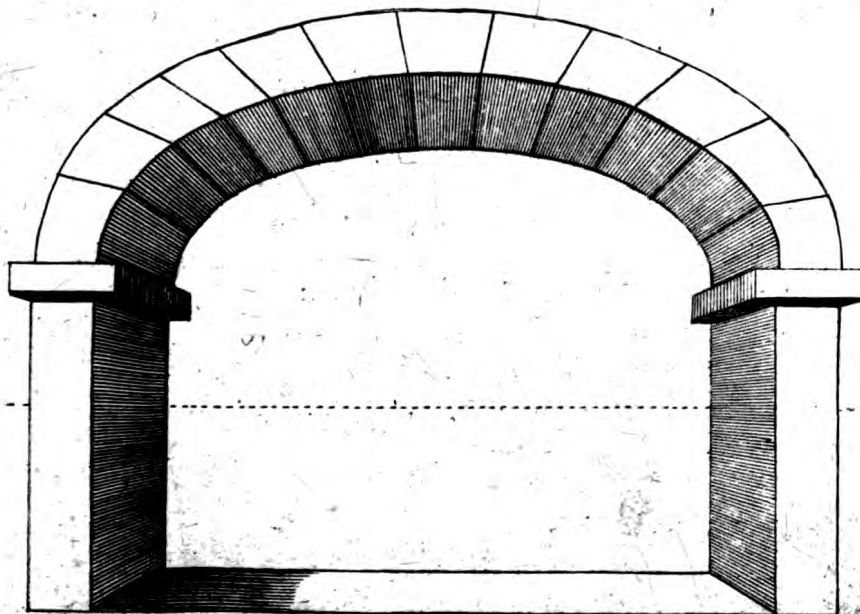
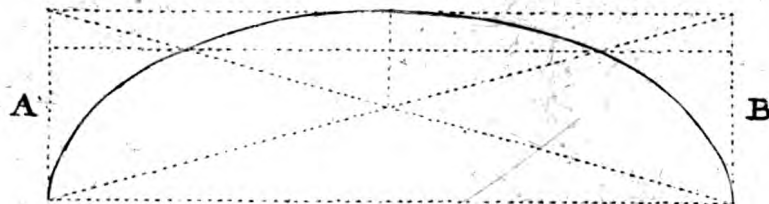
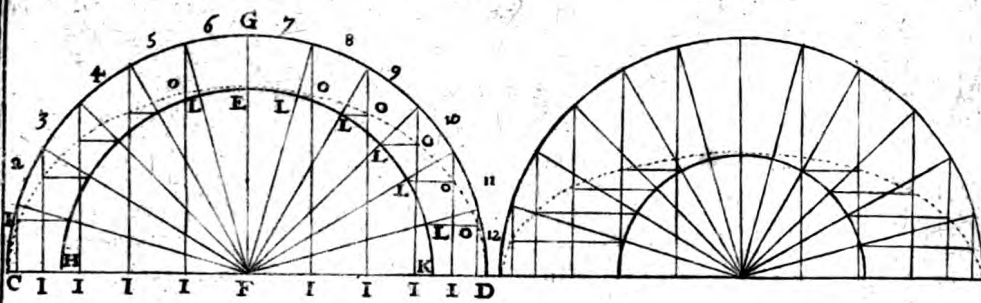
An expeditious method for ARCHES viewed obliquely in perspective.

THE following method may serve when a person is straitened, and does not desire to be so very exact; as also to avoid a multiplicity of lines, which in the preceding method is indispensable.

Having formed the first arch N O as already directed, across it draw little parallels to the base in any number at pleasure, as here Q Q, &c. then with your compasses take the breadth of the spring of the arch, as P O, and set it off on the little parallels Q, by this means you will have the points R R; through which a curve line being drawn, will form the thickness of the arch.

It is certain, that according to the rules of perspective, objects appear the larger as they are the nearer to us; of consequence, therefore, the line O P should be the smallest: but the difference is here so very small, that it is not worth the minding. Beside, I do not give this as a constant rule, but only for an expeditious shift in cases of necessity.





To exhibit ELLIPTICAL or FLAT ARCHES.

THE method of putting these arches in perspective, is the same with that of the semi-circular, as appears from the figure A B. All the difficulty is in finding the out-line, which is done two ways.

The first by two centres and a string, the method already mentioned page 4, for describing an oval; these flat arches being, in effect, semi-ovals.

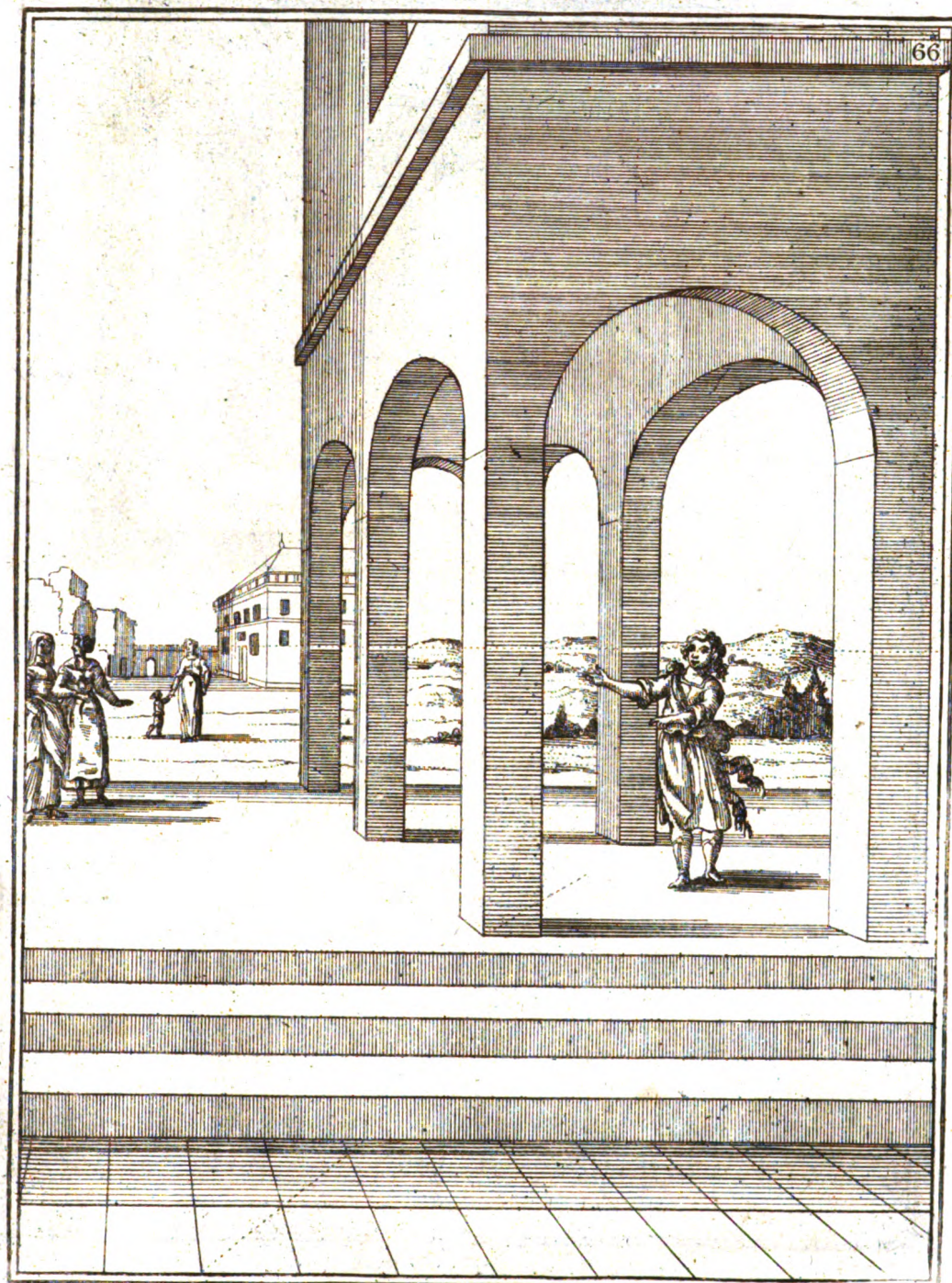
The second method is thus: Suppose the line C D given you to raise a flat arch upon of the height E F, from the centre F describe a semi-circle C G D, and divide it into any number of equal parts at pleasure, as is here done into twelve; and from all these divisions draw lines to the centre F; then again, from all these divisions draw perpendiculars to the diameter or chord C D, as are here the lines O I; this done, describe a semi-circle of the given height of the arch, as here H E K; and through the intersections made by this lesser circle on the division-lines of the greater, draw little parallels to meet the perpendiculars which fall from the same divisions, for instance L O, L O, &c. and the several points O connected together, as is here done, will give you the arch required.

The other figure makes the arch still flatter, and by the same rules it may be made of any lowness at pleasure.

The figure underneath shews one of these arches in perspective, such as it should appear, when finished, in a front view. I say nothing of the method, as having already intimated it to be the same with that for the semi-circle.

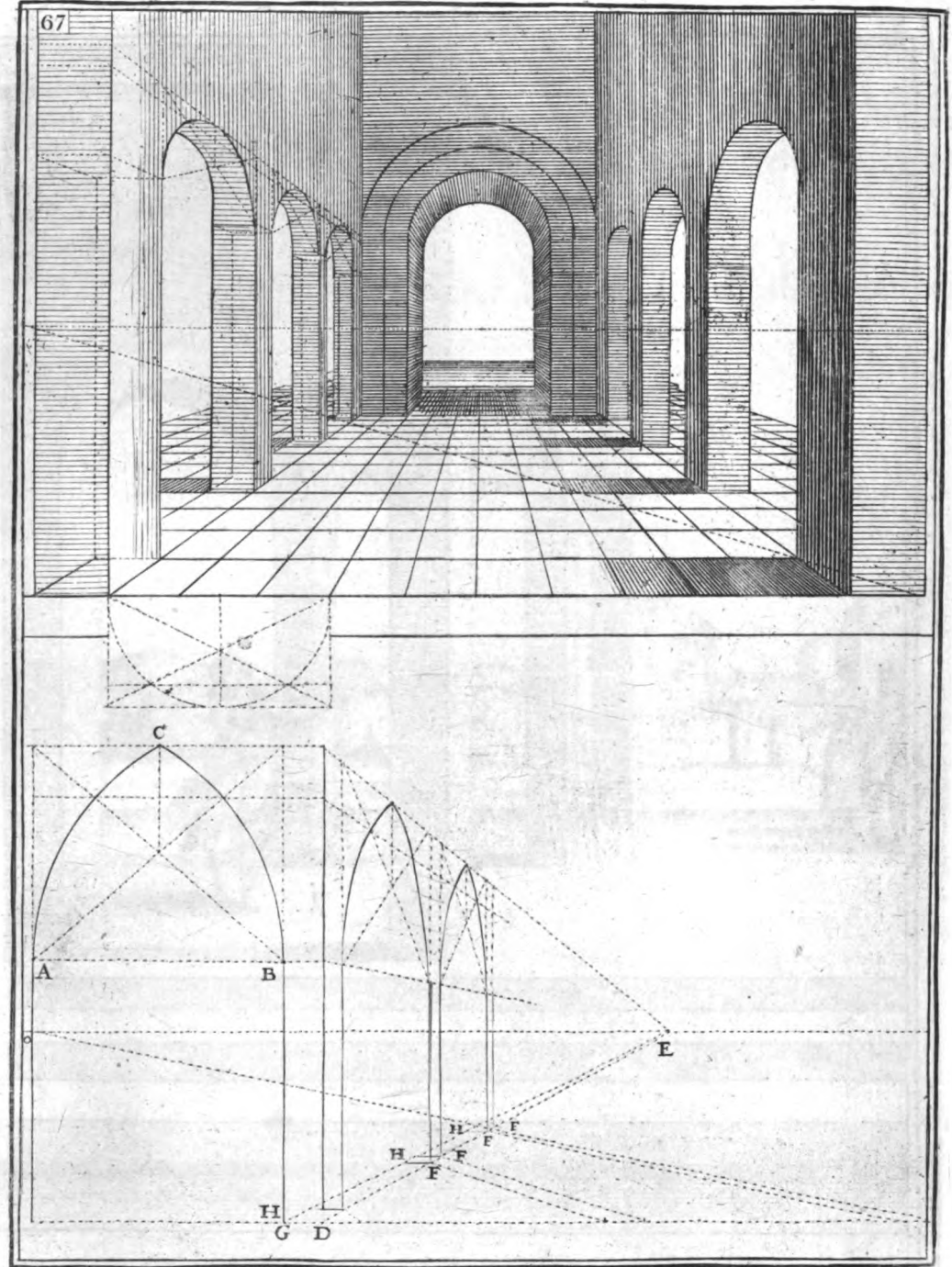
IN the figure here represented, you have an instance of the fine effect of ARCHES when they are well centred, that is, when their just rotundity is given them, in their different perspective situations.

As for the steps and figures, I shall have occasion to treat very particularly of them hereafter.



N 3

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To raise ARCHES upon Pilasters or Columns.

IT looks as if there were no pilasters formed in the last figure, for which reason I determined to add this, which may shew, that the method is precisely the same, and that all required farther, is to leave room for the breadth, &c. of the pilaster between every two arches, which is done by means of the plan, or base line ; as already directed for *circular arches*.

GOthic ARCHES.

GOthic ARCHES and VAULTS, called also arches in the *third point*, see page 60, are performed in the same manner as the semi-circular ; so that having done one, you will do the other with ease. The figure shews the rest. As to the out-line, I have already shewn that nothing is more easy. The breadth A B being given to form an arch of, open your compasses to the breadth, and setting one leg in A, with the other describe the arch B C ; then removing them to B, describe another arch A C ; and the point wherein the two intersect, will be the point or apex of the arch C.

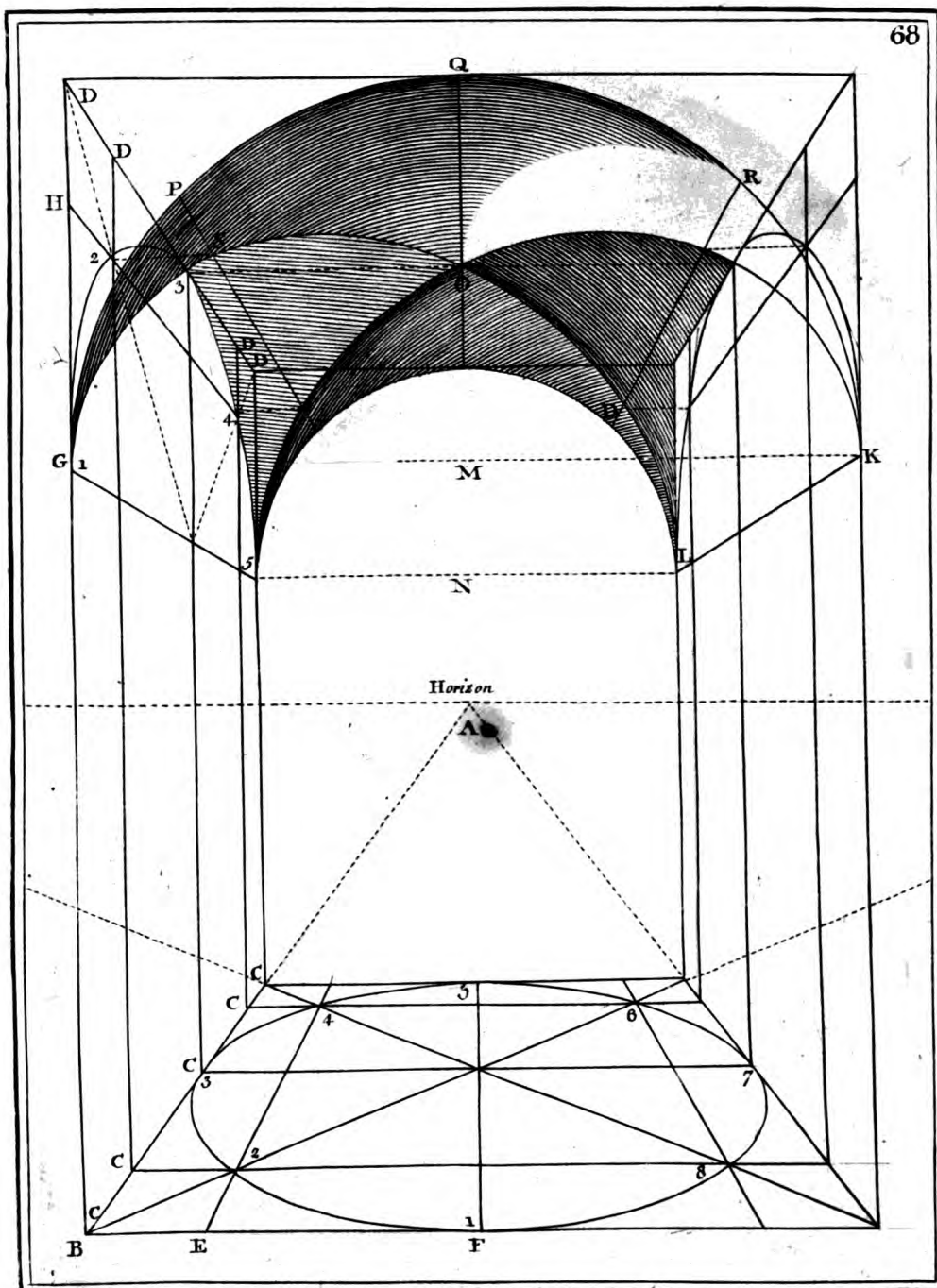
As the other arches seen on the side view are performed after the same manner as the semi-circular, page 62, I shall not repeat it. All the business is, that here are pilasters between each two, that are not in the other. This may serve to confirm and exemplify what I have already said, that all that is to be done is to draw lines from these divisions on the base to the point of distance O, which will cut the ray D E in the points F F, &c. on which points perpendiculars are to be raised ; then setting off the thicknesses G, and drawing the ray G E for the breadth of the pilasters H, from the same point H erect perpendiculars, to be connected to the other by the right lines, &c. as in the semi-circle.

To find CROSS VAULTS in perspective.

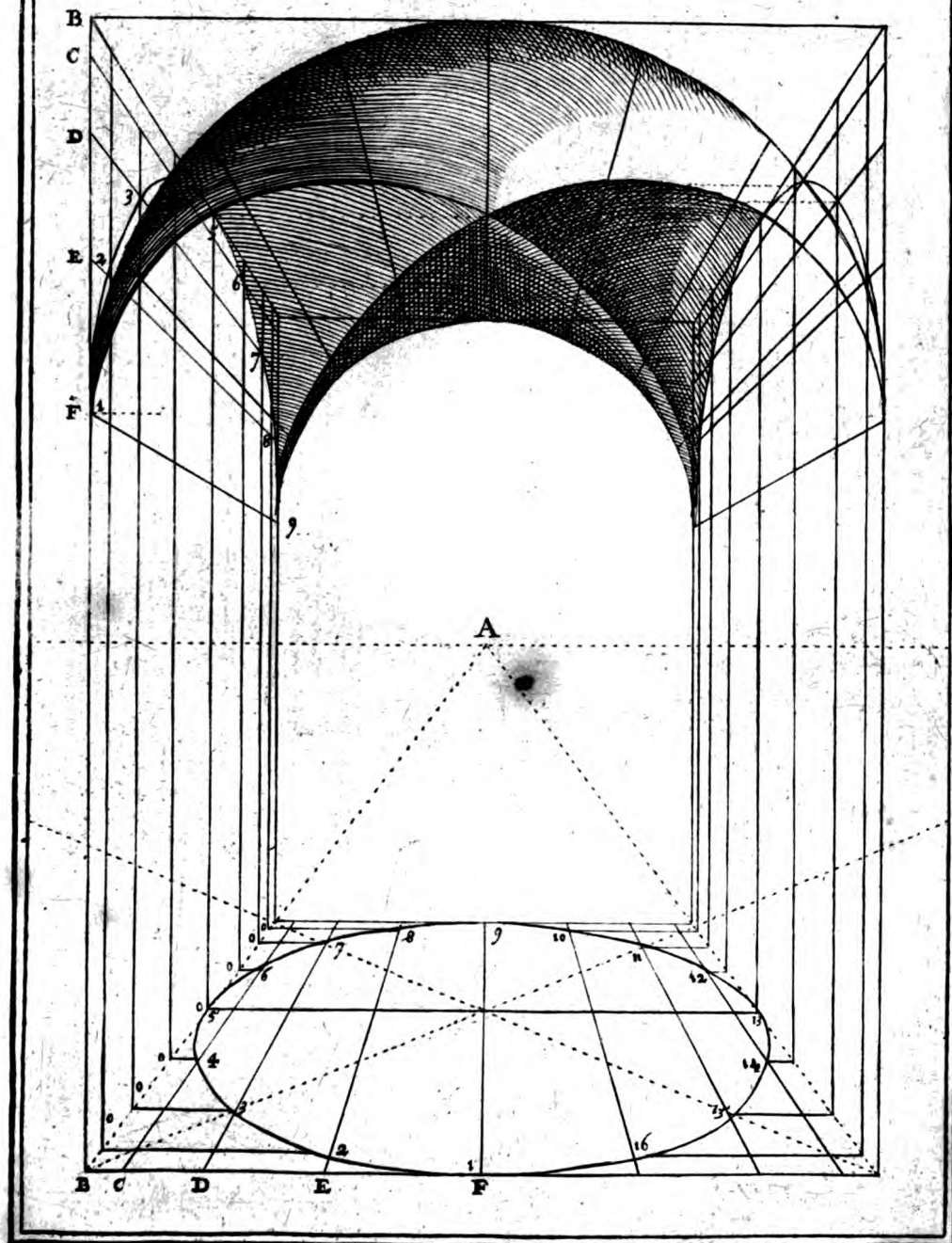
THE reader must remember, or have recourse to, what I have said in page 28. where, speaking of putting a circle into perspective, I divided it, for the greater exactness, into sixteen parts; but as in such a division there necessarily occur a great number of lines, I have here chose to take up with a division of eight parts, which if it be the less exact, it will be the less confused. The other division I shall resume in the following page.

Having then formed a plan of a circle divided into eight parts, 1, 2, 3, 4, 5, 6, 7, 8, parallels to the base line are to be drawn through the several divisions thereof, as far as the ray B A, which will give the points C C, &c. on which erecting perpendiculars C D, C D, &c. the first of them, B D, being the line of elevation, all the measures of the semi-circle B E F must be set thereon, by which means you will have the points D H G; from which rays are to be drawn to the point A, and in the intersections of the perpendiculars C D, you will have the same divisions as in the first, second, third, fourth, and fifth PLANS. For a semi-circle, draw curve lines as in the arch of the first side, the divisions whereof are to be transferred to the other, in order to have two collateral arches from the centre M; the other in the bottom 5 L, from the centre N. And thus you have the four arches ordinarily found in cross-vaults. All that remains is, to make the cross, or crooked diagonals, resting on the corners G 5, K L, and passing through K or the groin O.

Now as the circle is divided into eight parts, the arches, which are but halves of circles, are only to contain four parts; the semi-circle G K, therefore, is to be divided into four parts, in the points G P Q R K, which are to be drawn to the point of sight A, as far as the bottom of the circle 5 L. Now what follows is the great secret of the cross, namely that parallels to the horizon are to be drawn from all the intersections of the circle on the side 1, 2, 3, 4, 5, in such sort, as that G, which is the first division of the circle, touch the intersection 1 in a point; that from 2 a parallel be drawn to the second division P, and the point S to be marked; that from 3 another parallel be draw to the third division which will give O, the place of the key or groin; and from 4, another to the point T; lastly, connecting G S O T L with curve lines, you will have a diagonal; and doing as much for the other side, you will have the entire cross, and the vault complete.



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To draw the same VAULT more accurately.

A PERSON who has a good notion of the former method, will find no great difficulty in managing this; all that is required being to double the lines, and take care of the intersections, which are here more numerous, by reason the circle is divided into more parts:

How to form the plan is taught in page 28. Having produced the circle, and obtained the divisions on its periphery, from these divisions draw parallels to the ray B A, and their intersections will give the points O, O, O, &c. from which perpendiculars are to be raised. The rest of the process is the same with the method laid down in the preceding page, over which this has the advantage of exactness, and enabling you to draw the vault more easily, because the divisions are closer to each other.

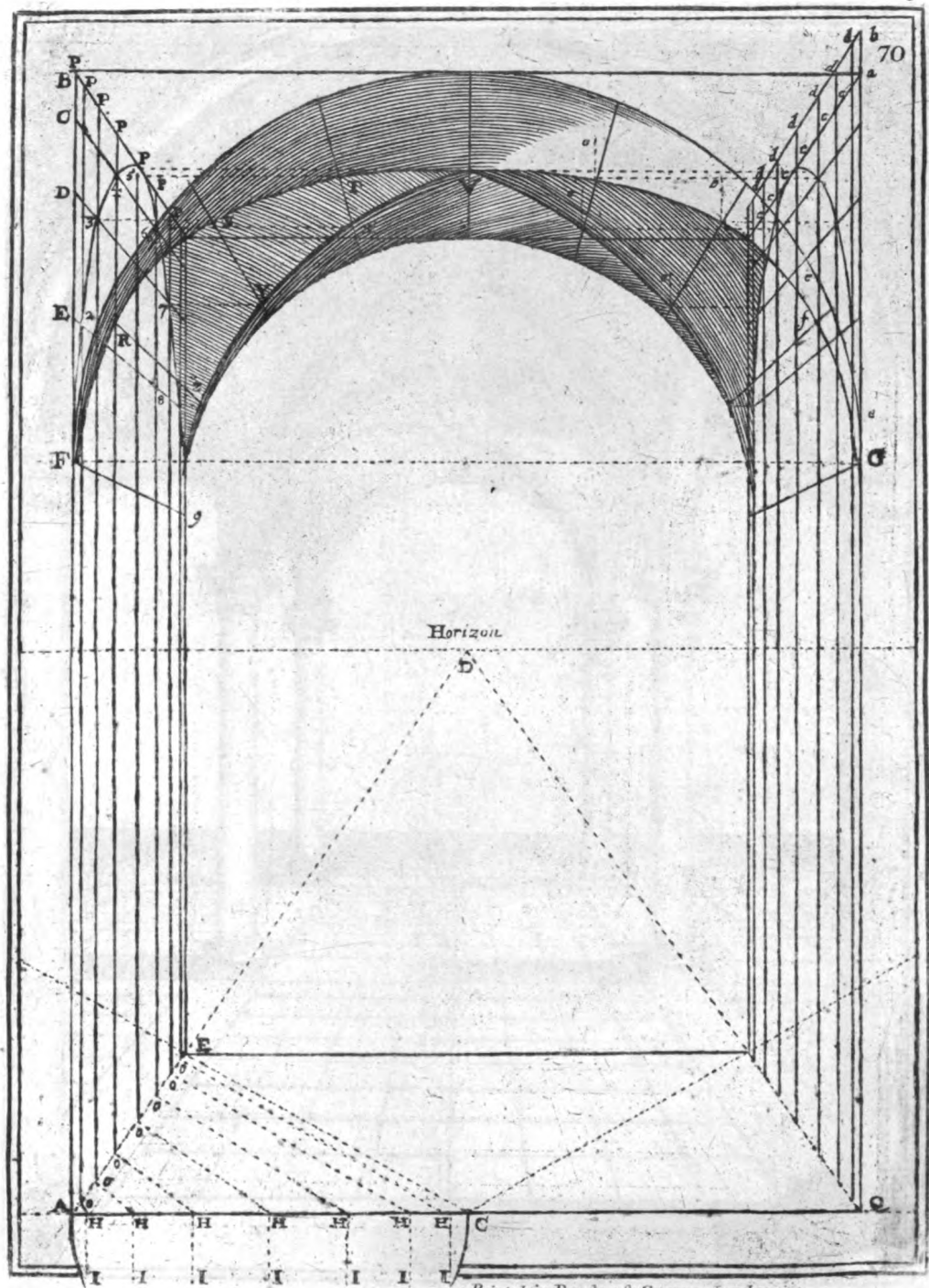
To form narrow VAULTS.

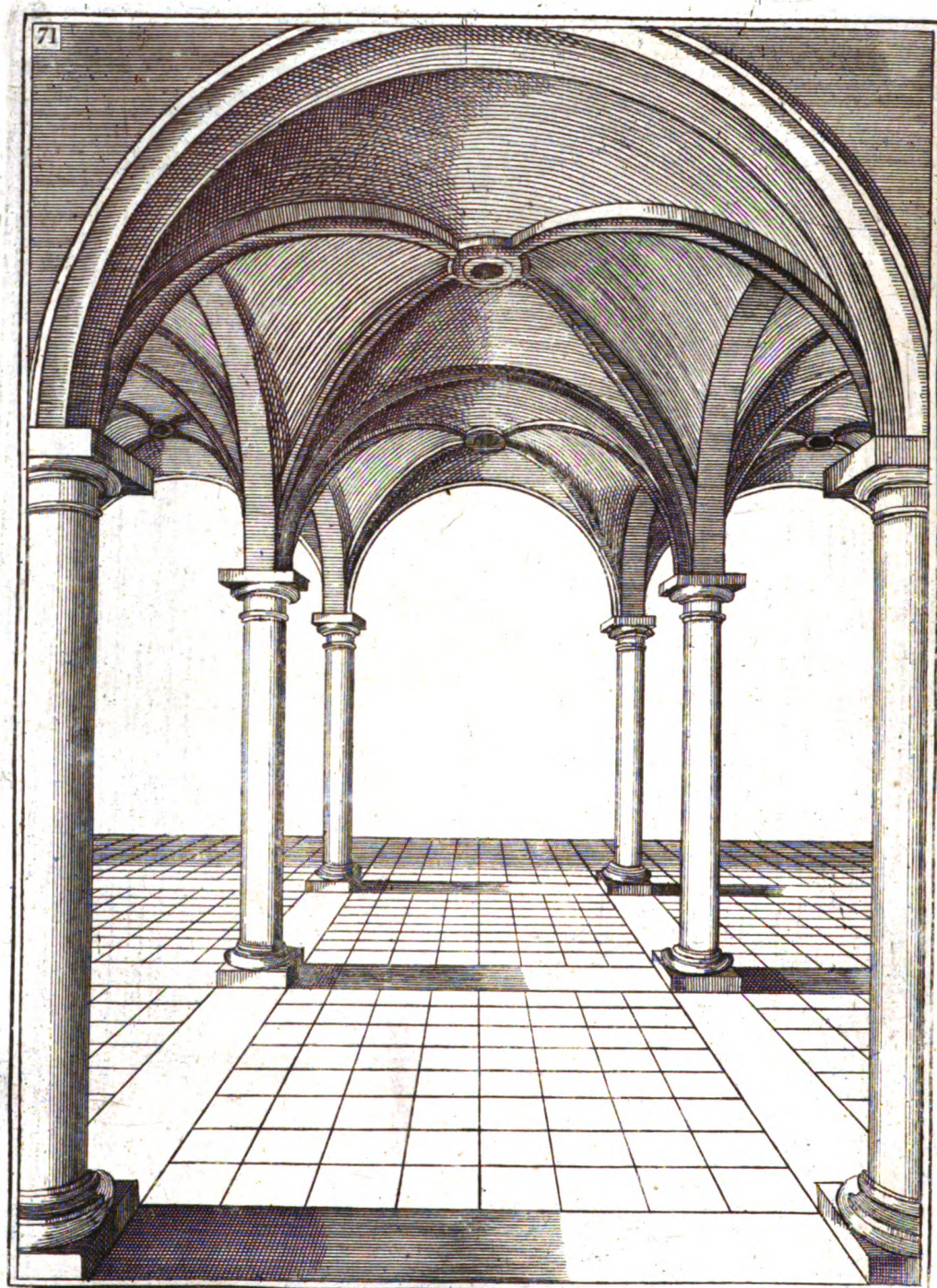
THERE are two processes in this figure ; the one for contracting or straitening side-vaults ; the other for giving the thickness to the crofs. I shall begin with the first.

The two methods for vaults already laid down, suppose them perfectly square, that is, that their breadth and depth, or distance, is equal ; both in those represented in front, and those in side-views. But a person only instructed in these, would find himself strangely at a loss were he put to construct a church, where the side arches are usually much narrower than those in the front or middle.

I proceed, therefore, to offer you an expedient whereby you will be enabled to make the side arches of what dimensions you please, and that by means of the base line A Q. Suppose then the front arch A Q forty feet broad, and the side-arches limited to fifteen or twenty, you are now, according to the instructions in page 17. to set this measure on the base line, and to draw a line from the same to the point of distance, by which you will have the depth of the same figure in A E. Thus, in the present example, A C being supposed twenty feet, a line drawn from C to the point of distance, (which here is supposed beyond the limits of the paper) cuts the depth twenty feet in the point E ; then returning to the base line, an arch or semi-circle is to be struck on the line A C, and divided into as many parts as the larger arch F G has divisions, namely, eight ; and from the several divisions perpendiculars H H to be let fall on its diameter A C, and from the points H, lines to be drawn to the point of distance, intersecting the ray A E in O, O, &c. Perpendiculars O P, O P, &c. are to be raised ; then the plan of the semi-circle F G is to be made in some separate place, and the divisions thereof transferred from F to B. And since the plan of the preceding figure, see plate 69, is equal to F G, take the divisions of half of it, B C D E F, and transfer them upon the perpendicular A F ; and from the points E F D C B draw lines to the point of sight D, and through the intersections which these rays B C D E F make with the perpendiculars O P, draw curve lines, which will form the side-arch. Then drawing parallels through the intersections 1, 2, 3, 4, 5, 6, 7, 8, 9, to the divisions of the arch F G, you will have points F R S T V X Y Z, to form the crofs after the manner already mentioned.

For the thickness of the nerves, or branches, a little line of elevation must be made, *a b*, which I have here added at the top of the perpendicular raised from Q. This line A B, being drawn to the point of sight D, cuts all the other perpendiculars in the points *c d*, and this gives the proportionate heights to each perpendicular raised from the intersections of the crofs, that is, from the intersections made to find the out-line of the crofs : the first elevation *a b*, for instance, gives the first perpendicular G *e* ; the second elevation *c d* gives the second perpendicular F *e* ; and so of all the rest in their order, which all give points *e e* ; and which being connected by a crooked line, give the thickness of the nerves or reins of the vault : as is seen in half the adjoining figure.





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A VAULT on the Principles of the preceding Rules.

THE several rules already delivered, suffice for the constructing the various arches of a complete VAULT, as that hereto annexed. The rules for the columns, or imposts, I shall have occasion to shew hereafter.

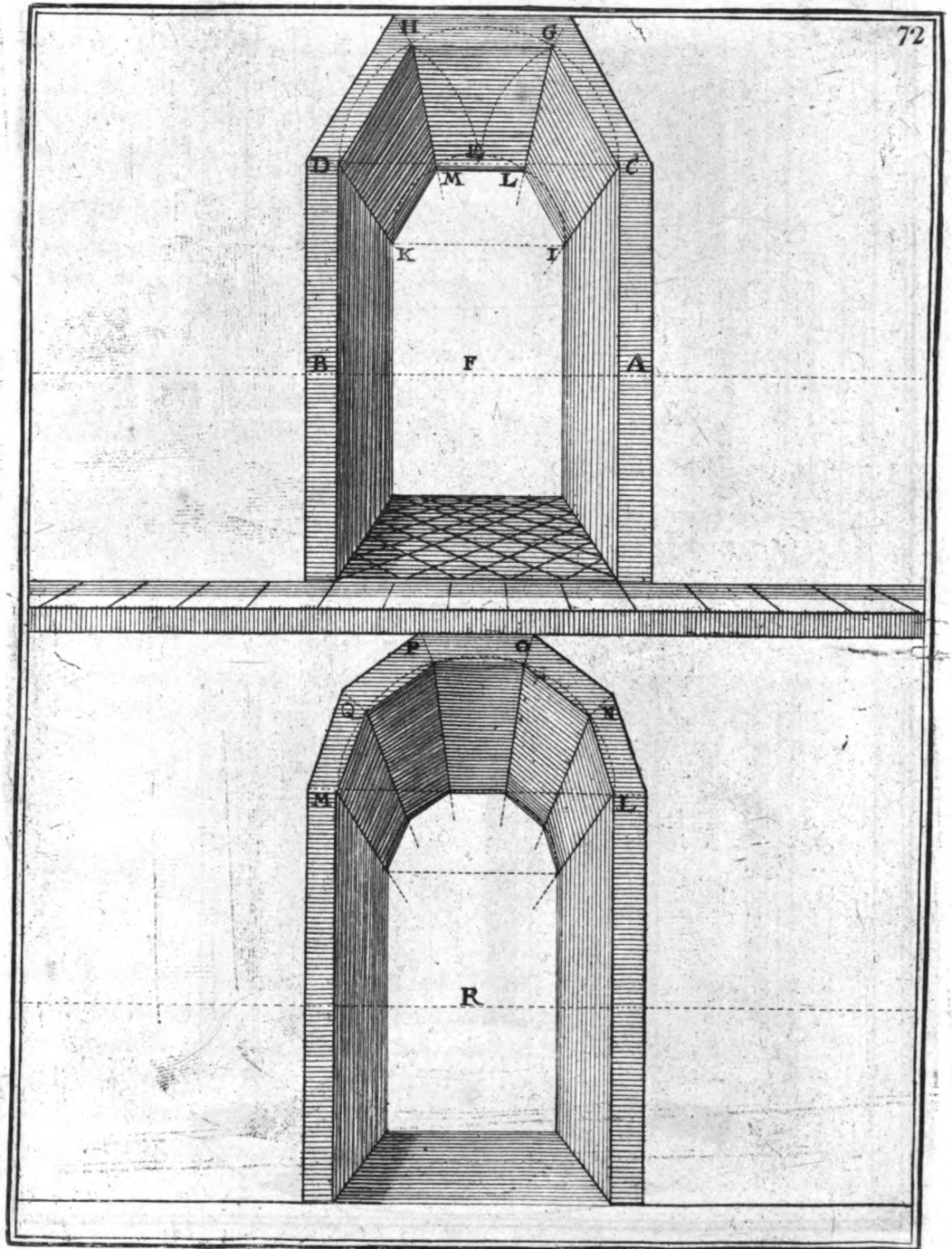
To exhibit ARCHES with three Sides.

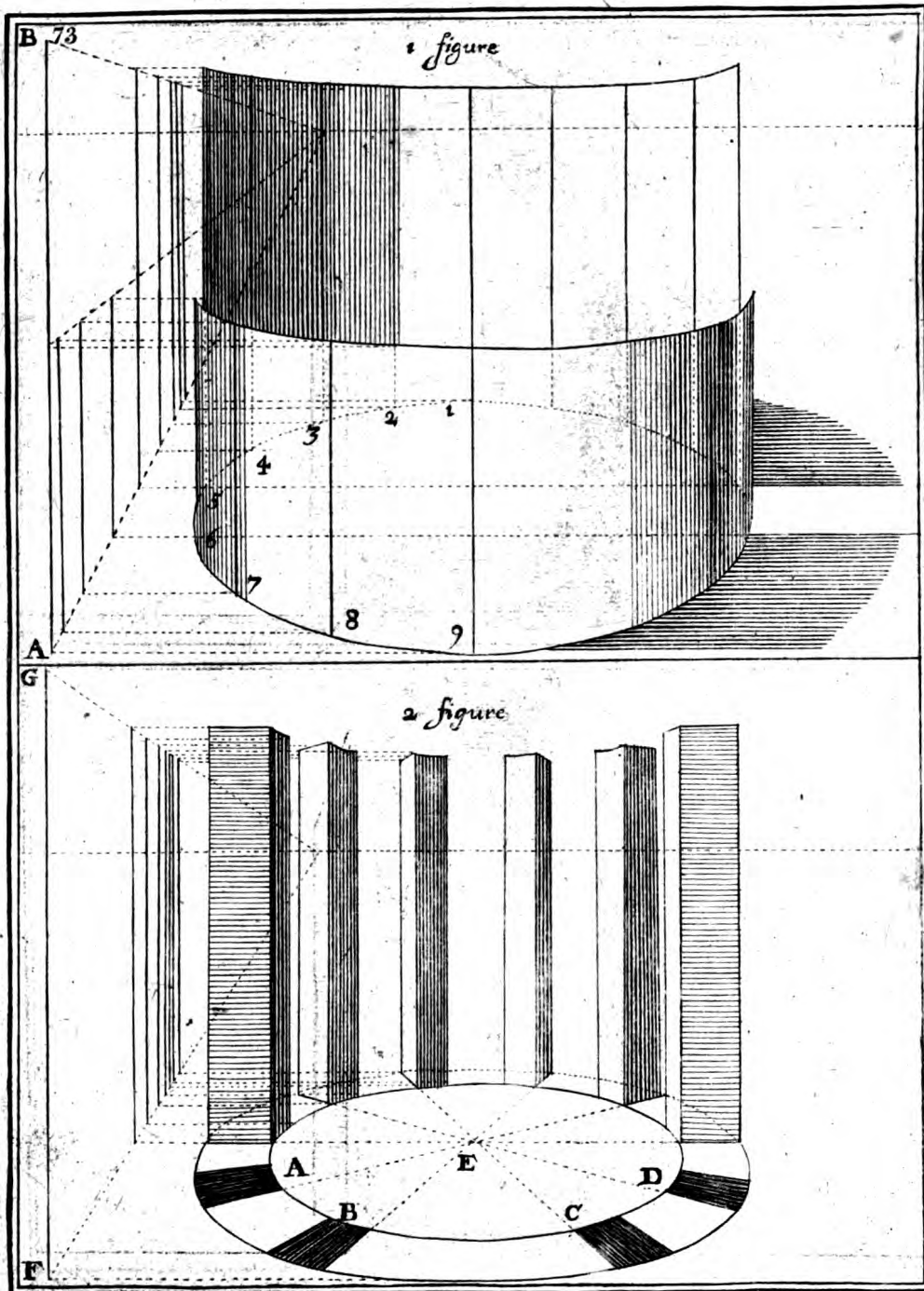
THERE is another sort of cieling which sometimes serves for a vault over doors and galleries, and even churches, having a pretty good effect in perspective, and easy enough to perform. I have added it here after the circle, by reason it is formed of a semi-circle divided into parts.

Having raised the walls A B, describe a semi-circle including the whole breadth C D ; then holding the compasses open to the width of the radius E C, and fixing one point in C, with the other strike an arch upwards, cutting the semi-circle in G, and another arch E H from the point D ; then connecting the four letters C D G H by right lines, you will have a semi-hexagonal arch. A semi-circle is likewise to be drawn upon the breadth I K, for the bottom of the arch ; and to divide it, lines are to be drawn from the angles of the former to the point of sight F ; at the intersections of these rays with the lower semi-circle, right lines being drawn, will form the arch I L M K.

To exhibit an ARCH with five Sides.

THIS arch is performed after the same manner as the former ; all the difference lies in the division of the circle, the first being into three, and this into five. Accordingly the semi-circle L M being divided into five parts, N O P Q, and lines drawn from all these points to the point of sight R, the rest is performed after the manner already laid down.





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To exhibit the Elevations of Round OBJECTS.

THE desire I have of enabling my reader to put all kind of objects in perspective with the utmost ease, has induced me to shew the method for raising circular figures to any height at pleasure; and the same rule may serve for exhibiting all other rotundo's, as cupola's of churches, amphitheatres, towers, &c. &c.

Having put the plan of the round in perspective, as already directed, and raised the line of elevation AB by the side thereof, from the several angles of the plan, which are here the several points whereof the round consists, namely, 1, 2, 3, 4, 5, 6, 7, 8, 9, &c. parallels are to be drawn to the ground line, and from their intersections with the line A O perpendiculars are to be raised thereon, as already taught, and the lengths of those perpendiculars transferred upon other perpendiculars, raised from the points 1, 2, 3, 4, 5, 6, 7, 8, 9, &c.

The front part of the semi-circle has but half the height of the hinder part, and both the one and the other are mere out-lines without any thickness.

There is no round figure but may be put in perspective by this method. Round figures, I mean, that are parallel to the horizon: for as to such as are perpendicular thereto, they are already taught in the rules for vaults.

For the Elevation of PILASTERS.

THE circle must be drawn in the plan double, as already shewn in page 29. and between the two circular lines must be placed the plan of the parts or members to be raised, as those here marked A B C D, which all tend towards the centre E; then perpendiculars are to be raised from all the angles of these plans, and their proper heights set off from the line of elevation F G; as already shewn in the first figure.

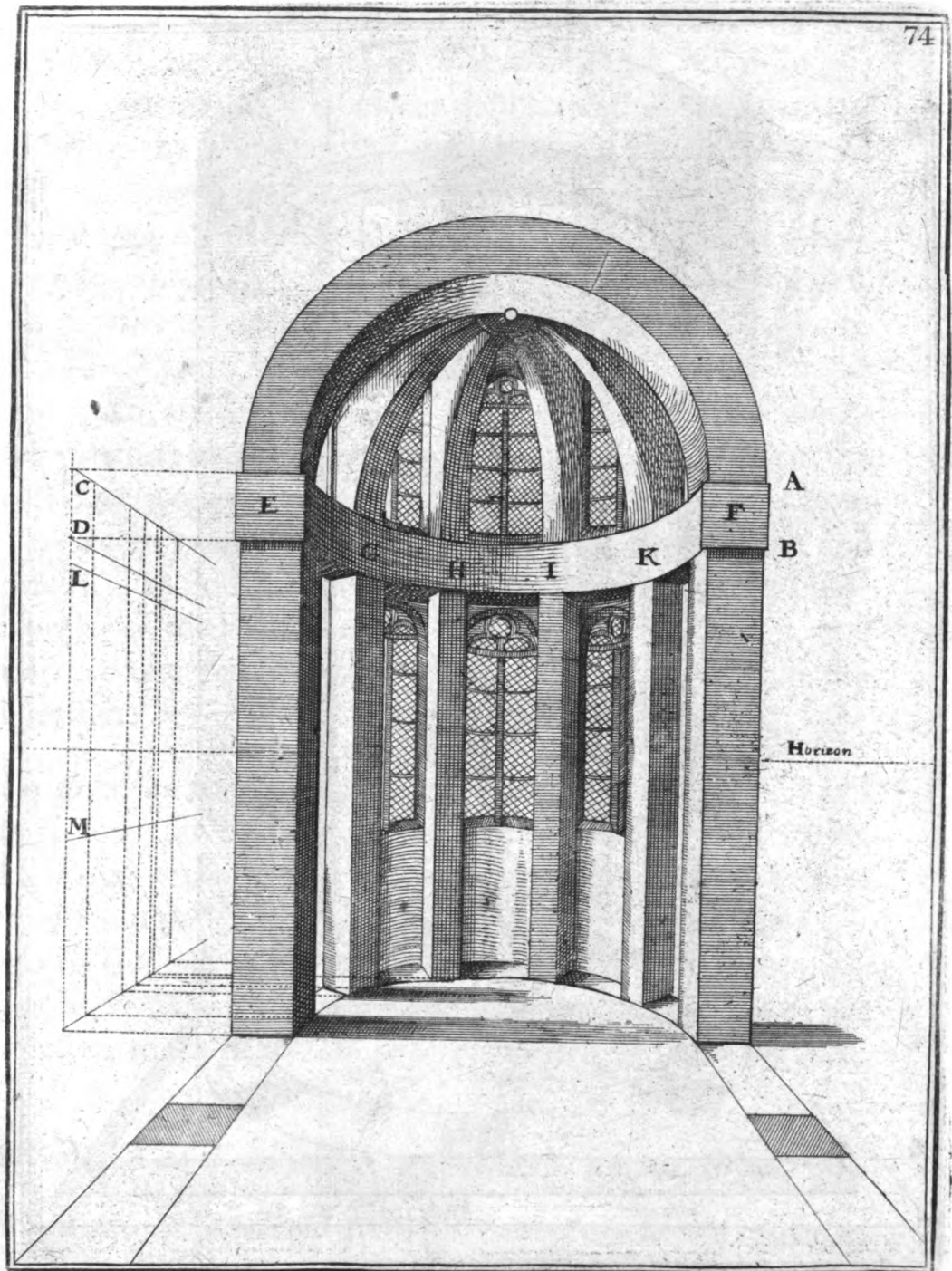
A VAULT in form of a Shell, in Perspective.

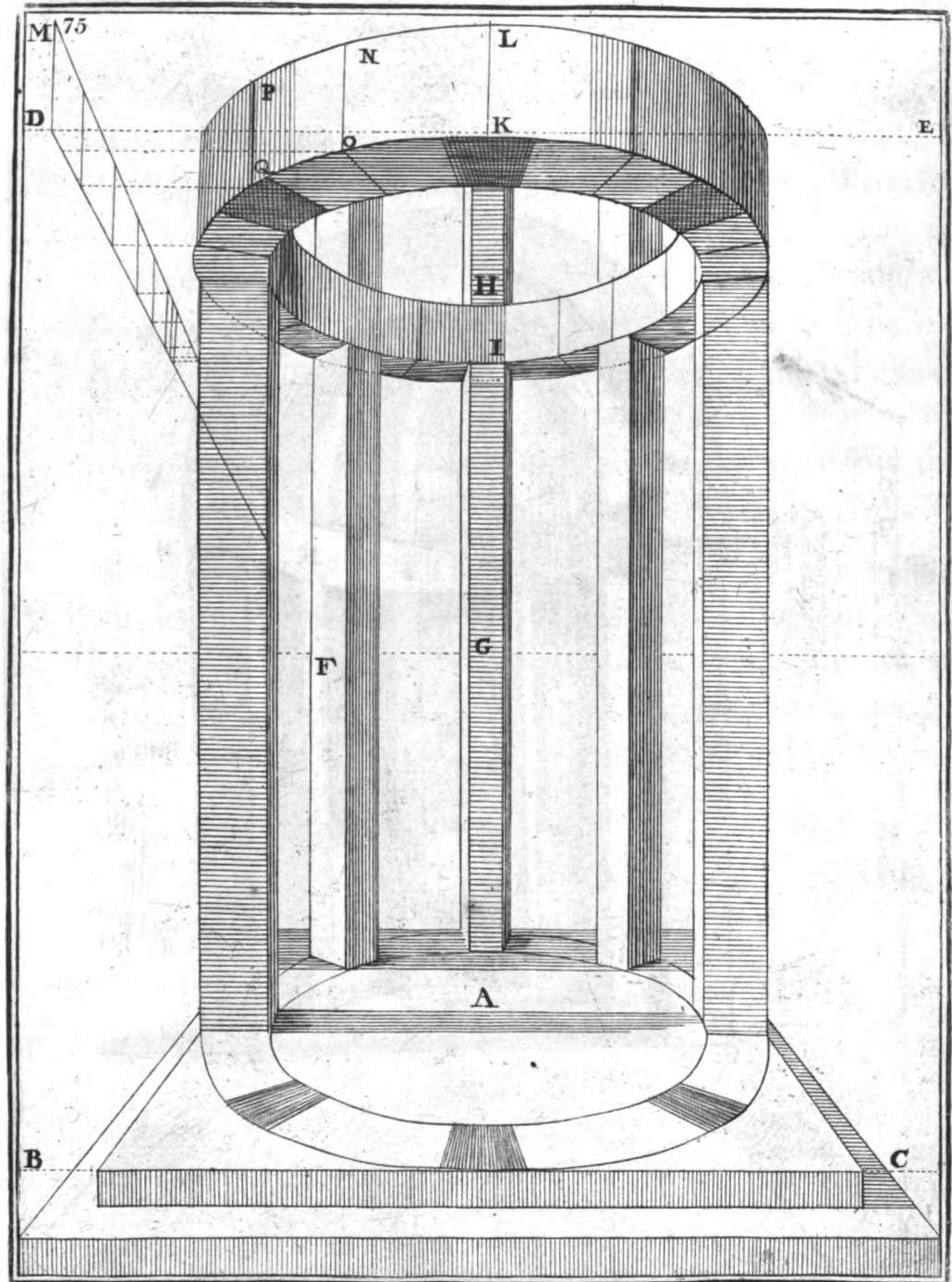
THIS figure, with little variations, will either serve for the *bollow* of a church, or grotto, a *niche*, or the like. The elevation is performed after the manner already directed.

To draw the plat-band, or border A B, which might serve for a cornice, its diminution is to be taken on the line of elevation in C D, and transferred thence to the pilasters.

For the vault, take the first arch E F, as before taught, and in the middle of the inside describe a semi-circle O, to which draw curve lines springing from the pilasters, and you will have the ribs or reins of the vault, as in G H I K. The heights of the windows must be taken on the line of elevation between L and M. For the rest, see the figure.







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To exhibit open DOMES, or VAULTS, in perspective.

HAVING made the plan of a double circle according to page 29, and marked the places of the pilasters between the two circles, the lines of all of them tending to the centre A, set off the height intended from the ground to the cavity of the dome, as the line D E, which is to serve for a base line, upon which the measures already laid down on B C drawn parallel to the ground line to touch the circle, are to be placed. Then from the same point of sight G make another plan at the top, like that at bottom, all the places of the pilasters tending towards the centre H. To form the pilasters, all required is to draw lines from the places opposite to each other, which will thus give the breadth and thickness. I have drawn no lines for the three front pilasters, both for the conveniency of shewing those behind, and to instance that the plan of them must be drawn both at top and bottom.

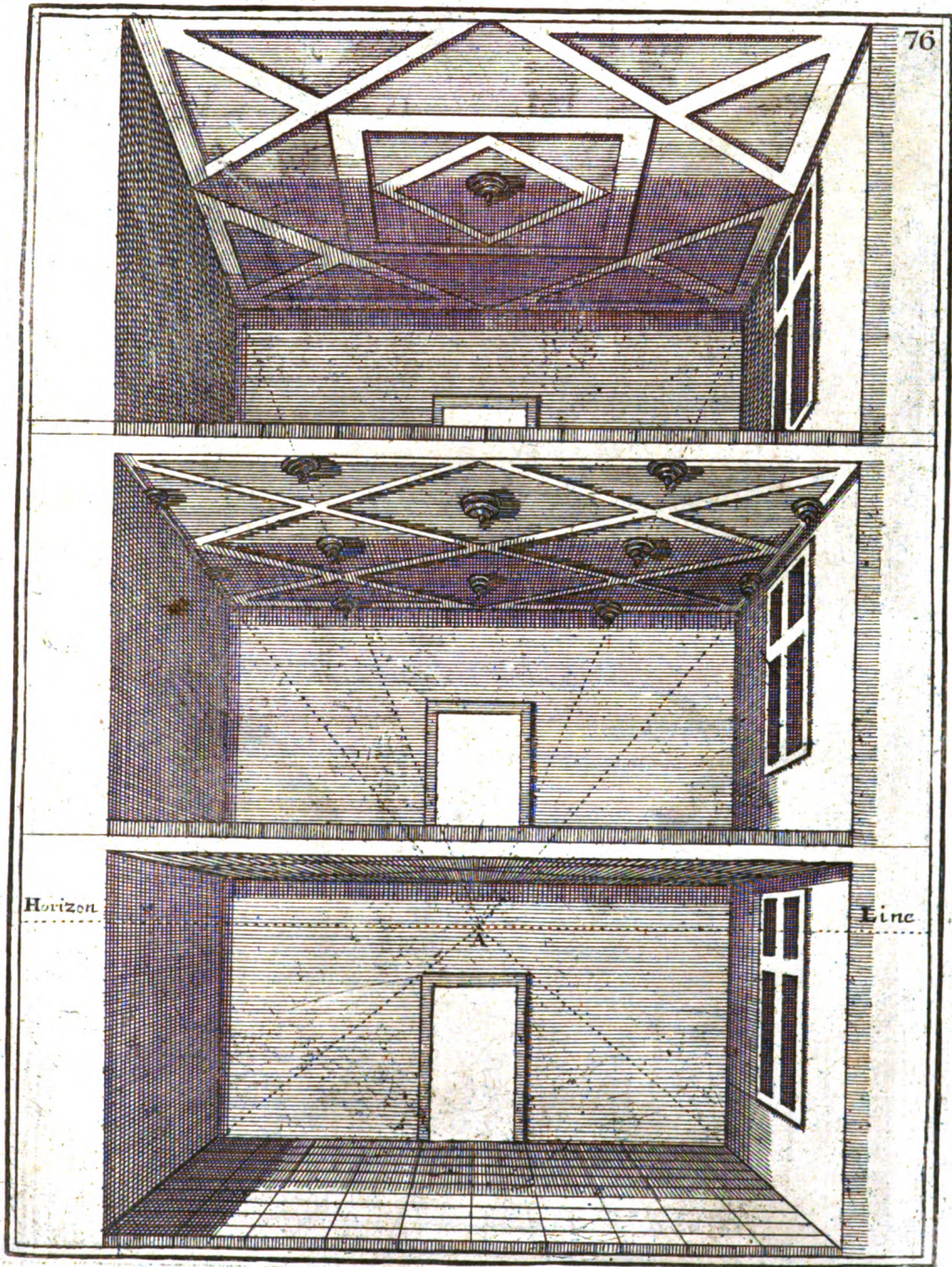
To give the thickness of the rotundo from I to H, and from K to L, set the intended height on the line of elevation D M, from whence draw lines to the horizon in the point F; and from the several points of the upper circle draw parallels to the line D F, at their intersections erect perpendiculars, as D M, which are to be transferred thence, with the compasses, to the perpendiculars raised from the points K L, N O, P Q; and so of the rest.

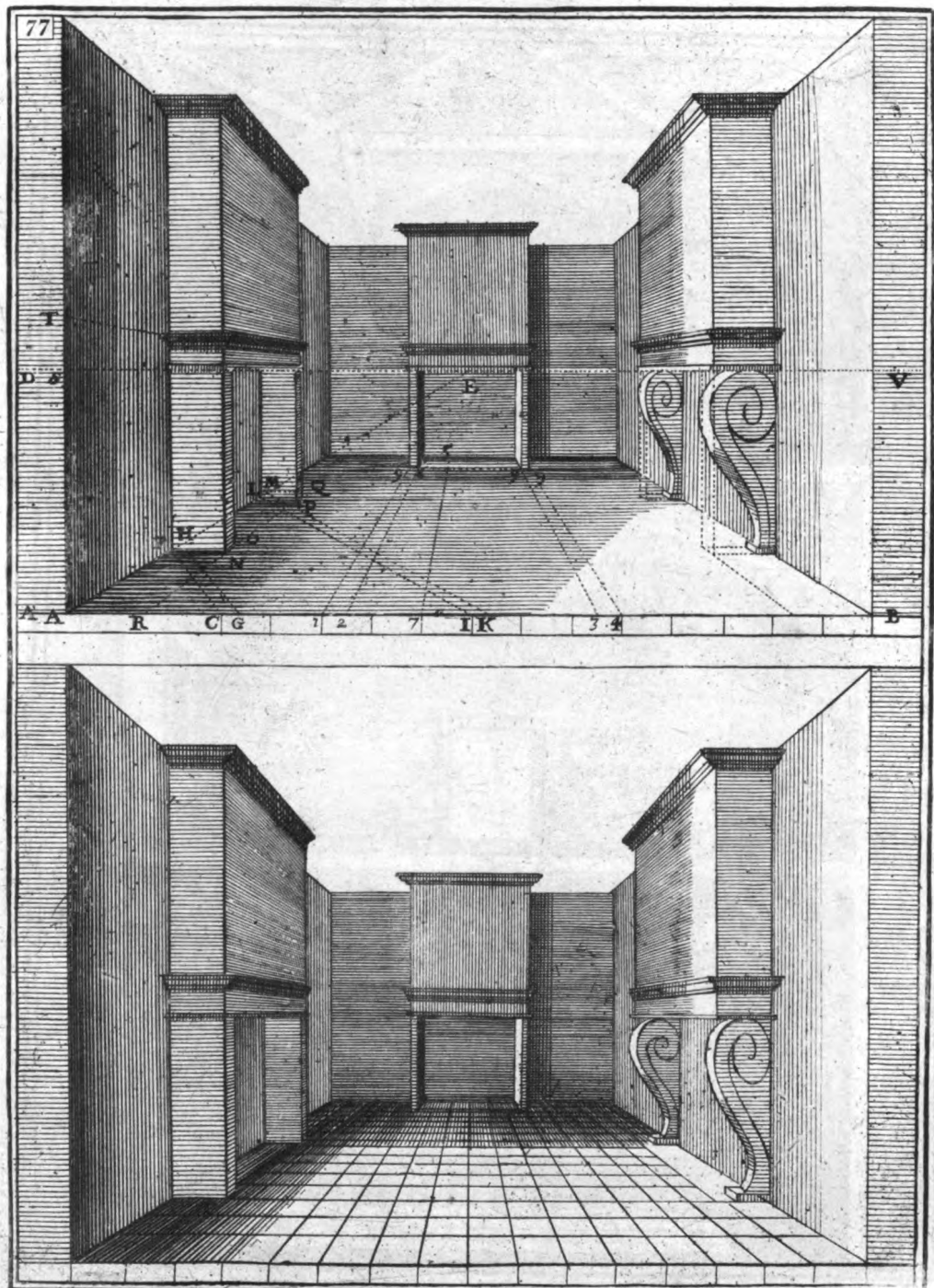
If instead of a round you require a square, or polygon, the same method is to be observed.

That a Number of OBJECTS, and Plurality of STORIES, only admit of one Point of Sight.

IT has already been observed, that only one point of sight is ever to be used in a picture, and that the ignorance of certain painters is published to all the world, by their making as many points of sight, and horizons, as they make lines.

It is not long since I remember to have seen a painting, wherein there were several rooms one over another, each of which had two or three points of sight; and yet the painter wonderfully esteemed his performance. The present figure may serve to correct this error, and to shew, that there should only be one single point of sight, to which all the objects, and all the rooms, though they were a hundred over or aside of one another, are to tend. As the three apartments do all here tend to the point A. The rest is performed by the rules heretofore directed.





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To put CHIMNEYS in perspective, either in the front or side-view.

THE measures are to be taken on the base line A B, which, to that end, must be divided into equal parts. The divisions may be accounted any thing at pleasure. The present is divided into eighteen, which we call feet.

To make a chimney, or fire-place, in a wall, A, three feet within the room, take three divisions as A, R, C, and from the point C draw a line to the point of distance D, which cutting the ray A E in the point F, gives a depth of three feet. Proceed to set the thickness of the jamb from C, for instance, to G; then drawing a line from G to D, it will give the thickness of the jamb in the point H. Then set the breadth of the chimney from G to I, four feet and a half; and half a foot, namely, from I to K, for the thickness of the jamb; then drawing lines from I and K to the point of distance D, you will have their measures on the ray A E, in the points L M: and from the four points F H L M draw little parallels to the base line, as F N, H O, L P, M Q. For the breadth of the jambs take a foot and a half, namely, A R, and the ray R E will cut the little parallels in the points N O P Q; from which, and from F L raise perpendiculars. For the height of the mantel-tree take five feet on the base line, and set them off on the corner of the wall from A to S; and from S to T set off the cornice. All the rest is obvious from the figure.

The other chimney opposite to the first is done after the same manner. For thus the jambs are in all cases to be managed. And of the jaumbs may occasionally be made columns, termins, or, as we have here done, consoles.

To find the hole, or aperture of the chimney, with the depth of the jambs, which are a foot and a half, draw a line from 7 to the point of sight, cutting the line of depth in the point 5, which will be a foot and a half, then, from the point of distance V, draw a diagonal through 5, cutting the ray 2 E in the point 6; and from this point draw a parallel, cutting the four rays 1, 2, 3, 4, in the points 9, 6, 9, 9: from which perpendiculars are to be raised, and the rest conducted, as above.

The second figure represents what I have been speaking of, free and unembarrassed with lines.

To exhibit STEPS or STAIRS in Perspective.

THERE is nothing gives a perspective so much grace, or deceives the eye so easily, as a number of returns and breaks; by reason these introduce a number of different lights and shadows, which give the objects such a force, that they seem to protect or stand out from the ground. Now *stairs* have this advantage, that what way soever you place them, they have always a variety of shades, and of consequence are agreeable to the sight. I shall add a few instances of steps in different positions by way of specimen.

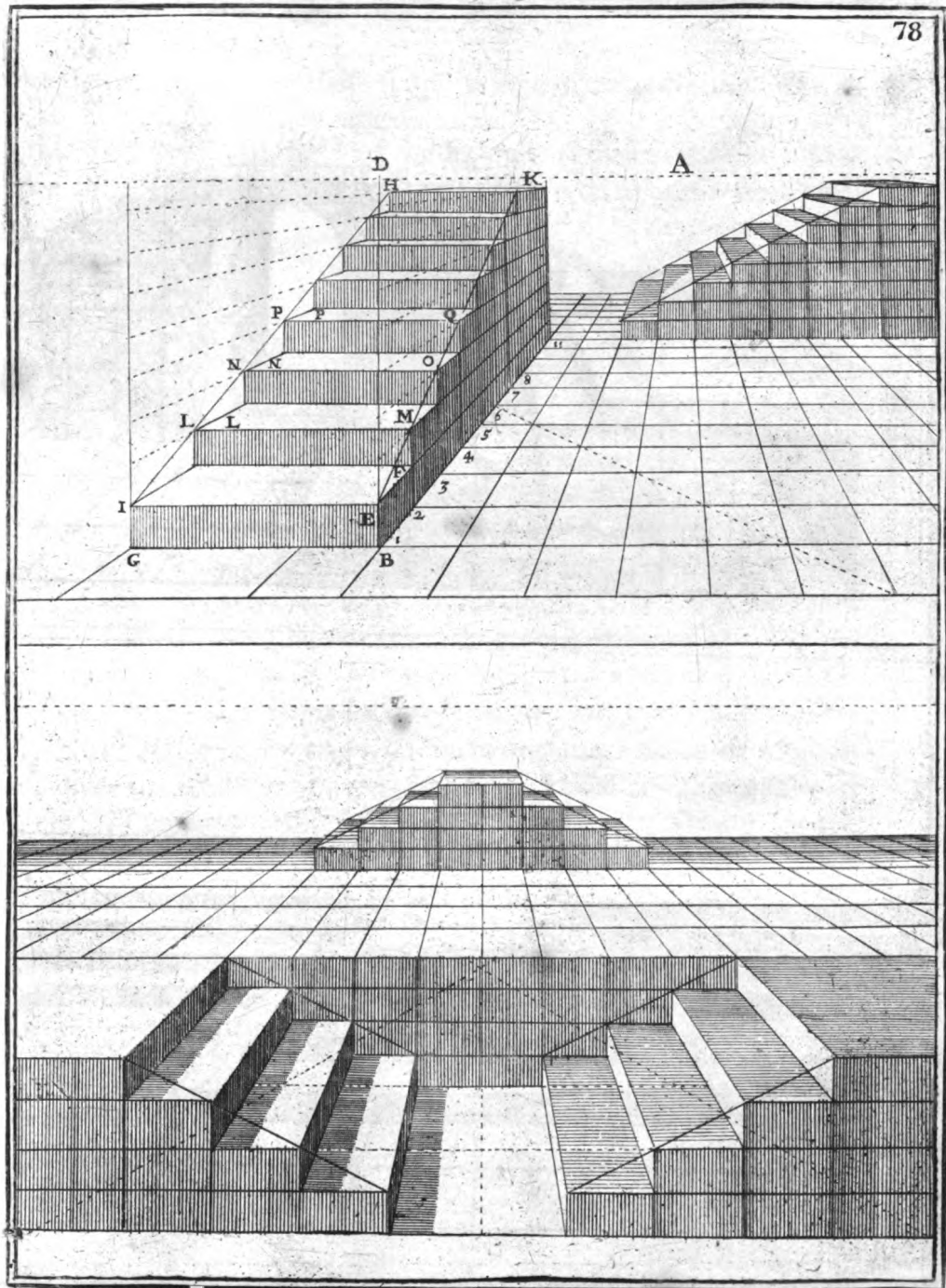
If you make use of squares, there will be the less difficulty, all required being to raise perpendiculars of as many squares as you would have steps: then to set the line of elevation, divided into any number of parts, on the first square, and from the divisions to draw lines to the point of sight, which will intersect the perpendiculars in the places where the steps are to be.

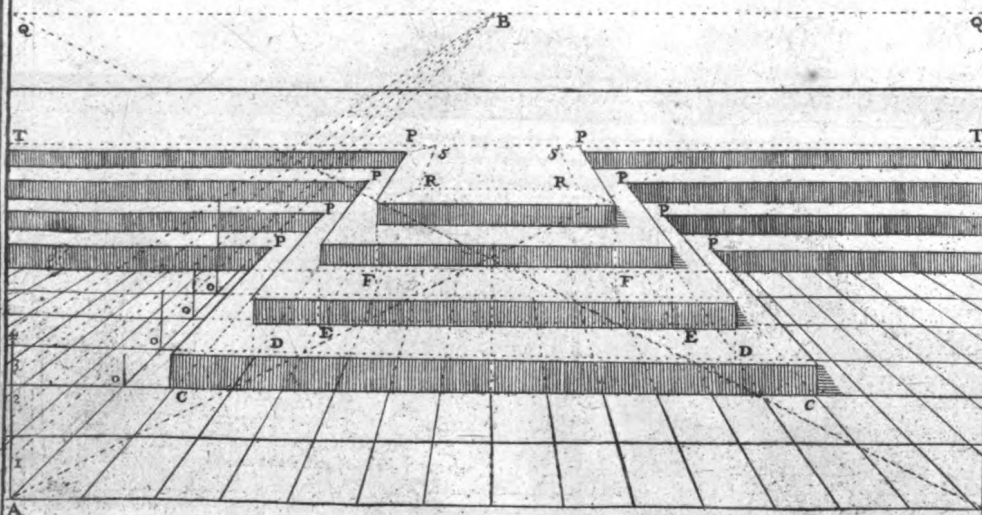
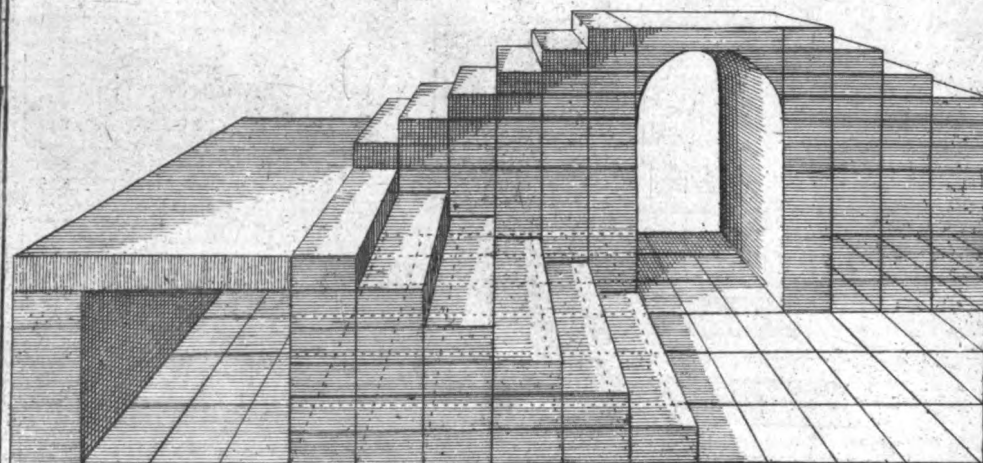
It is desired, for instance, to construct a stair-case of eight steps, the last of which to be the breadth of three feet. Take the number of squares of the plan, beginning at B, and proceeding 1, 2, 3, 4, 5, 6, 7, 8, and allowing three for the last marked 11, from all these angles erect perpendiculars, to be cut according to the divisions on the line of elevation B D, in manner following.

The first division, which, supposing the square to be a foot, is four inches high, will cut the first perpendicular, and must be continued to 2, which makes the top of the step; and so of the rest. The steps you may make as long as you please, by supposing the square a foot. Accordingly the uppermost here, taking three divisions, is three feet. Perpendiculars should likewise be raised, as in this instance, on the side B: but that trouble may be saved, by taking the height of the last step H, and that of the first I, and drawing the line H I, raising the angles on the side I, as E K does on the side B; for this done, you need only to draw parallels to the base line from all the stairs from the side B, to cut the line H I in L M N O P Q, &c.

One might likewise do without making squares; for laying all the measures on the base line, and drawing lines from them to the point of distance, the same measures would be had on the line A B.

The other figures we are silent upon, this much being sufficient for the understanding and executing them all.





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STAIRS open or perforated underneath.

THE method of managing these stairs is the same with that already described.

As to the aperture, a bare sight of the figure is sufficient to shew how it is to be put in perspective. These two may give occasion to the inventing many others.

STEPS or STAIRS viewed in Front.

THIS method is founded on the use of the line of elevation : the same number of perpendiculars are to be raised from the angles of the squares of the plan, as there are required steps, for example, C D E F ; and from the same angles parallels are to be drawn to the ground line meeting the line of elevation A, the intersections whereof give the points O O O O, from which perpendiculars are to be raised till they cut the occult rays of the divisions of the line of elevation. These measures are to be taken in your compasses, and set off on the perpendiculars raised from the angles of the plan, each in its order ; the first for the first step, the second for the second, &c.

To find the returns P P, &c. from the same angles P, &c. lines are to be drawn to the point of distance Q, and notice taken where they cut the line of the plan, or the bottom of the step ; for instance, over the fourth step is the plan of the fifth : now to find its return P, from the point P draw a line to Q, and the point S, wherein it intersects the parallel R R, will be the line of return S T ; and so of the rest.

To exhibit STEPS that shew four Sides.

THERE are various manners of ordering such steps, two of the easiest of them follow. Take the length of the first step, and set the number of steps required upon the same; as on the line *A B* are here set the points *C C C C*, for four steps. From these points draw rays to the point of sight *D*, which rays are to be cut by the diagonals *A F* and *B E* in the points *III*, from which perpendiculars are to be raised, and parallels to the ground line drawn to the line of elevation *G*, which give the points *H*, to be raised as *H K*.

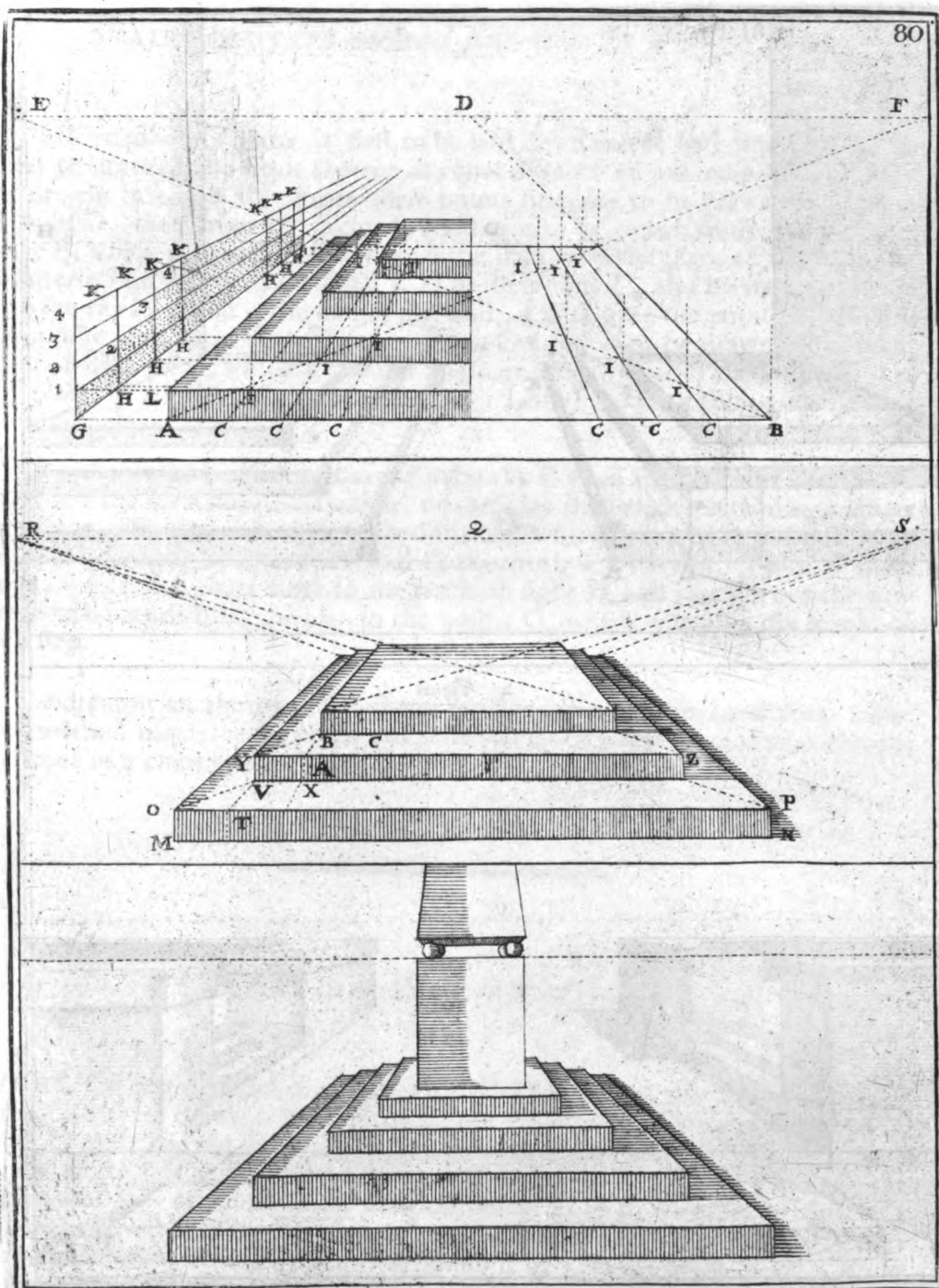
On this line of elevation *G*, as many equal parts must be marked as there are steps desired, for example, four, here marked 1, 2, 3, 4. From these four points of division rays are to be drawn to the point of sight *D*, to cut the perpendiculars *H K*, and give each its proper height.

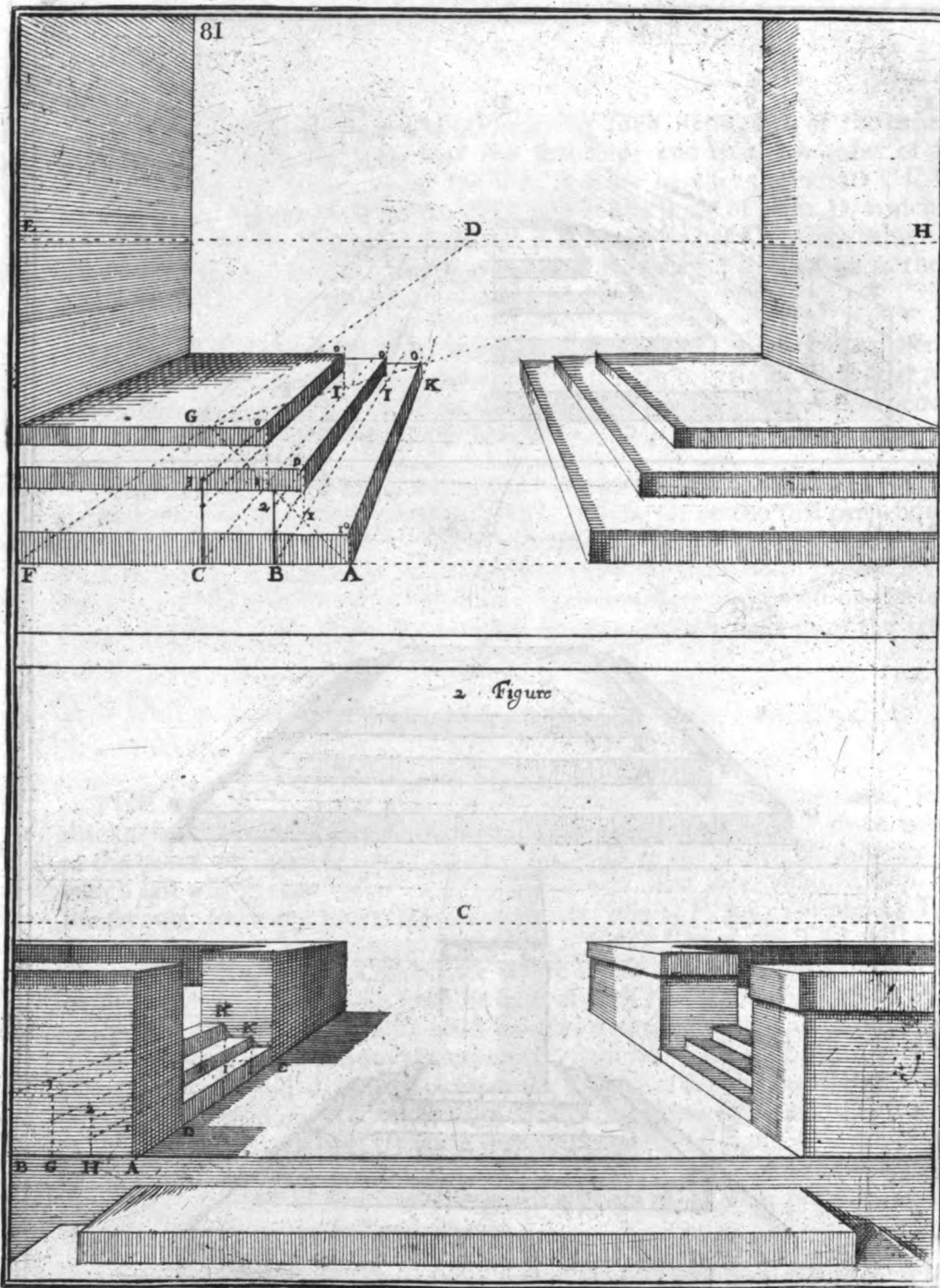
These measures must be taken in your compasses, and transferred one after another, beginning with the first *G*, which is to be set on the first perpendicular on the angle *A*, namely *A L*; then a parallel to be drawn to the other side *B*, (though here I only give half of it, to have room for the plan in the other.) For the second stair the second measure *H 2* is to be taken, and set off on the second perpendicular *I*; and a parallel is to be drawn as before; and so of the rest.

Another Manner.

THE side *M N* being given, make a parallel *O P* over the same, for the thickness or height of the first step. From the two points *O P* draw two rays to the point of sight *Q*, and again other lines to the points of distance *R S*; which last will give a square after the usual way, and form the first step. For the second, set the intended breadth on the line *O P*, for example, *O T*, and from *T* draw a ray to the point of sight *Q*; which line or ray *T Q* will cut the diagonal *O* in the point *V*, the place where the second step must be raised. The height of this second degree must be half of *V X*, as *M O* is half of *O T*. The point *Y* thus gained, a parallel must be drawn through it as far as the diagonal of the other side drawn from the corner *P*; then from *Y* and *Z* draw lines to the points of sight and distance, to form the square, as for the first stair. For the third, set the measure *V X* on the line *Y Z*, extending for example, from *Y* to *A*; and from the point *A* draw a ray to the point of sight *Q*, which intersecting the diagonal of the point *Y*, will give the point *B* for the third step. Its height will be half of *B C*, which is always that of *O T* in perspective. The rest the same as in the first and second.

The third figure shews these stairs free of all the confusion of lines and letters.





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STAIRS or STEPS *viewed side-wise in Perspective.*

THE number of stairs is first to be laid down on the base line, that is, so many points are to be made thereon at equal distance as you intend steps; as in the present case A B C. From these points lines are to be drawn to the point of sight D; then from the point A, another is to be drawn to the point of distance E, which diagonal A E will give the plan, and the place of the stairs, by its intersection with the rays B D, C D in the points I; and by its intersection with the ray F, which is the foot of the wall, it will give the point G, which is the middle of the plan of the stairs. From G a line is to be drawn to the other point of distance H, which gives the angle of the last stair in the point K, and the place of all the rest in the points II. Lastly, from all the points I, erect perpendiculars.

Now to give the heights; from the points A B C on the base line erect little lines, serving for a line of elevation; on these lay the heights according to their number. The perpendicular A, for instance, which is the first, will only have 1; B, the second, will have 2; and C, the third, will have 3. From all these points 1, 2, and 3, draw lines to the point of sight D, and you will cut the perpendiculars raised from the plan in the points O, which will give the height of each step.

The draught on the other side shews the steps free of points and lines. The same method may serve for divers purposes; as for the steps of an altar, a throne, the front of a church, a gate, &c.

STAIRS *in a Wall in Perspective.*

MAKE as many divisions at the end of the base line as you intend stairs, as in this case, three between A and B, and from A and B draw lines to the point of sight C; then, having determined the space the stairs are to take up, as D E, a parallel to the base line E F must be drawn, which in the points I I will receive the intersections of lines drawn from the points G H to the point of sight C; and from the same points I I, perpendiculars I K, I K are to be erected, to receive the heights of the stairs, by drawing points 1, 2, 3, to the point of sight C, as appears from the figure.

To exhibit a STAIR-CASE with Landing Places in Perspective.

DO but recollect the preceding methods, and you will find it exceeding easy to construct such stair-cases. However, to save the trouble of too irksome a retrospect, I shall explain the whole here.

By reason stair-cases of this figure usually run over a space equal to twice their width, to raise one of them in perspective, the horizon must first be disposed at pleasure; then a square to be made according to the common rules, and this to be doubled, as directed in page 16: then divided by an unequal number of small squares, that the wall, which is supposed in the middle, may be the measure of a square.

In this figure each square has nine sides, or squares, on either hand, which being doubled, give eighteen; of these, four being left at each end for the landing-places, remain ten squares, or stairs, each whereof we suppose equal to a foot every way.

At the distance of four squares from the point A, erect the perpendicular B pretty high, then a second perpendicular C at the other angle of that square, and a third D; and so onwards on the other angles of the squares, to the number of ten. This done on one side, the same must be repeated on the other; and such perpendiculars will give the depths or breadths of the steps.

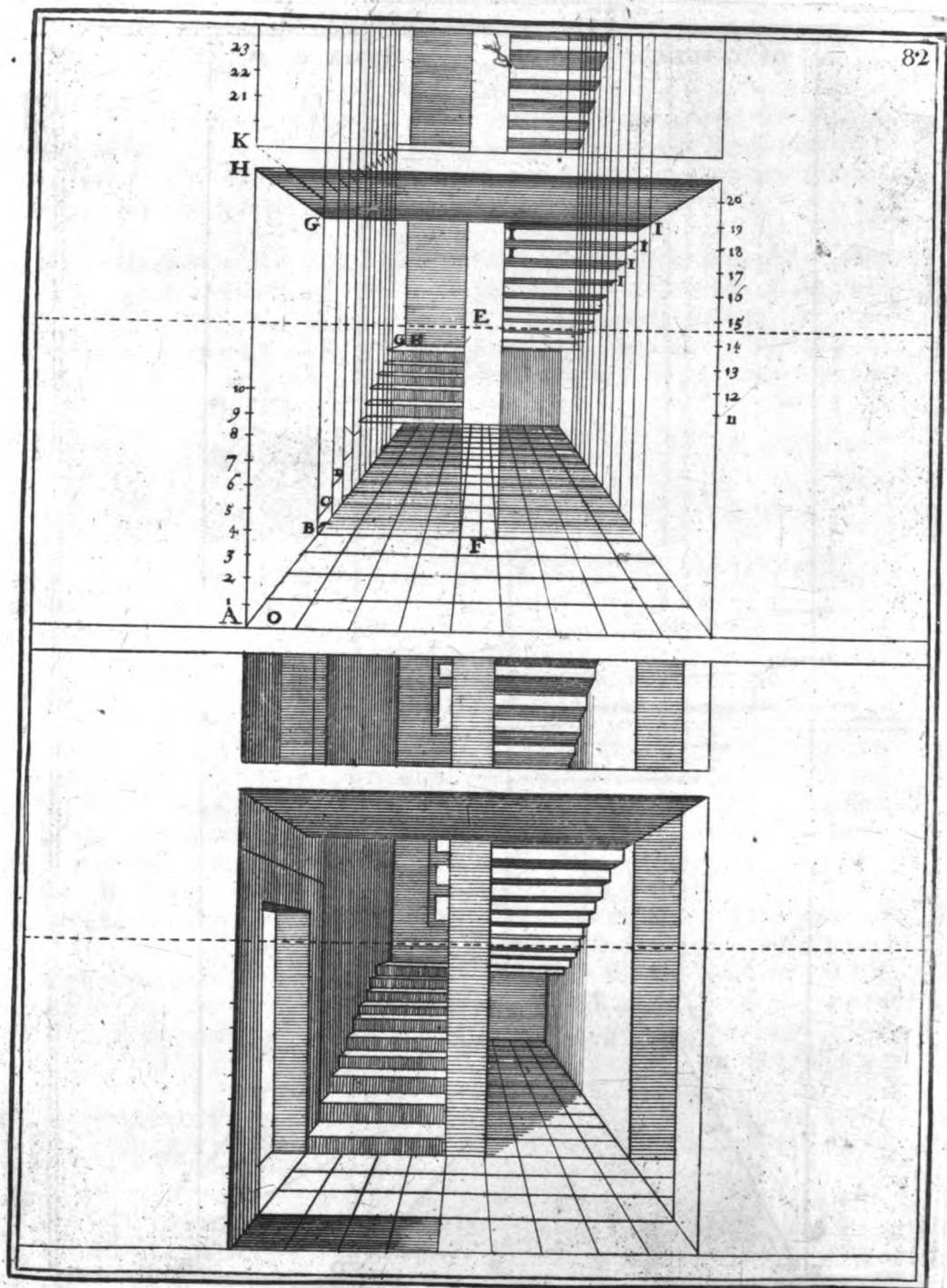
For the heights, if they be a foot broad, they must be half a foot high, or half the little square A O: which height being taken in your compasses, set it on the first angle, which is to serve for a line of elevation, beginning at the bottom, or the point A, and making as many divisions thereon as you intend stairs, namely ten, from the bottom to the first landing-place; where you begin to mount up the opposite side, and the series of numbers is continued to twenty-three.

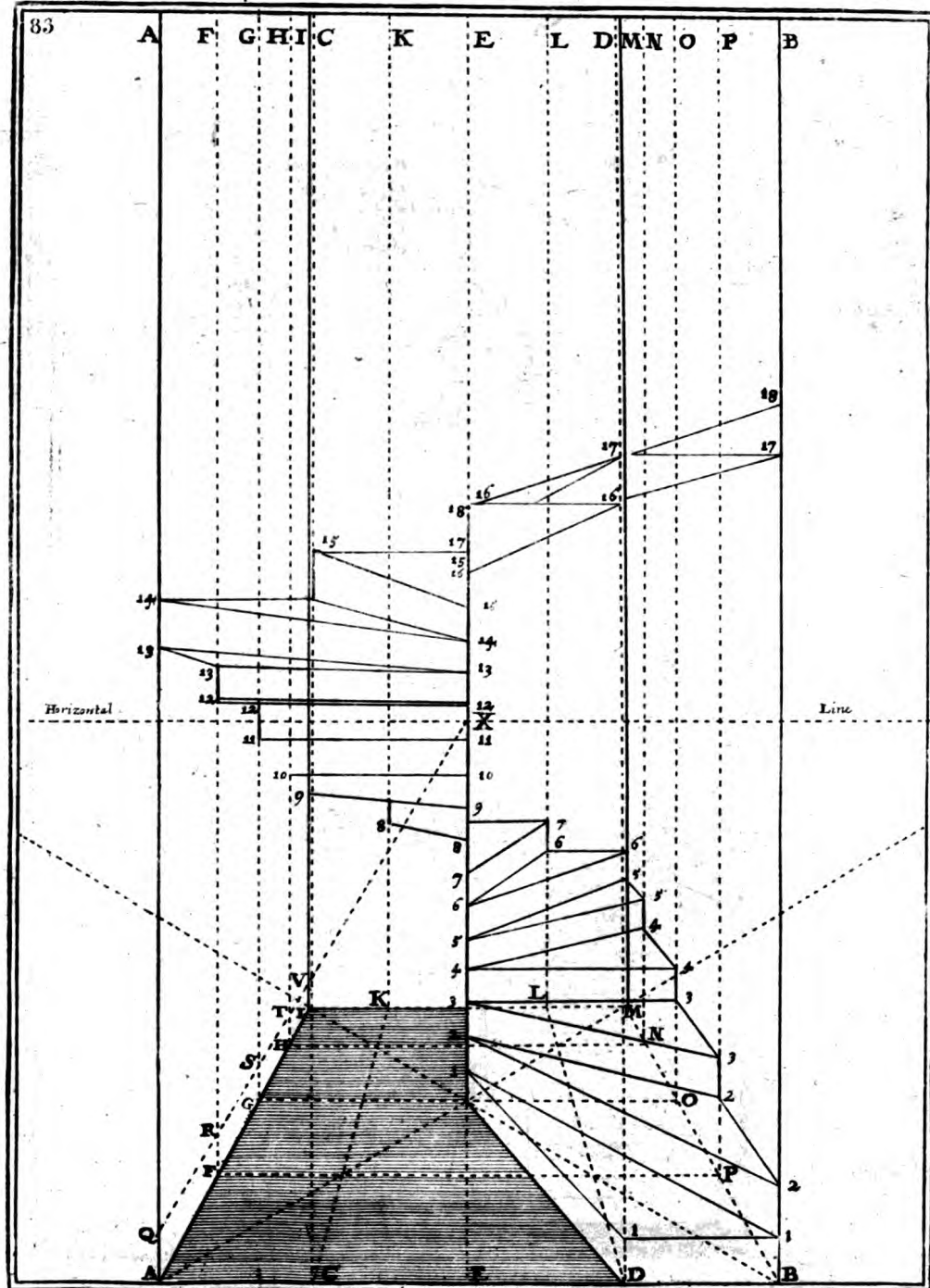
From all these twenty-three points, lines are to be drawn to the point of sight E, and take care to cut the perpendiculars in their order, that is, having laid your ruler from the first point to the point of sight, cross the first perpendicular B to C with a little stroke, for the first step. For the second step, from the second point draw a line, crossing the second perpendicular C to D. And so of all the rest on both sides.

From the angles of all these little strokes between the perpendiculars draw parallels to the horizon, as far as the wall F erected in the middle; such are the lines I I I I, which I have only added on one side, to avoid confusion: It is these parallels alone that form the stairs. All the other lines hitherto drawn should be occult, and not to be seen when the figure is finished.

The landing-places should contain all the vacant spaces between the last perpendicular and the wall, as from G to H. Their height, or thickness A K, is half a foot, the same as that of a stair.

The lower figure is the same with the upper, only that one has the apparatus of lines, &c. necessary for the performance, which the other is without.





To exhibit Winding or Spiral STAIRS in Perspective.

ONE side of the flight, or ascent, is to be set on the base line, and divided into as many parts as you require stairs. Suppose, for instance, A B the side of the stair-case, and sixteen steps required in the whole circuit of the square; each side, in this case, will contain four; consequently A B being divided into four, a square is to be formed thereof, as here represented, divided into sixteen, according to the usual rules.

From all the divisions on the sides of the plan, perpendiculars must be raised to give the bounds of the stairs. Suppose then the perpendiculars A A, B B, C C, D D, E E. Thus E E stands for three of the perpendiculars, by reason the point is in the middle, and serves as a newel, * or common centre of them all. On the first perpendicular A, which is to serve for a line of elevation, the height of a stair Q A must be set, and from the point Q a line be drawn to the point of sight X, which by its intersections with the perpendiculars Q R S T V, gives the dimensions of all the stairs. Thus A Q is the height of the first, F R of the second, G S of the third, H T of the fourth, and I V of the fifth. This last is the height of all those at the bottom, as A Q is of those in the front.

Since G S is the measure of the third, which is that in the middle of the side, it must likewise be the measure of the centre, and of the newel of the flight: for this reason, having taken the measure G S in your compasses, set it off in the centre of the square or the newel as many times as you would have stairs in the flight; for example, eighteen times for eighteen stairs.

All things thus disposed, the rest is easy. For the first step you are to take the division A Q, and set it off upon the perpendicular D in the point 1, and from 1 to draw a parallel to the perpendicular B; then from the two points 1 1 draw lines to the third 1 at the newel or centre of the square. These three 1 1 1 will form the first stair. For the second, since its angle reaches to the perpendicular B, which is on the fore-side, it must have the same measure A Q; which will be 1, 2; then from the point 2 a line is to be drawn to the point of sight X, cutting the perpendicular P in the point 2; from which points 2 and 2, lines are to be drawn to the 2 at the newel. Thus will you have formed the second stair. For the third, since it is found on the perpendicular P, the measure F R must be taken for its height; and the same process observed as in the former.

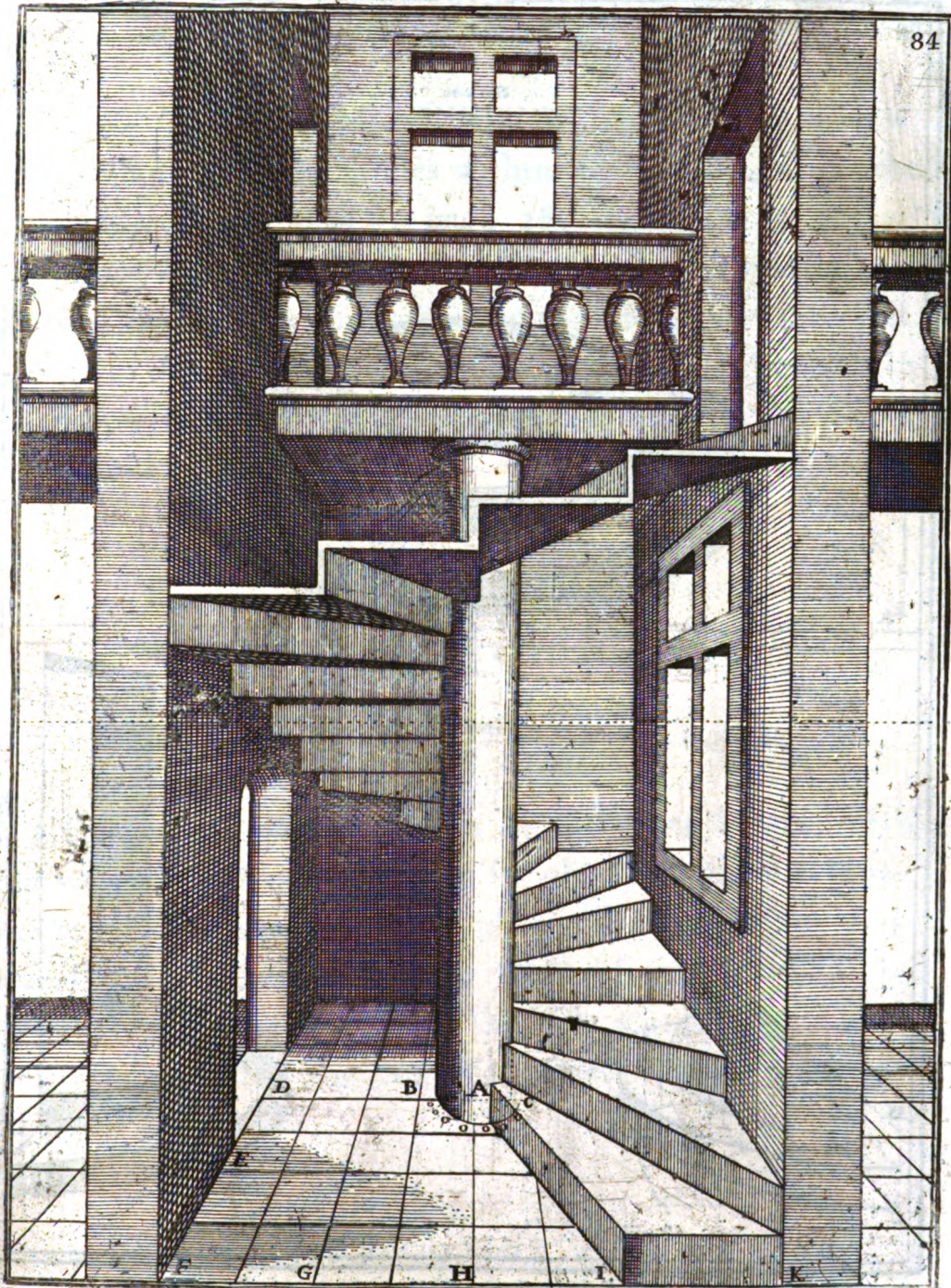
If you would have them round withal, the square must be reduced to a circle, according to the preceding rules: and for the rest, the same method will serve for both.

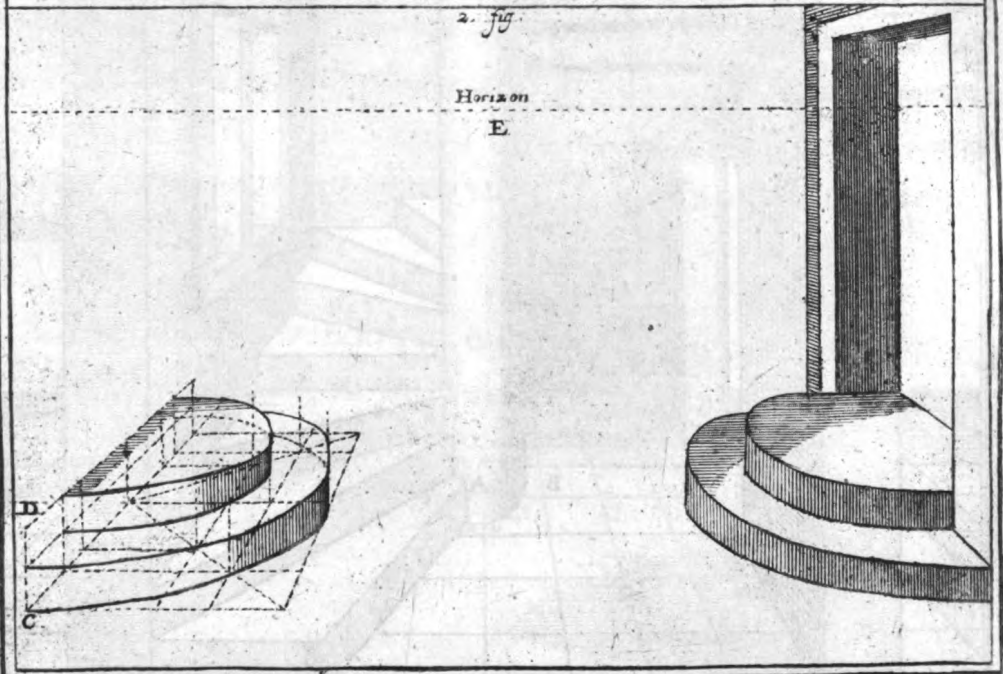
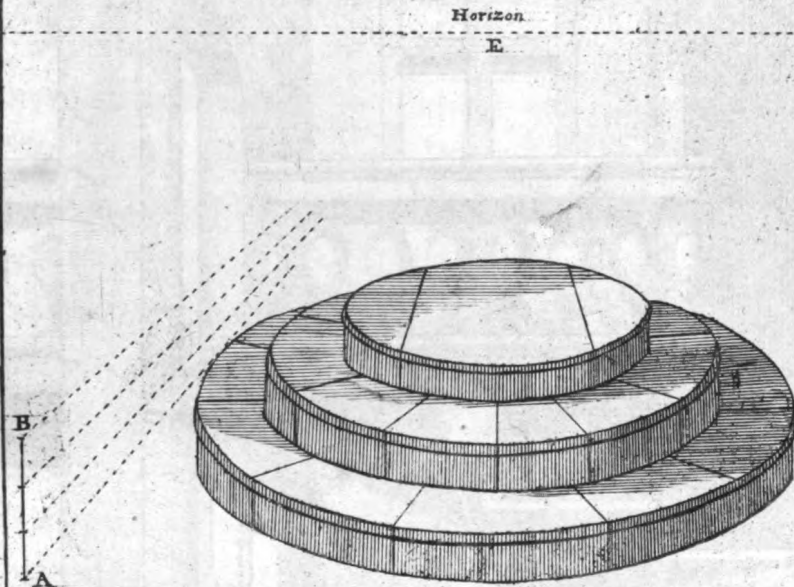
* The newel is the upright post which a pair of winding stairs turns about.

WINDING-STAIRS.

THIS figure is the same with the preceding one, which was not shaded, that the method of the operation might be the more conspicuous. For the same reason the newel of the stair-case was reserved for this figure. It is formed by assuming the point A as a centre, and thence describing a circle ; or rather a semi-circle, as B C, because only half of it is to be seen. To the centre of this semi-circle lines must be drawn from all the divisions of the square of the first plan, as D E F G H I K, which will cut the arch B C into eight parts ; and from the intersections O O, &c. perpendiculars are to be raised ; taking care they cut precisely in the points, where the steps are placed ; the step I, for instance, to be cut by the perpendicular raised from its point in the semi-circle, as in A ; the second step to be cut by the perpendicular raised from the point which K gives in the semi-circle : and so of the rest.

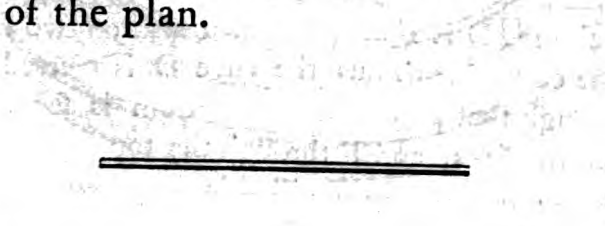
The doors, windows, &c. in the figure, are all constructed according to the rules already laid down.





To exhibit ROUND STAIRS in Perspective.

TO raise these three round stairs or steps, in a front view, make a plan of three circles within each other, after the manner already directed in page 28, and from the several points that form the circle draw lines parallel to the base, as far as the ray A, which is the foot of the line of elevation AB. This gives the elevations, which are to be taken thence with the compasses, and set off on perpendiculars raised from the several points of the plan.



ROUND STEPS *viewed side-wise.*

THE rules for objects viewed by the sides I have often observed are the same with those for objects in front. However to shew we are not always obliged to observe the division of the circle into sixteen, these of the side-view we have divided into eight. For the rest, it is the same as in the preceding cases, the line of elevation is CD, drawn to the point of sight E.



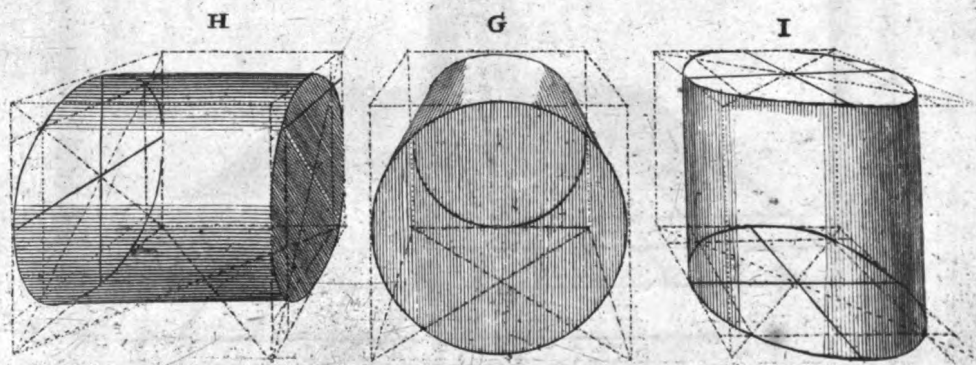
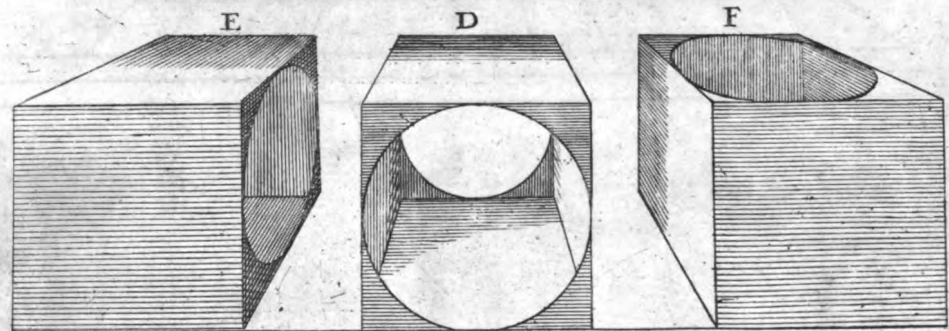
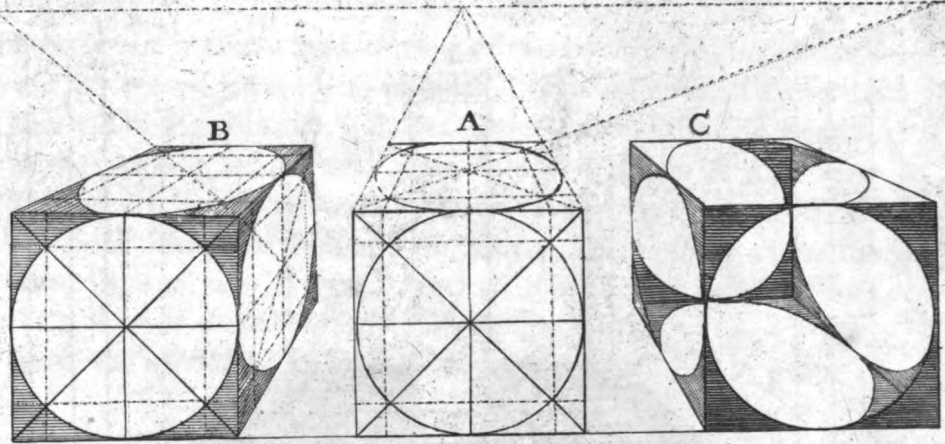
To exhibit SQUARES, with Circles therein, in Perspective.

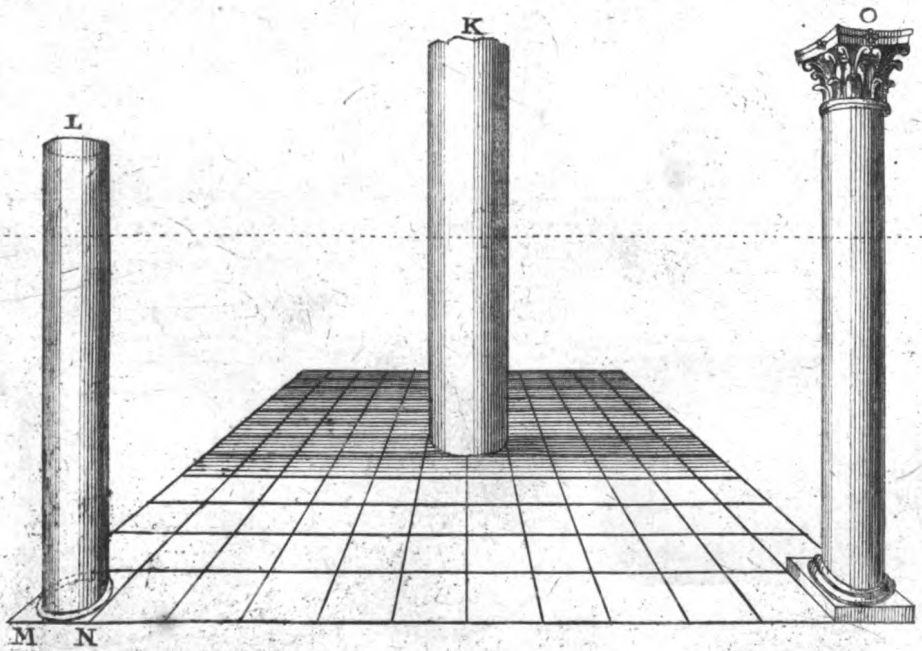
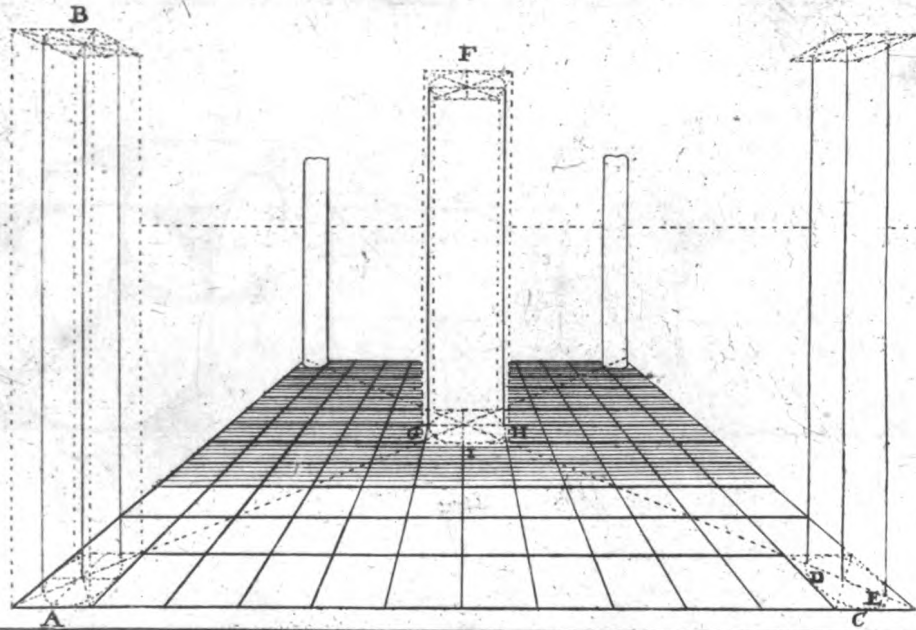
THE method for this process, is the same with that delivered for putting planes in perspective. The circle, for instance, is to be divided into eight parts, as in figure A, wherein the circle on the front of the cube, gives the diminution of that on the top; and that in the front, with that at top, give the diminutions of all the other sides; as in figure B, where the circle is also diminished on the side, and in the figure C, where it is diminished on three sides of the cube, I mean both on the outer and inner sides.

The three figures D E F are perforated each on two sides, according to the plan of the circle A. Thus the cube D is pierced through its fore-side; and through that perforation the bottom is seen. Thus also E is perforated on the sides, and F through the top and bottom, though the latter perforation be not distinguishable, by reason the object is not supposed transparent.

The three figures underneath represent the pieces cut out of each cube. G, for instance, out of the cube D. H out of E, and I out of F.

Upon the whole, the method of disposing square figures in circles appears very easy; nor can the attentive reader find any difficulty in placing columns under any disposition whatever. The reason why I have yet given no directions for them, is, that I chose to render the raising of elevations as easy to conceive, and the practice as little embarrassed as possible. Thus much may serve for the beginning of columns; how to carry on and finish them shall be shewn hereafter.





To exhibit COLUMNS in Perspective.

WHAT has been just observed is not confined to the cube, but extends equally to any object which is to be rounded. For instance, if from the square, A, you will raise a column A B, describe a circle within the square, according to the common rules ; and at the intended height describe another square with a circle within it, B. Now to get the two lines D E, which make the thickness, or diameter of the column, observe where the circle cuts the diagonal of the square, and on those points raise the lines which form the sides of the elevation. Thus C is formed by perpendiculars raised from the intersections D E of the circle with the diagonal of the square.

Thus much regards the column in side-views. As to those in front, for example, the Figure F, they always shew the semi-circle G H I, and for this purpose the perpendiculars are to be raised from the extremes of the diameter G H ; and in both those in front, and those in side-views, perpendiculars to be raised from the centre, to give the diminutions.

As to the three columns underneath, as they shew the former instances more clearly, and with the addition of shadowing, they likewise serve to point out the manner of proceeding to finish the *columns*. The middle figure, K, is quite round, without any ornament at all, and being viewed in front, is raised by perpendiculars from the extremes of the diameter. The second, marked L, shews, that when a base is required, a double circle must be described on the square that serves as a plinth, whose upper part is M N ; the internal between the circles to be the projecture of the base, and the inner circle the plan of the base, from which perpendiculars are to be raised.

The third figure, O, is a column with its ornaments ; which every one is to make at his discretion ; taking care the abacus answer, as it ought, to the plinth. These two columns L and O being seen side-wise are raised by perpendiculars from the points where the circle cuts the diagonals of the square.

Q

CORNICES and MOULDINGS in Perspective.

AFTER the *columns*, which are the chief ornaments of architecture, we proceed to the *cornices*, or *mouldings*, with their projectures; which have hitherto been omitted, for fear of rendering our elevations perplexed.

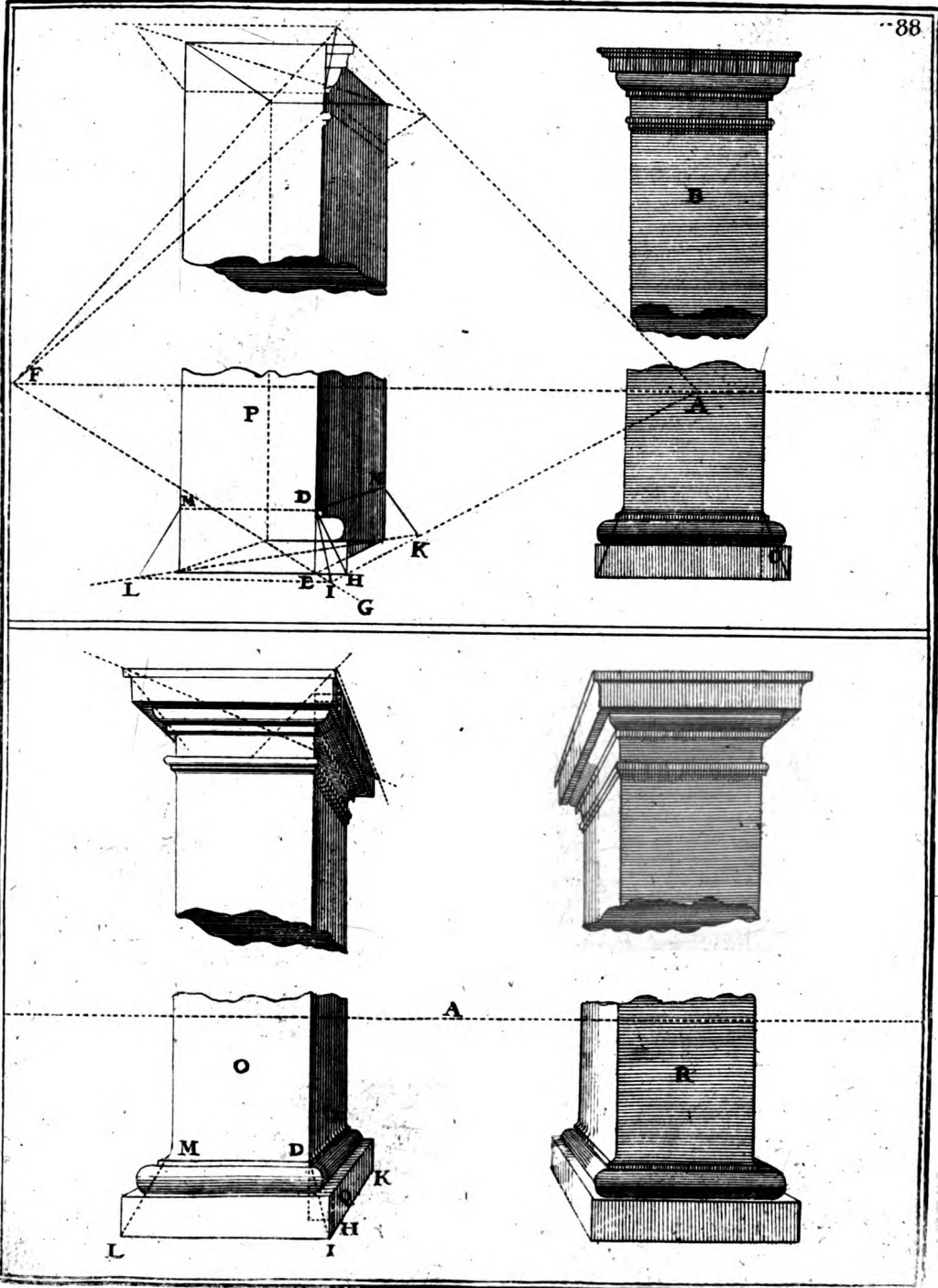
There is scarce any building but has some moulding or projecture by way of enrichment, and to render it pleasing to the eye: for this reason, it is proper to give the rules for these; not the rules for their construction, nor their measures and proportions, for in that case I should be obliged to give all the orders of architecture, and a thousand other instances, which the reader will find elsewhere: but rules to put them in perspective, when any particular ornament or order is pitched upon.

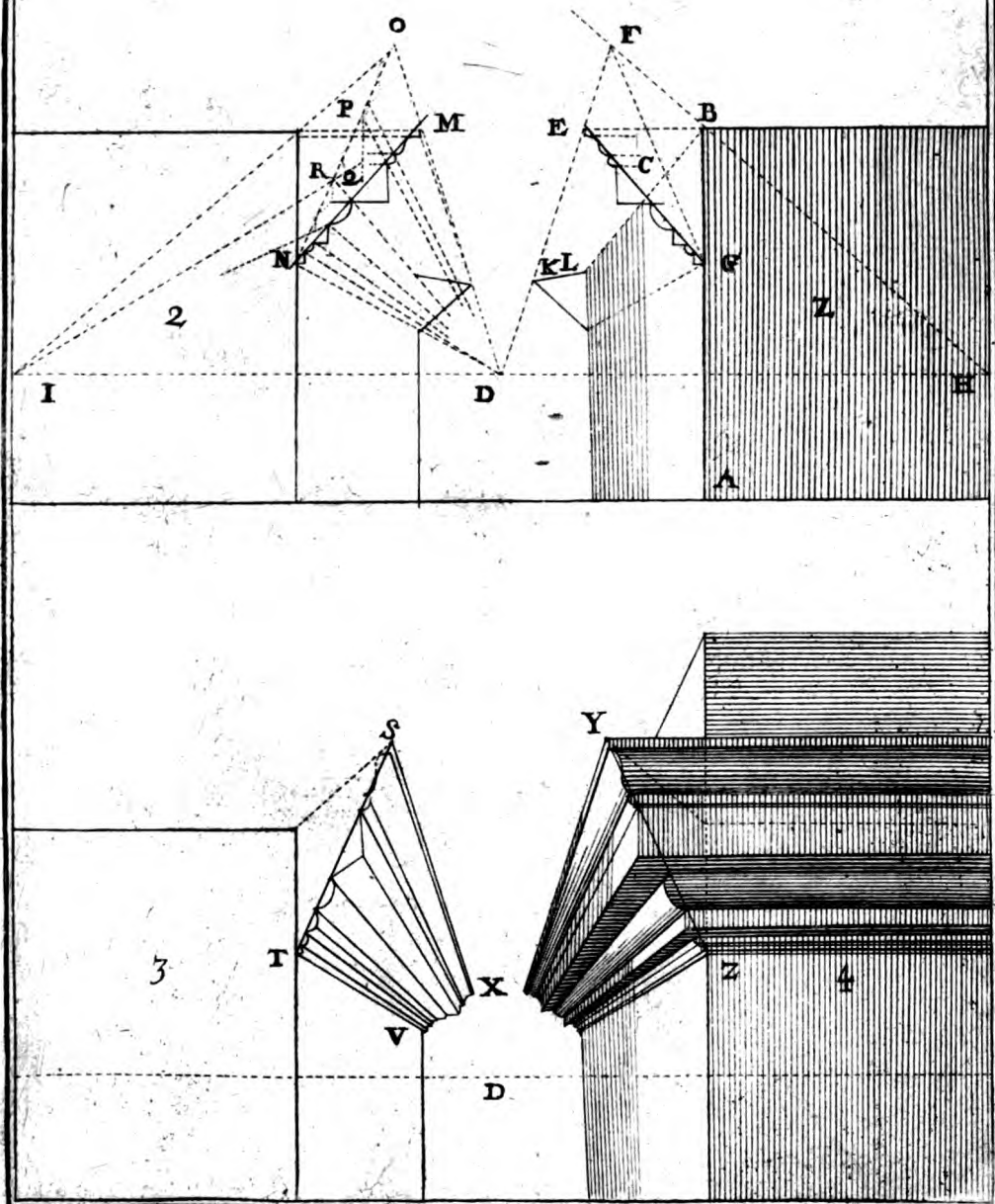
To put the pilaster A B, with its ornaments or members in perspective: its breadth being taken, and a square plan made as usual, erect perpendiculars from all the angles thereof, and you will have the body, or shaft, of the pilaster.

Proceed now to take the projectures, or jettings, as for example, the base of the pilaster C, and lay down the several measures thereof in D E. To put this in perspective all round the pilaster, from the point of distance F draw a diagonal to the point E, and farther at random, as to G; then to the point of sight A draw a line to the bottom of the projecture H, and in the point I, where this cuts the diagonal, will be the jet, or projecture, of the whole base. The same line A H gives the projecture of the bottom, by its intersection with the other diagonal in K. For the projecture of the front, from the point I draw a parallel to the base line, till it cuts the diagonal in L: this gives the other corner of the projecture of the front. Then drawing lines from the top of the base to these points, as from M to L, and from N to K, you will have the breadth and height of the whole base. The same method serves for the capital.

The figures underneath shew the rest, and even the effect of what is said, free of confusion. For the pilaster O, regard must be had to that above in P, where the line D H has upon it all the intersections of the base. For this reason lines are to be drawn from the point of sight A, which passing through the divisions of D H, will express the same on the lines D I and N K; then parallels being drawn from the points D I to M L, nothing remains but to draw the outlines. When there happens squares, or fillets, either at top or bottom, they are formed by perpendiculars. Thus, for the plinth, perpendiculars must be raised from the points L I K, and from the point of sight A a line to be drawn through the angle of the plinth to Q; this will give the height of the perpendiculars I and K. Lastly, L is to be made equal to I.

This instruction for the base will suffice for the capitals; the operation being the same in both. The last pilaster R, is only meant to shew one clear of lines. They are all broke in the middle, that there might be room to express both the base and the capital; the page not allowing them to be represented whole.





*To exhibit a large CORNICE above the Horizon, in
Perspective.*

THE method is the same as that just delivered ; but being somewhat troublesome by reason of the number of lines, I have judged proper to repeat it again here, in order to avoid confusion.

To the purpose then : having taken the profile of the cornice, and its projection, you are to transfer it to the place where the draught is to be made ; as here the profile C, &c. is at the corner of a wall A B. To find what height it must have, and to make it shew its bottom, from the point of sight D draw a line through the extreme of the profile E, as the line D F ; then draw a diagonal from the point of distance H, passing through the corner of the wall B, and prolonged till it cut the ray D E in the point F ; from which draw the line F G, which is to represent the angle in perspective, and to receive all the measures of E G. The corner of the other end of the wall, K L, is to be drawn to the point of distance I, as being the other diagonal.

In *Fig. II.* it is shewn, that all the figures which are on the line M N, are to be transferred, by means of visual rays drawn from the point of sight D, upon the line N O ; in order for parallels to be drawn through all those points, which are to give the cornice complete. But before we go farther, it is to be observed, as has been already hinted, that all plat-bands and squares are formed by perpendiculars. Thus, for instance, to form the large square of the cornice, having made the doucine, and the fillet ; from the bottom of the fillet, which is the top of the square, let fall the perpendicular P Q : then, to find the place it is to be cut in, to shew the bottom, a line must be drawn from the point of distance I, through the point at top of the quarter round R, to the perpendicular P Q ; and you will have your desire. What has been said of the large square, holds equally of the lesser ones ; as the denticles, fillets, &c. which are all to shew their bottoms.

The third *figure* shews, that having found all the points, and drawn lines on the line of the angle S T proportional mouldings must be drawn thereon. I mean, that when they project much, as is here the case, by reason the point of distance is near, the mouldings must be helped out a little ; that is, the quarter round must be inclined a little, the doucine be erected, the fillets enlarged ; and the same done at one end as the other ; for example, the same on V X as on S T.

This done, all that remains is, to draw parallels to the base line to form the front-side of the cornice.

The fourth *figure* is the cornice complete. In this we have drawn parallels from all the points of the line of the angle Y Z ; and one end of the wall is made to pass over the cornice, to shew that we are at liberty in such matters ; and that the rule is general.

To find the Bottoms of large PROJECTURES.

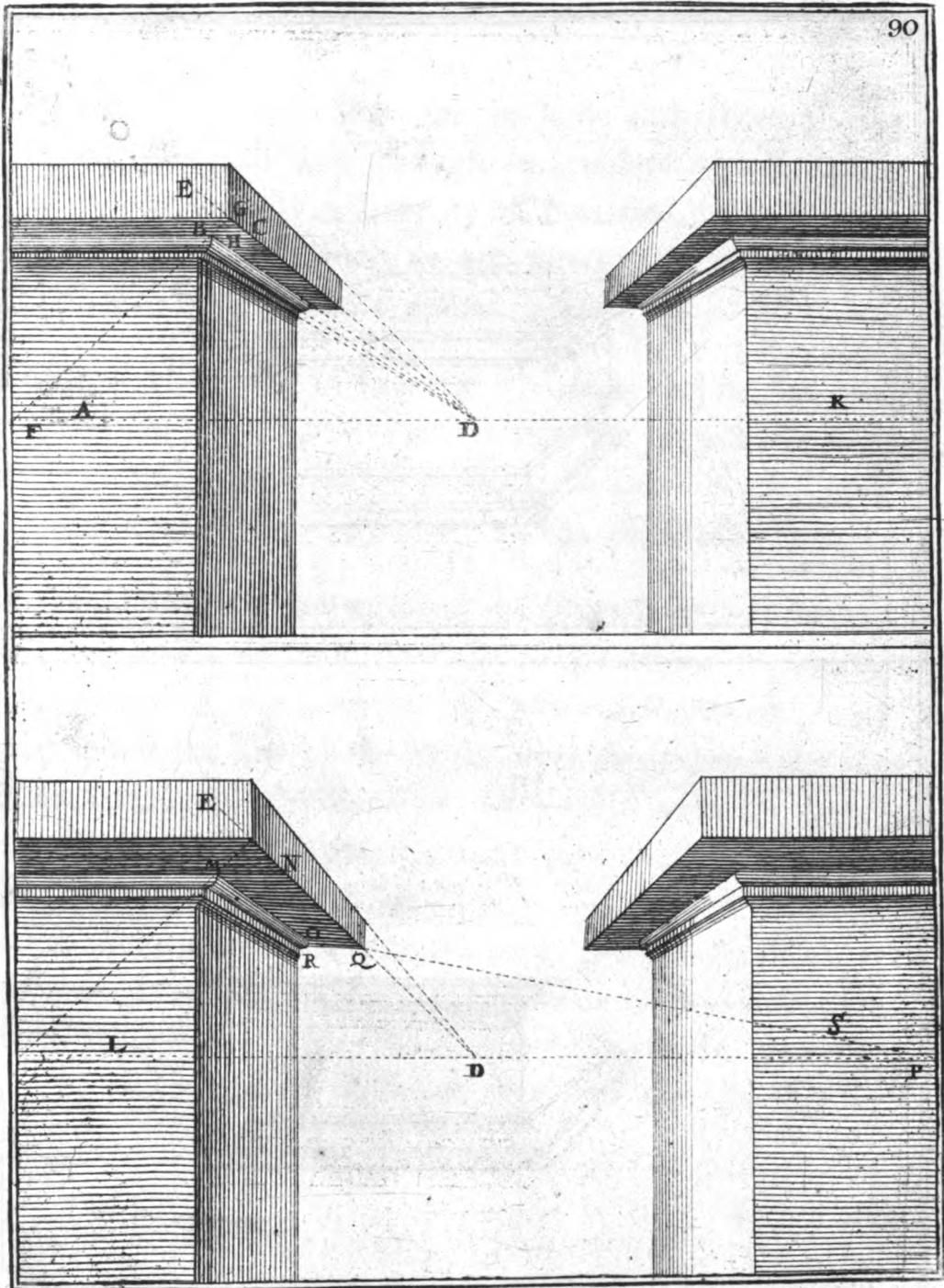
TO find the projecture of the corona of the wall A ; on the angle of the quarter round B, make a line equal to the length of the intended projecture, as B C ; then from the point of sight D, draw a ray E, passing to the extreme of the measure C. This done, draw a diagonal from the point of distance F, passing through the quarter round B ; and the point G, wherein it intersects the ray D E, will give the bottom on both sides, B H : as is more clearly expressed in the opposite figure K.

The projecture of the wall L, is formed after the same manner as that of the former A. All the difference is, the projecture M N of the wall L, is half as big again as that of B C ; to intimate, that the same rule makes them as big, or as little as one pleases.

It is likewise observable in the same wall, how the return of the projecture, &c. is found. For instance, from the point O of the quarter round in the fund of the wall, a diagonal is drawn to the point of distance P ; and the intersection of that line with the ray C D will be a point, through which a little parallel to the horizon R Q being drawn, will give the return required.

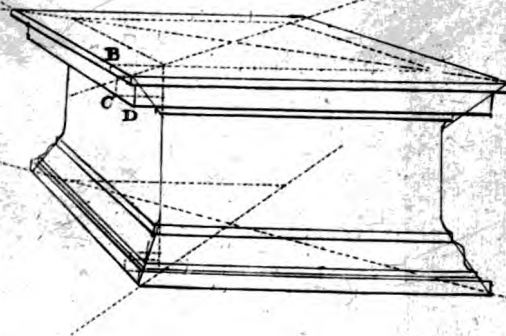
The same method may serve for all squares on cornices and mouldings both great and small.

The wall S shews all the mouldings on that of L, more distinctly.

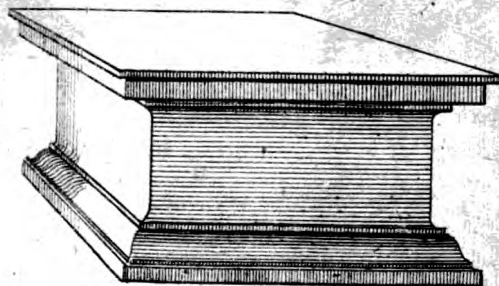


A

1. fig.



2. fig.



To exhibit CORNICES and MOULDINGS below the Horizon.

THE rules that obtain here are the same with those of the preceding cases ; though through an accident which sometimes falls out, namely, a diversity of horizons, there arises a little variation, which such as are unacquainted therewith might chance to be puzzled withal.

I observe then that in viewing a cornice below the eye, and of consequence below the horizon, the projectures hide sometimes half, sometimes more ; more or less of them being seen, according as the eye is more or less elevated.

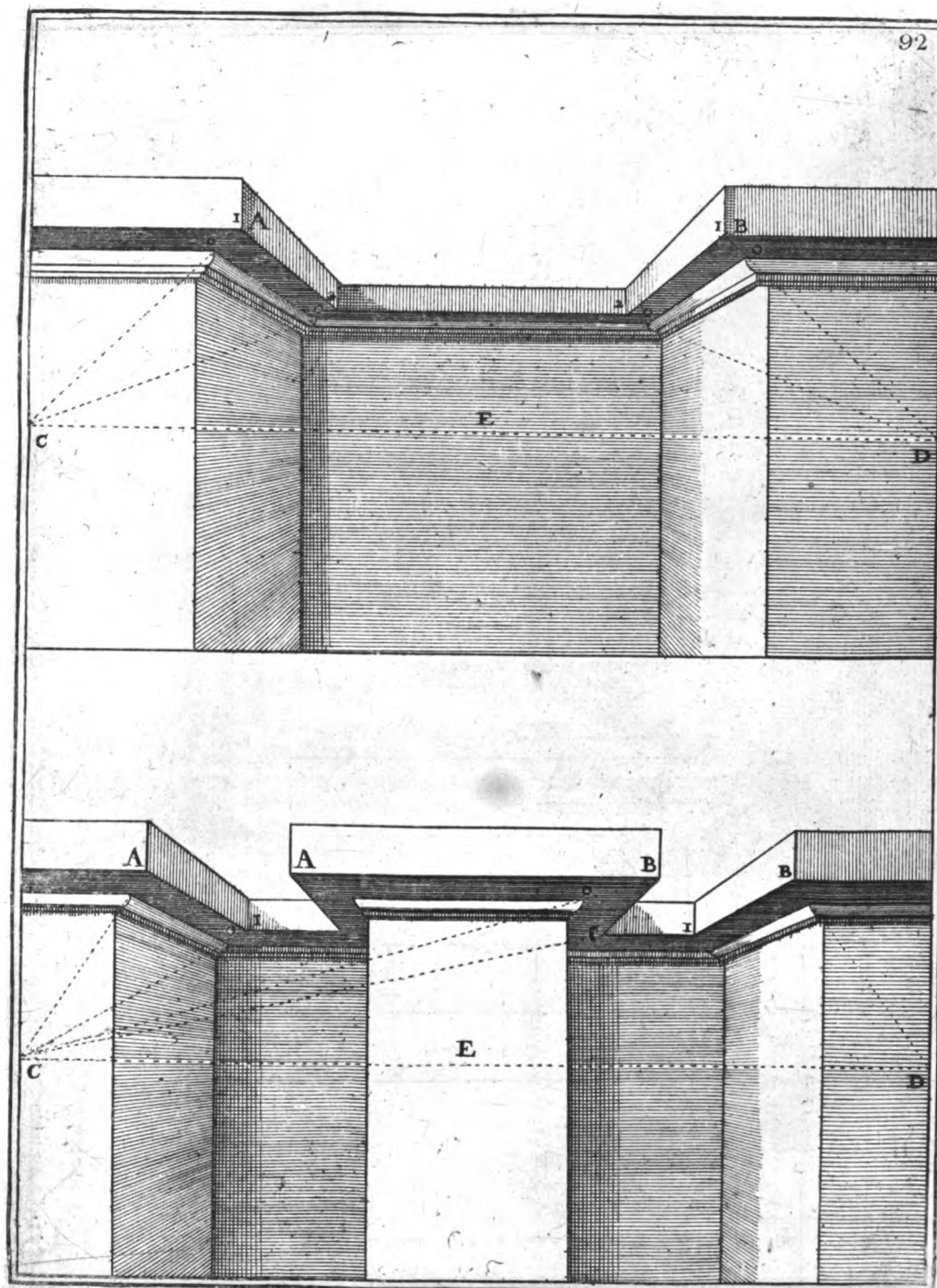
To find precisely how much of the projection is to be covered, and how much not ; set the profile of the moulding on the corner of the body to be enriched therewith ; and having found the line of the angle, after the manner already directed, draw the divisions of the profile upon the same. Thus will you find that the square, or plat-band, covers the whole astragal underneath, and only lets half the fillet be seen. For, drawing a line from the point of sight A, through the profile B C, it cuts the perpendicular from the line of angle in D, and shews how much is to be covered: For the moulding at bottom the same method serves as for that at top.

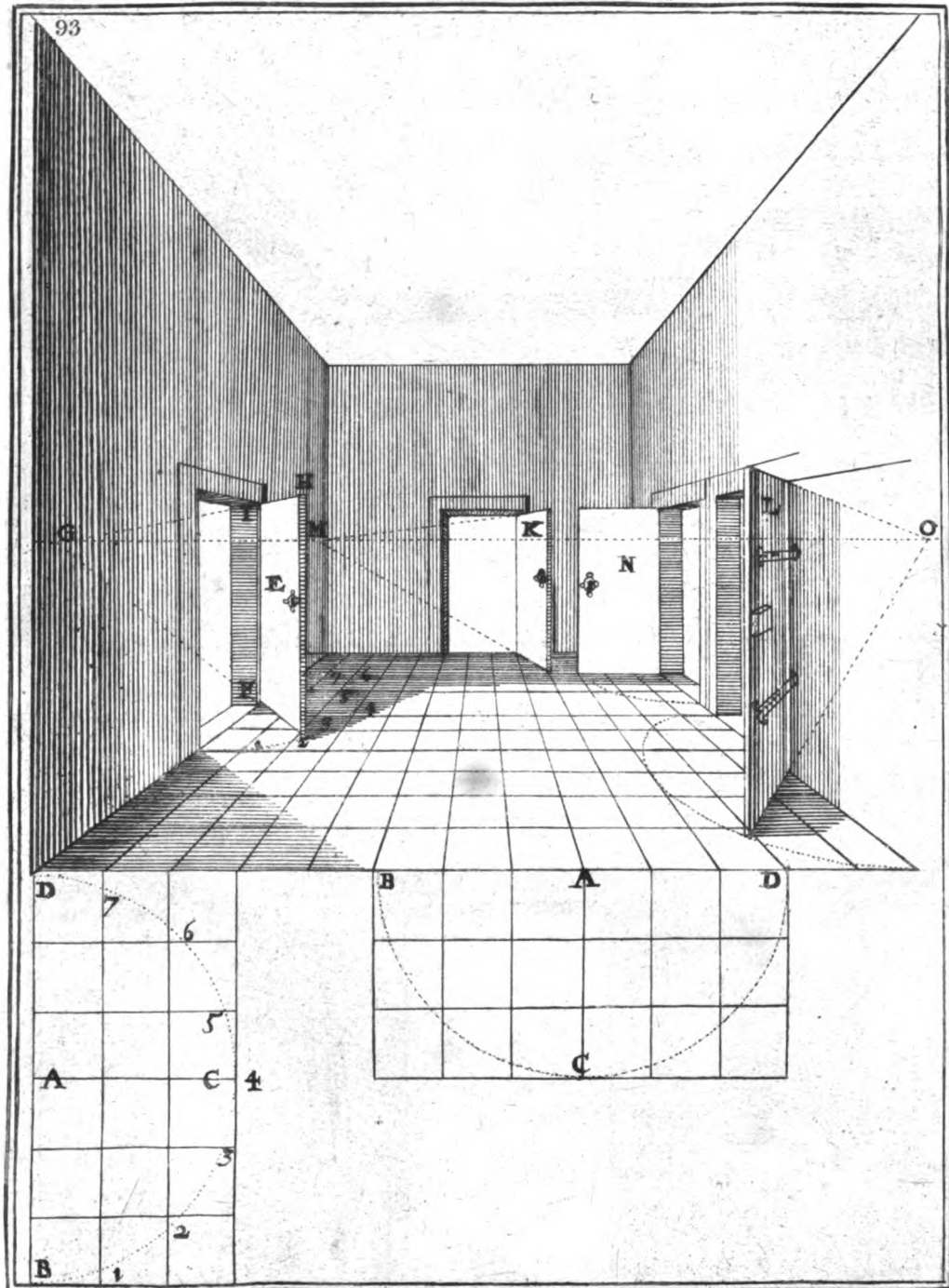
To exhibit CORNICES with several Returns.

WHEN there happen divers turns and returns in the cornices or mouldings, their bottoms must always be taken from the point of distance. Thus, having drawn rays, A and B, to the point of sight E; from the point of distance C, or D, a diagonal must be drawn through the angle of the quarter round O, till it cut the ray A or B in I. From which point, I, a parallel to the base being drawn, gives the bottom or projecture of the square; as already shewn in page 90.

I would willingly have made a much bigger cornice; as that would not have been a whit the more difficult; but the compass of the page obliged me to be contented with this.

If you would have returns on the ground, in the manner as these are above the horizon; the same method is to be observed. For proof of this, invert the paper, and you will find it have the same effect.





To exhibit the APERTURES of Doors in Perspective.

IN my instructions, I have kept pretty close to the order observed in the actual erecting of buildings of all kinds. I now proceed to shew how to furnish and dispose them for the reception of inhabitants. I begin with wooden doors; and hereafter shall find occasion to speak of other apertures, as windows, cupboards, &c. then of moveables, as tables, beds, chairs, chests, benches, &c.

All doors are to open and shut far or little at the pleasure of the person who opens them. For this reason I shall shew an easy method of putting them in perspective, at any degree of width or aperture at discretion.

Now it is observable, that doors, windows, cabinets, chests, and, in fine, every thing intended to open and shut, always describe a semi-circle in opening. The reason is, that the side hung by hinges keeps its place, like the fixed leg of a pair of compasses, while the other side, like the other leg of the compasses, sweeps its arch. Thus in the plan underneath the opposite figure, the fixed side A extending to B, if you open the door quite, the side B must describe the semi-circle B C D, whose centre is A. Hence it follows, that if the door be three feet broad, as in the present case, the radius A C will likewise be three feet, and the whole chord or diameter of the semi-circle B A D six feet. Of these six feet in length, and three in breadth, a plan must be made, consisting of eighteen squares, wherein the semi-circle A B C D is to be described, this method is directed to render the making of the same semi-circles in perspective the more easy. Always observing where the semi-circle of the plan cuts the squares, that those in the perspective may be cut after the same manner, and a semi-circle be drawn, taking up the same space, traversing as many squares, and cutting them in the same places. An instance of which you have in the door E, where the intersections are marked the same as in the plan underneath, 1, 2, 3, 4, 5, 6, 7.

When a door is to be represented open in perspective, a semi-circle must be struck on its plan, and the point of aperture placed on any part thereof at pleasure. Thus for the door E the point of aperture is fixed at 2. From this point 2 a perpendicular must be raised, as 2 H; and from the same point 2, a line must be drawn through the corner of the door F, and continued till it cut the horizon in the point G; from which another line must be drawn through the other corner of the door I, and continued till it cut the perpendicular raised from the point 2, in the point H. Thus will you have the door open F I H 2.

All apertures are performed by the same rules as is farther seen in the doors K and L. The door K shews its outside, and that of L its inside; yet both are performed after the same manner as the first. The accidental point of K is drawn from the point M in the horizon, and that of the door L from the point of distance O. If bolts, locks, or the like, be added on the doors, they must all be drawn from the same accidental point; as the bolts and lock of L tend towards O. What accidental points are, has been explained, page 12. Now all apertures have one such point in the horizon, excepting two sorts. The first, when the door is quite open; in which case its accidental point is the point of sight. The other, when its position is parallel to the horizon; by reason the parallels, in that case, never intersect: as in the door N.

To exhibit APERTURES of Casements in Perspective.

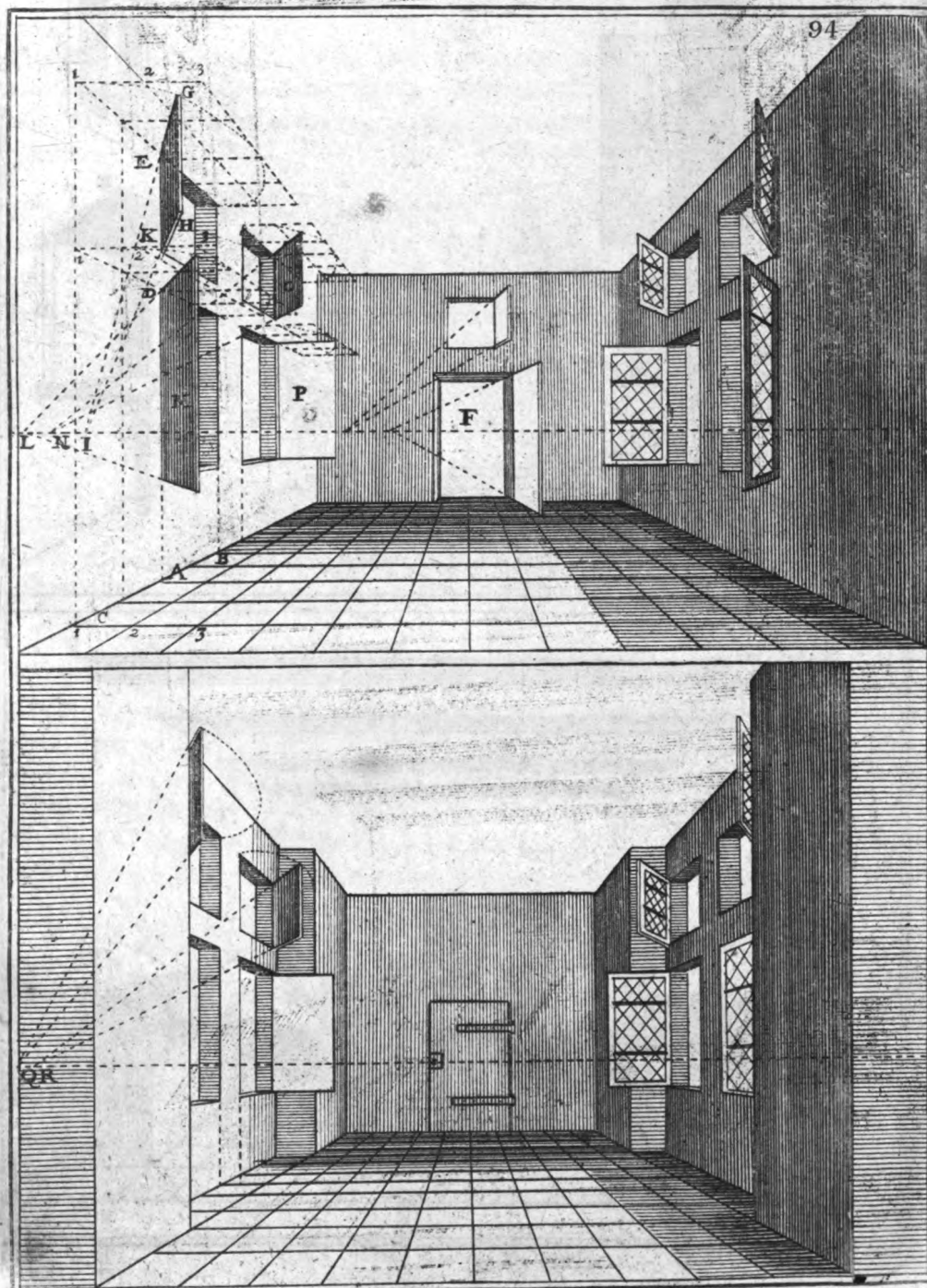
ALL the difference between the *apertures of casements*, and those of *doors*, lies in this, that doors have their semi-circle of aperture on the plan, and casements in the air; by reason windows are raised, and doors usually turn on the ground. On this account, the semi-circles of casements may be either over or underneath them. And in such semi-circles is the point of aperture to be placed.

Thus, for instance, if a casement be two squares, or panes, broad, as A B, and it be made quite open, it will then take up two squares more C A, whereof A is the middle, and the centre of the semi-circle A B C. But by reason the window is raised above the ground, the semi-circle must also be raised; as is here actually done in the semi-circles of the windows D and E: whereof the same D and E are the centres; and which are easily formed by erecting perpendiculars from the intermediate squares, till such time as they intersect the rays drawn from the corners of the casements D, E. From these intersections, lines must be drawn to the base line, and the measures of the squares of the plan 1, 2, 3, be set thereon. From the same points 1, 2, 3, lines are to be drawn to the point of sight F; which cutting the parallels, will give squares to fix the aperture by. Proceed then to take the apertures after the same manner as those of doors. For example, the point G being given in the upper semi-circle, from the same G draw two lines; the one, G H, perpendicular; the other passing through the corner of the window E, and cutting the horizon in some point, for example, the point I. From this I, draw a line through the corner of the window K, till it cut the perpendicular in the point H, which gives the casement open K E G H. The same is to be observed with regard to all the rest; and the point still to be taken in the horizon. Thus, L is the point for the casement M; and N, that for the casement O. The casement P has none at all, as being parallel to the horizon.

The casements on the other sides are performed after the same method, without any of the confusion of lines. Both the one and the other range with the wall, to facilitate the operation. The door at bottom is done after the manner already directed; and the casements according to the method last delivered.

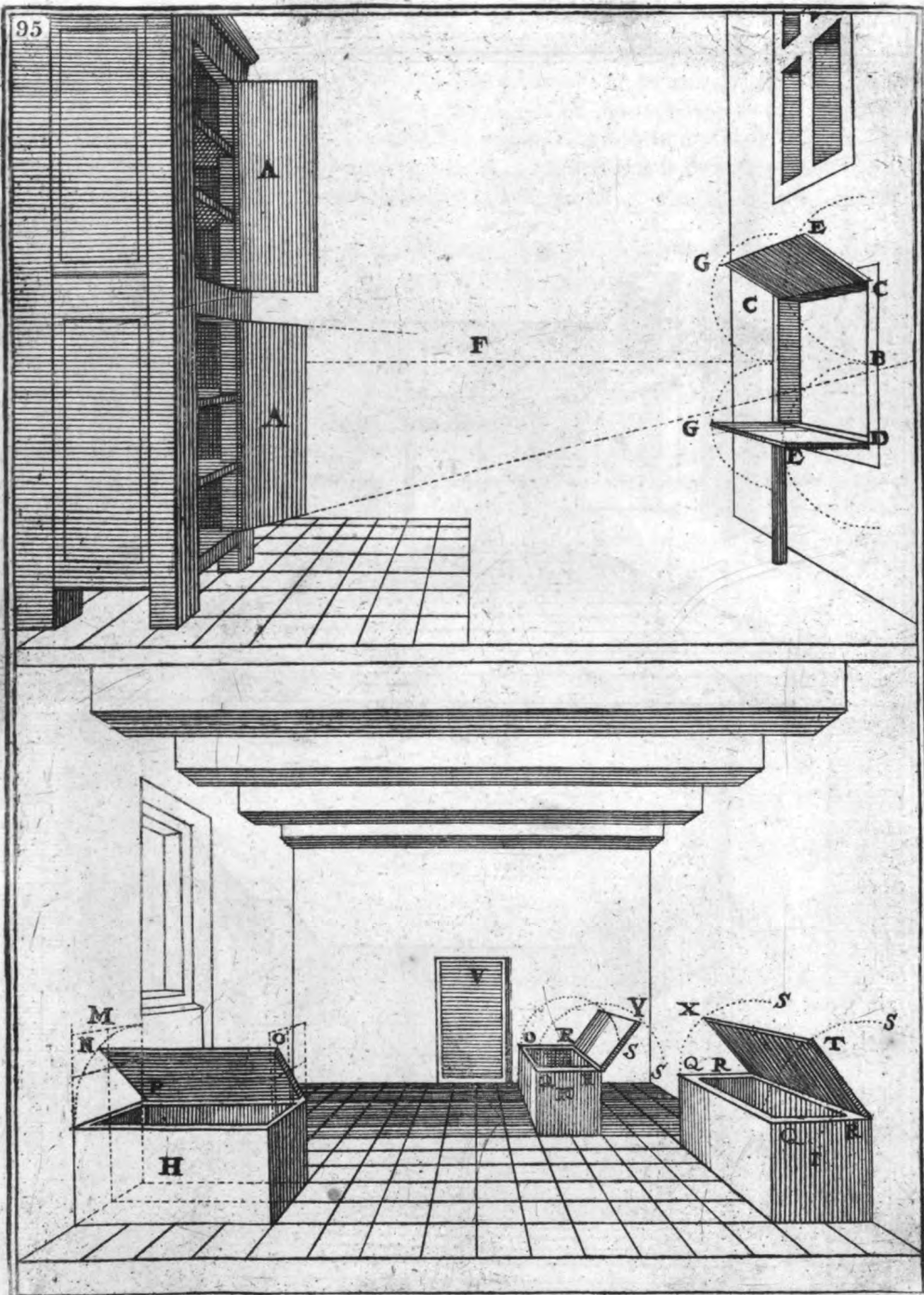
APERTURES of Casements with Embrasures.

THE rules for these are the same as for those that range even with the wall, excepting that these are not capable of being quite opened, by reason of the thickness of the chamfraining, or embrasure. On this account we never give them a whole semi-circle, but a portion answerable to the aperture they admit of. The accidental point should always be in the horizon, for upper windows, as here in Q and R; that below is parallel to the horizon.



R

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Divers other APERTURES.

THE *openings of cupboards, presses and chests*, are at least as necessary as those of doors and windows ; nor had the omission of the one been a whit more excusable than that of the other. Their doctrine will be exemplified in two figures.

The cupboards or presses A A, are opened according to the rules delivered for casements, which it would be needless here to repeat. I shall only add, that the uppermost is parallel to the horizon ; and that the latter tends to the point of distance B.

The *shop* on the other side is opened by two leaves, one of them rising upwards, and the other falling downwards. Each of them describes its semi-circle from the centres C and D ; which being drawn with the compasses, the apertures are fixed at any point at pleasure ; as here in the point E ; from which a ray is drawn to the point of sight F, till it intersect the semi-circles at the other ends in the points G. From these points E and G, lines being drawn to the centres C D, give the leaves opened in that position.

In the lower figure there are three *chests*, differently opened. To open the first, H, the quadrant M is put in perspective, according to the measures of the squares of the plan. Thus, observing the width of the chest, which is two squares, perpendiculars are to be raised thence, and a semi-circle, or quadrant, described for the opening, which is here fixed at the point N ; and from this a parallel is to be drawn to the other quadrant O ; and from N and O lines to be drawn to the centres P P. If a greater aperture is required ; a semi-circle is to be drawn in lieu of a quadrant.

The chest I in that position has the easiest of all openings, for having taken the breadth Q R, from the centre R describe the semi-circle Q S ; then take any aperture at pleasure, as T, and draw a line to the point of sight V, cutting the other semi-circle in X ; and, lastly, from the points T and X, draw lines to the corners R, and you have the lid formed with that aperture.

If it is required to open the chests farther, you have only to fix the point of aperture high in the semi-circle ; as Y is in the chest K. The rest of the process is the same as in the first chest.

R

Plans and first Elevations of *Moveables*.

THESE plans I should have placed in their order among the rest, but for this consideration; that had I treated of them at the beginning of the work, without shewing the necessity thereof, they would have passed for useless, and accordingly have readily dropt out of remembrance. They now come in properly, and cannot fail of being well received and learnt with pleasure; inasmuch as numerous sorts of *moveables* or *household goods* have a dependence upon them.

The first plan, A, may serve for *beds, tables, chairs, stools, &c.* The other B, which is twice as long as it is broad, serves for *long tables, cupboards, buffets, chests, trunks, &c.* The third, C, which is long and narrow, serves for *benches, or forms, couches,* and other pieces of furniture with six legs or feet.

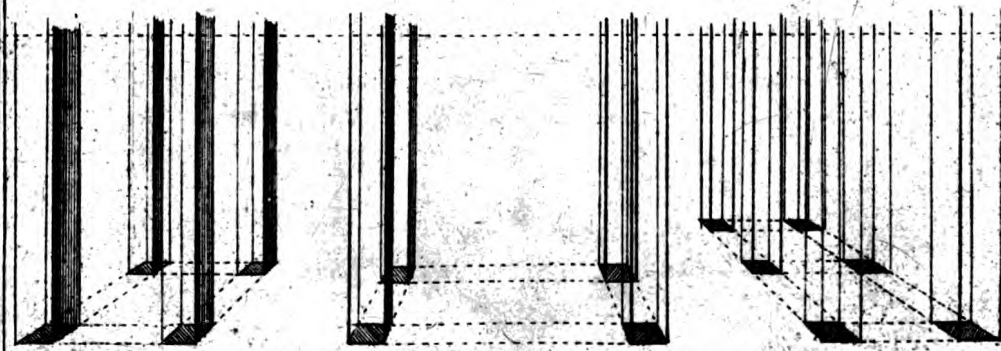
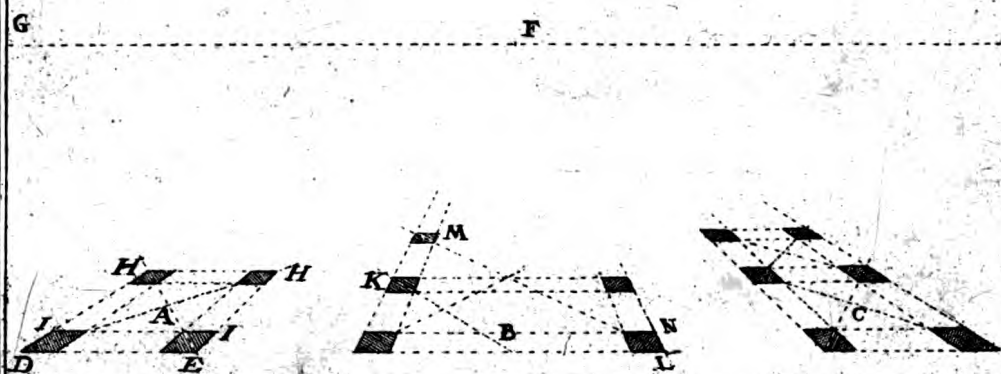
The acquaintance the reader is supposed to have with the other plans already treated of, will render the performance of these easy; there being nothing more required than to lay down their dimensions on the base line, draw lines thence to the point of view, and shorten them by means of the points of distances.

Thus, for example, for the first plan A, the two measures of E and D must be set on the base, and lines be drawn thence to the point of sight F. Then from one of the points of distance, a line is to be drawn to one of those measures, as from G to E; and through the points H and I, wherein it intersects the rays, parallels are to be drawn; by this means four little squares will be formed, whose measure you may account as much or as little as you please. For a table they must be more than for a stool, that is they must have more breadth; the latter being usually two inches, and the former four.

The plan B is performed after the same manner; excepting that on account of its length, which is double its breadth, a line must be drawn from B to one of the points of distance, to find the half K. For if a line were drawn from L, it would intersect in M, and give a whole square; whereas we only want half of it. Parallels then must be drawn from K to the points of intersection with the ray; and from the corner L, a line must likewise be drawn to the point of distance G, intersecting the ray: Thus will you have the four little squares.

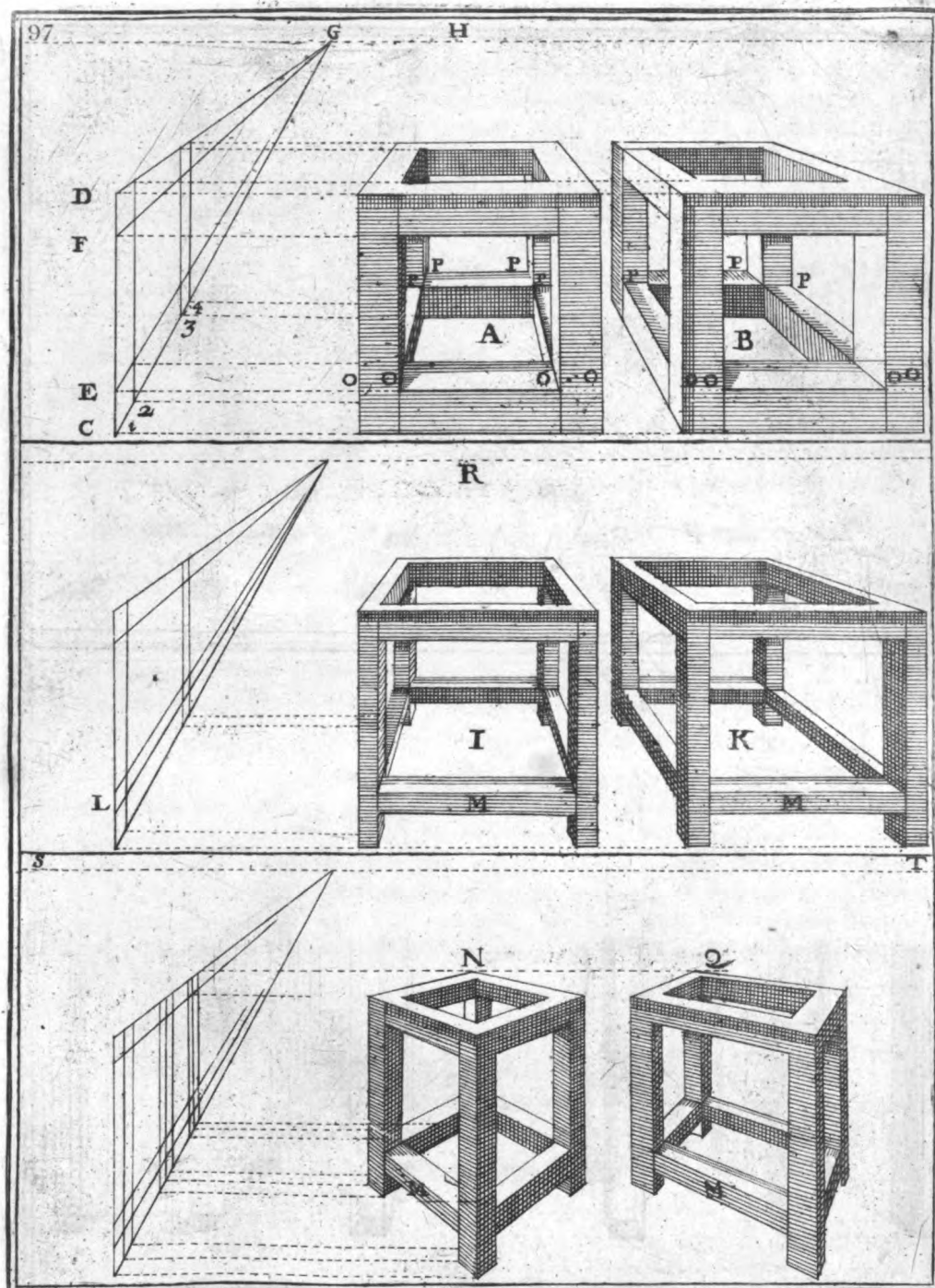
The third plan, C, needs no explanation; it being evident that it is formed like the first A; and that the squares must be doubled to get the six little squares.

The figures underneath are intended to shew that perpendiculars must be raised from all the angles of the aforesaid squares, to begin to form the moveable pieces of furniture hereafter shewn.



R 2

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ELEVATIONS *of* Moveables.

HAVING raised perpendiculars from the plan, as already intimated ; a line of elevation must be made in some part of the painting, on which the heights, cross pieces, &c. are to be laid.

Thus the line *CD* being a line of elevation, and *CE* and *DF* breadths or depths of the cross pieces ; from these four points draw lines to some place in the horizon, as to the point *G*. Then having erected perpendiculars from all the angles of the plan, as in *A* and *B* ; from the angles draw parallels to the base line, till they cut the line *CG*. Thus will you have the points 1, 2, 3, 4 ; from which perpendiculars are to be raised, and the intersections those perpendiculars make with the line *DG*, will be the points to cut the perpendiculars of the plans, as shewn in the figure ; where a parallel being drawn from the point *E*, cuts the first perpendiculars of the plans *AB* in the points *O* ; from which drawing lines to the point of sight *H*, the other perpendiculars of the plans will be cut in the points *P P*, &c. And doing the like from the point *F*, &c. you will at length have a cube perforated on all its sides. Which process being well understood, all the other pieces that follow, and even all that can be conceived, will be readily performed.

Instead of parallels from the points on the line *DG*, to cut the perpendiculars of the plan, the measures of them taken with the compasses and transferred to those perpendiculars will answer the same purpose, as has been shewn elsewhere.

It is easily observed, that the two frames or stands of tables, *I* and *K*, are performed by the same rule as those above. All the difference is in the cross-bar at bottom, which is higher in the line of elevation in this latter case, than in the former. In the latter, for instance, we find it in the line *L*, which gives *M M*. The feet of the stands or that part of the perpendiculars which are beneath the cross bars, one may either leave them square, or round them into bowls.

As to the last frames, *N* and *Q*, there is nothing in them more than in *I* and *K* ; only that they are viewed by the angle, and the other in front. The plans of those stands, *I* and *K*, are drawn to the point of sight *R* ; and these latter to the points of distance *S T*.

The figures in this plate, with little variation, may be adapted to divers sorts of moveables. Thus, for instance, to make a bedstead of *Fig. I* or *K*, nothing more is required than to give it a proper height and breadth. In every thing else the operation is the same as for a couch, a stool, or the like. For a table you have only a top to add. For a joint-stool, beside the top, it must be made more in height than width, but the construction thereof with four legs, and the four cross-bars, is the same as in this figure.

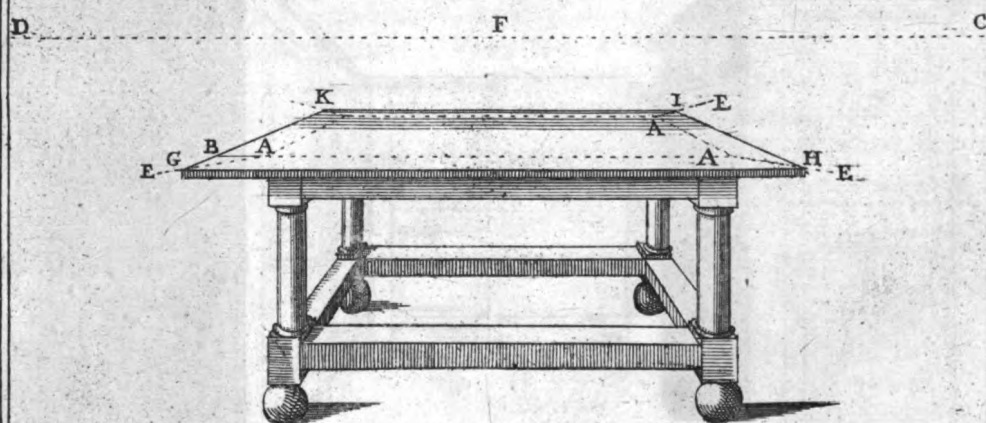
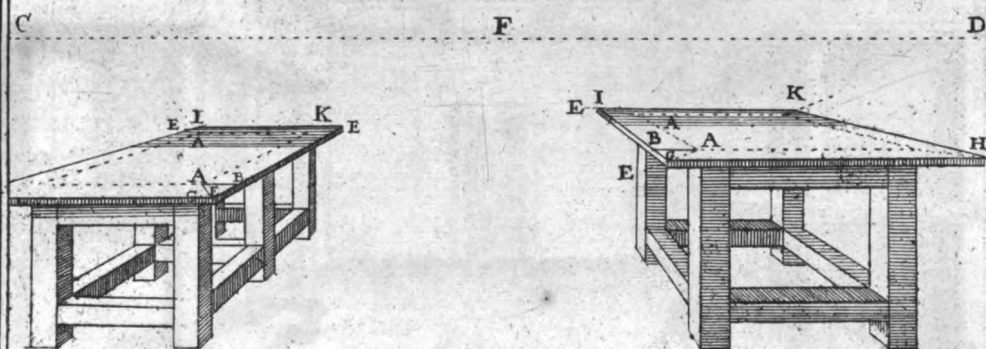
To exhibit the upper Part of Tables, Stools, &c.

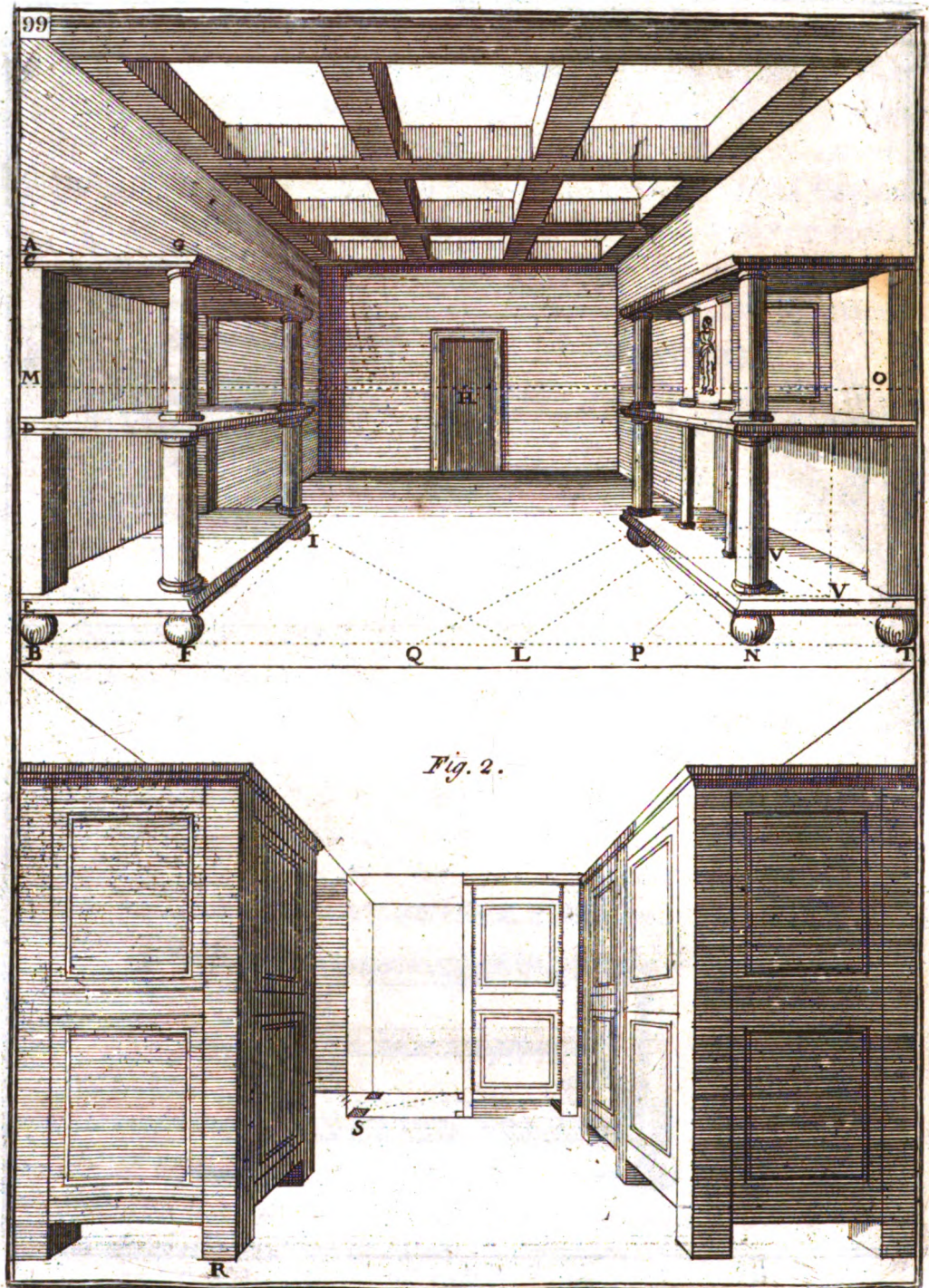
HAVING raised perpendiculars from the plan, as directed in the foregoing page, and fixed the proper height thereon, the frame will be complete. Now to make a cover to it perfectly on a level, and which shall not extend beyond the frame, there needs nothing more than to leave the top of the cube plain, without expressing any other lines but those which bound the four sides, which will make the upper part of a table, stool, or the like.

But if it is desired the upper part or cover shall have a projecture, or ledge; from one of the angles of the frame a parallel must be drawn, as A B; and on this parallel the measure or quantity of the intended projecture must be set, as here A B. Then from the points of distance C and D, occult lines A E, A E, &c. must be drawn through the angles of the square of the frame here expressed by dotted lines. And to make the measure A B give the proper breadth to all the sides and angles of the table; draw a line from the point of sight F, through the point B, continuing it till it cut the line C A E in the point G. From the point G draw another parallel, cutting the other occult line in H. Then drawing lines from the points G and H to the point of sight F, the other diagonals will be intersected in I and K; which will give the upper part of the table, with the projecture that was set on the line A B.

The thickness of this upper part of the table is fixed at pleasure.

The same method may serve for the upper parts of any objects, whether in front or in side-views below the horizon, and for the bottom of those that are above the horizon, as particularly shewn in pages 49 and 50.





Printed for Bowles & Carver, London.

To exhibit the Elevation of Buffets, Presses, and Cup-boards.

HAVING made the plan, and raised perpendiculars from all the angles, as already taught ; upon the line A B, which is here to serve for a line of elevation, the measures or proportions of the distances of the shelves, with their thickneses, &c. as here C D E, must be laid down. Then from the points C D E, draw parallels to the base line, as far as the upright post G F ; and from the points thus marked on G F, draw lines to the point of sight H ; as far as the other post I K, forming the breadth of the buffet. This breadth is fixed at pleasure, by laying down the intended measure on the base line. Thus for the breadth of the present buffet, the distance F L is laid down ; and from the point L, a line is drawn to the point of distance M ; and the point I wherein it intersects the ray F H, is the place of the last post.

The buffet on the opposite side is performed after the same manner. To adjust the proportions of the little cabinet, or locker, supported by two columns in the middle thereof, take the points L P, which are in the middle of Q N, or of the breadth of the buffet ; and drawing lines thence to the point of distance O, where the ray N H is intersected thereby, draw parallels to the base line, cutting the ray T H in the points V V. And perpendiculars raised from those points will give the little cabinet in the middle.

The large presses, or cup-boards, in Fig. II. are performed after the same manner as the buffets above ; only that in the middle being viewed in front, needs a little explanation to determine its depth. I observe, then, that its plan must be formed, as already directed, and as one half of it is here shewn. Then, to make cross pieces equal to these in the front, occult lines must be drawn from the first upright post R, to the perpendicular of the depth S ; and from the points of intersection draw little parallels to the base. The rest of the operation is plain.



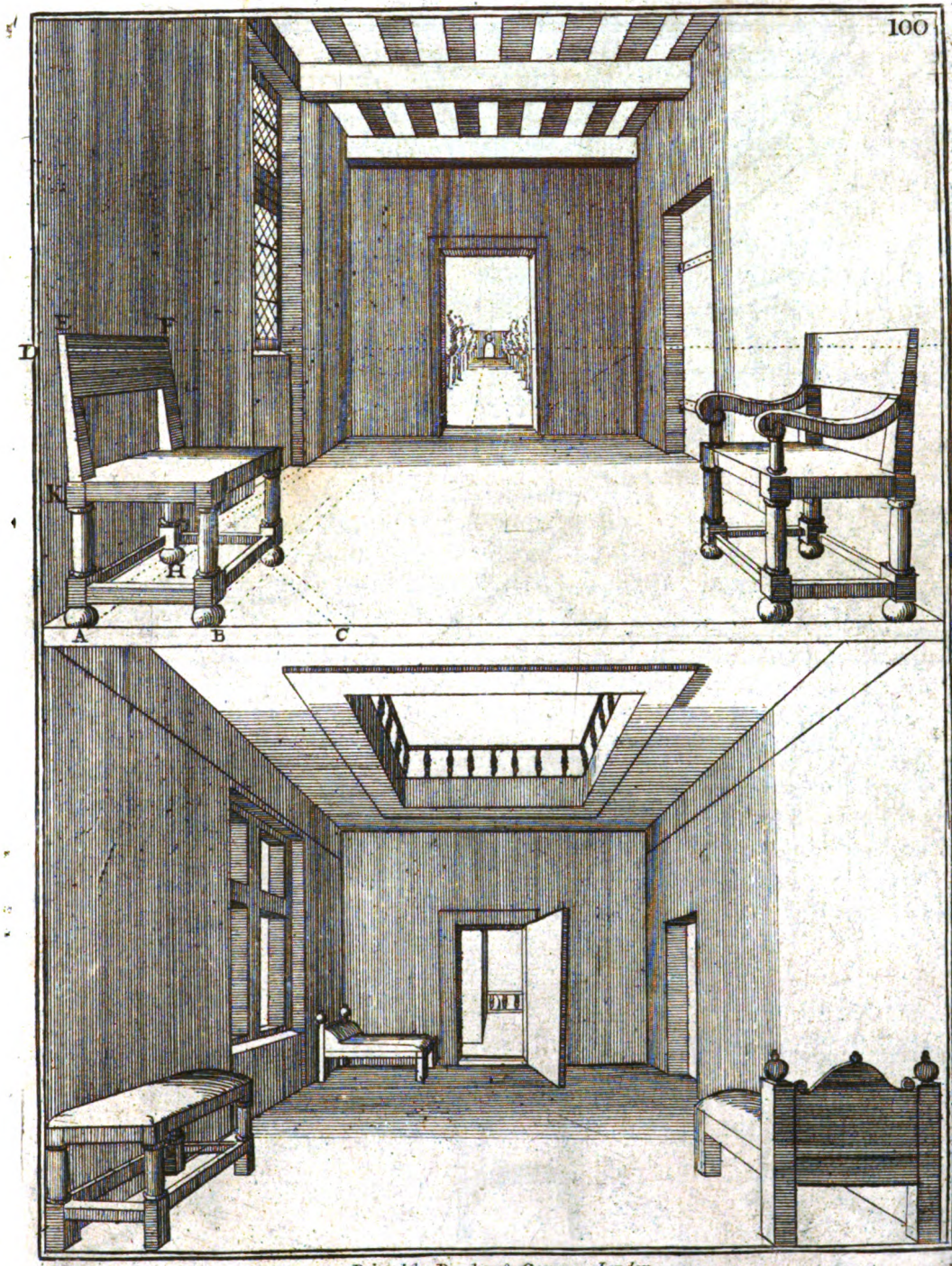
The ELEVATIONS of Chairs, Forms, and Couches.

TO *raise a chair*; from the dimensions A B C, erect perpendiculars, and proceed in the same method already directed for table-feet, or frames without tops. All that is to be done farther, is to procure the back of the chair; which may be made of any height at pleasure. In the present case the height of the back is equal to that from the foot A to the seat K: Which proportion may serve equally for elbow chairs.

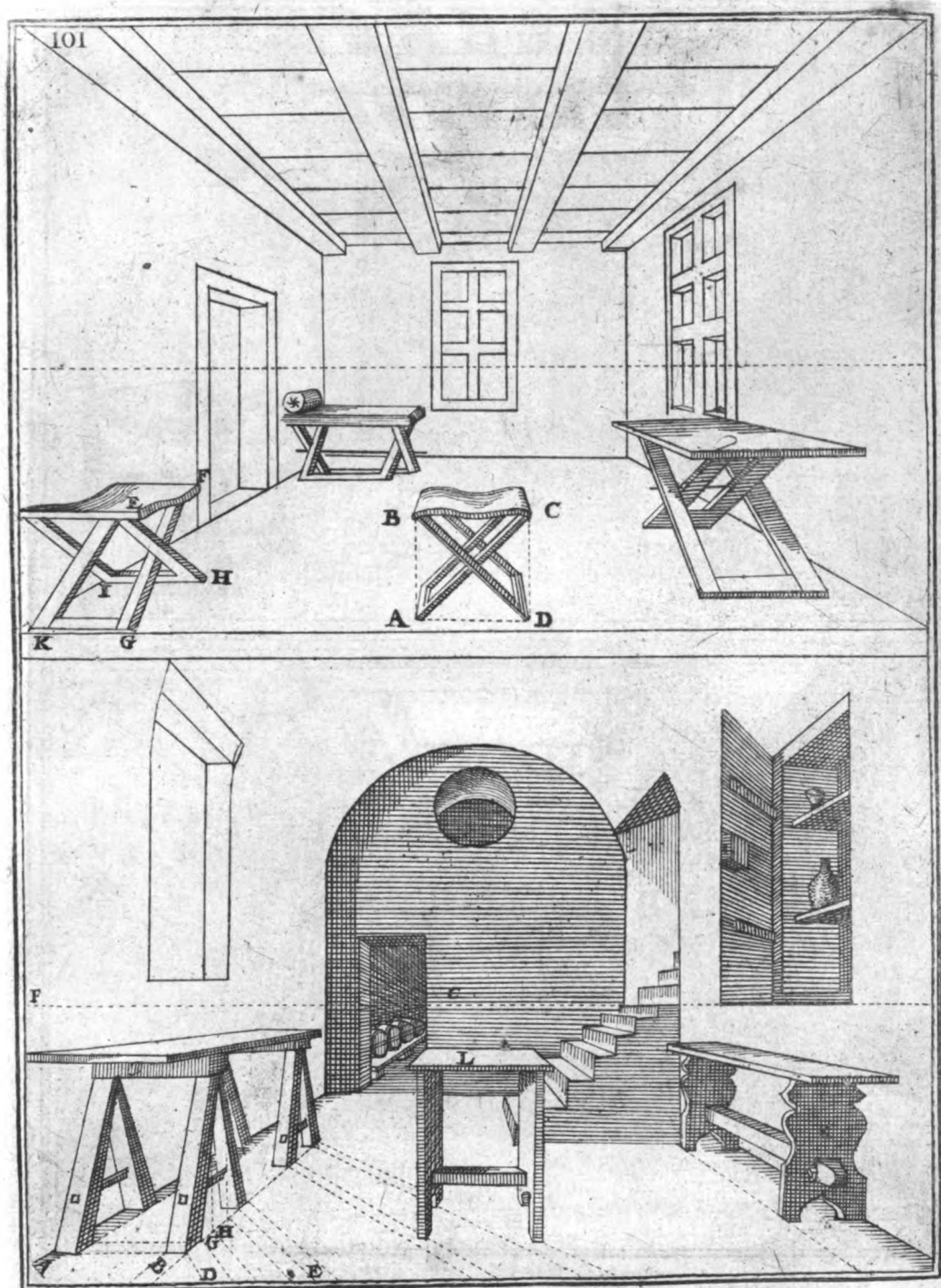
From the figure it appears evident enough, that to form the back there is nothing needed but to prolong the perpendiculars of the legs, as here A E; and from the point E to draw a line to the point of sight G; which cutting the perpendicular or post raised from the plan, or the foot H, gives the point F. The rest of the figure makes clear.

If elbows are required, you have only to raise the perpendiculars of the front legs higher, as the hind ones are for the back, and to draw a cross piece, or bar, in the shape you would have the elbow.

In the figure underneath, you see a form, or bench, covered with cloth, and two couches. The head of one is turned back in the front of the picture, and the other is viewed obliquely. It would be loss of time to dwell upon the manner of making them; the rules being altogether the same as those already laid down for other moveables, namely by making a plan, raising perpendiculars, &c.



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Another Method of putting Moveables in Perspective.

THERE are some *moveables* that *fold*, or shut down, and that serve for tables, seats, beds, &c. very easy to be put in perspective.

As to the elevation, it is performed as that of a cube, as shewn in ABCD, which is viewed in front; or E F G H. Then two diagonals, A C and B D, are to be made for that in the middle of the front; or E H, and F G for that of the side: and these will serve for the drawing of the two crosses; taking care that one enter half through the other, as G K does through H I; and both of them to be fastened by the middle to make them fold.

In the figure underneath we add a table upon treffels, that even the least considerable moveable might not be wanting. To put them in perspective, from the points A, and B, which are the interval between the feet of the treffels, draw a line to the point of sight C; then, laying down the thickness of the same feet on the base line; as here D and E, draw lines from the same to the point of distance F, and observe where they intersect the ray B C; and from the points of intersection draw little parallels to the base line; by which you will have the little squares or plans of the feet, as in A and B: then between the distance D and E, lay down the breadth intended for the top of the treffel, and drawing a line thence to the point of distance F, it will cut the ray B C in the points G and H; from which points, perpendiculars are to be raised to any height at pleasure, as here to I. Lastly, from the angles of the little squares of the plan draw lines to I. The second treffel is performed after the same manner as the first.

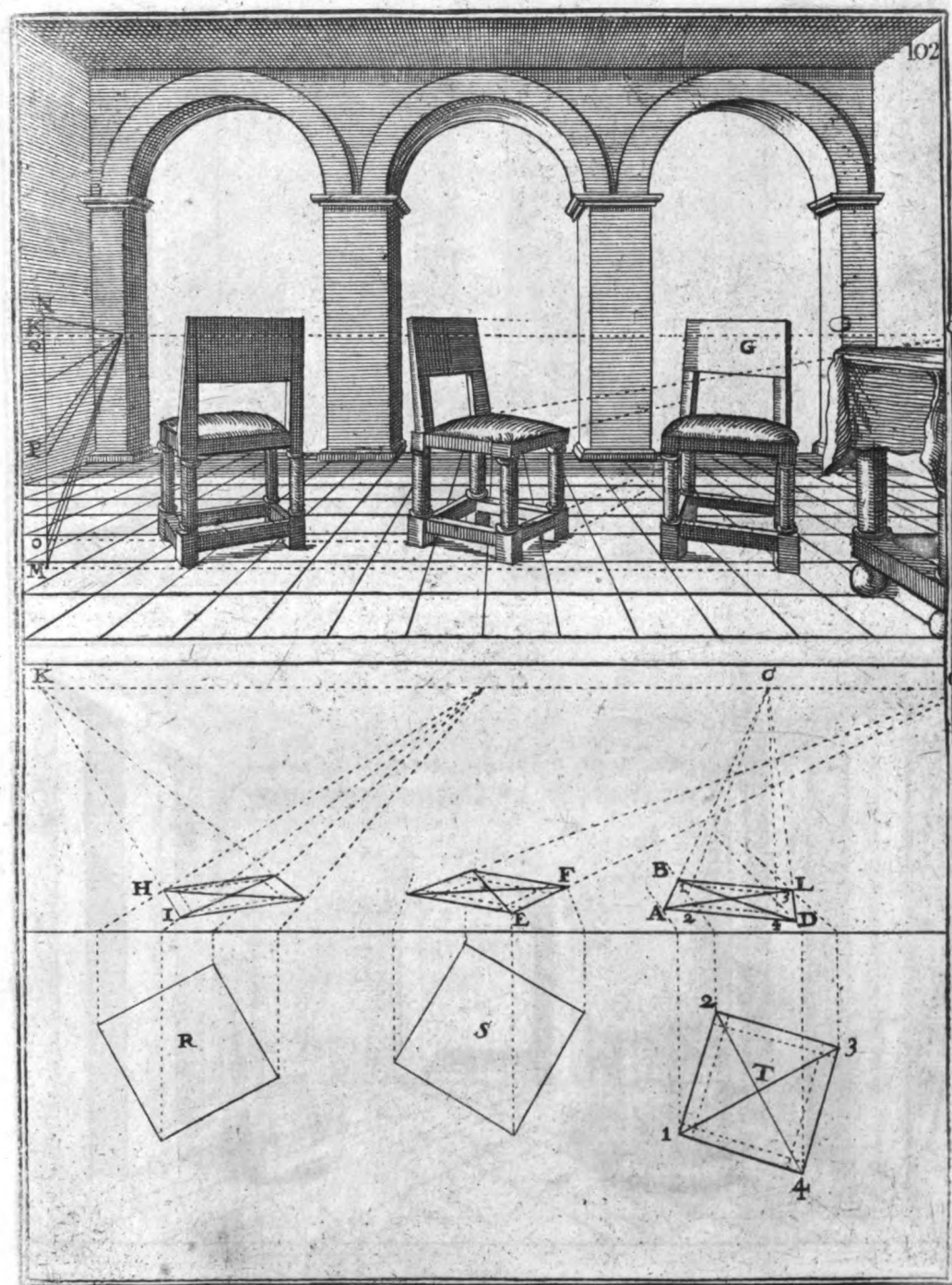
The *form* K, and the *table*, or *seat* L, need not any explanation, to put them in practice, as having nothing but what is common with the pieces above-mentioned.

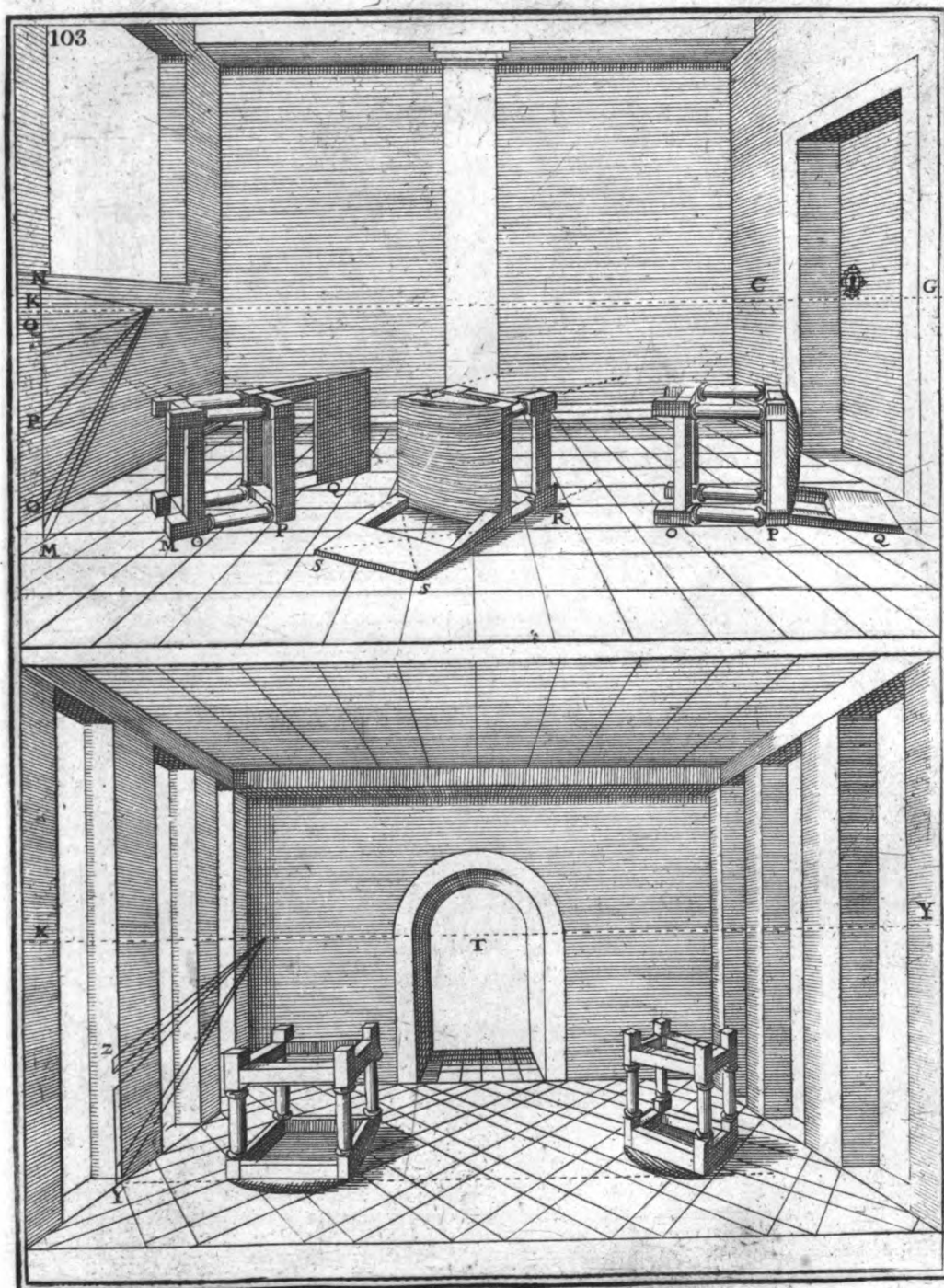
To exhibit MOVEABLES placed without any Order.

WHEN moveables are placed orderly along the side of a wall, or in the direction of the rays and the base line, it is easy to put them in perspective by the rules already delivered; but if they be irregularly placed, as in this figure, you are to proceed as I shall now direct. Draw the geometrical plans, R, S, and T, for plans of three chairs; which are to be diminished or put in perspective by the rule delivered for the irregular figure, page 40, and the plans will be found situated like the chairs, or rather the chairs like the plans. Now the plans being in perspective, lay a ruler along one of the sides, to see what accidental point it gives in the horizon; thus, laying a ruler along the side A B, you have the point C in the horizon for an accidental point, to which all the lines of that and the opposite side must be drawn. In this manner you see that A and D are drawn to the same point C. It is true each plan placed irregularly should have two accidental points, but they are frequently so far off in the horizon, that it is doubtful whether you find them both. The present plans have each of them one; as A B has C; and A D, the other side, would have another, if our paper were broad enough. E F gives G for its accidental point, and I H gives K. As to the little squares 1, 2, 3, 4, they are the plans of the feet of the same chairs, as may be made broader and narrower at pleasure.

Proceed then to erect perpendiculars from all the angles of the plan, and on the side of the picture add a line of elevation M N, whereon to lay the dimensions of the cross pieces; as O, for the lower bars; P for the bars of the seat; and Q for the backs of the chairs. Things thus disposed, from the angles of the plan draw parallels to the base line, as far as the line of elevation, and in the points of intersection erect perpendiculars. These will give the dimensions, as already observed of the former figures.

All the lines of the sides are to be drawn to the accidental point of the plan. Thus, in the middle chair, all the sides are drawn to the point G, which is the point of the plan, as appears from the figure.





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To exhibit MOVEABLES laid or tumbled on the Ground.

FROM the same plan, which has been given for chairs standing on their feet, it is easy to form these which are laid on the ground.

At the several angles of the plan erect perpendiculars, and give the side on the ground the same dimensions as when it was standing above it. For example, having erected perpendiculars from the angles, you will have the breadth M in the chair laid on its side, which is drawn to the point K. This measure M, being doubled, gives O for the bar at the bottom of the chair; and the perpendiculars raised from the plan, give the bar of the seat P: from which points, lines drawn to K, will cut the other perpendiculars of the front in the places required to shew the same bars on all the sides they are visible on. As to the height of the back of the chair, make it the same with the height of the seat; but for the back of that in the middle, you are to draw a double diagonal, and observe where it cuts the rays, or sides, R S. The rest is obvious.

The two other figures underneath, with their feet aloft, are easily performed. One of them is drawn to the point of sight T, the other to the point of distance Y, X. The line of elevation is Y Z.

The method of raising them, is the same as for elevating those upon their feet: that is, perpendiculars must be raised from the angles of the plan; and from the same angles, lines be drawn to the line of elevation; by which you will obtain the dimensions of each of the upright parts, and the places of the cross parts both of top and bottom.

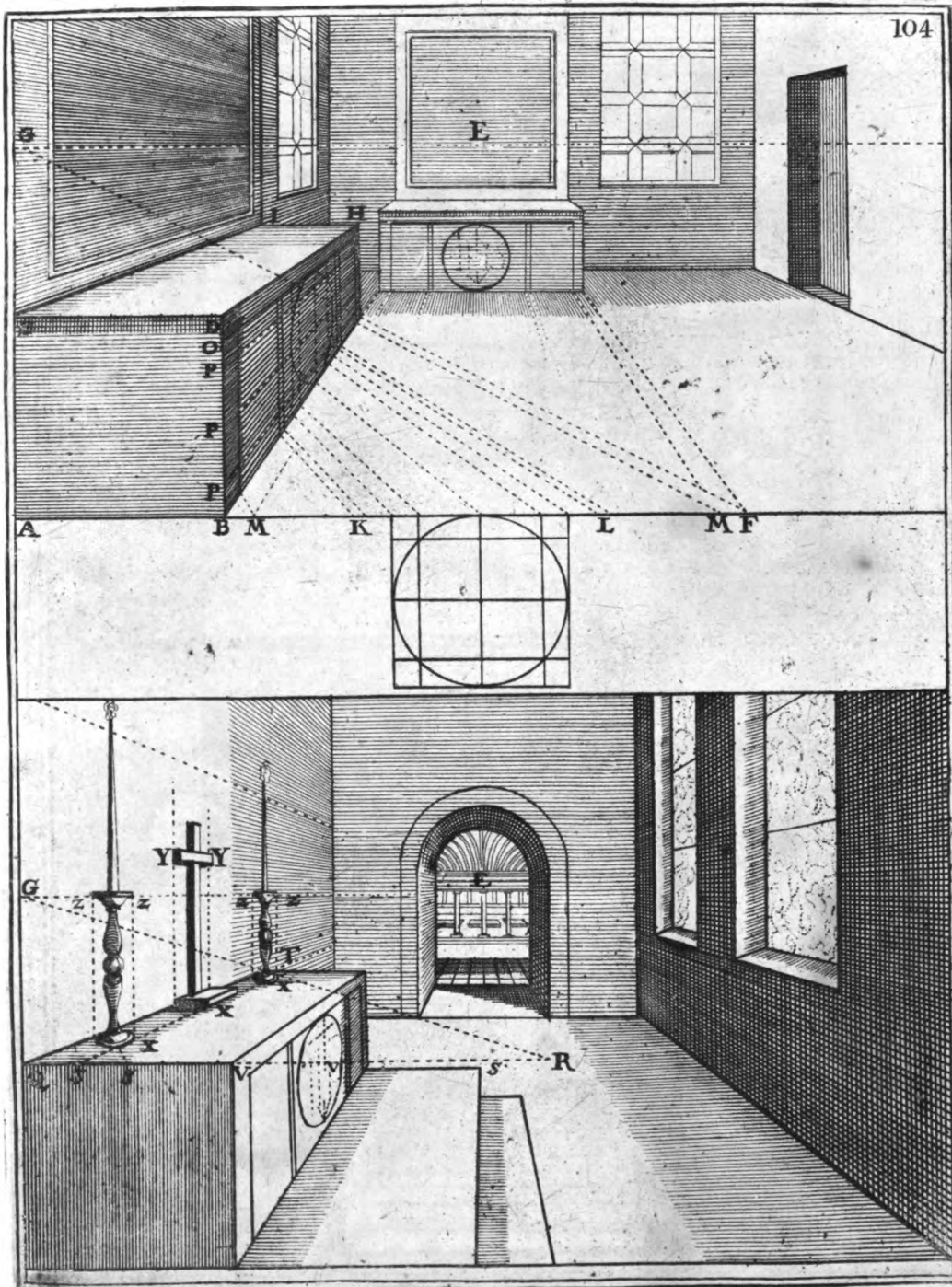
To exhibit ALTARS in Perspective.

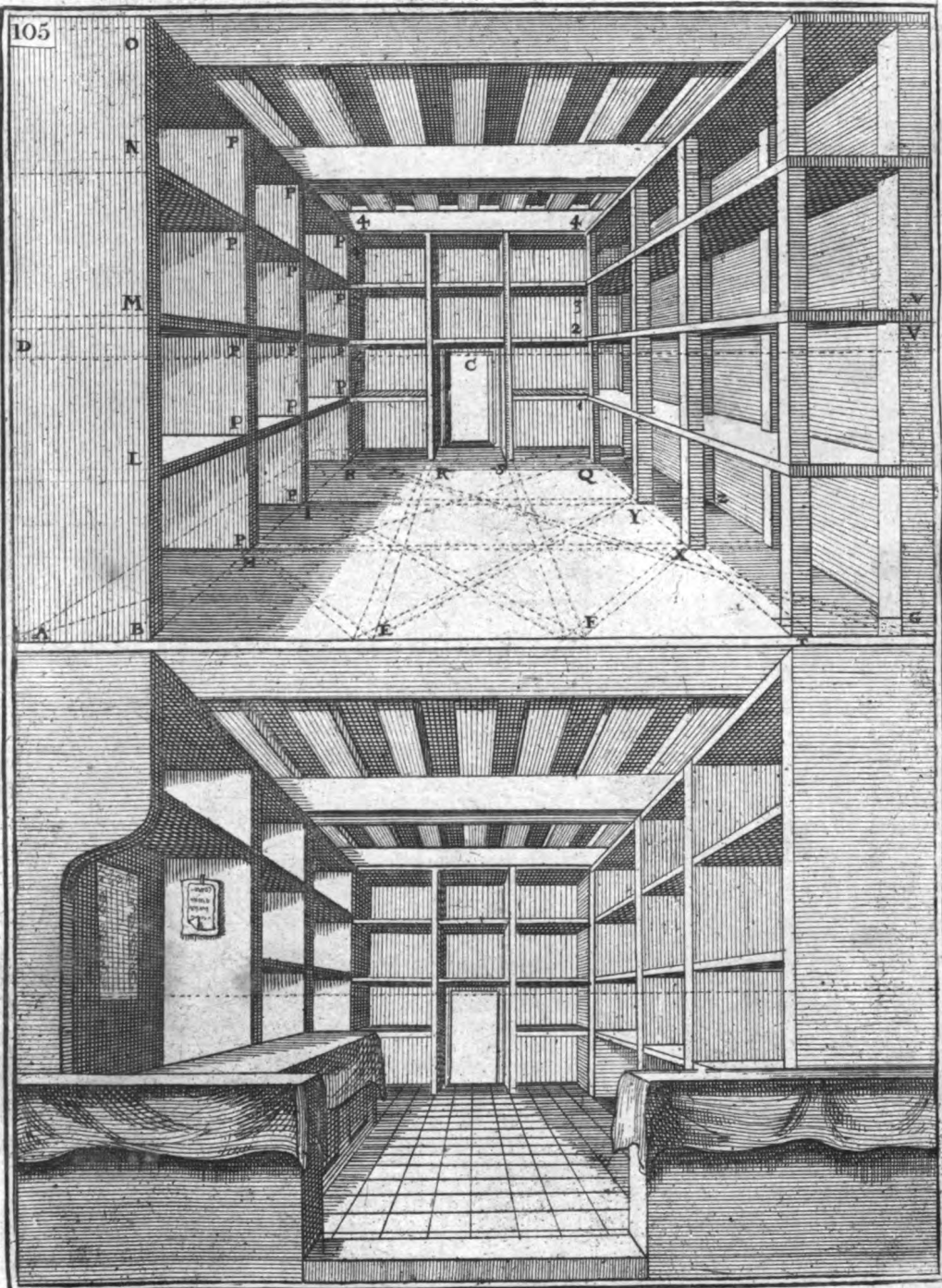
THE method for raising altars is the same as that for frames of long tables, all that is farther to be done, relates to the circle in the middle, the edges of the cloth and the laces ; of each whereof in its place.

In raising the *altar* here viewed in front, there is but little difficulty ; for having adjusted its height and length, there remains nothing but to draw lines from all the points on the base line to the point of sight E ; and from the interfections those lines make with the bottom of the altar, erect perpendiculars, which being joined by a parallel at the proper height, give the front, and rays drawn to the point of sight E form the sides. As to the circle in the middle it is struck with compasses. The rest is obvious.

For a *fide-altar* set the intended breadth and height in the place where you would have it begin ; as the breadth A B, and the height B D in the figure. Then, from B, D, and C, draw lines to the point of sight E : and since B F on the base line is the length of the front altar, and we would make this equal thereto, from the point F, draw a line to the point of distance G, and observe where it intersects the ray B E ; and from the point of intersection raise a little perpendicular to touch the ray D in the point H. Then drawing a little parallel from H, it will give the point I in the ray C ; and by such means you will have the top of the altar, C D H I. For the two ornaments that are on each side the circle, they are found on the ray B E, by drawing lines thence to the point of distance G. M gives the breadth of the border of the altar cloth. Now taking the measure B M, set it off from D to O, for the breadth of the cloth at the top. As to the circle, I need not repeat what has been already said of the method of putting it in perspective. I shall only here observe, that lines must be drawn from all the divisions thereof on the base line to the point of distance G ; and in the interfections with the ray B, perpendiculars to be raised. Then, the same dimensions to be taken and set off between O and B ; as P P P, and from those three points rays to be drawn to the point of sight E, observing where they cut the perpendiculars raised from the other divisions of the circle, and connecting those points with a circular line, which gives the circle in perspective. The method of diminishing would be the same, if in lieu of laces and a circle there were an embroidery.

In the figure underneath, the same altar is shewn free of lines and points, and farther adorned with a crucifix and two candlesticks. In order to this, the corner line of the altar must be prolonged, as Q R. Then, from the point of distance G, a line to be drawn through the corner of the altar T, and continued till it cut Q R ; and the line Q R will be the length of the altar, equal to B F in the first figure. Hereon must the dimensions of the crofs and candlesticks be laid ; for example, V for the crofs and S S, &c. for the candlesticks. From all the points S and V, lines to be then drawn to the point of distance G, and through their interfections with the ray Q E, little parallels to be drawn ; which cutting the ray S E, give squares upon the altar, X X, &c. for the crucifix, and candlesticks. This square must be left for the foot of the crucifix ; and from the middle of the square, the crucifix is to be raised. For the proportions of the arms of the crucifix, erect occult perpendiculars from the angles of the square, as here Y Y ; and draw lines to the point of sight E, for the candlesticks. Then turn the squares, for their feet, into circles, and observe where they intersect the diagonal : For perpendiculars erected from the points of intersection, give the breadth of the basons or stands ; and lines drawn to the point of sight, the height. Lastly, from the middle of the foot erect a perpendicular for the body of the candlestick, and the taper therein, which is to be made high or low at pleasure. To proportion them, draw a line from the top of the first to the point of sight E. The rest as already said. The figure will call to mind the methods.





To exhibit the Fixtures of SHOPS in Perspective.

TRADESMEN's shops are usually encompassed with shelves, boxes or drawers, wherein their goods are disposed.

The rule for designing boxes, presses, or shelves, is much the same as that already laid down for doors and windows ; for example, in lieu of the thickness of the wall used in making a window, you are here to put the board A B, and from the point B, to draw a line to the point of sight C. Then, for the width of the shelves or presses, having laid down the distances on the base line in E F G, from these points draw lines to the points of distance D. These make intersections H I K, with the ray B : from which intersections, perpendiculars being raised, will give you the upright divisions.

For the cross boards, set any number thereof at pleasure on A B, or only on the first perpendicular BO ; such are here L M N O : from all which draw rays to the point of sight C, and at their intersections with the perpendiculars in the points P P, draw little parallels to the base line, which will shew the top and bottom of each shelf, and separate them from the sides.

As to the *front* divisions and shelves, there only needs to draw rays from the points of measures E F, and in the points of their intersections with the lines Q S, to erect perpendiculars R and S. The cross pieces are had, by drawing parallels from all the divisions on the perpendicular K : as here, P 1, P 2, P 3, P 4.

As to the divisions on the opposite side, where there are square upright posts to sustain the shelves, their depth is had by drawing lines or rays from the measures T, G, to the point of sight C. And to get their plan, or square, lines are to be drawn from the measures A E F on the base line to the point of distance V, which give the intersection X Y Q on the ray T C. Through these intersections little parallels must be drawn till they cut the ray C G in Z ; and from the angles of these little squares, perpendiculars are to be erected, which give the upright post, as in the figure.

The figure underneath shews a shop quite fitted up, and ready to receive goods of any sort : for a bookfeller it must be stocked with books ; for an apothecary, with drawers and gallipots ; for a draper, with pieces of cloth, stuff, &c.

BUILDINGS *viewed on the Outside.*

HAVING now considered every thing relating to the interior parts of buildings, I proceed to give rules for the exterior.

Many of the methods already laid down for the insides, may likewise serve for the outides; the process for the doors and windows is the same in both cases, and as these are very material, and distinguishing parts of every structure, the reader is already in great measure qualified for the elevation of buildings. If they be adorned with orders of columns or pilasters, instructions have also been given for these.

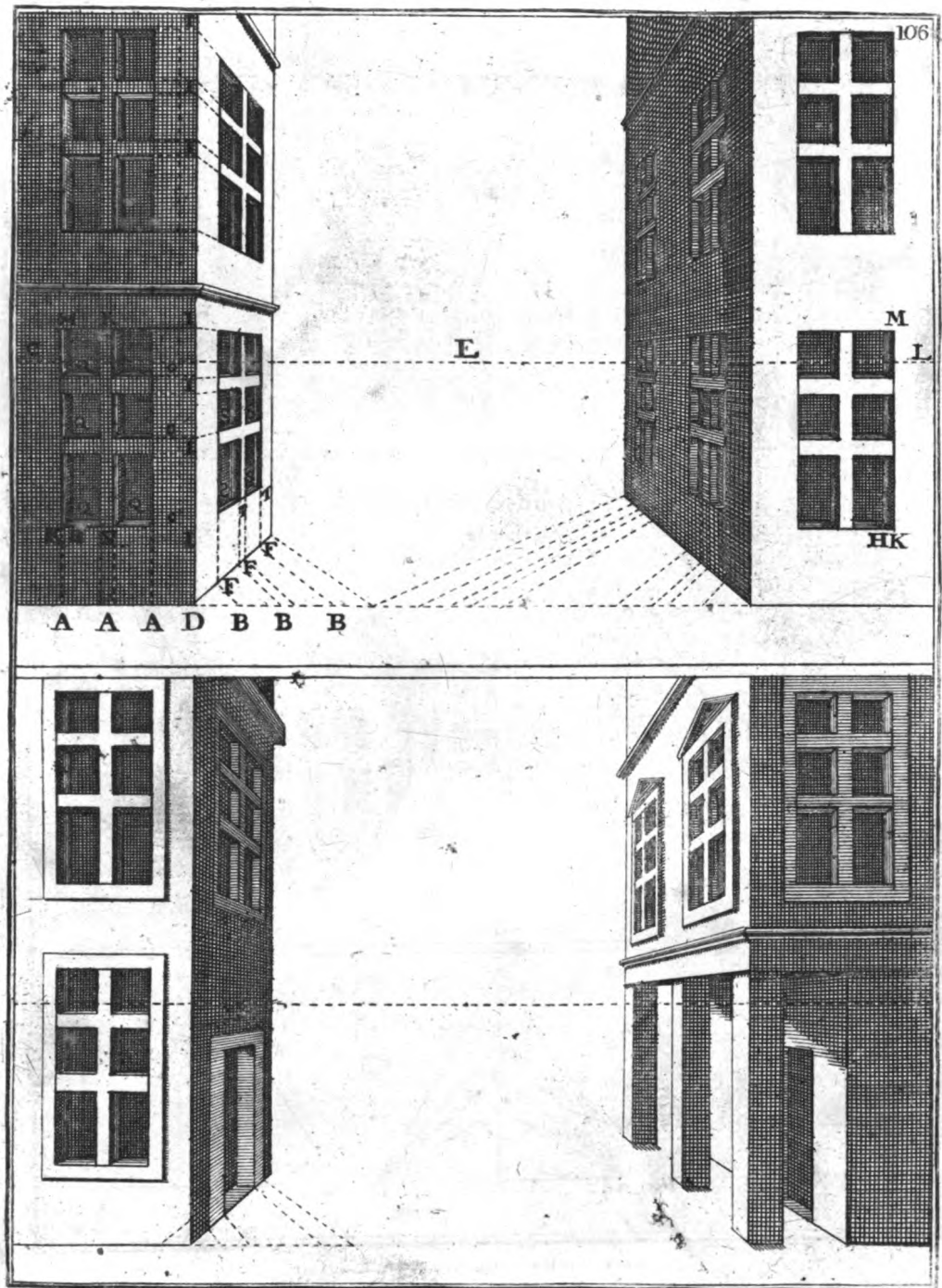
Suppose there be windows in front, as A, and it is desired to have others in the same proportions on the other side, the proportions A A A must be transferred to the base line, as here B B B, and lines be drawn thence to the point of distance C: and in the points F F F, where they intersect the ray D E, perpendiculars to be raised for the *uprights* in the window,

For the *cross pieces*; those in the front window must be continued to the perpendicular D, by which means you will have the points I I; from which lines are to be drawn to the point of sight E, which cutting the perpendiculars F, give the cross bars in the side-window.

If the number of windows were much greater, nothing farther would be required but to continue their rays, in order to make the measure and height of the cross pieces the same in all. An instance of which we have in the house on the other side, which has two windows from the same rays. As to the breadth or thickness of the posts or cross bars of windows in front, it must be set on one of the traverses, as here on K H; and from the corner of the window K, a line be drawn to the point of sight E; and from the point H, another to the point of distance C, for the window A, and to the point of distance L, for the window on the other side; and in the point, where those two last lines intersect, a perpendicular, H M, must be raised. Then, from all the corners of the window lines to be drawn to the point of sight, and from the points Q Q, &c. where they intersect the perpendicular H M, parallels must be drawn to give the thickness of the cross bars. The thickness of the middle post, N, will be had by drawing a line from the corner, N, to the point of sight; and in the points Q Q, where it cuts the thicknesses of the cross bars, erecting perpendiculars Q R, Q R.

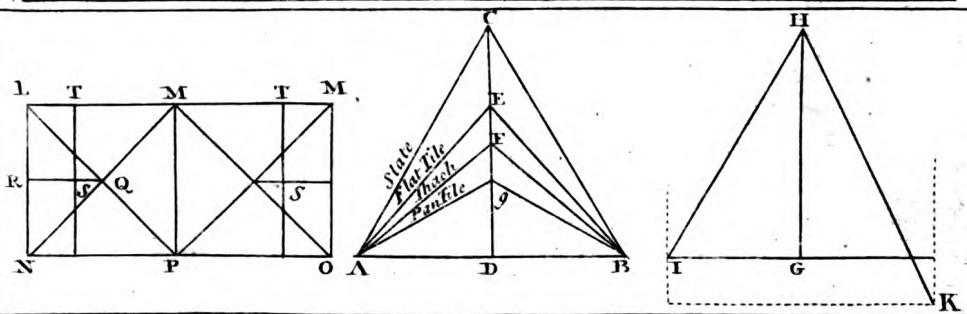
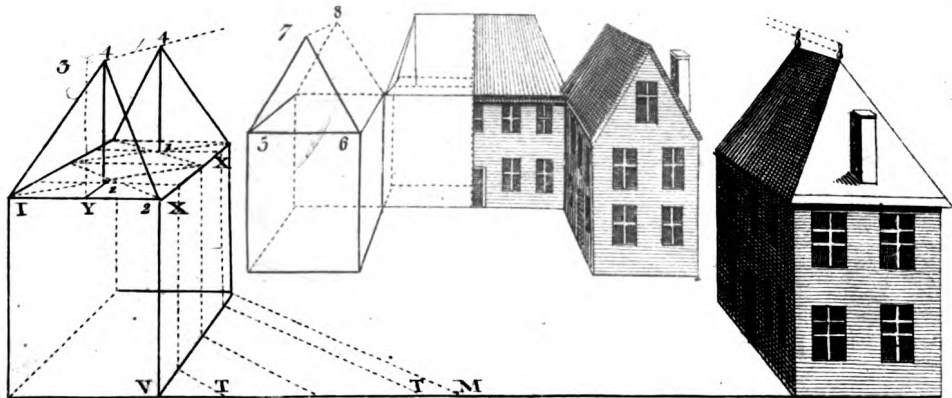
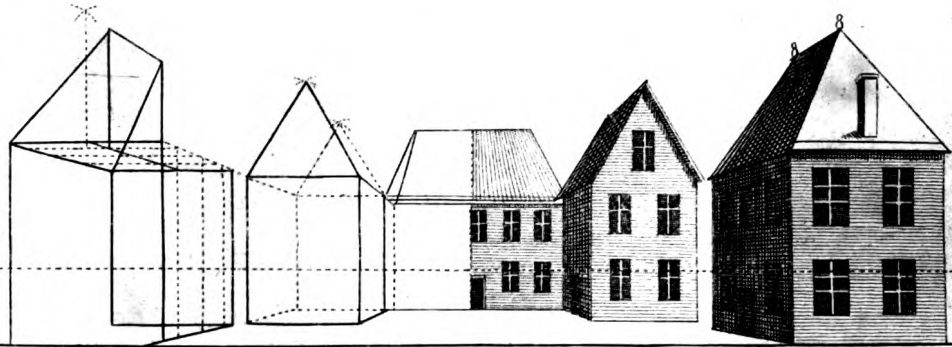
To fix the thickness of the window on the other side, it must be set in the corner of the wall, on the perpendicular D, as the distance I O; and from the points O O, &c. lines must be drawn to the point of sight E. Lastly, little parallels to be drawn from all the corners of the windows, as S T; which, intersecting the ray O, give the thickness in the point S. These rules may serve for all kinds of windows, both high and low.

In the figure underneath is shewn a door diminished according to the rules delivered heretofore. As, in effect, every thing belonging thereto is very easily understood, and readily practised, on some or other of the preceding methods.



S 3

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To exhibit ROOFS of Houses in Perspective.

ROOFS are made of different heights according to the materials they are covered with. Those of *slate* are the most upright of all. Their usual measure is an equilateral triangle; that is, their slope, or the declivity of the roof, is equal to the width of the house. Thus, in the little figure at the bottom of the present plate, C A, or C B, is equal to A B. Others make the breadth A B equal to the punchion, or middle top, D C, which is higher. But that practice is much less usual than the former. For *flat tiles*, we only make the roof two thirds of the height of those of slate, or the width of the house, as in A E B. For *thatch*, the height is usually but half the width: and for *pan-tiles*, only one third; as A G B.

Before we go any farther it is to be observed, that what we call *punchion*, or middle top, is a timber raised perpendicularly on the beams that sustain the ridge, and wherein the rafters are all jointed. *Rafters* are the pieces of wood which form the declivity of the roof, as H I. The other pieces in the corners, which go to the middle top, are called *flays*, and are usually longer than rafters, as H K.

There are three kinds of roofs in use; pavilions, pinnacles, and pent-house form. The first have four sides, the second only two, and the last but one.

To put a pavilion or turret, in perspective, the place of the middle top must be known, that the flays may be drawn to the same. For this reason it was that I made the geometrical plan L M N O; to shew, that a square, L M N P, is to be made of the breadth of the house L N, and two diagonals drawn through the same, intersecting in Q. Some put the punchion in Q, but that advances it too far, and renders the end of the declivity too squat. It has a much better grace when more upright. With this view, it should be approached towards the wall L N a third part of the distance Q R, which will bring it to the point S; from which point a perpendicular, S, must be drawn upon the line N P. Then the measures L T and T M are to be set on the base line, and lines drawn from them to the point of distance, which is here more remote than usual; and from the points, wherein they intersect the ray V, perpendiculars to be erected to the top of the wall, which will give the points X X; from which, parallels to the base line are to be drawn as far as the other ray I. Then, from the middle of the wall Y, a line to be drawn to the point of sight, cutting the parallels in the point Z, Z, &c. from which points the punchions are to be raised. To give them the proper height regard must be had to the materials intended for the covering, and the height to be adjusted thereby, according to the proportions already fixed. Thus, suppose the covering slate, an equilateral triangle, 1, 2, 3, must be made of the breadth of the wall; and from 3, a line be drawn to the point of sight, cutting the punchion in the point 4. To which point, lines being drawn from the corners of the house, will give the form of the pavilion.

For *pinnacle roofs* there need not so much ado. You are only to make an equilateral triangle, 5, 6, 7, of the breadth of the wall 5, 6, and the like for the other end of the wall, which will give you the point 8. Then joining 7 and 8, you will have the form and measure of the roof.

The figures on the other side shew the same thing unembarrassed with lines. The projecture standing beyond the roof is made at discretion.

The front house is covered with a pavilion, performed after the same manner as that on the side.

In the present figure, where the letters are, the horizon is placed very high, to shew the tops of the houses, and render the practice more easy and conceivable. But, as it is not often such a case happens, I have added the other figure at the top, wherein the horizon is as low as usual. Though the rule in itself is the same as that already delivered.

Sequel of the Roofs in Perspective.

IN the preceding figure the *pinnacle roofs* are viewed in front, in this plate they are shewn laterally; the method for constructing them with their returns in the side-views is now to be given.

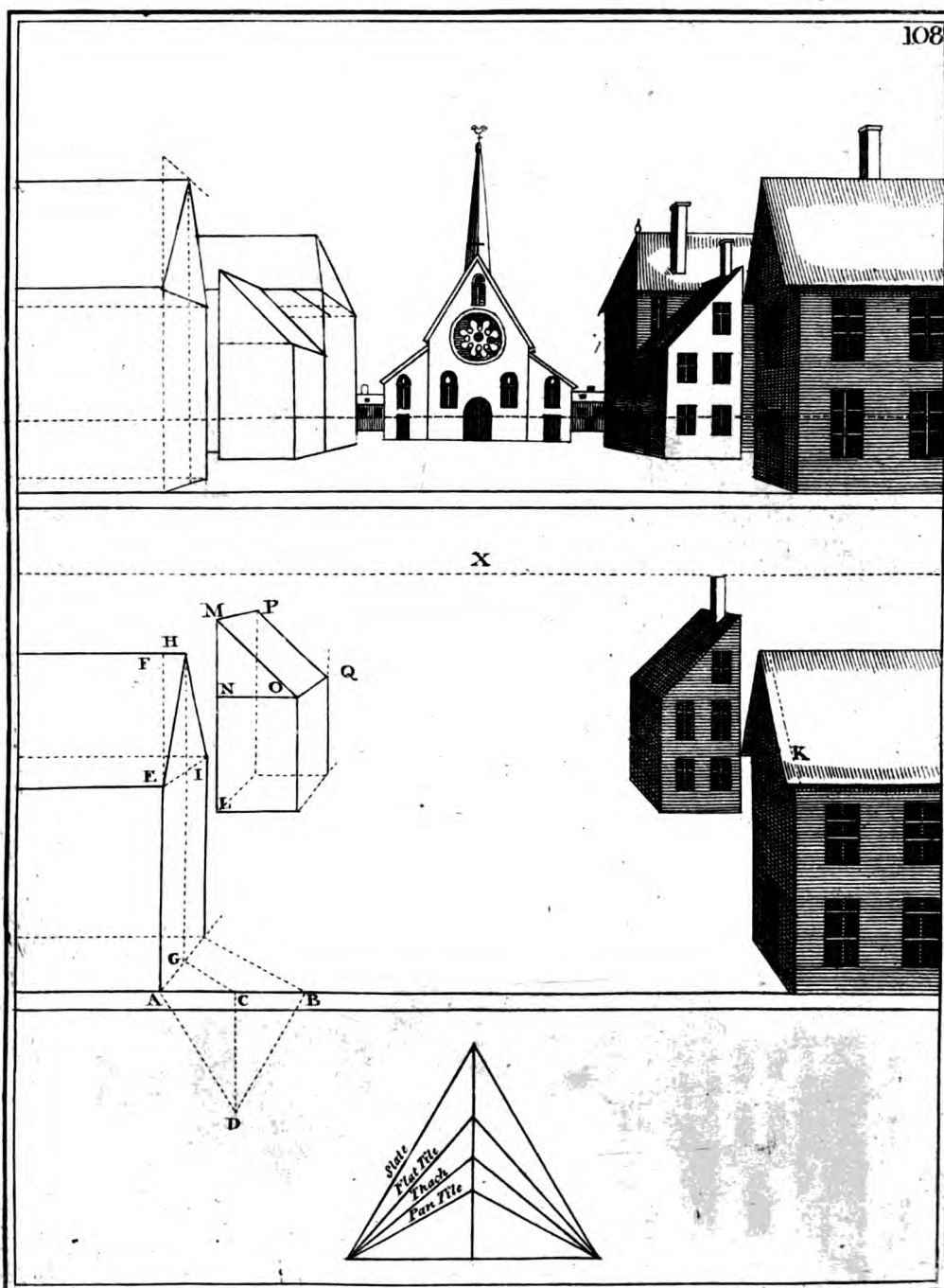
The width of the house must be set on the base line, as here A B; and of this width a triangle is to be formed with the dimensions of the sides according to the form of the roof. The present is an equilateral triangle, whereof C D is the height intended to be set perpendicularly on the corner of the house, at the height of the wall, as here E F. Then half the breadth of the house is to be laid down in C, which is the middle of A B; and from thence a line to be drawn to the point of distance; and in the point G, where it intersects the ray A, a perpendicular must be raised. Lastly, from F, a line is to be drawn to the point of sight X; the intersection whereof with the perpendicular H, will be the point, or tip of the pinnacle: to which lines must be drawn from the corners of the house, E I. If you would have eaves, they are easily added, as is seen in the figure K on the other side.

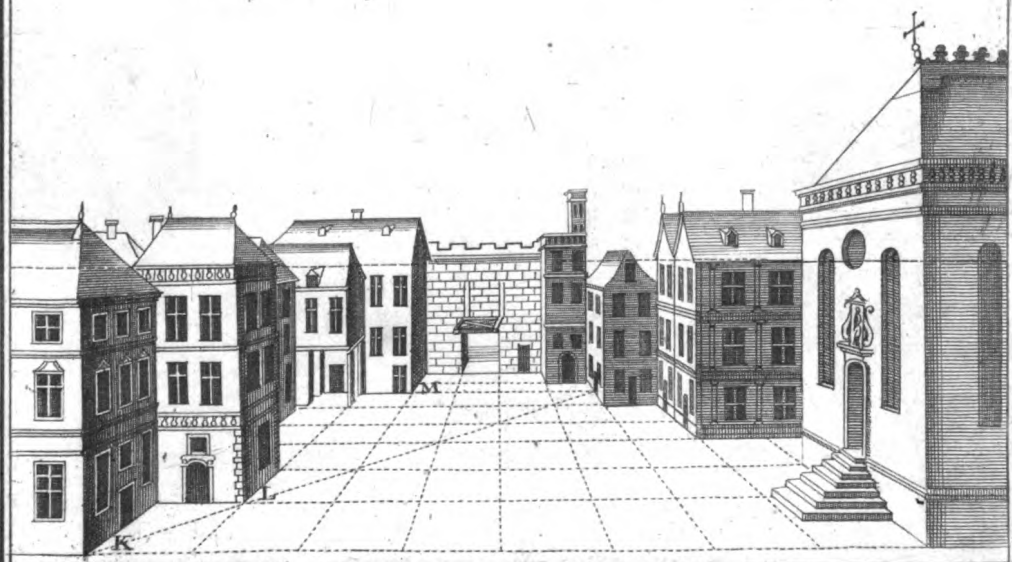
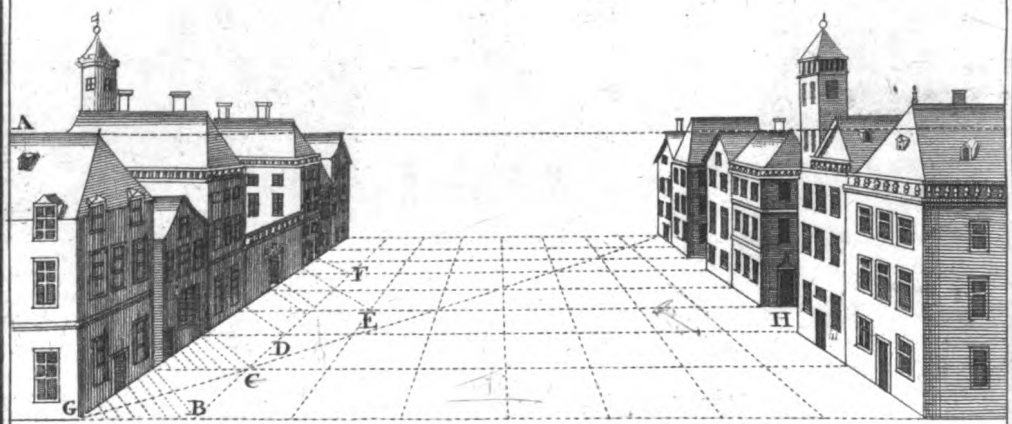
For the constructing of *pentices*, you have only to draw a line to the height of the roof, as here the line L M, and give it any declivity at pleasure. In the present, the height of the roof M N, is the same with the breadth of the building, N O. If then, from the points M O, lines be drawn to the point of sight X, the perpendiculars of the depth will be cut in the points P and Q; which being connected by a right line will form the roof. The figures on the opposite side shew houses covered after such manners.

The uppermost figures are only intended to shew that the same rule is to be observed, though the horizon be changed.

A church is seen in the middle, which is covered or roofed with pinnacles; and the wings with pentices.

There is also a pavilion viewed end-wise; mention whereof has been made in the preceding page.





To exhibit Rows of Buildings, or Streets in Perspective.

A BARE sight of the figure must suffice to shew the method, which is exceeding easy. All you have to do is to make a plan of simple squares, the common way ; and to take one, or two, or three of the squares for the breadth or length of each house ; and on such breadth, &c. to set off the measures of the doors, and windows ; and to get the diminutions by drawing lines from the several measures to the point of distance ; as here from B C D E and F, the lines are supposed to be drawn to the point of distance A.

The first angle of each house may serve for a line of elevation, as the angle G for the first house. As to the roofs, I have already said how they are to be managed.

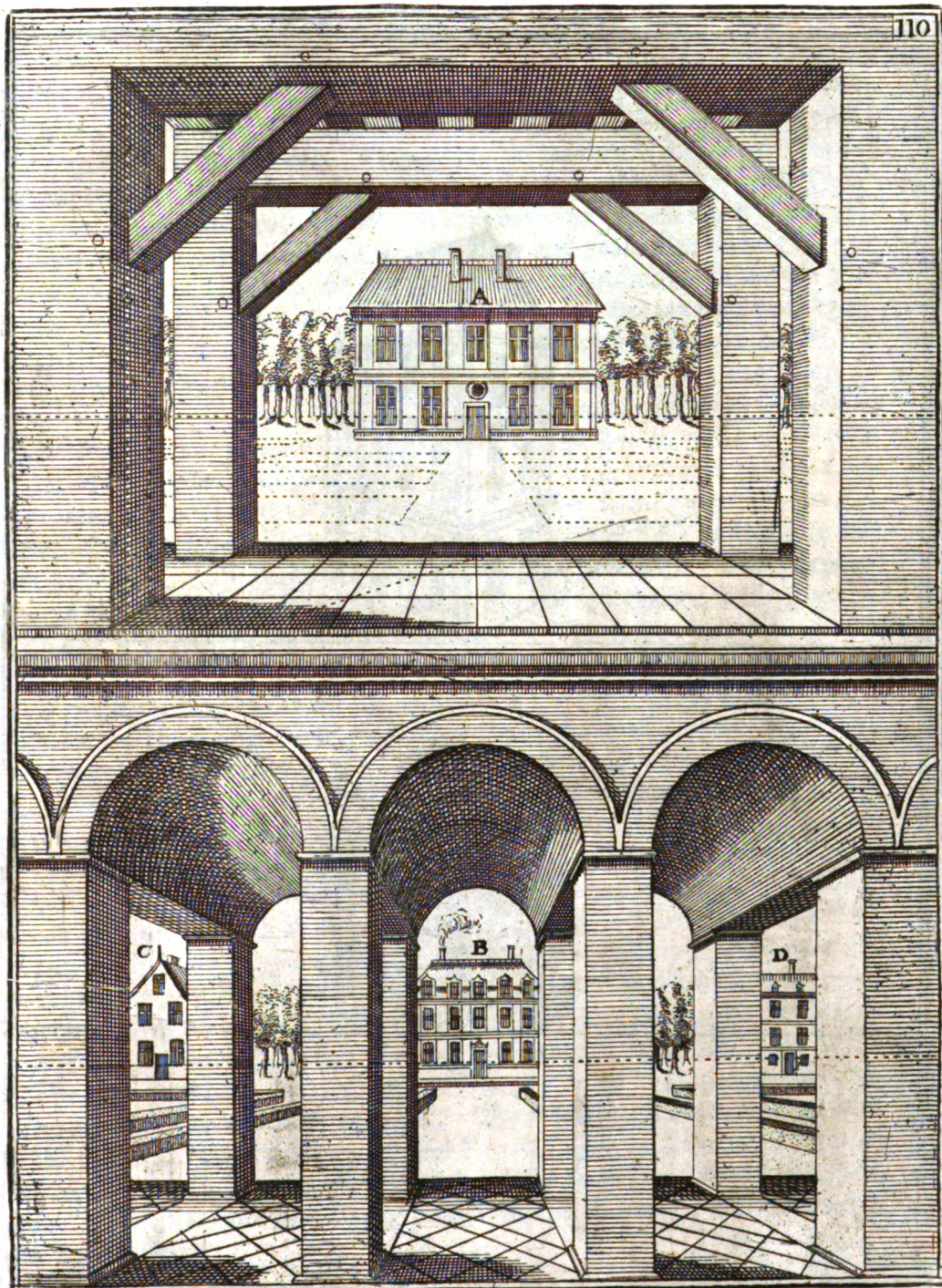
If you require any cross streets, one, two, or three squares are to be left vacant, and nothing upon them, as here H and I.

The figure underneath is to shew, that where houses are to advance beyond others, or fall further back, you have only to put their elevations forwarder or backwarder on the plan of squares. Thus L advances a square farther than K, and M farther than L ; and so of the rest.

*A Demonstration that remote Objects do not shew their
Thicknefs.*

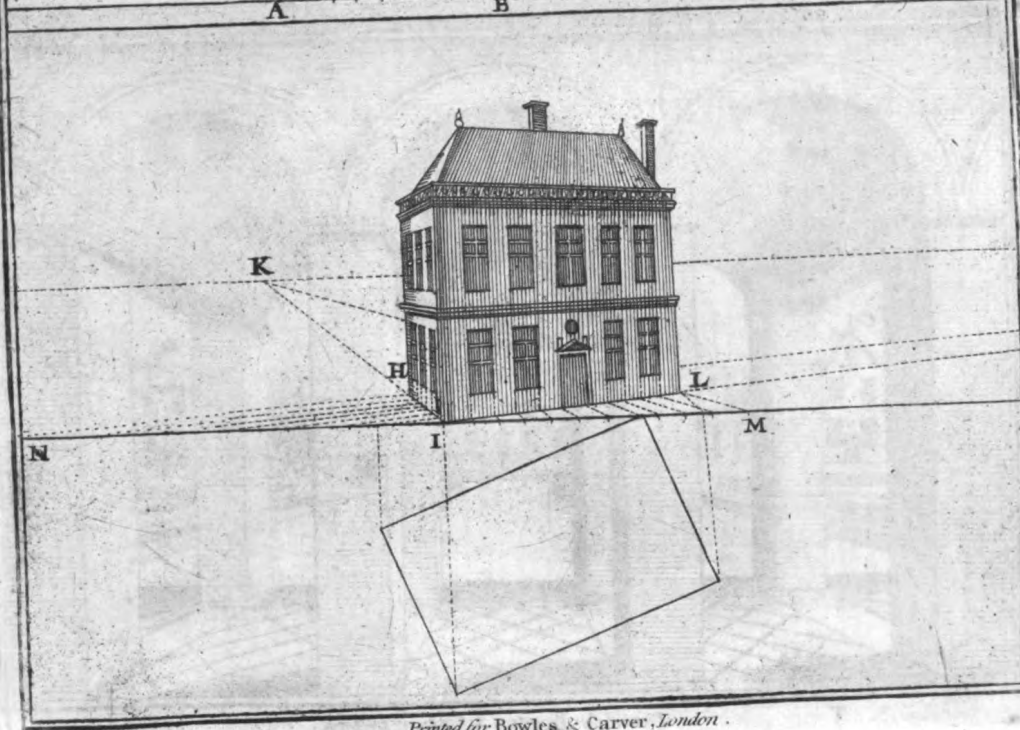
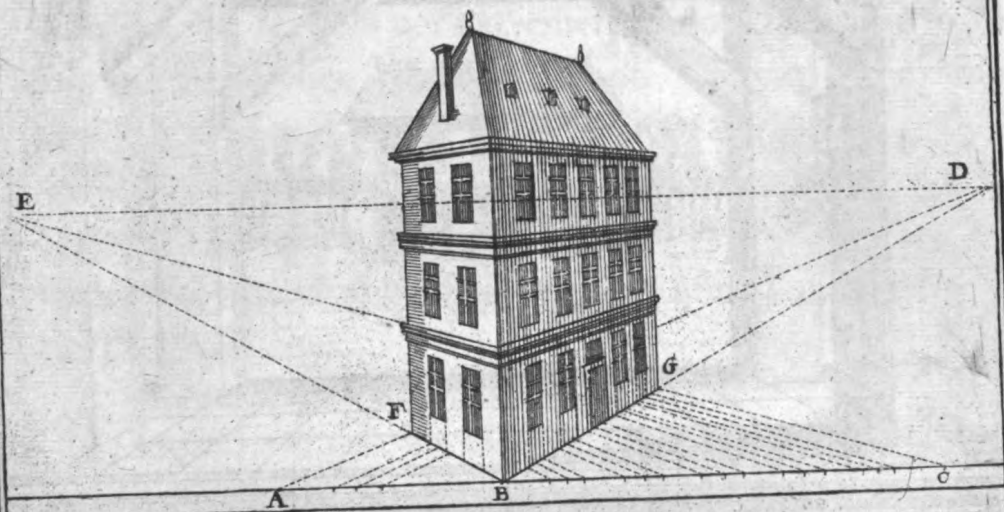
IT must be here remembered, that objects near the horizon, that is, such as are extremely remote, are not to shew any thicknefs when viewed in front. Thus, for example, the windows and doors of the houses A, B, C, D, should not have any thicknefs shewn, but be exprest only by mere lines. The reason is, that the visual rays proceeding from the front parts of the object become united in the eye with the collateral ones.

I should have given a strict demonstration hereof, had I apprehended it any way necessary. But as I do not see of what use it would be, and as I stand engaged from the beginning of the book not to enter into such demonstrations, I therefore think it proper to decline it.



T

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To exhibit BUILDINGS viewed by the Angle.

OF these two buildings seen angle-wise, the first is performed after the manner already delivered for squares viewed by the angle, and elevations of other objects in side-views. However, to save the trouble of recurring to the one and the other, I shall here observe, that to perform such buildings the measures must be set on the base line, and from each of them, lines be drawn to the point of distance, and from the points of intersection perpendiculars to be raised; the perpendicular raised on the first angle serving for a line of elevation. Thus, in the present building, the breadth being A B, and the length, B C, double its breadth; from A and B, lines are to be drawn to the point of distance D; and from B and C to the point of distance E; and from the intersections B F and G, perpendiculars to be raised for the corners of the house. As to the dimensions of the doors and windows, they must be laid down on the base line between A B and B C; and lines be drawn from them all, to the points of distance D and E. Then, observing where B D or B E are intersected thereby, raise the posts of the windows therein. The perpendicular of the first angle B serving for a line of elevation, will give the cross pieces, and the height of the windows. The rest is obvious.

As to the figure underneath, the method is the same as for chairs placed irregularly, see page 102; that is, having made the plan, put it in perspective as irregular objects are put. Then, laying a ruler along each side of the plan, observe where it cuts the horizon, and marking those accidental points, draw lines to them from each part of that side of the building. Every side or face of a building has its particular point. Thus the plan being put in perspective, the side H I, gives the point K on the horizon, to which all the rays on that side must be drawn. The other side I L, should likewise have its point; but for want of paper-room, we could not here express it. These two points found, a ruler must be laid thereon, and an occult line drawn over the other side of the building parallel upon the plan to that which gave the point in the horizon, and continued to the base line; as from R, through L to M; and from the other point continue an occult line through H to N. Then setting the number of windows of the side H I, between N and I; and between I and M, setting the number of windows on the side I L, draw lines from all these points, or measures on the base line to the points in the horizon, and proceed as in the figure above.

T.

To exhibit Walks, with Rows of Trees, in Perspective.

THOUGH the preceding rules might furnish sufficient instructions for putting walks with trees in perspective ; I have judged it not amiss to add a particular rule which may render the method still more easy.

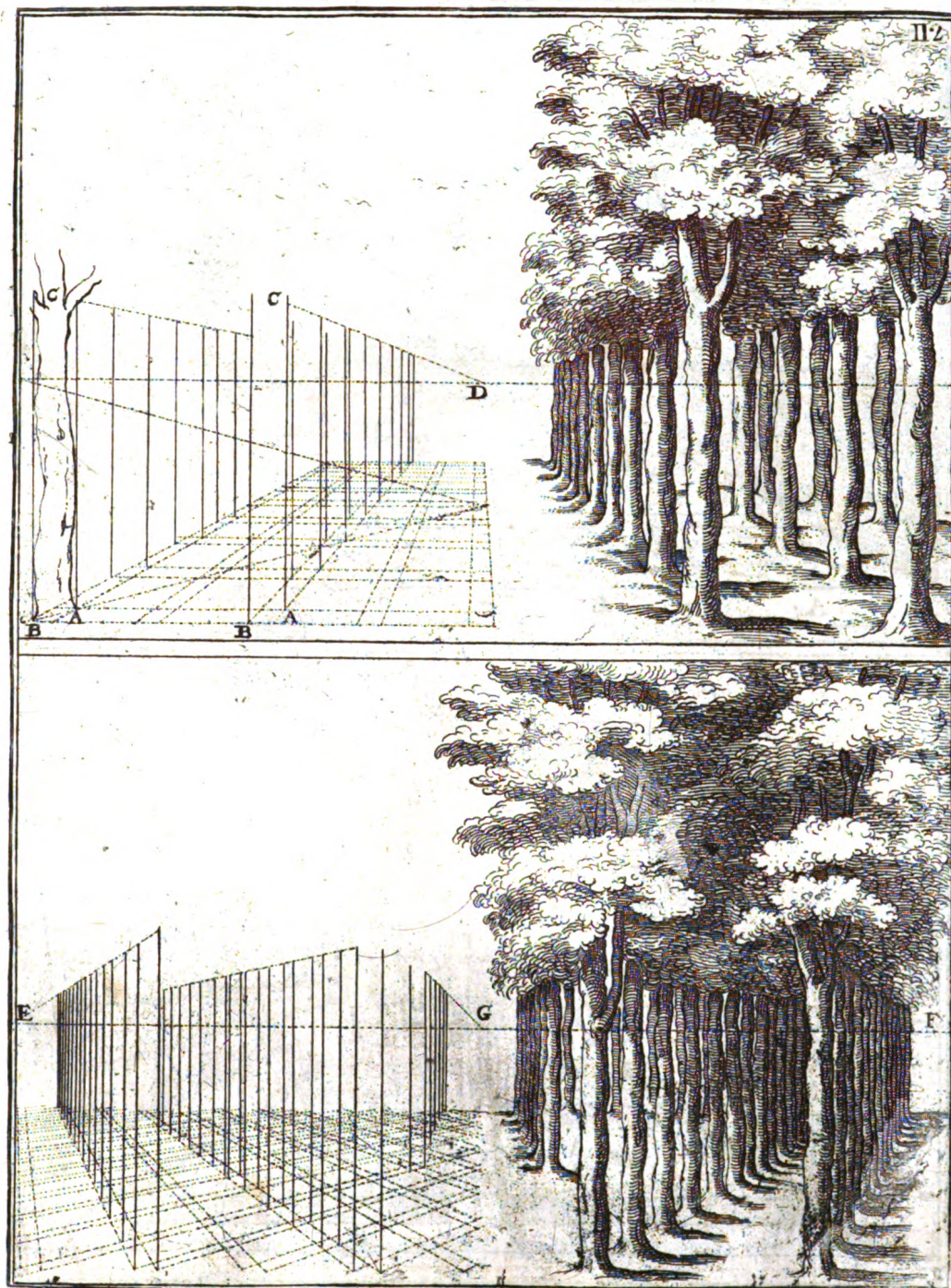
If only a single row of trees on each side be required, there is no need for making a plan of squares, or chequers : what is directed in page 17, will suffice.

But where a number of walks are to be shewn, I think it adviseable to form a plan in occult lines, as already taught in page 31, and from the diagonals of the little squares, to erect perpendiculars, as is shewn in A B. If you desire to have the trees farther or less apart, increase or diminish the distances of the squares on the base line.

When you have given the stem of the first tree its proper height, as A C, draw a line from C to the point of sight D, which ray C D is to bound the stems of all the other trees. The first tree, A B, shews that you may give what turn or form you please to the body of it between the two perpendiculars A B, for it should not be drawn with the straightness of a ruler.

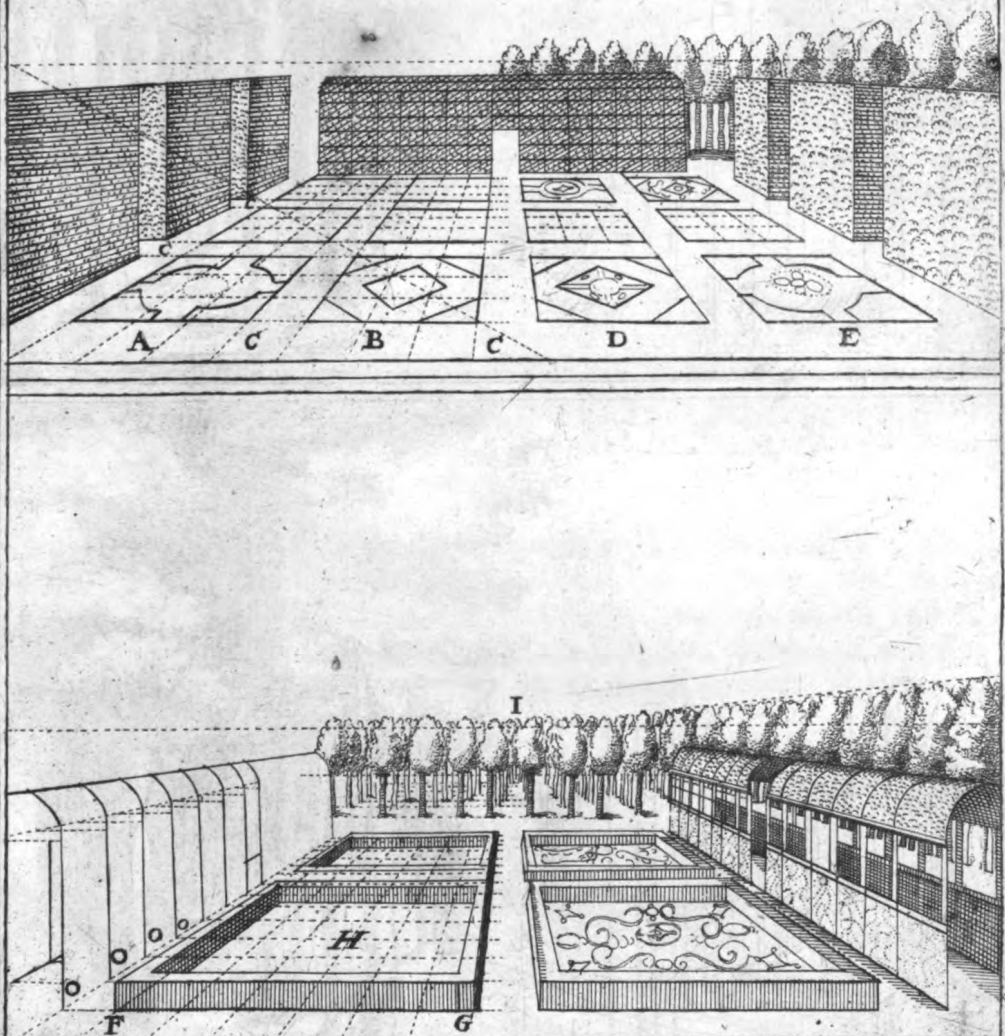
The figure underneath is performed as that above, all the difference is, that the squares of the upper are direct, or in front ; and those of the under are viewed angle-wise : whence the measures on the base line, in the latter case, must be all drawn to the points of distance E and F. Perpendiculars are to be raised from the angles of the little squares ; and the rest as above.

In the same perspective, wherein are walks drawn to the points of distance, one may add others, drawn to the point of sight. Thus the middle walk tends to the point G, which is the point of sight ; and the others to the points E F, which are those of distance.



T 2

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To put Gardens in Perspective.

IN the doctrine of plans was shewn, page 35, the manner of diminishing, or putting the plan of a garden in perspective, by an easy rule; supposing that you have the plan thereof. But, as I always endeavour to avoid geometrical plans, by reason it takes up too much time to make them, I have added the present figures; whereby it appears, that having made a chequer, or plan of squares, you may take as many or as few of them as you please for the beds of the garden. As here, A and B have each of them three squares every way; the rest serving for walks, as C C. If you would have compartments, or knots in the beds, you are to use the little squares or divisions of each bed; cutting them, and forming them into the figure required; as is shewn in the squares of A and B; and those of the other side, D and E. The palisades and arbours are cut through the breadth of the walks.

To exhibit Beds with Borders, Arbours, and Groves.

WHEN Borders are to be given the beds, the intended heights and breadths must be set on the corner; and from those measures lines must be drawn to the point of sight. Thus, in the lower figure, F G being the breadth and depth of the borders of the bed H, lines must be drawn from the angles of the little square F and G, to the point of sight I; and go on with the rest, as abovesaid.

To exhibit *arbours*, raise upright posts, or perpendiculars, O O, from the angles of the squares of the walk, and perform the rest as already directed for arches viewed side-wise, in page 60.

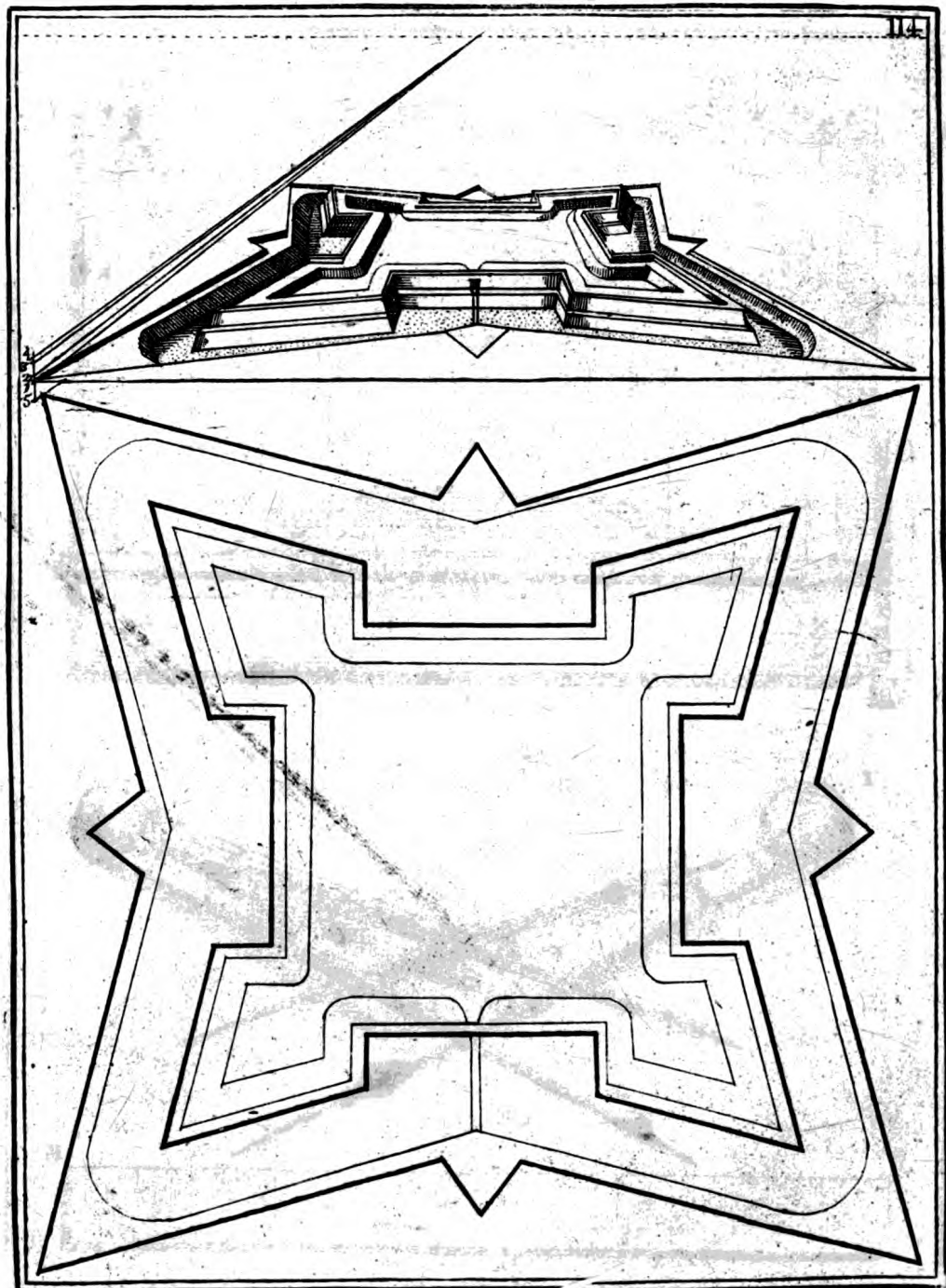
The *grove* in the middle is performed by erecting perpendiculars from all the angles of a chequer, &c.

To put Fortifications in Perspective.

I NEED not here repeat the method of diminishing, or putting in perspective, the plans of all sorts of fortifications: what has already been said in page 39, is clear enough.

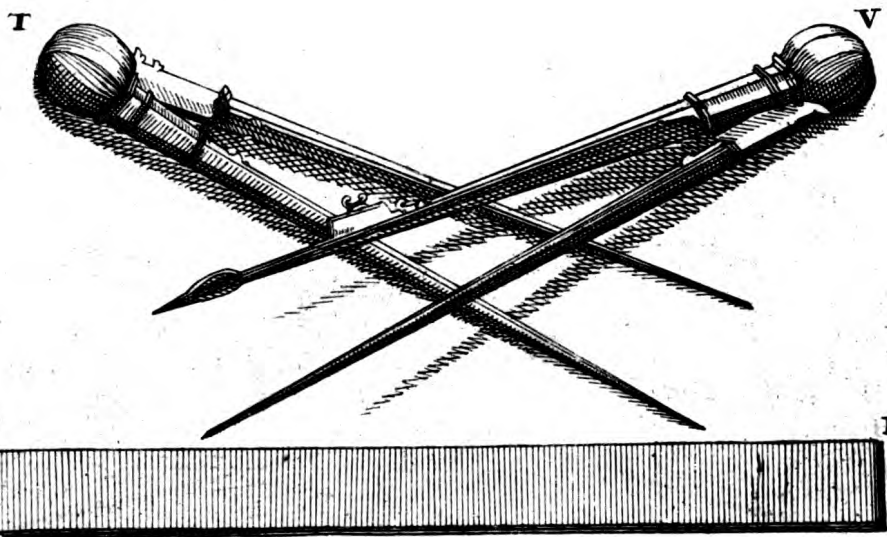
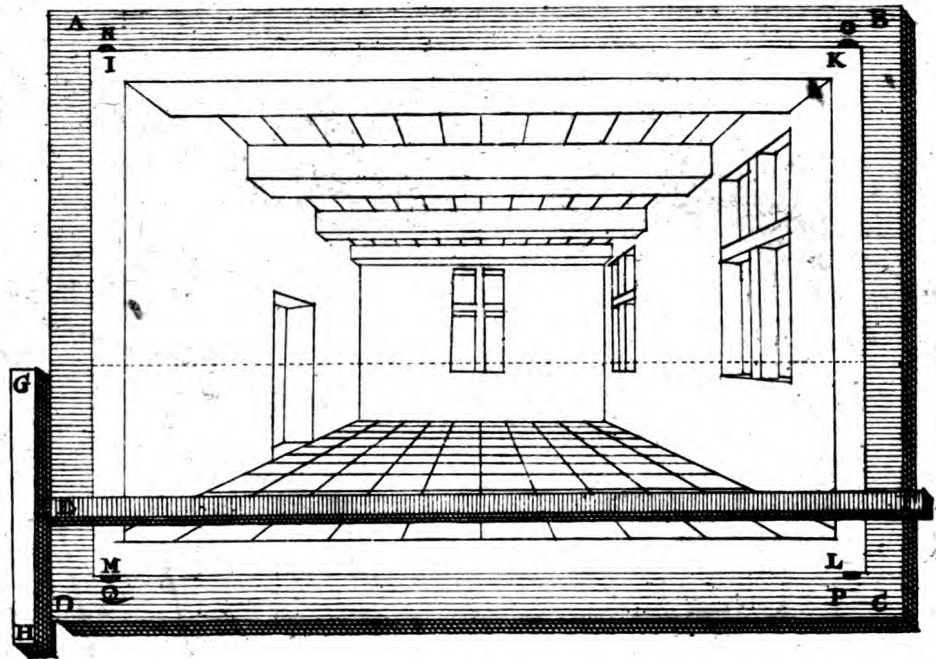
There is no more difficulty in raising them than in the elevation of a bare wall; only more time is required, by reason of the greater number of angles which are to be drawn all to the line of elevation, to give their heights thereon; as has been mentioned over and over in treating of other works.

The little line of elevation is divided into four parts: The first, from 1 to 2, is the height of the *parapet of the covered way*. From 2 to 3, is the height of the *rampart*. From 3 to 4 is the height of the *parapet of the rampart*; and from 5 to 1, the depth of the *ditch*.



T3

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To make Designs in Perspective.

THERE is no master so excellent, but he makes designs of the works he would succeed in. If this be usual in most arts, it is necessary in this, by reason of the great number of points and lines to be strictly observed, and nicely managed, without which nothing is to be done correctly, or in any wise pleasing to a person that has taste or skill.

Since then there is a necessity of making designs, we are to look out for what may be assistant therein. And as every body knows that the length and tediousness of such works lie in the drawing of parallels and perpendiculars, I have sought, both in authors and in experience, for a method of doing the same as expeditiously as possible. The result is, that nothing of this kind has appeared to me worth the recommending, but the plate and square, which *Viator* has left us in his writings; which are instruments such people as have occasion to spend much time in designing will find a deal of ease and benefit from.

The figure gives a tolerable notion of the instrument, and the method of using it, but it may be convenient to give some description thereof. The plan A B C D, then, is to be perfectly on the square, a foot and half long, fifteen inches broad, and half an inch thick. The wood to be dry, firm, and smooth. To make it the softer, and favour the pen, a sheet of paper may be struck on it.

The square E F is a ruler a foot and a half long, an inch broad, and a quarter of an inch thick, fitted at right angles in another ruler G H, eight inches long, one broad, and three quarters of an inch thick. Now to draw lines, this last ruler, G H, is held close to the board A B C D, in which case the other ruler E F, is certainly parallel to the base line, provided the board and ruler be exactly formed.

When you go to work, fasten the sheet of paper I K L M, on the board with four pieces of wax, N O P Q; then may you draw lines from any point, secure that they are right. And for raising perpendiculars, you have only to lay the handle of the ruler, G H, on the side G D, in which case E F will be perpendicular to C D.

For myself, I find a wonderful ease herefrom. The truth is, without such a contrivance, a man must never be without the compasses in his hand. All the trouble now remaining is for the visual rays. And for these, some use a ruler perforated at one end, and fastened by a needle to the point of sight. But this is to run into a trouble greater than what you would avoid. The common ruler does every whit as well.

S R is a common ruler. T a pair of compasses. V another pair of compasses, with a drawing pen therein; for circular lines.

These are all the instruments necessary for making of designs in perspective.

*The Method of enlarging perspective Draughts out of Small into Great ;
and of reducing great Ones, into lesser.*

AS designs are more easily made of a small, than of a large size, it is but reasonable they should always be so made. This has put me on giving a method of enlarging small designs on the canvas.

The method commonly used by the painters is to divide their little design, and the canvas they intend the large ones to be on, into an equal number of little squares, and to transfer what is in the squares of the design, into the correspondent squares of the canvas. This way some greatly approve of.

Here follows another, which, in my opinion, is easier and surer. Provide a scale proportionate to the little design, and another proportionate to the canvas. To make a design, the first thing to be determined is the scale, which is to fix the measures of all the parts of the work. Thus, in the little design A, the scale B C of five parts, which we may call feet, is the first thing made. From this scale are taken the horizon, the height and distance of the trees, the breadths of the walks, &c.

To enlarge this design the method is this. Consider whether or no the draught is to have its natural horizon, that is, whether, when the bottom of the painting is on the ground, the horizontal line be the height of the eye, which is about five feet. Then, of the five divisions between B and C, make a scale of five feet F G, that thus, having taken all the measures and proportions in the small one, you may transfer them to the great one, after the following manner.

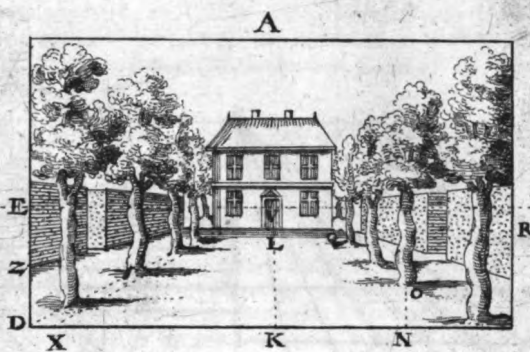
The two scales thus fixed, the first thing to be done is, to take in your compasses the distance between the base line D and the horizon E, and to apply the compasses thus opened, to the little scale B C, noting what number of parts it includes, as here it does five. Take therefore five divisions on the large scale F G in your compasses, and set them on each side the painting, or large design, beginning at the bottom of the cloth H H, and ending in I I. From the points I I, strike, or score a line with a chalked or blackened packthread. This line I I will mark the horizon in the large draught. Then take the distance, or depth, K L, of the little design, which gives the bottom of the house, note how many divisions it includes, and take the same number from the large scale, and set them on the edges of the canvas, H M, H M, which you must strike with a packthread for the bottom of the house. Proceed to take the distance N O, which includes two parts of the little scale ; accordingly two parts are to be taken on the great one, and set off from H to P, which must be struck as before, for the depth of the second tree. Do the same for all the parallels to the base line, as the other trees, windows, roofs, &c.

The method is the same for the perpendiculars as for parallels ; only that they are to be struck or scored not from the side, but from the top and bottom. Thus, for the two corners of the house, the interval between them and the side of the draught being taken in the compasses, and found on the little scale equivalent to seven divisions and a half, as many divisions must be taken from the great scale, by which you will have H S, T S, to be struck as before. And the like must be repeated for all the other perpendiculars, as buildings, trees, palifades, &c.

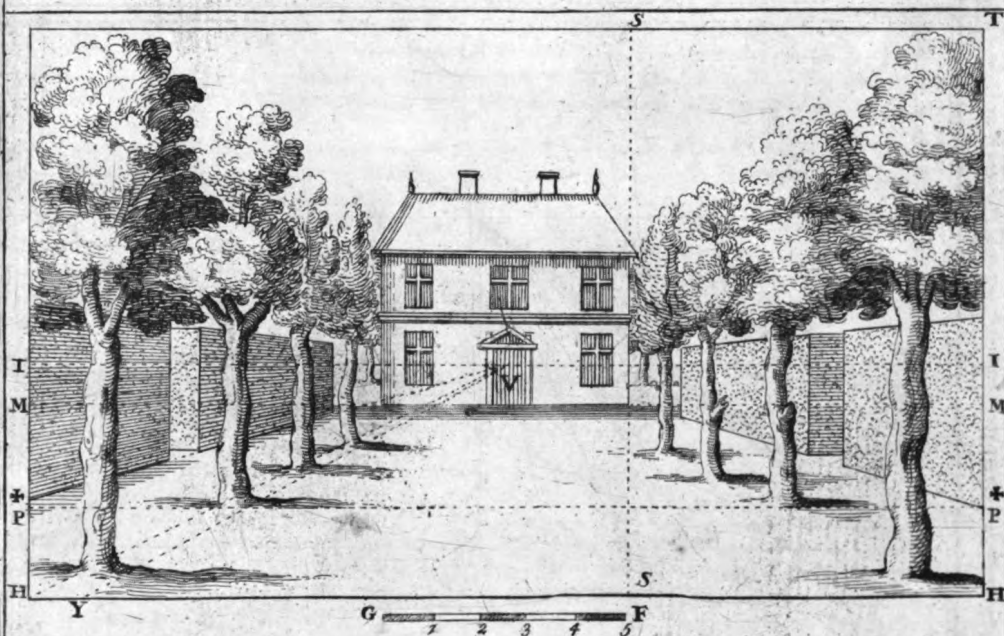
To find the visual rays, which are the lines proceeding to the point of sight V, fasten a packthread to this point V, of the length of the painting, and with this strike or score all the rays very exactly. Thus, for the two rays D X, which give the breadth of the trees in the little design, take the distance D X, set it on the little scale B C, and take an equal number of divisions from the great scale, this will give you H Y ; to which points H and Y, lines are to be struck with the packthread, from the point V. For the ray of the palifades, take the distance D Z, and set it on the little scale, and take as many divisions from the large scale ; by this means you will have H †, which are to be struck from the point V, as before.

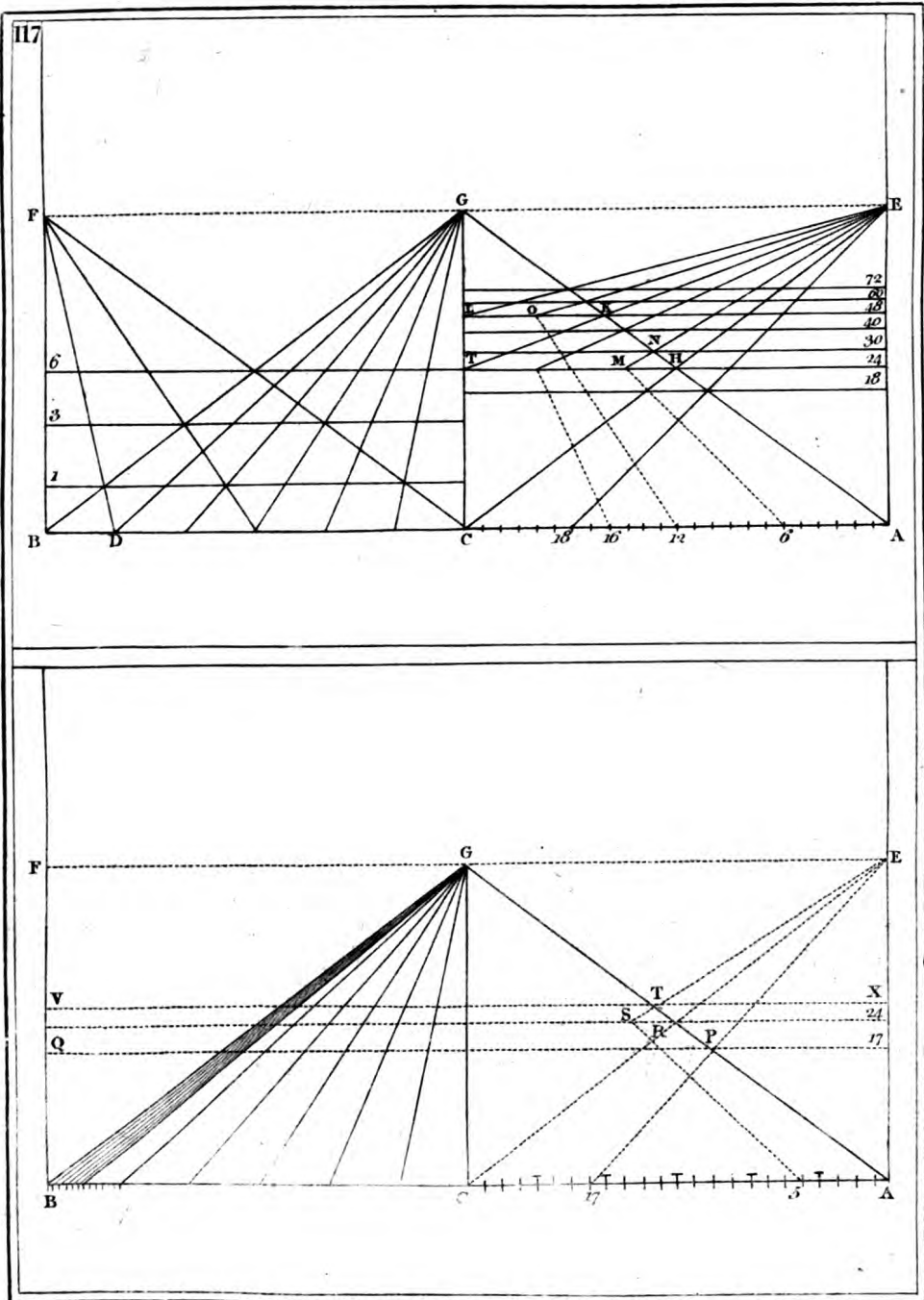
Every thing in a perspective ordinarily comes under one or other of these three sorts of lines, parallels, perpendiculars, and visual rays : and having shewn how to describe these with a good deal of ease on the canvas, there remains nothing difficult in the process of enlarging a small design.

As to the reducing great into little, you have only to invert the process ; that is, take the measures first on the large scale, and diminish them proportionably on the small one. Thus, if the horizon of the large design were five divisions of the large scale, five divisions of the small scale were to be taken for the height of the horizon of the small design. And so of the rest.



C 1 2 3 4 5 B





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Apparatus to the universal Method of the Sieur G. D. L.

AS several, for whose benefit I intend this work, may not be sufficiently skilful to see clearly into this universal method of the Sieur G. D. L. the author, I believe will allow me to make it as easy as I can, that they may be the better enabled to reap the benefit thereof. For this reason I have added the two following figures, which will call to mind what has been already touched upon in the second, third, fourth and fifth observations, pages 16, 17. The design whereof was to facilitate this method, and accordingly in them is shewn how to take all the measures on the base line; and that as many rays as cut the diagonal C F, so many squares are formed in the depth of the draught; which squares may be made of any magnitude at pleasure.

Now, not to have so far back to seek, view the first figure, where the base line is A B, the point of sight G, and the points of distance E, F. This base line I divide into twelve equal parts, which I suppose equivalent each to one foot, from all these divisions draw lines, or rays, to the point of sight, whereof A and B are the last. Now, if a line should be required that is sunk a foot deep in the draught, draw a line from the first division B D, to the point of distance F; and where this line D F cuts the ray B G, will be the point for a line to be drawn through, that is sunk a foot. If another three feet deep were required, take three of these parts on the base line, and from the third draw a line to the point of distance F, and the point where it intersects B G, will be the place for that line. Consequently, if from C a line be drawn to F, the point where C F cuts B G will be a line six feet deep.

If of the other six parts remaining of A C, you make twenty-four, by dividing each into four, and yet account each division a foot, you will have twenty-four feet between A and C; so that if a line should be required eighteen feet deep in the draught; I would reckon eighteen little parts from A, and from the eighteenth would draw a line to the point of distance E, which by its intersection with A G would give a point for that line. If a line were required twenty four feet deep, the whole line A C must be taken, and from C a line be drawn to E, and from H, the point wherein C E cuts A G, the line H I must be drawn, to appear twenty-four feet deep in the draught.

In perspective, the line H I is equal to that of A C, that is, contains as many parts, or feet. So that if from I, a line be drawn to E, the intersection of I E with A G, will give the line K L forty-eight feet deep. And if from the point L, a line be drawn to the point of distance E, by its intersections with the ray A G, you will have a line twenty-four feet farther off than the other.

If you would have a line thirty feet deep, from the point A reckon six small divisions, and from the sixth draw a line to the point of sight G, observing where it cuts the line H I, as here in the point M. Then from M draw a line to the point of distance E, and the line M E will intersect the ray A G in the point N, through which the line required must be drawn. If a depth of forty feet were required, from A sixteen divisions were to be reckoned, and the rest to be done as before. If sixty feet be required, twelve divisions must be taken, and from the twelfth a line be drawn to the point of sight G, as far as the line K L, which will give the point O. Then from O, a line to be drawn to the point of distance, and its intersection with the ray A G, will give the line.

As to the second figure, from what has been said it is easy to find a point of any depth or distance at pleasure. It remains to shew how the same is found within or without the rays A G or B G. In order to this, the line B C is to serve as a scale of six feet, one of which we divide into twelve inches; that we may have the half, third, fourth, &c. of a foot. Things thus disposed, if it be required to shew a point seventeen feet distant, and a foot and a half within the ray A G, a line must be drawn from the seventeenth division of the base line, to the point of distance E, and where the ray A G is intersected thereby in P, the line P Q to be drawn. Now since a foot and half is required within the ray A G, I take the extent on the same line N Q in my compasses, and set it off from P to R, which point R is the point required. If a point twenty-nine feet distant, and seven and a half within the ray A G be required, a line must be drawn from C to the point of distance E, and through the point where it cuts A G, a line being drawn, gives twenty-four feet. Then, from A taking five lesser parts, a line must be drawn from their extent to the point of sight G, till it cut that line in the point S; and from S a line is to be drawn to the point of distance E, and from the point wherein it cuts the ray A G, a line T V must be drawn. And since seven feet and an half are required beyond the ray A, that space must be set on the same line from T towards V to the point X, which point X will be the point desired. After such manner, may any distance at pleasure be determined.

An universal method of performing Perspective without having the point of distance out of the painting or Ground of the work; made public by the Sieur G. D. L.

IN this method a geometrical plan is required, or at least a scale of measures both for the plan and the elevation, in order for the one or the other to be put in perspective.

For an object or subject, we shall take the author's own example, which is a square cage, terminating at top in a point, or a building with a pavilion roof. The measures whereof shall be given by a scale.

Now having made the plan of the cage M I L K, which is here added at the top of the figure, a line $a b$, must be drawn at the distance the object is to appear at in the draught, as here the line $a b$, 17 feet, which is to be the base line, or bottom of the piece, and to be placed accordingly to the aspect the object is to be viewed in. Then, from the two extremes of the line $a b$, two indefinite lines must be drawn parallel to each other, as the line $a g$, and $b g$. On one of which lines, as $a g$, you are to draw little parallels to the base line, proceeding from the angles of the plan, and by means of the scale see how far each angle of the plan is removed from this line $a g$, and mark the same on each line. Then, from the place the painting is intended to be viewed from, which is here the point c , five feet distant from b , describe a perpendicular to $a b$, namely, the line $c t$; and to this line allow as many little parts of the scale, as the spectator is to be distant to view the painting, namely, 24 feet. At the extreme of which 24 feet, which is the point t , erect a little perpendicular of the height of the eye, namely, the line $t f$, equal to four feet and an half.

The cloth, wall or paper thus disposed for putting the plan in perspective, and making the elevation on the plan, divide the base line $A B$, into as many parts as $a b$ in the plan is divided into, namely twelve, each accounted a foot; and over the points A and B , set the height of the line $t f$, namely four feet and an half; that is, taking in your compasses four and a half of the divisions of $A B$, set them perpendicularly over the points $A B$, by which means you will have the points E and F . Draw the line $E F$, therefore parallel to $A B$, and it will be the horizon. Then, as in the plan, the point C , which is the place the draught is to be viewed from, is five divisions distant from b , you are to reckon as many parts from B ; and from the fifth C , erect a perpendicular to $A B$, which cutting the horizon in the point G , gives the point of sight G , to which all the rays $A G$ and $B G$, representing the parallels of the plan $a g$ and $b g$, must be drawn.

As to the point of distance, it will be the point F , and as the line $c t$ is 24 feet long, 6 divisions must be taken from the line $A B$, namely, from A to D , and each subdivided into 4: which 24 parts are to serve as a scale for the depths or distances, being sufficient for the same; tho' they were infinite. And the 6 parts remaining between B and D , will be a scale for the feet, according as the lines drawn from the points found for the plan, shall cut the rays down to the point of sight G . For as this scale is a pyramid, whereof $B D$ is the base; the measures diminish in proportion as they are farther off. One of the parts is divided into inches, that all the measures may be there, as on the plan.

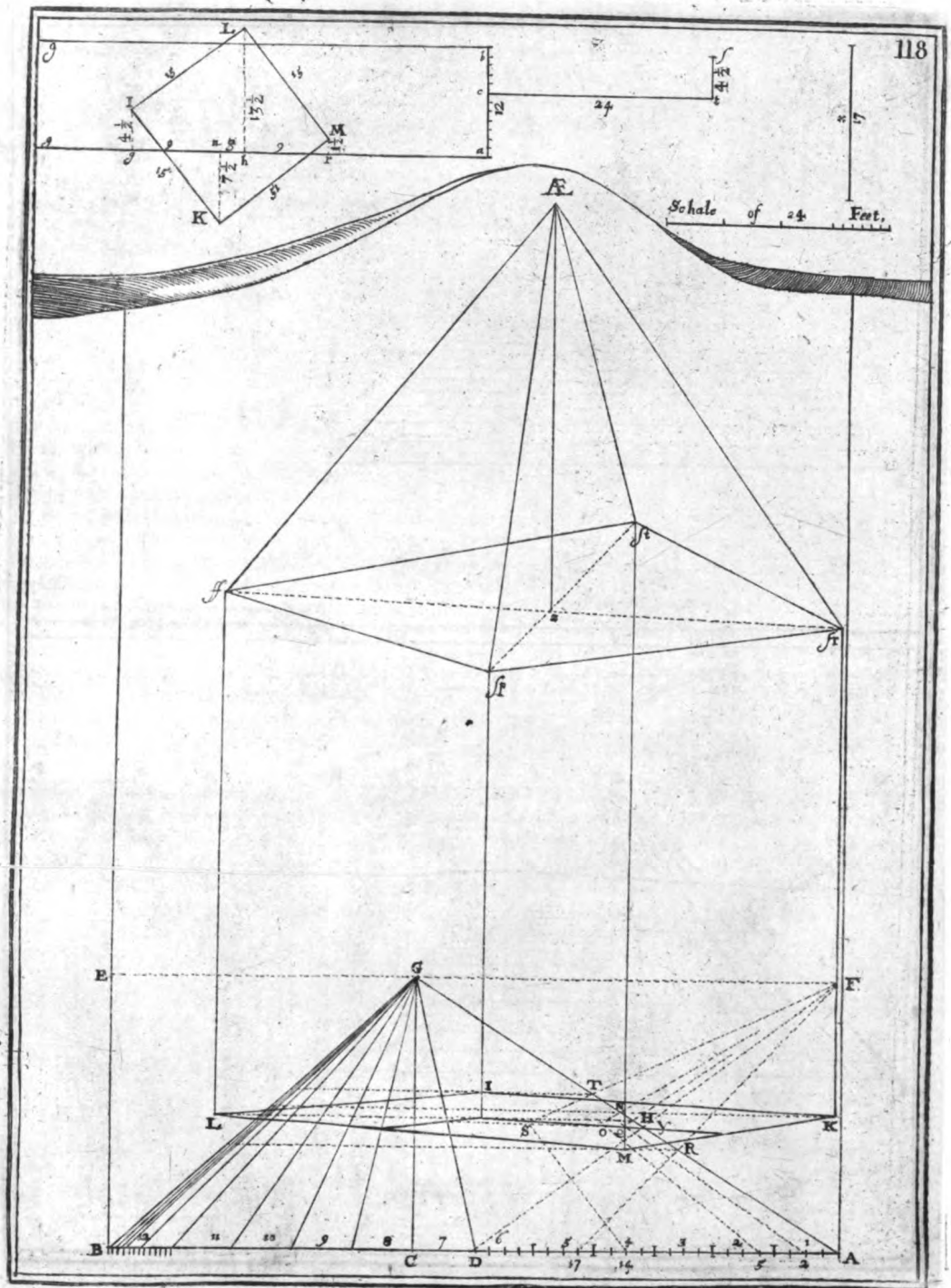
By the scale of distances, the points of the plan are found, and by the scale of measures the lengths of the lines both of the plan and elevation.

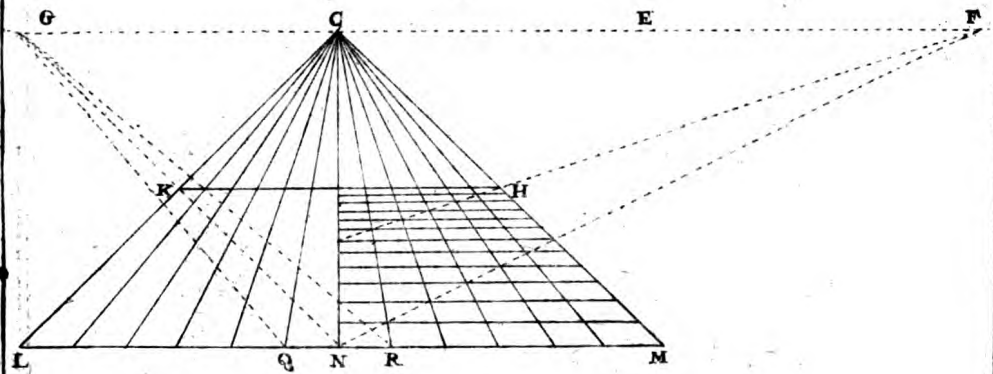
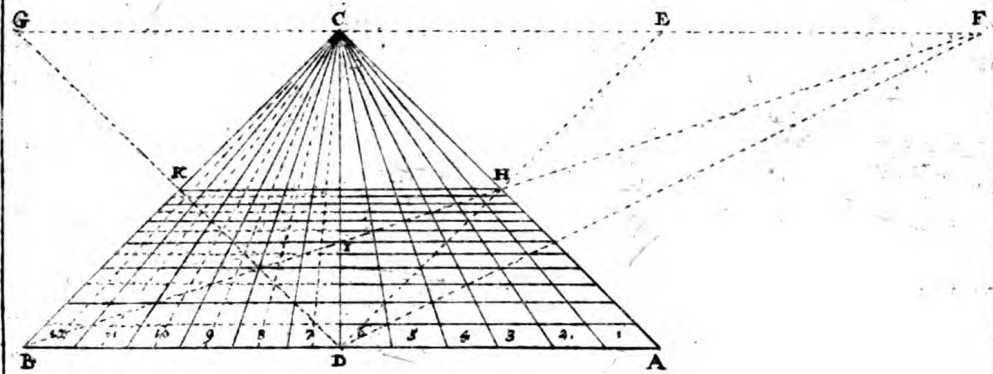
Now to put the plan in perspective, all the measures of the geometrical plan must be observed. The first angle of the plan $r m$ is 17 feet distant from the point a , on the line $a g$. For this reason we reckon 17 parts, beginning at A , and from the seventeenth draw a line to the point F , cutting the ray $A G$ in R . From this point R , a parallel to the base must be drawn: and by reason the point m is within the ray $a g$, by a foot and an half, therefore, on the side $B D$ of the line R , must a division and an half be taken, and set off within the ray $A G$, which will give the point M , representing the angle of the plan m . As to the angle l , which is 26 feet distant from the point a , a line must be drawn from the point D , which is 26 feet from A , to the point F ; and where the ray $A G$ is intersected thereby, namely, in the point y , a parallel is to be drawn. Now as the point y is not remote enough by 2 feet, a line must be drawn from the second division of the scale to the point G , and where this ray cuts the parallel y , namely in the point Q , the line $Q F$ to be drawn, which will give the point H on the line $A G$: from which point H a parallel to $A B$ must be drawn, and on the side $B D$ of the same line H , must the divisions for 14 feet and an half be taken, namely, from the point H to L .

For the point k , which is 29 feet distant from A , a line must be drawn from the fifth part of the scale $A D$, to the point G , and where this ray intersects the parallel y , namely in the point O , the line $O F$ must be drawn, which gives the point N on the line $A G$. Then from N draw a parallel, the side whereof $B D$, 7 feet and an half, must be taken, to be set off without the ray $A G$, namely, from N to K .

For the point i , which is 38 feet from a , take 14 divisions on the scale $A D$, and from the fourteenth draw a ray to the point G , which cutting the parallel in the point S ; from that point draw a line to F , cutting the ray $A G$ in T , which is 38 feet from the point A , inasmuch as the parallel y is 24; to which, 14 being added, gives the whole 38. And since the angle i is 4 feet and an half within the ray $A G$, that extent must be set on the side $B D$ of the parallel T , namely from T to I .

To form the plan, those four points $M L K I$ must be connected by right lines, and perpendiculars erected from their angles, as $M \beta$, $L \beta$, $K f r$, and $I \beta$; each of which will be seventeen feet, as is expressed in the plan of the line X . Then, from the extremes of these perpendiculars, draw two diagonals $\beta, f p$, and $\beta, f r$, which intersecting in Z , from the same point Z erect a perpendicular $Z \mathcal{A}$, thirteen feet and an half. Lastly, drawing lines from all the four angles $\beta, \beta, f p$ and $f r$, to the point $\mathcal{A}$, the cage will be formed in perspective. If you would have it sunk a foot under ground, add a foot underneath each point of the plan, and connect them by lines.





To give any precise distance required, without removing the point of sight out of the piece.

SUCH as are disposed to make use of this universal manner ought to know, that the number of feet you take on the base line are to have a regard to the point of distance proposed.

To make the proposition understood: in the first figures are put two points of distance, the one fix, the other twelve feet, which have an easy ratio to each other; inasmuch as the six parts being each divided into two, you have twelve.

Suppose then the line *AB* divided into twelve parts, and from each division lines drawn to the point of sight *C*; take half these divisions *AD*, and from *D* to the point *E*, which is the distance of six feet, draw *DE*. It is certain its intersection with the ray *AC* will give the diminution of the squares viewed at six feet distance. And if from *D* a line be drawn to *F*, which is the distance of twelve feet, the line *DF* cutting the ray *AC* will give the diminution of six squares, viewed at twelve feet. And if the diminution of twelve squares, viewed at twelve feet distance, were required, from the point *B*, which is the whole base line, a line must be drawn to *F*, and its intersection with the ray *AC*, in the point *H*, will give the thing required. Or from *I* a line *IF* is to be drawn, which will give the same point *H*, the line *HK*, in each case, being the depth of twelve squares, viewed at twelve feet distance. Hence we observe, that twelve squares, viewed at twelve feet distance, meet in the same line *HK* with six squares viewed six feet off, and that all the lines of the six squares, given by the intersection of the diagonal *DG*, have a relation two by two to those given by the diagonal *DF*. The reason why the diagonal *DF* gives two lines for one of those *DG*, is, that the distance is double. If it were triple, it would give three, and four if quadruple. Now, to find the same intersections, and the same number of squares on the side *BD*, as are on that *AD*, without having the point of distance out of the piece, you have only to divide each of the six equal parts between *B* and *D* into two, by which means you will have twelve parts: then draw occult lines from each division to the point of sight *C*, and drawing parallels to the base line through all the intersections the diagonals make with all those rays, you will have twelve squares depth in the same line as if the distance were twelve feet, though in reality *G* be but six. The reason is, that in multiplying the rays you multiply the squares, and multiplying the squares you remove the distance farther. Such is the reason why having made twelve parts of the six that were between *B* and *D*, there are procured twelve squares, which have the same depth as if at twelve feet distance. And if a distance of twenty four feet were required, you have only to divide each of the parts between *B* and *D* into two, which making twenty-four parts, from the twenty-fourth draw a line to the point *D*, and the point *K*, wherein it intersects the ray *BC*, will be the depth of twenty-four feet.

In the second figure the same measures are laid down on the line *LM*, as on *AB* of the first figure, and the same depth and distance on the side *MN*, as on the side *AD*, which gives the line *HK*; to shew, that if a line were drawn from the fifth part, as *QG*, or from the seventh, as *RG*, the true depth would not be had, which is at *K*. For *RG* would not sink it enough, and *QG* would sink too much: even though those five or seven parts there were made twelve or twenty-four.

For this reason you are always to observe to take a number which may be multiplied by the distance, as here the distance of 6 may serve for 12, 18, 24, 30, 36, 42, 48, &c. the distance 5 may serve for 10, 15, 20, 25, 30, &c. and the distance 8 for 16, 24, 32, 40, 48, &c. In this way you cannot fail; for supposing the point of distance cannot be nearer the point of sight than *G* is to *C*, it follows, that if *G* be six, seven, eight, or ten feet from *C*, that then half the base line will have the same number, which is to be divided proportionally to the distance intended. For instance, if there be eight feet from *N* to *L*, and I require a distance of thirty-two feet, without moving *G* out of its place; I divide each of the eight parts, or halves of the base lines, as *LN*, into four, accordingly, four times eight makes thirty-two rays. So that the diminutions of the squares will be thirty two feet distant.

These little divisions do none of them remain after the painting is finished, only the principal divisions of feet, which are drawn to the point of sight, and the diminutions, that is, the parallels to the base line, which still stand.

A very curious Method of drawing all Perspectives in the most natural Manner, without observing the Rules.

HAVING given all the necessary rules for drawing perspectives in the exactest manner, I have thought fit to add this and the following method of drawing very correctly after nature, without being tied to the process of any one rule.

Many lovers of painting, and who entertain themselves in drawing after nature, would willingly be excused the trouble of opening the compasses, or taking up the ruler, and in this method neither the one nor the other are required; and yet the proportions and distances of objects will be exactly preserved.

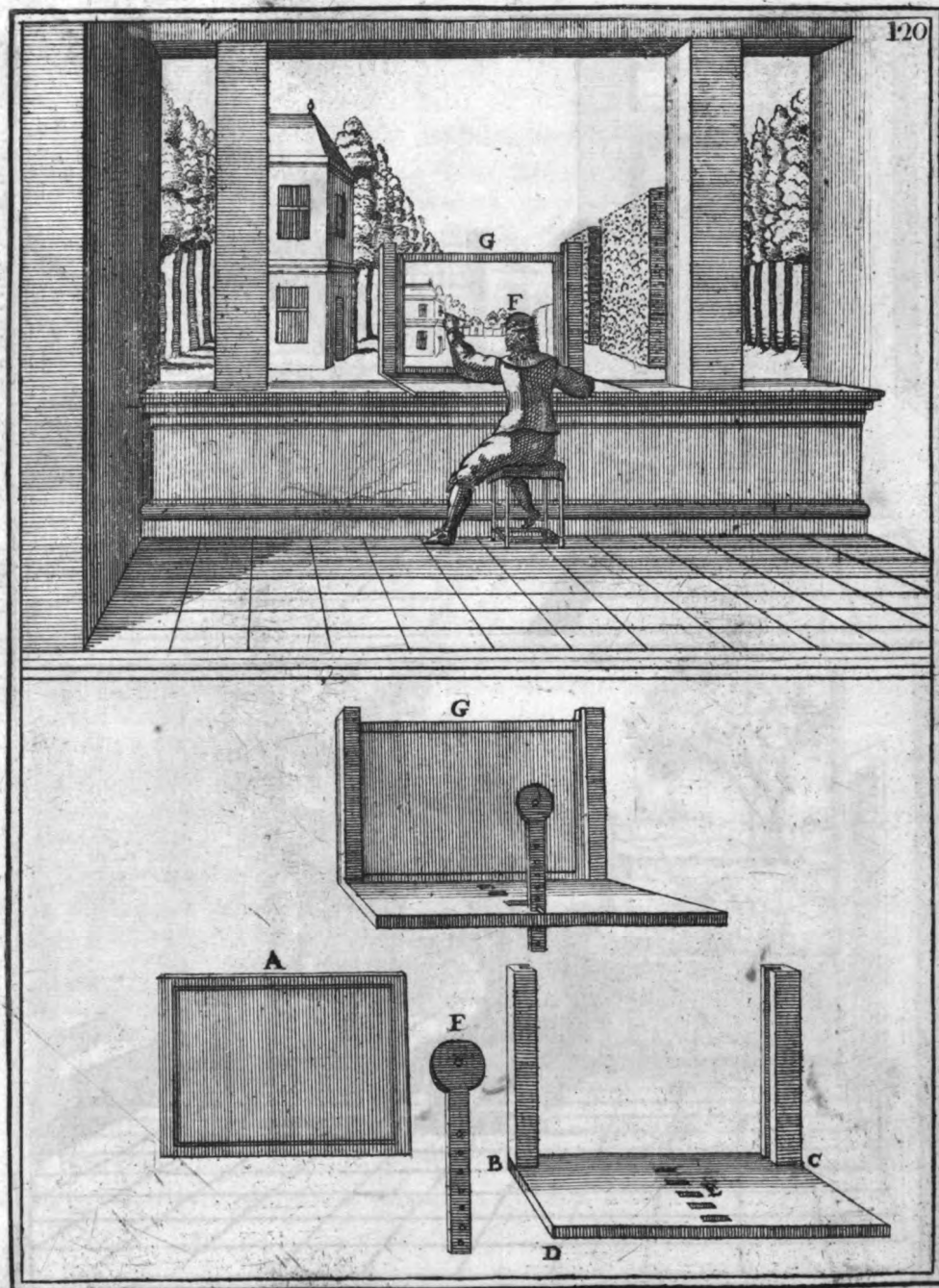
Before I come to the method of performance, I must describe the instrument used therein. The principal requisite is a large piece of fine clear glass, fitted in a wooden frame, expressed at the bottom of the plate by the letter A. This frame is to slide between two cheeks or pieces of wood an inch and a half thick, which are raised at the two extremes of a board the breadth of the frame, that is, about a foot broad, as shewn in B C, the cheeks are grooved to receive the frame A. In the middle of the board square holes must be made as in E, to receive the slit ruler F, so as it may be raised or lowered at pleasure. At the top of which ruler is a circle of three or four inches diameter, but very thin, being made of tin, or the like, and having a little aperture about the size of a pea in the middle. The whole is represented put together in G.

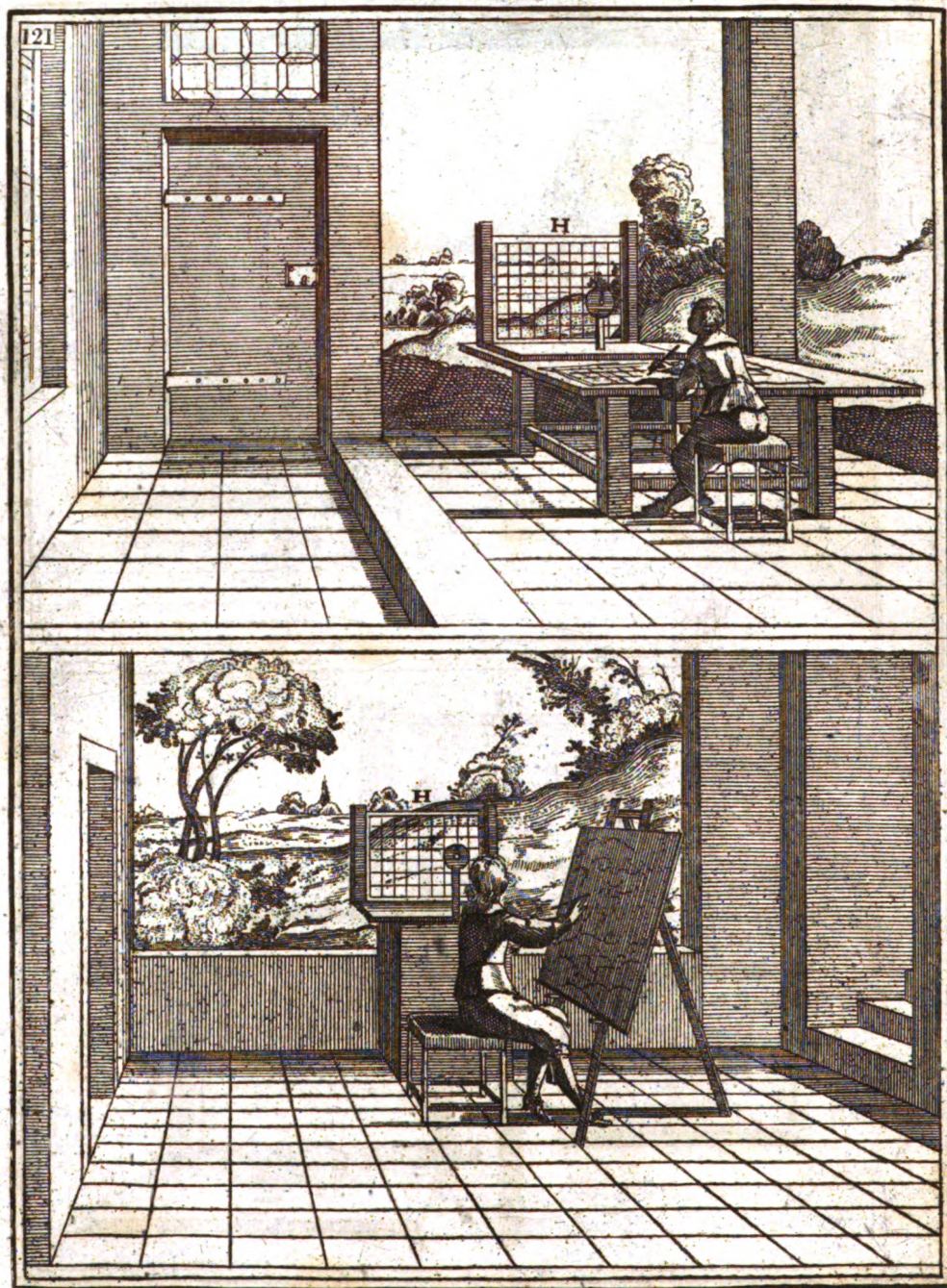
The figure of the instrument shews the application, yet I shall describe the method of proceeding. Place the instrument G before the object you would draw, look through the little hole or sight F, and if you see all the proposed objects represented on the glass, the instrument is rightly fixed, otherwise bring the sight nearer the glass, till you see the whole of what is required. The piece thus rectified, draw on the glass every thing that you see thereon through the hole F; which has the same effect here, as the point of sight in the other methods. And it is certain, every thing thus drawn on the glass, the eye being fixed to the little hole, will be according to the strict rules of perspective.

It is well known how to take off or copy what is thus designed on the glass. One method is to draw on the glass with pen and ink, then wetting the backside of the glass a little, and laying a moist sheet of paper on the side that has the design, rub or press the paper gently thereon with the hand, and the whole draught will be impressed or transferred from the glass upon the paper.

Some advise to make use of a hair pencil and colours, but every body is left to his own discretion. It is enough to know the method in general. The draught of a palace is as easily taken this way as a landscape, and a church as a house or chamber. All required in any of them being to pitch on a situation where the whole object intended to be represented, may be seen, and to bring the sight to a proper nearness to the glass.

A painter may use the same method for the drawing of figures or postures, from nature, statues, relievos, and every thing else. It being certain, that a little practice will render the method exceeding easy.





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Another curious Manner of practising Perspective, without understanding the Rules.

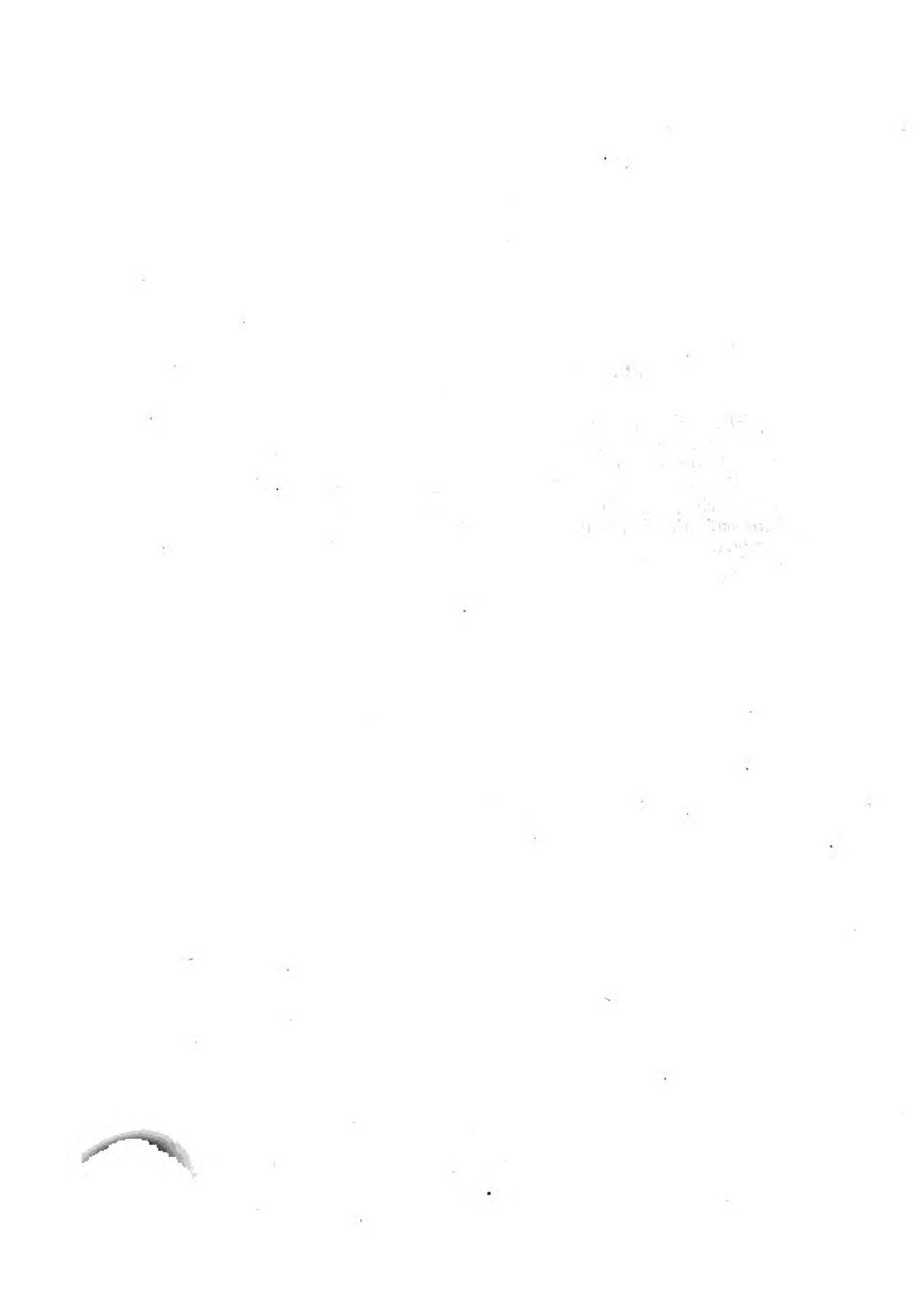
THIS method is as curious as the former, and some even prefer it, because a double draught is required in that, one on the glass, and a second copied or imprinted from it. Whereas in the present method only a single draught is made, and that as exactly as the former.

I shall not describe the structure of this instrument, it being the same with that already mentioned ; excepting that the frame, instead of a glass fitted in it, must be divided into a number of little squares by fine threads, drawn at equal distances from each side of the frame, across each other, forming what we call a *reticular* or lattice. As to the number of squares, it is left to discretion. But they must not be too large that you may work the more exactly, nor too small for fear of being confused.

For the practice, place the instrument H in such manner as that you may see all the objects you intend to draw, through the hole of the sight I. If your draught is to be larger than the compass of the frame or *reticula*, squares must be made on the cloth or paper, larger than those of the frame. If your drawing be intended smaller than the frame, make the squares less. But in all cases make the same number of squares on your paper or cloth, as you see in the frame when you look through the sight I. Then, transferring proportionally from the squares in the one, to the corresponding squares in the other, the perspective will be as just as if you had gone by the strict rules, and used the compass and ruler.

The two figures shew how the instrument H is to be placed, in order to draw on a table. The expedient is of excellent use in painting, and serves to draw very exactly any perspective from nature, or to copy from paintings.

Some people will be apt to urge, that the method is not new ; there being few painters but what know how to enlarge or diminish paintings by means of the chequer, or squares. All this I allow, but must take the liberty to say, that I do not know of any that ever yet used the sight-hole, which, however, is of very great advantage to the artist.



PRACTICAL PERSPECTIVE,
PART IV.
MEASURES AND PROPORTIONS
OF
FIGURES

For Perspective DRAUGHTS, PAINTINGS, and
RELIEVOS.

Figures in Perspective.

HAVING shewn how to draw all kind of views in perspective, I proceed to give directions for adjusting the height of figures.

I would here make one observation concerning the altitudes of figures. Those which are placed at the end of a gallery, hall, or in a garden at the termination of a walk, with a design to deceive the eye, and appear at a distance to be real life, are best represented in altitudes which do not suppose a progressive motion. Whereas those figures which are introduced as part of the composition of a picture, admit of every kind of attitude to the design of the piece.

The number of horizons which our painters frequently introduce in the same piece, leads them into innumerable faults, in not being able to give the figures their proper heights, proportionate to their horizons. I shall therefore here give a single rule, which may prevent their failing, be the horizon what it will.

For Figures that have the Eye in the Horizon.

IN perspective draughts placed at the end of a gallery, hall, or walk, to deceive the eye the horizon should always be its natural height, that is, five feet, which is that of an ordinary size.

And figures intended to appear there the size of life must have the eye in the horizon. For, having the eyes in the same horizon with ourselves, they will be of our own height. This might pass as sufficient instruction; but to make the point more clear and obvious, I shall instance in these three figures, instead of twenty others which might be brought.

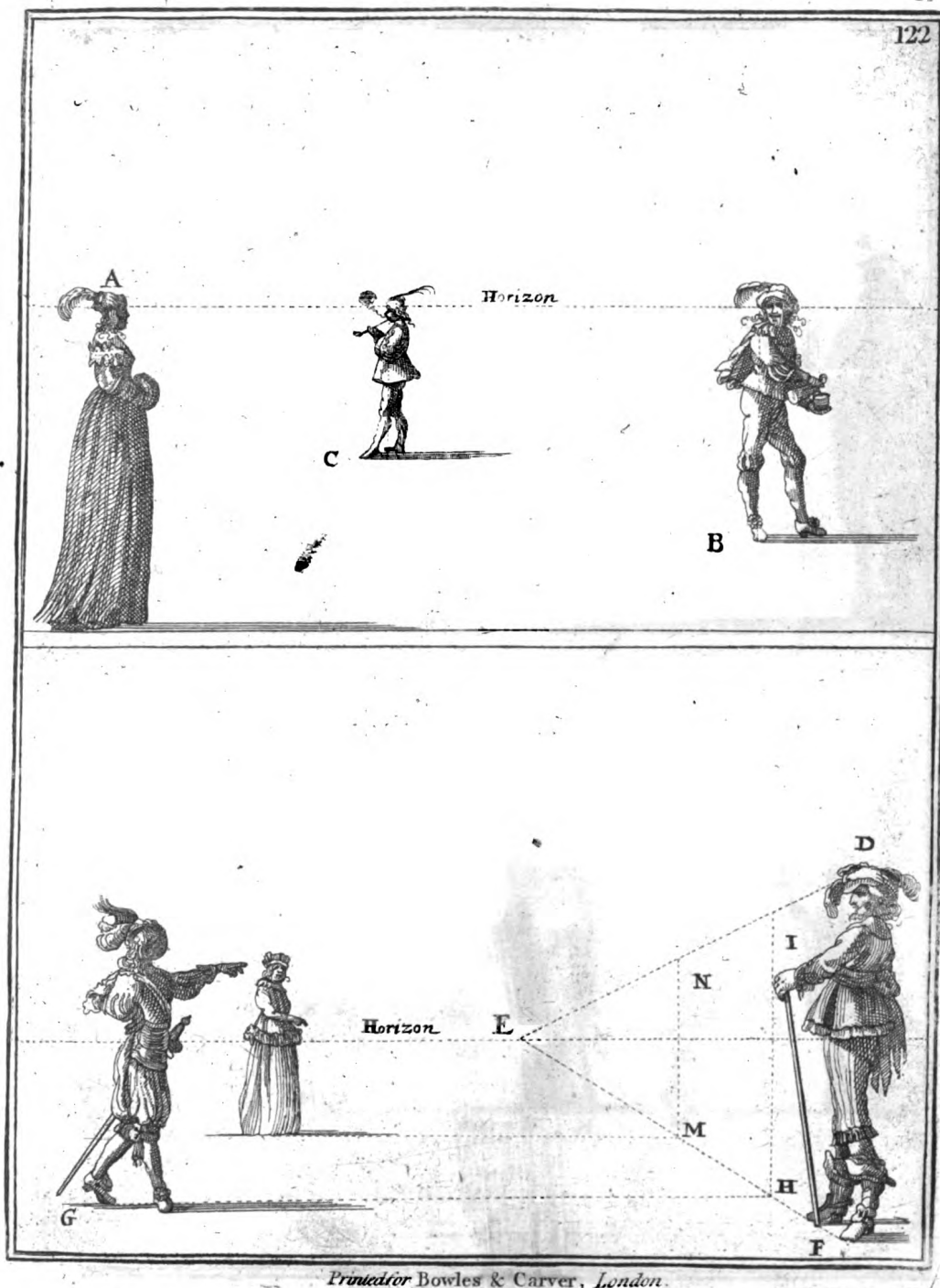
The first figure A is the natural height, and has its eye in the horizon. If a second figure be required in the place B, from the point B a perpendicular must be raised to the horizon, and it will appear of the same height with the former. If you require a third at C, let his eye likewise be in the horizon, and he will be the same height with the rest, in appearance. In effect, though there were a thousand, there need no other rule be regarded, when the horizon is the natural height. I must not here be understood as including children, which are to be made in proportion to the large figures, according to the discretion of the painter.

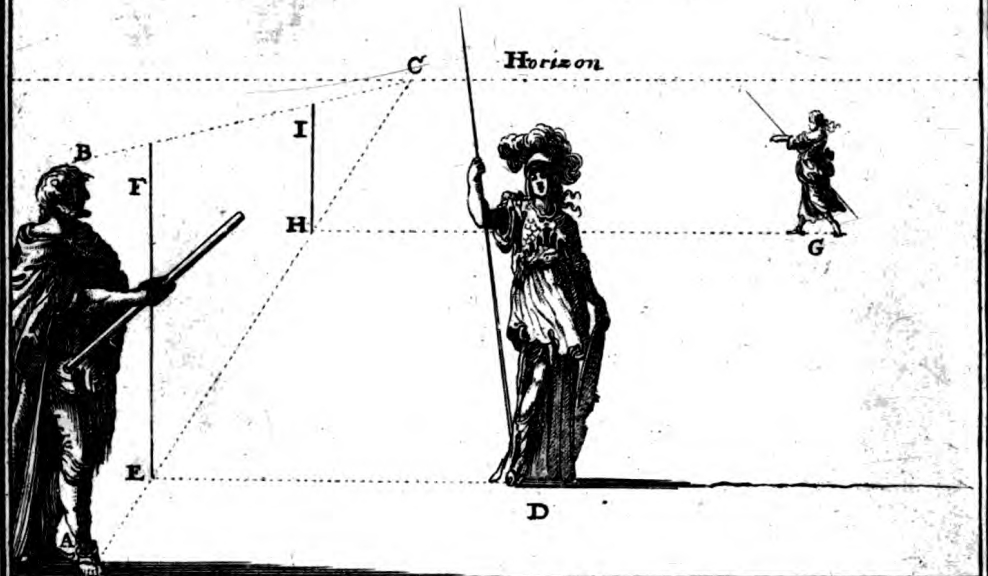
For Figures that have a low Horizon.

IN painting for halls, which are usually hung pretty high, the horizon must be lower, to bring it as near the eye as possible.

Now, to give each figure its just height and proportion in whatever part of the painting it be, some one must be drawn of any height at pleasure, in any part of the piece, as the figure D F, which is here to do the office of a line of elevation.

And to find the height of the other figures in the painting which are to appear as high as the first, draw lines from the head and feet of this figure D F, to a point in the intended horizon, as E, and within this triangle D E F, will be found the heights of all the rest. Thus, for example, if the height of a figure in the point G be required, from that point G draw a parallel to the base G H, till it intersects the line or ray F E in the point H, and the perpendicular H I gives the height of the figure, which is to be taken in the compasses, and set off in the point G. If another be required in the point K, the same operation is to be repeated, and we shall have the perpendicular M N for the just height. And so of whatever number of figures you please.





To exhibit Figures that have a high Horizon.

WHEN the horizon is high, as it necessarily is when objects are viewed from an eminence, the same rule already laid down for the remote figures in a low horizon, must be observed; as in that case, the hindermost figures are placed highest, and are most diminished, so in the present case, their distance is expressed by raising them further off from the base line, and diminishing them in proportion to their distance.

Having drawn the first figure A B, draw a line from the top of its head, and another from the bottom of its feet to some point in the horizon, as the point C, then will all the heights of the other figures be taken within this triangle A C B. For example, if you would have the height of the figure in the point D, from D draw a parallel to the base line, D E, as far as the ray A C, which will give the point E, from which a perpendicular is to be raised as far as the line B C, which will give the point F. This perpendicular, E F, will be the height of a figure in the point D. If a figure be required in the point G, the same is to be done as for D, and you will have the perpendicular H I, for the height of the figure G. By the same method the heights of all other figures in any other places may be taken.

For Figures that have their feet in the horizon.

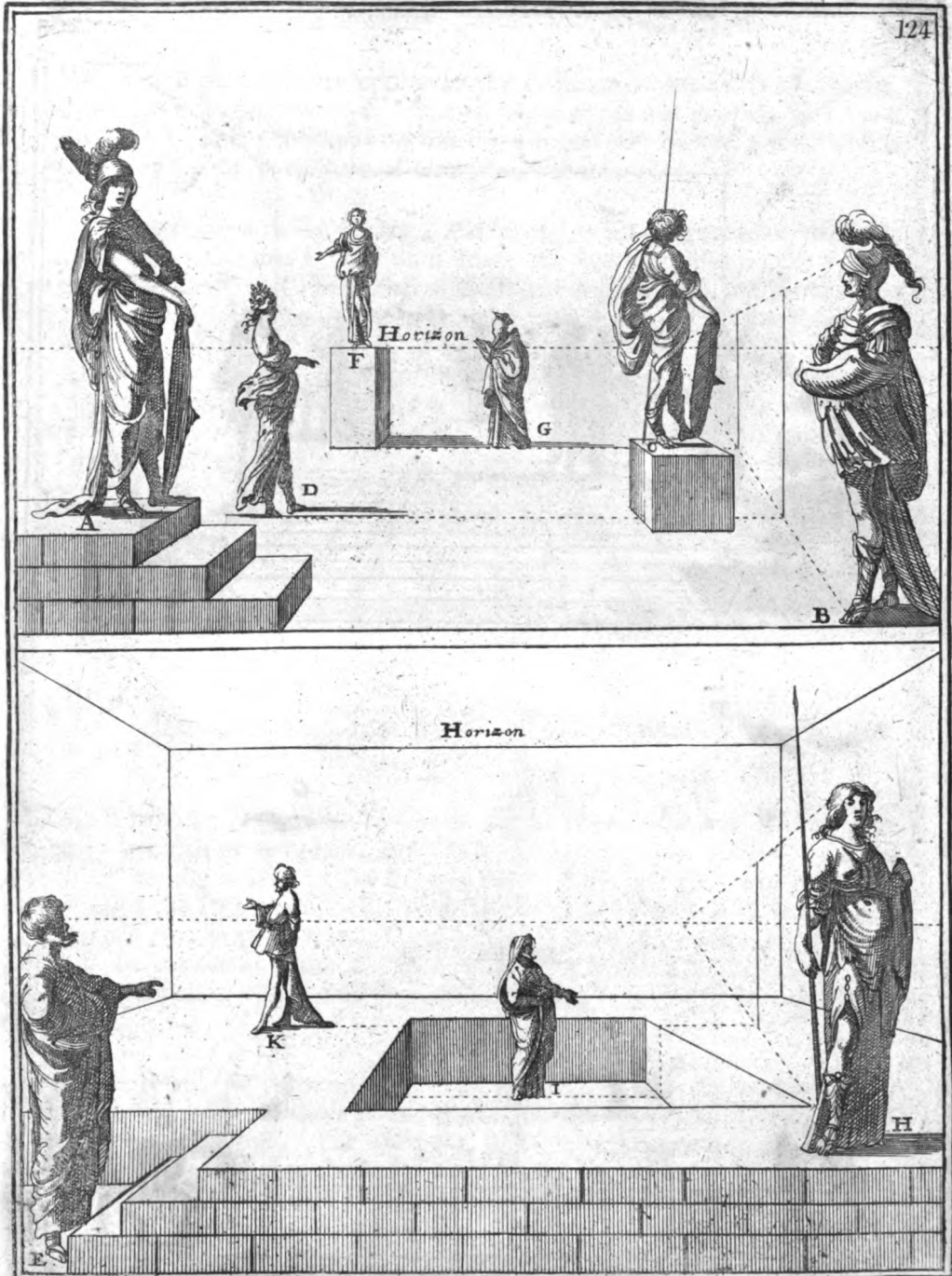
IT is but rare that figures are made above the horizon, but where there is a necessity for it, those intended to appear the foremost must be made the largest; that is, they must be made the natural height, and all the rest being made less, as they are more remote, will appear equal to them. Thus the figure K L is here the biggest and the nearest, and M N the remotest. All the secret here, is the painter's finishing the front figures more than those behind, and still the farther off they are, the fainter and less perfect must they be.

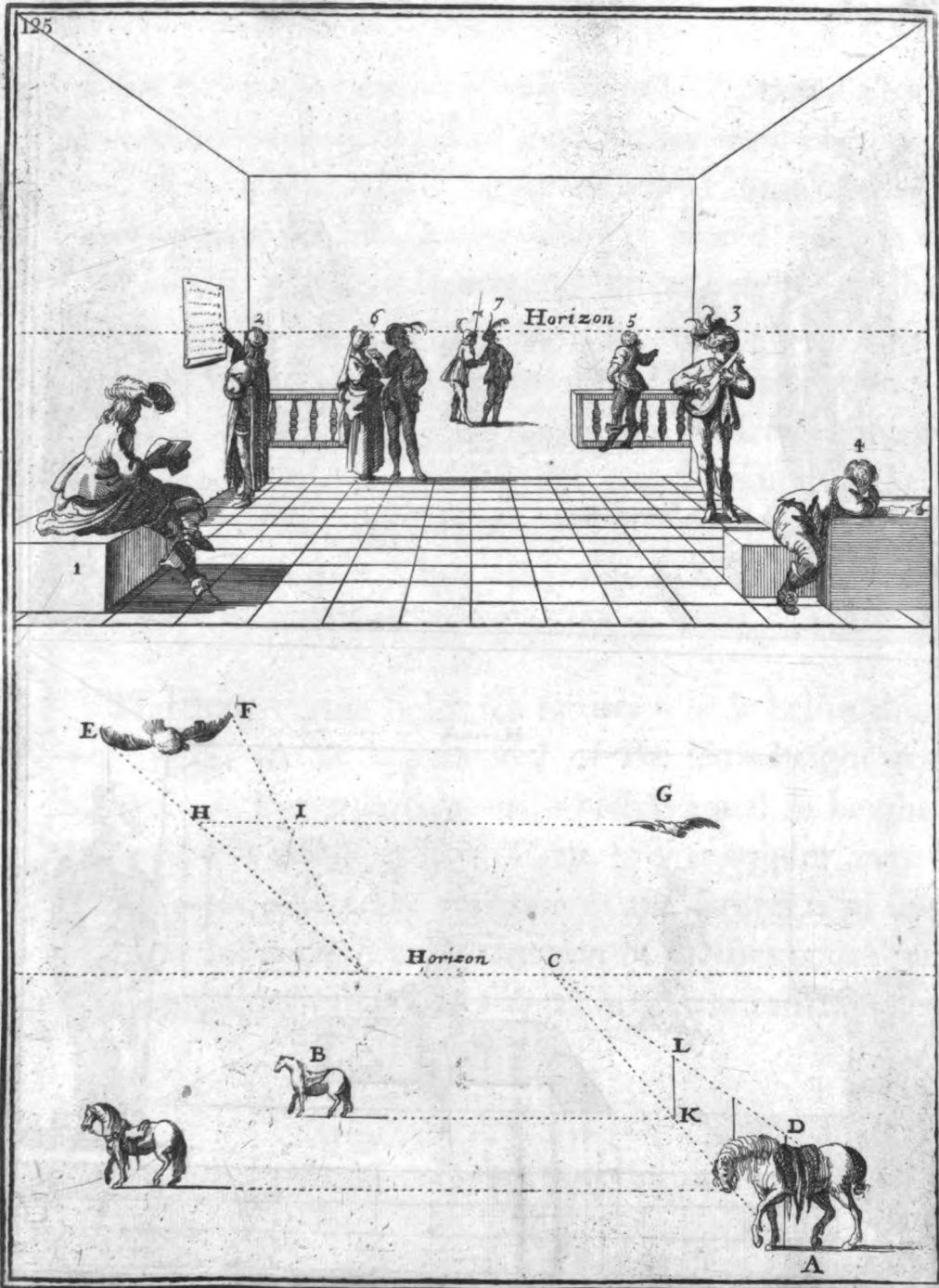
The rule for these figures, and for those which have their eyes in the horizon, is no other than reducing their height, and making them smaller and fainter, as they are thrown farther behind.

To exhibit Figures raised a small Matter above the Plan.

THERE are some who plead, that objects raised above the ground are more diminished than if they were on the plan ; and, of consequence, a figure mounted four or five feet should therefore be smaller than if placed on the earth. The rule is good for figures at a great height, as shall be shewn in its place : but an elevation so small as that just mentioned, can only make an insensible diminution. For supposing such an object or figure may be seen at one single view, that is, without raising the eye, it must be the same height when so inconsiderably raised, as when standing on the level ground. Thus, the figure A must be the same height as B, and the figure C as D, and F equal to G.

The same reason holds for figures a little below the plan, which are to be represented of the same height as those above it, as shewn in figure E, which is equal in height with H ; and I is as big as K. These two examples may serve for all cases, where the variation of the figures is as small as in these instances, the diminution of figures occasioned by high elevations will be the subject of future instructions.





The Postures of Figures in Perspective.

THERE must be a judicious choice in the postures, or attitudes of figures, when intended to deceive the eye. For all of them are not proper, as I have already observed. This consideration has determined me to add a few, which may pave the way for the invention of numerous others.

The first is a man who reads, sitting; the second is reading an advertisement posted on the wall; the third plays on a lute; the fourth is asleep; the fifth is lolling against the banisters; the group of two figures marked 6, are looking on a draught on paper; the remoter, marked 7, are in earnest discourse. One might add others, playing, speaking, or discoursing at table, writing, praying, &c. In effect, you have a choice of numberless postures, provided they be such as that a man may continue in them for a time. But never use such as are much in action; for you can never be deceived in seeing a leg or an arm in the air, or a person running without shifting his place.

BEASTS and BIRDS in Perspective.

THE same rules must here be observed as in human figures, giving each the height or breadth of the first, and from the two ends of this first measure drawing lines to the horizon from the measures of all the rest. For example, having intended the first horse, A D, to be the height of that other B, from the line A D draw a line to the horizon C, and from B draw a parallel to the base line B K, till such time as it cut the line A C, which will give the point K; from which a perpendicular K L being erected, will give the height of the horse in the point B.

As to birds: from the extremities of their wings F F, you are to draw lines to the horizon, and between those lines to take the dimensions of the rest, which we suppose of the same size. For example, to have the magnitude of a bird in the point G, draw a parallel to the base line G H, till such time as it cut the rays E and F, which will give the line H I for the magnitude of the bird G.

When beasts or birds are required, you must always make choice of such as are the stillest, or least active, as a dog sleeping or gnawing a bone, a cat watching a mouse, a parrot, &c.

To find the Height of Remote Figures, whereof the first is on a Mountain near the Eye.

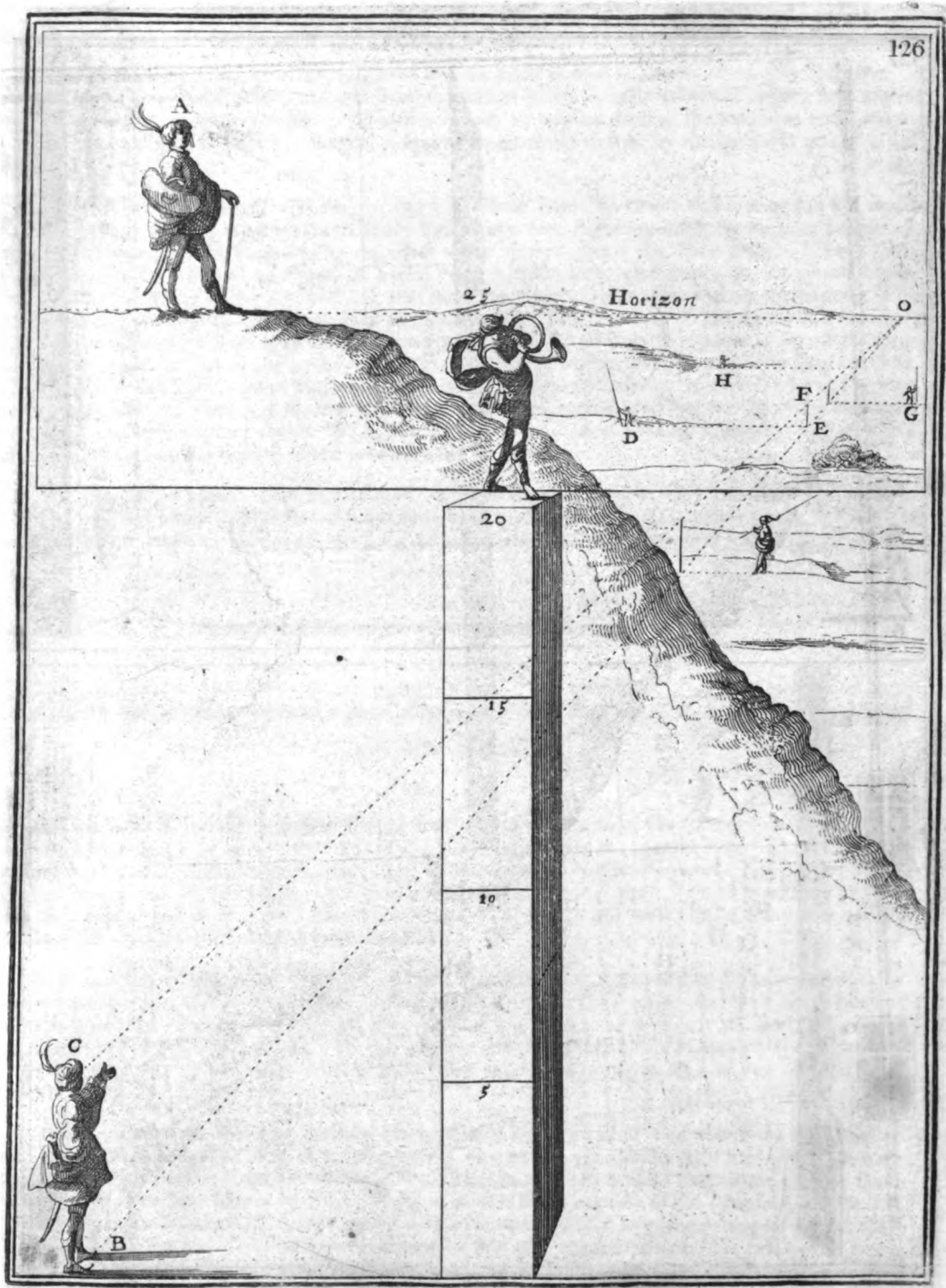
IT gives great satisfaction to the mind, when a person knows what he does to be right: on which account, no doubt, the reader will be pleased to have the following rule, with which but few practitioners are acquainted.

When figures are to be made, determine the height, that is, the space of the ground you would have it raised; and at that distance put another figure underneath, of the same height as the first; and from the feet and head thereof draw lines to the horizon; by which you will have the height of the other figures in the champaign. To explain myself:

The figure A, for example, which is at the top of a mountain, is five feet high, which is the natural height; and I suppose the mountain twenty-five feet high: If now a man be raised twenty feet, as is the piece in the middle, whereon the spectator is mounted (who himself is supposed five feet high) the horizon will be twenty-five feet as well as the mountain; and consequently will reach the top of the mountain: as is expressed in the figure.

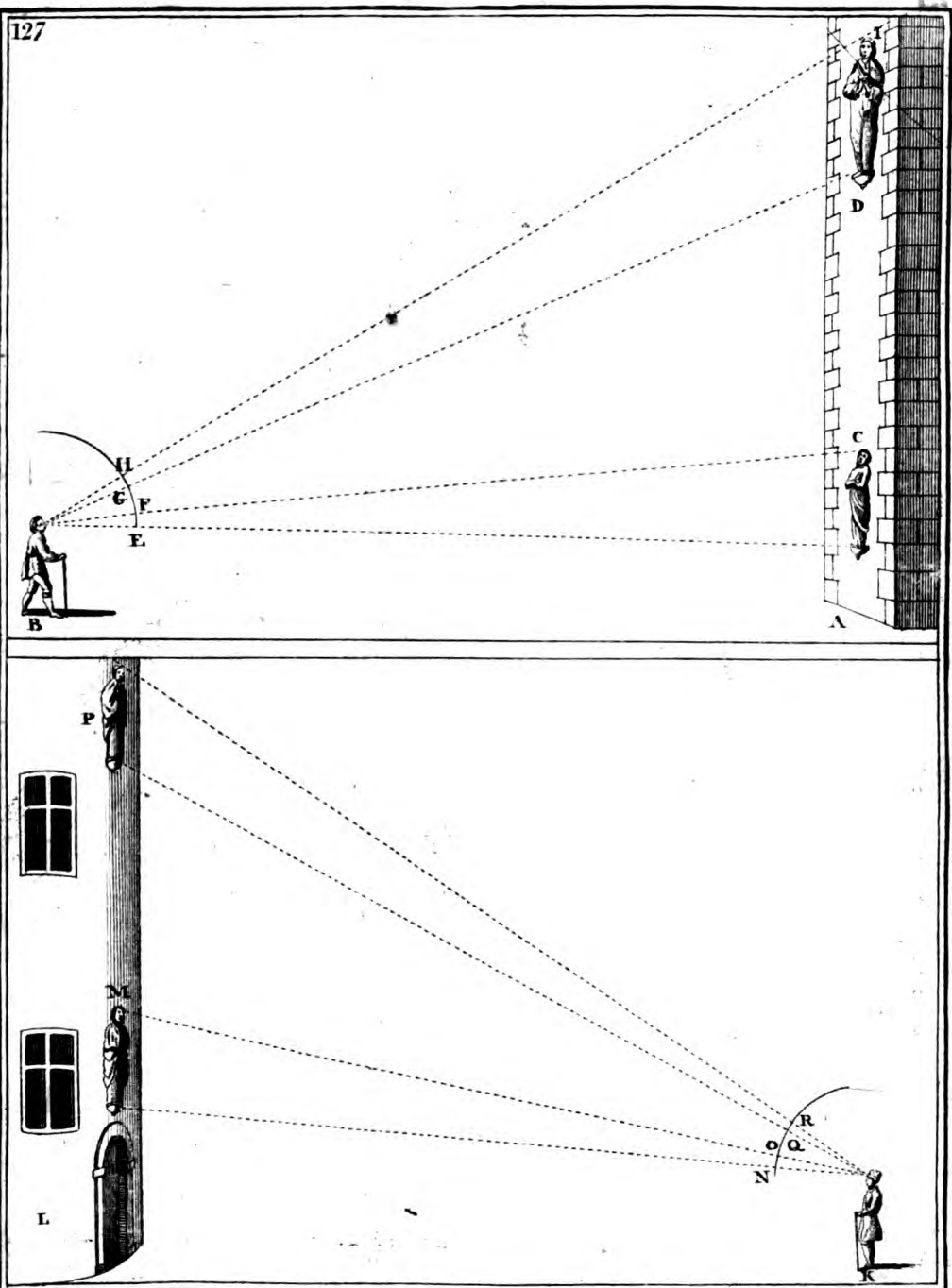
Now to find the height of the little people in the champaign, make a figure twenty-five feet lower, underneath the figure A, or in some other place, as B C; and from the feet B, and the head C, draw lines to some place in the horizon, as the point O; and between those two lines, B and C, drawn to O, take the height of the little figures, in the manner already taught. Thus, for the height of the figure D, draw a parallel to the base line, till it cut the line B in the point E; from which a perpendicular is to be raised, cutting the line C O in the point F: and take the height of this perpendicular E F, for the height of the figure in the point D. If you likewise require the height of the figures in the point G and H, proceed after the same manner as in the figure D, and you will have their heights between the lines B and C; to be taken in the compasses, and set off in the points G and H. The same you are to do for any other figures, still diminishing, till at length you come to a mere point.

This is all I have to say as to the measures of figures in perspective. But as I have engaged myself to give all the measures of this kind, the following rules come in my way, though they have no strict relation to that art.



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To give the natural or any other Height to Figures much elevated.

TO omit nothing relating to the heights of figures, I add the two following rules. The first given by *Albert Durer*, *Serlio*, and others, for adjusting the size of letters in inscriptions so as they may appear of the same size as others below. Which rule may be applied to find the measures and magnitude of figures placed at different heights to appear equal when viewed by the spectator placed at any height.

Thus in *B* there is a man five feet high, and fifty distant from the tower *A*, viewing the first figure *C*, which there appears of the natural size; and thirty feet higher another figure is to be placed, which shall appear of the same size as the other when viewed from the same place. Now, to find its dimensions describe a quadrant of a circle, or a lesser arch, on a paper to be placed before the eye: then looking at the figure *C*, it will give the distance or angle, *E F* on the paper. This done, without moving the quadrant, look at the point *D*, where the foot of the figure *D I* is to be; and observe what point it gives in the quadrant, namely *G*. And from this point *G* set off the same distance or angle, as that of the figure *C*, that is to say, *E F*, which being removed to *G* gives *G H*. Then looking through the point *H*, note what part of the perpendicular raised from *D* is cut thereby, namely, the point *I*; then will the interval *D I*, be the height required for the figure to be placed there. If you would have another still higher, the same operation must be repeated, and they will all appear of the natural bigness to the spectator, *B*.

If you require the reason thereof, you must recollect the principles already laid down, or recur to them again; and you will find that all objects viewed under equal angles appear equal. Now it is certain, that the angle *G H* is equal to *E F*; consequently the figure *D I* must appear equal to the figure *C*.

To find in what Proportion equal Figures grow less to the Eye, when placed over one another.

THE spectator *K* having a quadrant or part of a circle, like that of the former spectator *B*, looks towards the first figure *M* of the tower *L*; which there appears of the natural size. Then taking its measure from head to foot, he marks the distance thereof on the quadrant, namely, *N O*. After this, without stirring out of his place, he directs his eye to the head of figure *P*, and marks the angle it gives on his quadrant *Q R*. And if there be others still higher, he should take them all after the same manner, and lay them down on his quadrant.

Now to find the difference between the one and the other, take the angles or distances of each in your compasses, and you will find that the highest gives the smallest angle, and of consequence appears the smallest to the eye; the figure *P* only appears half the size of the figure *M*, though in reality both figures are of equal magnitude. If you ask the reason of this different appearance, I answer that the angle of the highest figure *P*, is only half that of the lower figure *M*; as you see that *Q R* is only half of *N O*, or nearly so.

By the knowledge of this rule we may arrive at that above, and by that above we can come at this. For if *M* and *P* be the same magnitude, and yet *P* appear to be only half of *M*, we may securely say, that to make *P* appear as big as *M*, it must be twice its present magnitude. The same may be said of the upper figure, where *D*, which is double to *C*, appears of the same size to a spectator in *B*. It might be added, that if the figure *C* was removed to *D* it would only appear half as big; so that one rule is the reverse of the other. Both the first and the second rules are best put in practice by the little foot, as the figures hitherto have been; by which we come to the difference and proportion of figures as securely as if they were taken from the life by a quadrant.

Measures for elevated Figures.

FROM what has been said concerning the diminution of figures when placed on high, we are to take our measures in proportion, for such as are to be raised in paintings, whether they be placed on mountains, the tops of houses, or above the clouds in the air. The two rules I shall now give, will render the method extremely easy.

For the first. Suppose the man A to be six feet; which height set off several times on the perpendicular B, and from the several divisions 6, 12, 18, &c. draw lines to the head of the figure A. Then setting one leg of the compasses in the point A, with the other describe the arch C D, and the intersections that arch makes with the rays, are the measures to be given the figures at those several heights or perpendiculars B. Thus, if you would have a figure appear forty-two feet high; take E D, which cuts the two last rays, and set it off to F, which is forty-two feet above the base line A B. If another be required thirty feet high, the distance G H must be taken, which cuts the ray 30, 36, and gives the height of the figure P; and so of the rest. The main point is the approaching or receding of the line B; which must always be the distance between the spectator and the object, namely here, thirty feet, or thereabout.

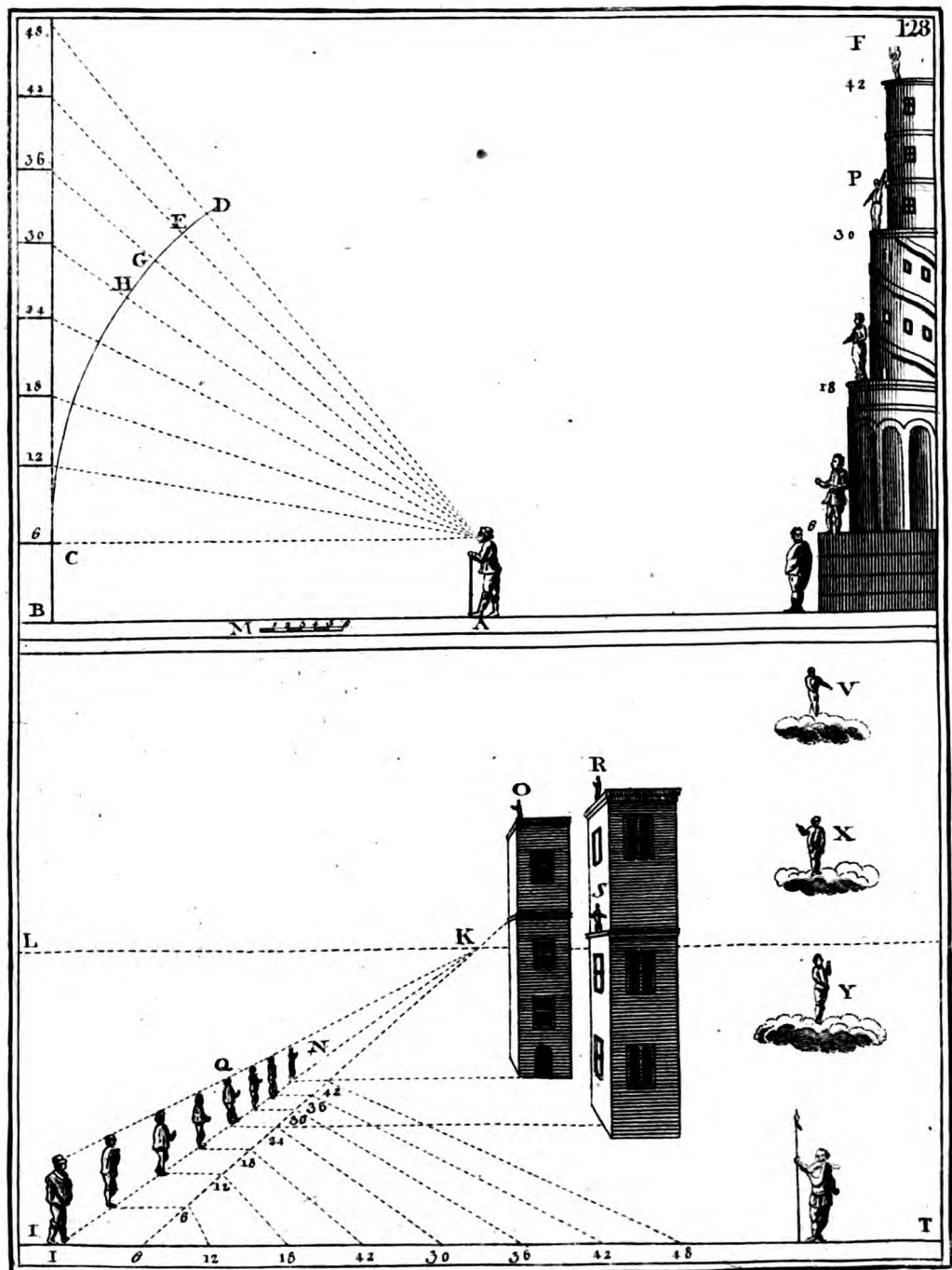
For the second rule. Instead of the perpendicular B used in the first figure, I here put the division from six feet to six on the base line I T. The two first points I and 6 are to be drawn to the point of sight K. Thus between the two rays I K, and 6 K, we have the measures of six feet, which is the height to be given the figures. Then from all the other divisions 12, 18, 24, 30, &c. draw lines to the point of distance L, and in the intersections made with the ray 6 K, draw little parallels to the base line, between the rays I K, and 6 K. These parallels will give the heights of figures of equal magnitude, but at different distances. Which may be proved by comparing the measures of the first method with those of the second.

If it be asked how much each figure is diminished from the first, which is six feet high, you need only to take the height of the figure required in your compasses, and set it off on the little scale M, and the question is solved. Thus having taken the height of the figure B, and set it on the scale M, it gives four feet; which shews, that a figure six feet high, raised thirty feet, will only appear to be four feet. The heights or diminutions of the rest are found by the same operation; provided the distance be the same with that of these. If the distance be changed the process must be begun anew.

The figures V, X, Y, placed in the clouds are of the same height and proportion as the figures in the uppermost draught. They are only here added to shew, that though the method be different, the effects are the same.

What has been said as to the diminutions of figures elevated over the base line A B in the first method, and I T in the second, must be observed in proportion between those figures which are sunk farther behind. Those of them which are placed on an elevation must have the same relative magnitude according to their height with the figure on the ground, on the same line with them, as F and P have to A. Thus, in the second rule, if over-against the last figure N, another figure C, be placed on a tower forty-eight feet high, its magnitude must be in the same proportion to N, as the figure at N has to that at I. And inasmuch as the figure at N contains only two and a half of the six parts which I contains, this at O upon the tower must only have two and a half of the six parts in the figure N. If I would have another figure R, on another tower, forty-eight feet high opposite the figure Q, I take two parts and a half of the figure Q for the height of the figure. If another were required in S, which is thirty feet high, in the same tower, he must take four of the six parts of the figure Q, that is, four feet; as already mentioned in the first method between the rays G and H.

What renders this rule the more valuable is, that all the proportions of figures may be learnt by heart. For whoever would be at the trouble of making this measure, where he might add more parts, they would serve him in all cases; and he would render them so familiar, that in a little time he would tell you off hand, that if you are thirty-five feet distant, and the figure six feet, or six parts high, when on the ground, another, that shall be of the same size, will only appear five and a half when raised to the height of twelve feet; only five, if raised eighteen feet; only four and a half, if twenty-four feet; only four, if thirty; only three, if thirty-six; and only two and a half, if forty-two: and so on, by six and six, to any number at pleasure.



X3

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PRACTICAL PERSPECTIVE,

PART V.

M E T H O D S

Of finding according to the Laws of PERSPECTIVE, the

NATURAL SHADOWS OF OBJECTS,

PROJECTED EITHER BY THE

SUN, CANDLE, TORCH, or LAMP.

*The Origin of SHADOWS, with the Laws of their Projection
from opaque Bodies.*

TO define a natural shadow, we do not call it an absolute privation of all light, for this would be to form a perfect obscurity, wherein objects would be no more seen than their shadows : but by shadow is meant diminution of light, occasioned by the interposition of some opaque body, which receiving and intercepting the light that should be cast on the plane, gives there its own shadow. For the rays of light diverge, and diffuse themselves on every thing not hid therefrom, particularly on every plain and smooth substance, but where there happens the least elevation, a shadow is produced, which exhibits the figure of the illumined part on the plan.

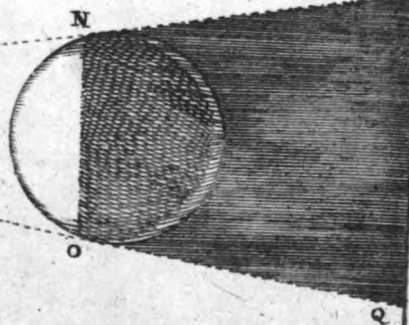
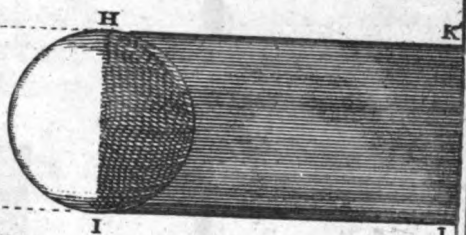
The diversity of luminaries occasions a difference of shadows ; for if the body that illumines be larger than the body illumined, the shadow will be less than the body. If they be equal, the shadow will be equal to the illumined, and if the luminary be less than the object, the shadow will be continually enlarging as it goes farther off.

The better to comprehend this, I here add three figures, which may serve as a foundation for all the rules to be advanced hereafter.

The first shews, that the luminous body A B, being larger than the illumined sphere C D, enlightens more than half the object, and gives a pointed or conical shadow, whereof the luminary is the base. This truth is evinced in an eclipse of the moon, which is rarely quite covered by the shadow of the earth, though the latter be above forty times bigger than the former. The reason is, that the sun, which is the luminary, is one hundred times bigger in diameter than the earth, which therefore it illumines more than half, and of consequence makes its shadow terminate in a point.

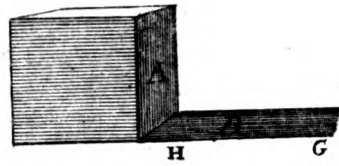
In the second figure, the luminous body F G is equal to the illumined sphere H I, therefore half of the object is enlightened, and its shadow projected parallel, H I K L, and it will be propagated in that form to whatever distance the luminary is capable of acting.

The third figure shews, that the luminary or light M, being less than the illumined N O, that object is not half enlightened. And of consequence the shadow N O P Q enlarging as it recedes farther from the object, makes a pyramid, whereof the luminary is the point or vertex.

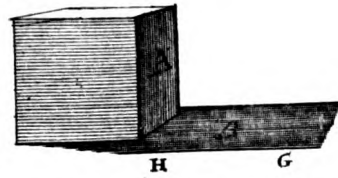




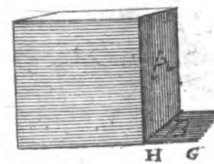
1 Figure



2 Figure



3 Figure



Of the difference of Shadows.

FROM what has been observed in the preceding page we draw this conclusion, that the same object may project shadows of divers forms, though still illumined on the same side; the sun giving one form, the torch another, and the day-light no precise form at all.

The sun always makes the shadow of breadth equal to the opaque object, that is, projects it parallel-wise, as in the first figure.

How this method is to be put in practice, and every object have its natural shadow, shall be shewn hereafter. It is certainly of consequence to all painters, engravers, &c. to observe these rules precisely, and not indifferently to use the same method for shadows produced by the sun and by artificial luminaries, as is too frequently done.

The shadow produced by a torch or flambeau is not projected in parallels, but in rays proceeding from a centre; whence the shadow is always bigger than the opaque body, and grows bigger as it recedes the farther. This is shewn in the second figure, where the shadow is larger than in the first, though the cube of the one and the other be of equal breadth and height. It appears, therefore, a gross abuse, to represent the shadow of a torch like that of the sun, and the shadow of the sun like that of a candle, when the difference is so considerable.

There is a third kind of shadow, neither produced by the sun nor a torch, but only a fine clear day, which wanting strength to finish and define its form occasions a dimness near the object, as in the third figure. Now for this there is no certain rule, but every body conducts it at discretion.

All these shadows, both those of the *sun*, of the *torch*, and of the *day-light*, must appear darker than the parts of objects not illumined. Thus A is less dark than B, by reason A receives the reflection of the brightness around it, and B has no reflection but from A, which itself is in obscurity. It must be observed by the way, that the part of the shadow most remote from the object is still darker than that nearest it; as G is darker than H, by reason A cannot communicate the little reflection it receives, as far as G, though it does to H.

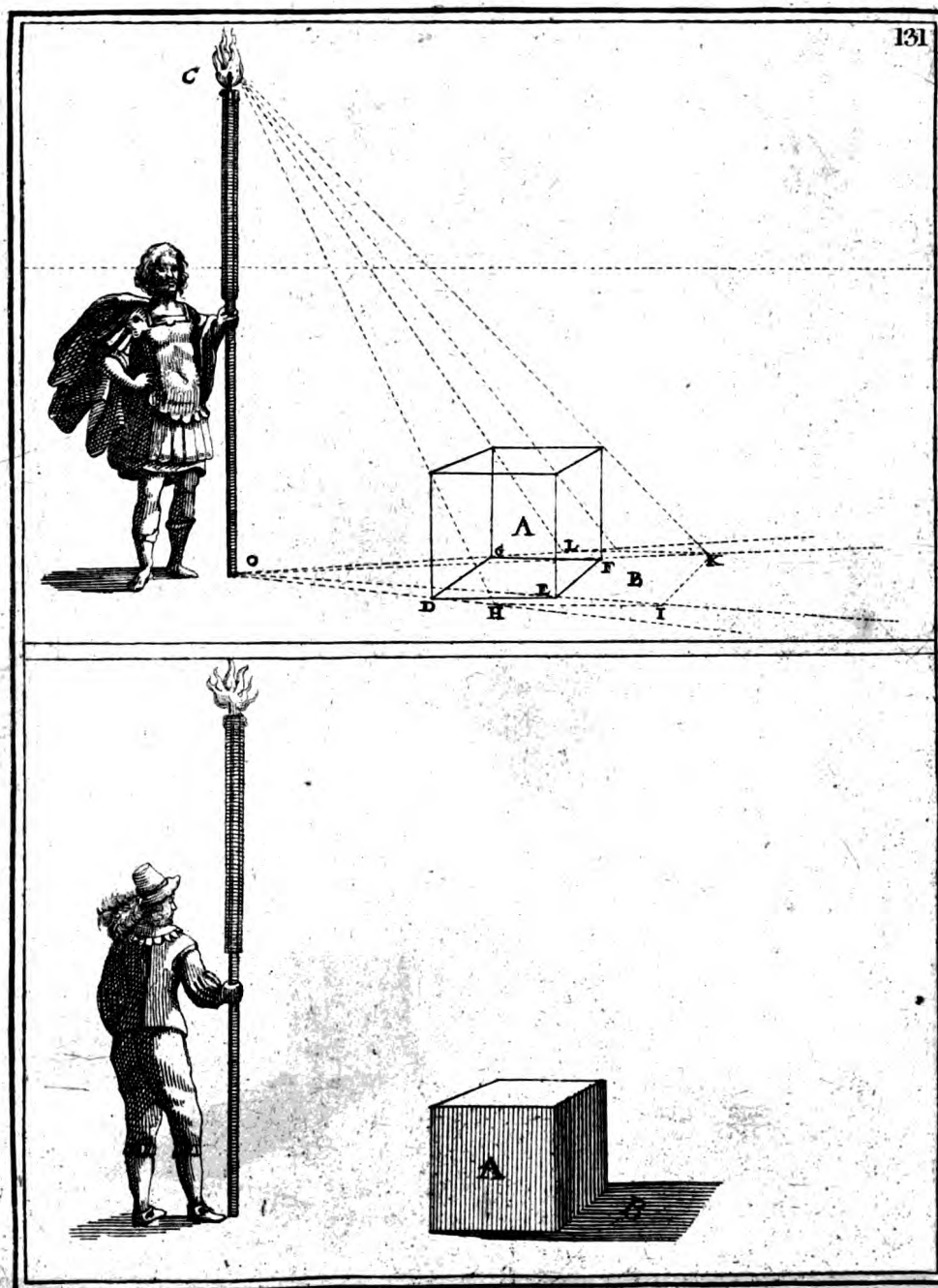
To find the Form of the Shadows.

IT may be remembered, at the entrance of this work, PERSPECTIVE was defined the art of representing objects which are on the ground or horizontal plane, upon a plane perpendicular to the horizon. But in the business of shadows it is quite the reverse, since we there conceive a body raised over the plan, which being illumined, casts its own shadow on the plan; as the body A gives a shadow B, on the plan.

To produce a shadow, two things are supposed, namely, light and an opaque body. Light, though quite contrary to shadow, gives it its being, as the opaque object gives its form and figure. *What we have here to consider is the shadows, the reader has been already instructed in what relates to putting the bodies in perspective.*

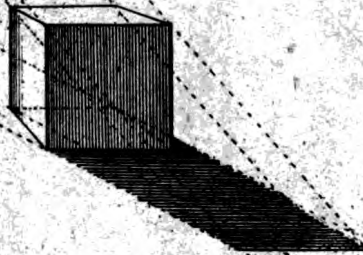
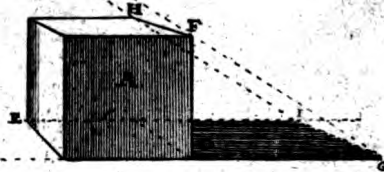
To conceive the nature of shadows more clearly, and render the practice more easy, it must be observed, there are two points to be made use of. One of them is the foot of the light, which is always taken on the plan the object is placed upon; the other is the luminary. The rule being common to the sun, torch, or any other light, with this difference, that the sun projects the shadow in parallels, and the torch in rays, from the same centre. I begin with the shadow produced by the torch, as leading to a more easy understanding of that by the sun.

Suppose then, for example, it is desired to have the shadow of the cube A here represented in B, lines must be drawn from O, the foot of the luminary, through all the angles of the plan of the cube, as here O D, O E, O F, O G. Then other lines are to be drawn from the point of the light of the torch C, through all the raised angles, till they intersect the lines from the point O. Thus having drawn a line from O through the angle D, another must be drawn from C through the raised angle, intersecting the former in H, which point H will be the shadow of that angle. And if from the same point C, the same be done through all the raised angles, the lines of the plan will be cut in the points H I K L, these points being connected together by right lines, you will have the shadow of the cube, as is shewn in the uppermost figure of intersection, and more distinctly in that below.





C



Shadows *from the Sun.*

THE sun, that magnificent luminary, being vastly larger than the terrestrial globe, as has been already intimated, must give the shadow of that sphere pointed, by reason it always illumines more than half thereof.

In consequence of this demonstration we might conclude, that all the sun's shadows must be less than the bodies that project them, and diminish more and more as they recede farther. Now this would be true, were there any conceivable relation of magnitude between the illumined body and the illuminer; but as all objects on the earth are so small, either in comparison of that star or of the earth, the diminution of their shadows is imperceptible to the eye, which sees them always of equal breadth to the body that forms them. On this account all the shadows caused by the sun are made in parallels, as is shewn in page 130.

From the whole it appears, that to find the shadow of any body whatever, opposed to the sun, a line must be drawn from that luminary perpendicular to the place where, according to former directions, the foot of the light is to be taken, and from this point an occult line is to be drawn through one of the angles of the plan of the object, and another from the sun through the raised angle; the intersection of the two lines will express how far the shadow is to go. The other line must be drawn parallel hereto.

For example, to find the shadow of the cube A, the sun being in B. From the bottom of the sun C, which is, as it were, the foot of the light, draw a line through one of the angles of the plan, as C D. Then from the other angle E, draw a parallel to this line. The breadth of the shadow being thus finished, to find the extreme thereof, draw a line from the sun B, through the raised angle F, cutting the line C D in G. Then drawing a parallel to this line through the angle H, it will cut the line E in the point I; these two points G and I being connected by a strait line compleats the shadow of the cube D G I.

If you desire to have the shadows cast forward, or any other way, you have only to determine the place of the sun, and the point beneath it, to draw the lines of the same angle, and the other lines parallel thereto. The method is the same as in the former case, so that it needs not be repeated. The figure shews the rest.

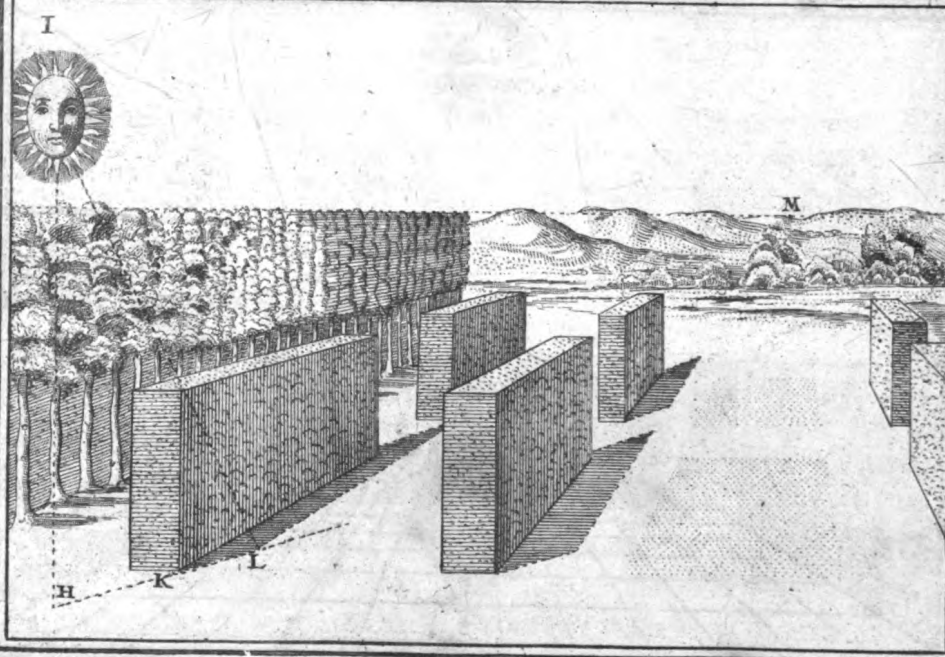
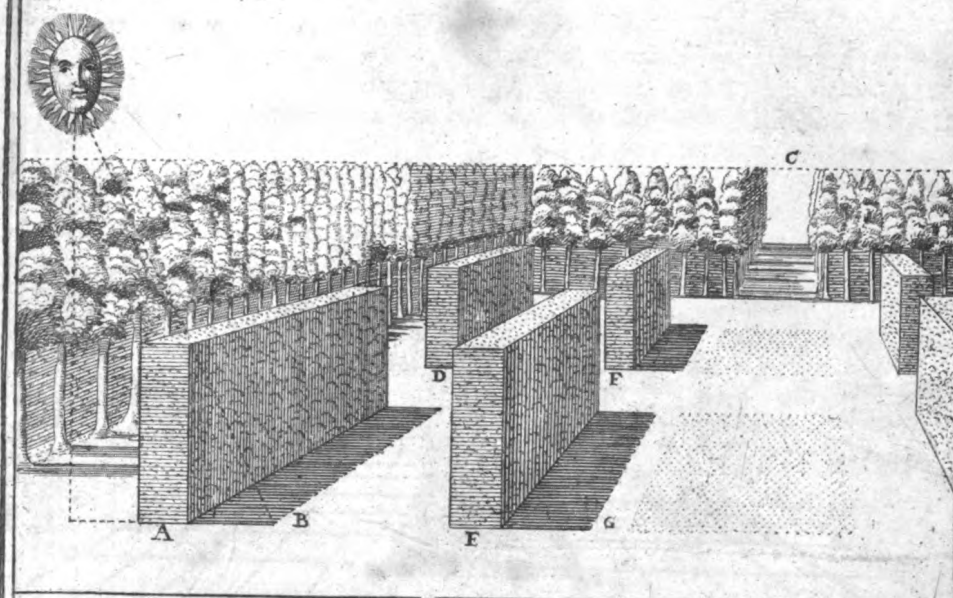
The Shadows produced by the Sun are equal in all Objects of the same Height, though at a Distance from each other.

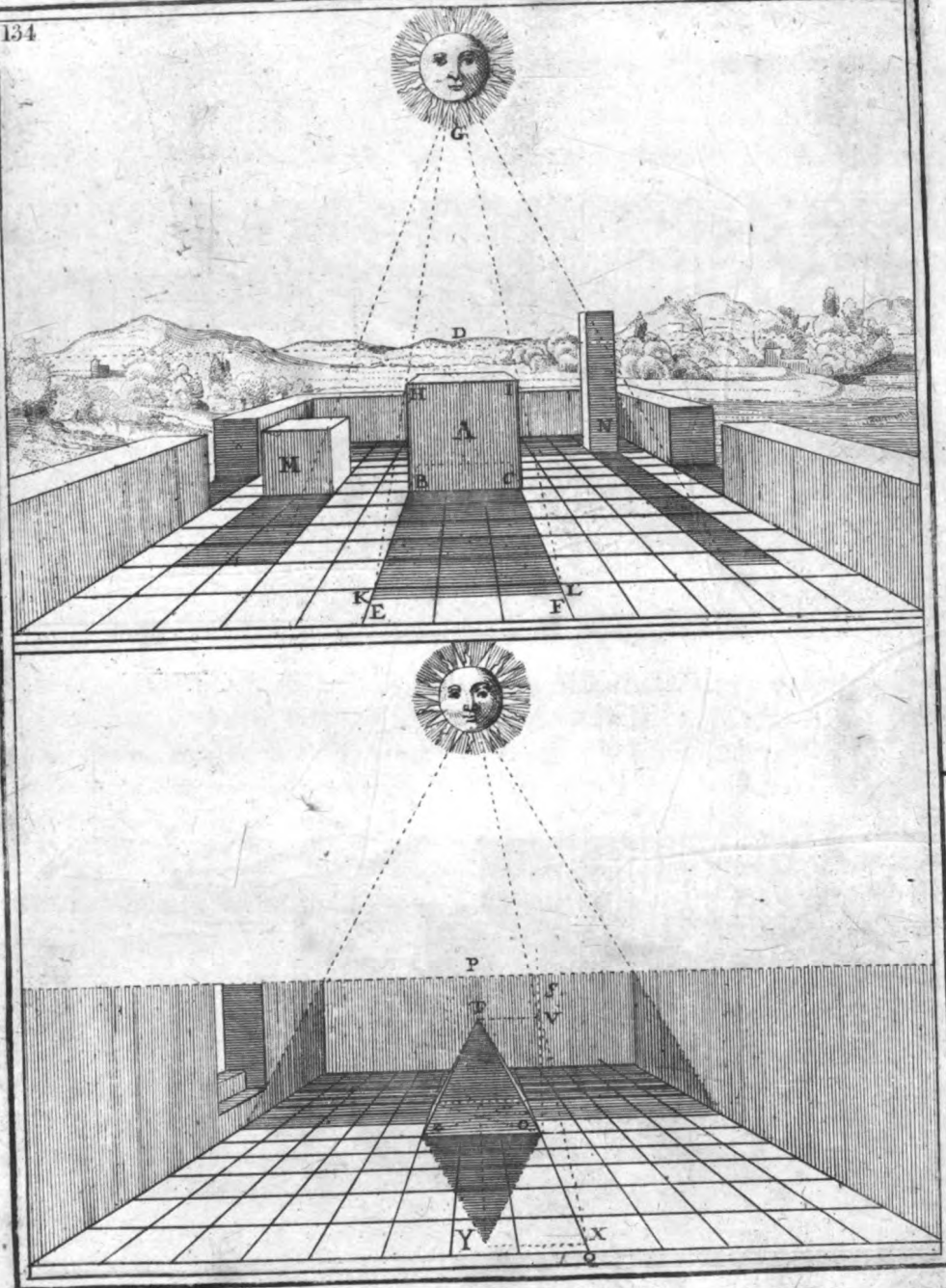
EXPERIENCE teaches us, that several elevations of the same height, removed to a distance from each other, do yet project equal shadows at the same time. I say in the same time, for the shadows are lengthening and shortening, in proportion as the sun comes nearer or recedes farther off: one or other of which he is continually doing.

For this reason, when the shadow of an object is to be produced, you must determine the place of the sun, and the point underneath which I call the foot of the luminary, and draw two occult lines from them, for the extremity of the shadow; as here the palifade A gives the extreme of its shadow in B. And if from this point B, you draw a line to the point of sight C, this line B C will be the shadow of the palifade D, as well as of that of A, and of all others of equal height in the same line to the very point of sight. In effect, it must be held for a certain maxim, that shadows always retain the same point of sight as the objects.

On the footing of this observation, that objects of the same height give equal shadows, if you would give the shadow of the palifades E, F, which are the same height as A, D; take in your compasses the distance A B, and set it on the foot of the palifade E, by which you will have E G; then from G draw a line to the point of sight C. And thus you are to proceed, be the walks ever so numerous.

If the light come from the fore-part, as in the figure underneath, the method must not be altered: but only the foot, or bottom of the sun, is to be brought nearer or farther off according to the sun's place, and lines drawn from the centre and foot of the luminary through the upper and lower angles. Thus the lines from H and I give the extreme of the shadow of the palifade K, in the point L; and from L a line drawn to the point of sight M limits the side shadow. From the remote angles of the plan of the palifade, a parallel to the line H drawn as far as the ray L M, will give the extreme end of the shadow, and the whole will appear natural.





Of Shadows, when the Sun is directly opposed to the Eye.

AS often as the sun is before the eye, that is, directly over the point of sight, the sides of the shadow it produces will be parallels, as all the visual rays are. For this reason, the point of sight is always to serve for the foot of the light when in that altitude, and the other ray, that is to determine the shadow, will be taken from the centre of the sun.

Thus the shadow of the cube A being required, draw lines through the angles of its plan B C, to the point of sight D, as the lines B E and C F. Then, from the centre of the sun G, draw two rays cutting the former in the points K and L, and passing through the raised angles H and I. By this means the shadow of the cube will be found in B K L C.

The shadows of the two other objects, M and N, are found by the same rule, and so might the shadow of any object whatever.

But my mind suggests, that there might be some difficulty, if, instead of a cube, a pyramid were given : by reason the ray from the middle of the pyramid, and that from the sun, passing through its vertex or point, only make one line ; and of consequence cannot terminate any thing for the shadow of the vertex of that pyramid.

When this happens, draw a line from the point of sight P, through one of the angles of the plan ; by which means you will have O Q. Then from O erect a perpendicular O S, and from the point of the pyramid T draw a parallel to the base, till it cut the perpendicular O S in the point V. Draw the ray of the sun through this point, and continue it till it cut the ray O Q in the point X ; from X draw a parallel to the base, as far as the ray of the middle of the pyramid, which will be cut thereby in the point Y, the extreme of the shadow. To Y draw lines from the angles Z and O ; and the triangles Z Y O will be the shadow of the pyramid.

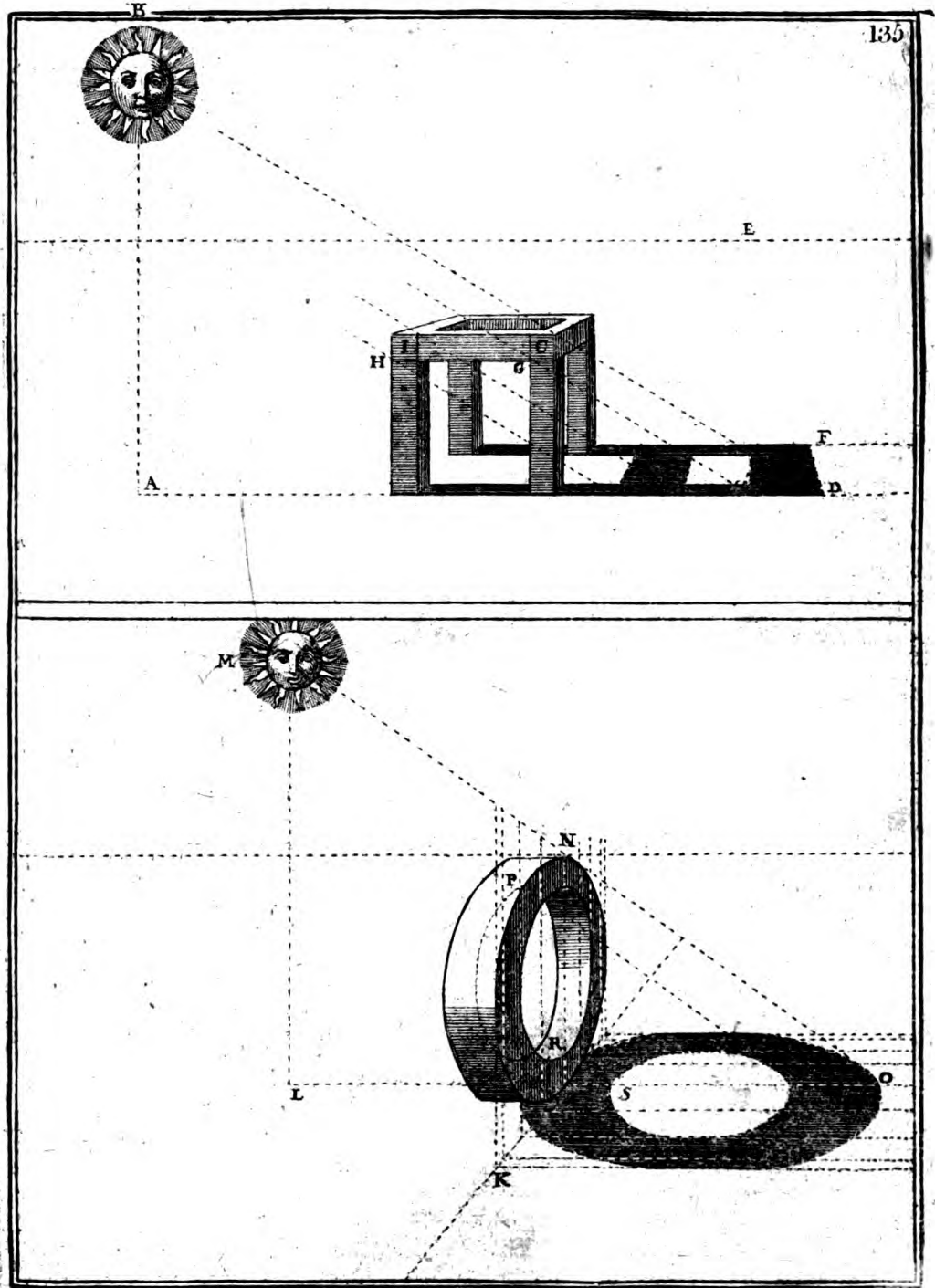
The like you are to do for the opposite face, if it be perpendicular to the plan ; and the same rule will serve in all cases. For example, if the point, or apex correspond to the centre of the plan, draw a line from the same centre parallel to the base, and of any length at discretion ; and from the end of the line, as here from O, draw a line to the point of sight, and proceed as before. Which will be a standing rule, whether the pyramid be viewed in front or side-wise. And hence you will easily judge what is to be done, if the point or vertex correspond to any other ray of the middle of the plan.

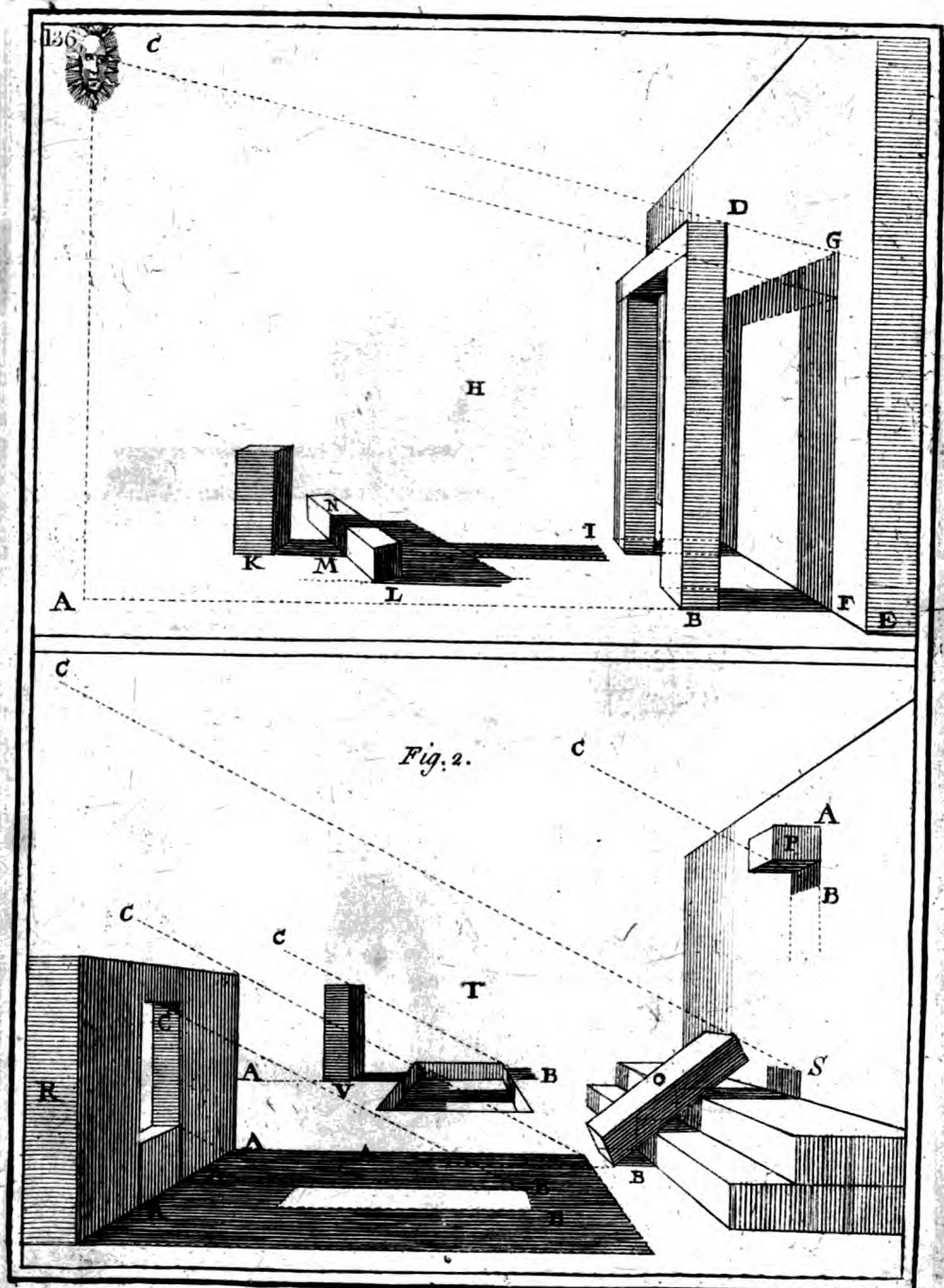
The walls in the front of each figure have their shadows as already taught in that of the cube A.

For the Shadows of perforated Objects.

WHEN the object is square or rectilinear, a line must be drawn from the foot of the luminary through the angles of the plan for one side of the shadow, and parallels thereto for the other sides ; then from the middle of the sun B, draw a line through the raised angle C, which will cut the line from A, in the point D ; through which point a line must be drawn to the point of sight, till it meet the remotest line from the plan F. To find the rest of the shadows ; draw parallels to the line B C D, through the angles G H I ; and inasmuch as the sun illuminates two sides of the object, and makes the shadow broader, as is shewn in the figure, where G C and H I are the diagonal of the square pieces ; where these lines drawn through G C and H I cut the line A, a line must be drawn to the point of sight E ; and you will have the whole projection, or shadow of the object.

If it be a round object, as represented in the second figure, a circle must be described, according to the rule given for arches in pages 62, 63, by erecting of perpendiculars, &c. And when the circle is formed, and its thickneses given, from the bottom of those perpendiculars, parallels to the base must be drawn : as here K, L. Then taking L, which is the parallel of the middle of the circle, for the foot of the luminary, from the middle of the sun M, draw a line passing over the circle N, and continue it till it cuts the parallel L in the point O ; which will be the extremity of the shadow. The vacuity or aperture of the rotundo is found by drawing a parallel to N O from the point P, which is the top of the object opposite to the sun, till it cut the line L O. The rest of the rotundo will be found by drawing another little parallel to N O from the point R, which will give S. The rest of the round object is found by drawing parallels to N O, through all the points of the circle of perpendiculars, which are to be continued till they cut the parallels to the base line ; as is here done for that of the middle L O. I could easily mark them all with points, but I forbear it to avoid confusion.





Shadows assume the Form of the Planes they are cast upon.

HITHERTO I have considered shadows on the horizontal plane ; being certain that a person who understands such, will find no difficulty in the practice of the rest which follow. For the rule is the same in all ; and one single instruction will suffice to shew how shadows sink and rise according to the planes on which they are cast.

To shew that these shadows are formed by the same rule as those preceding, draw a line from the foot of the luminary A, through the plan of the door B ; and another from the sun C, over the top of the same door at D ; these lines will intersect each other, though without the limits of our page, and give the extremity of the shadow ; as already is observed of the others on the horizontal plane. But the wall E preventing the line A B from being continued as it should be if the plane was horizontal, obliges it to rise, as we see in F G. For this reason the sun's rays, which should proceed to meet the line A B, cuts it on the wall in the point G, and there marks the form or shadow of the door ; the top whereof is drawn to the point of sight H.

The shadow of the object K is cast in all its length K I, and passes over that other L. And it is to be observed, that the shadow still preserves its length, though it meets with a raised object in the way : and that the shadow which passes over any thing assumes the same figure, as here the shadow M and N takes the form of the object L, or rather is lost in the shadow of L.

Though I have made the sun to appear in all my figures, it must not be imagined that he is so near the objects. My intention was to shew that the rays proceed from him when at such a height, though far without the limits of the paper, as in this second figure, which yet has the line for the foot of the sun A B, and that of the rays of the sun C ; by reason those are always required for finding the extremities of the shadow.

The shadow of the object O is found by continuing the line A B, and making its rise over the steps, and against the wall, till cut by the ray in the point S, by the rays passing over the corner of the object ; and from S drawing a line to the point of sight T.

To find the shadow of the object P, it must be remembered (as already observed) that the foot of the light is always supposed on the plan where the object is placed. Accordingly the ray C cutting the little line A B, shews how far the shadow of the little object P must go, to be thence drawn to the point of sight T.

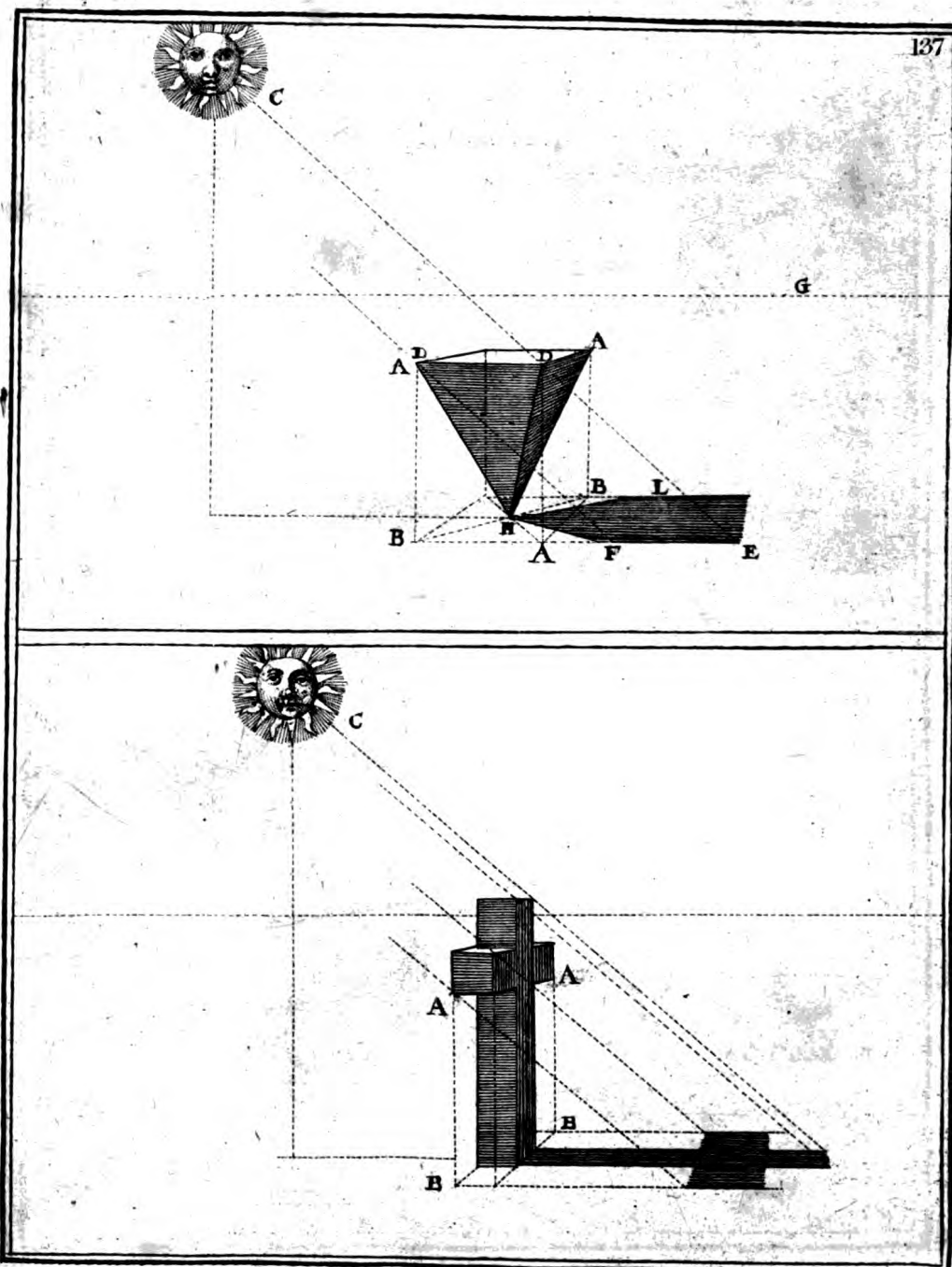
The object V casts its shadow the usual length, though in its way it descends into a pit and rises again.

The shadow of the wall R, is found by the same rule as the rest : as appears from the lines A B and the ray C.

To find the Shadows of Objects broader at Top than at Bottom.

WHEN the projection or shadow of a figure is required, whose top is broader or wider than the bottom, as in the two adjoining figures, the usual method is, to make a plan, and draw perpendiculars, as B A, B A, from the same. The plan finished, a line must be drawn underneath the sun, as already mentioned, and parallels to this line be drawn from all the angles of the plan. Then a line is to be drawn from the sun C, through one of the angles of the object, as D, till it cut the line of the plan of the same angle at F. Another line is to be drawn over the angle A, till it intersects the line B A in the point F. Then drawing lines from E and F to the point of sight, you will have the shadow of the square of the top of the object. Lastly, drawing lines from the point of the figure H, to the points F and L, you will have the shadow of the whole figure, which is a pyramid inverted.

It is evident that the projection or shadow of the cross underneath is performed after the same manner, which it is unnecessary to repeat.



To find the Shadows of Objects suspended from the Ground.

THE method of finding the shadows of objects suspended from the ground is rendered very easy by the preceding rule : all you have to do is to find the plan, and from the angles thereof to draw parallels to meet the perpendicular line under the sun, and then, from the same angles of the objects suspended in the air, to draw other lines, cutting those drawn from the plan ; by which means you will find the extremes of the shadows, as already mentioned under the preceding figures.

I am clearly persuaded, that my reader would easily conceive the method of these, or any shadows made by the sun, without farther explanation of the figures here annexed, they being all intelligible, and performed by the rules already taught.

However, as every instance has something particular therein, it may not be improper to take notice thereof, that there may be nothing but what is easily understood.

I observe then, that in the first figure the plan A B C D is alone made use of, to find the shadows of the objects E F, by reason they are both on the same line, and of the same height.

In the second, it must be observed, that the piece of wood G casting its shadow on the wall H, the shadow makes that same figure at the cornice I underneath. And the same is observable of the stick K, raised against the wall H.

To find the shadow of the board L, the rule already delivered for objects broader at top than at bottom, must be remembered ; for having drawn the perpendicular M, where it cuts the ray N O, you must draw the line from underneath the sun M P. Then from the board L, drawing a line to cut the line M P, the point of intersection will be the extremity of the shadow.

The shadow of the globe or ball Q is likewise found by letting fall two perpendiculars, of which the plan is to be formed, then through the centre of this plan drawing a line from beneath the sun R, and a tangent from the sun, as Q S, till it cut the line R in the point T, and lastly another, as V, cutting the same line R : this interval T V will give the extent of the shadow of the ball.

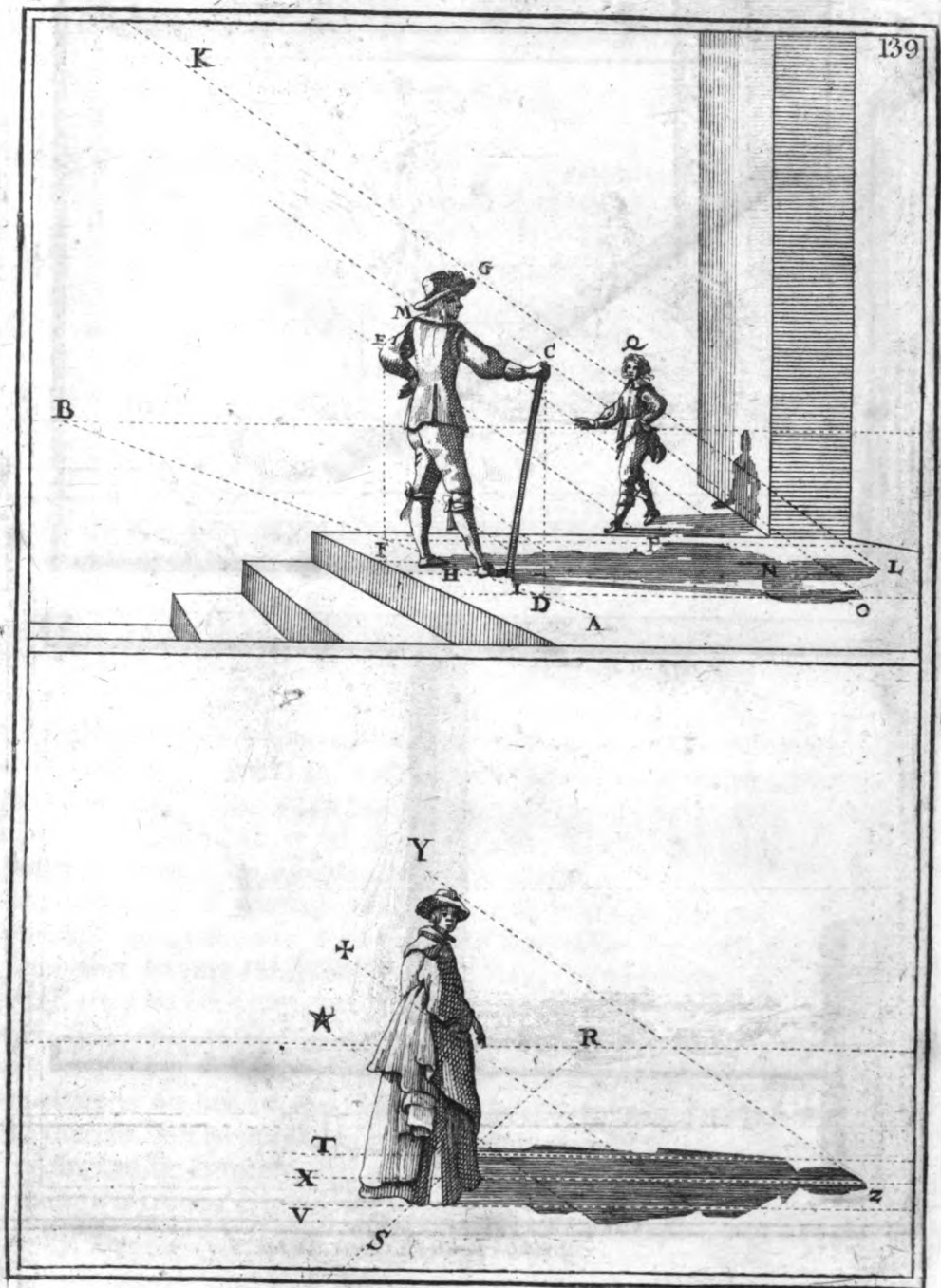
*To find the Shadows of human Figures, caused by the
Light of the Sun.*

THE shadows of figures is found by the same methods as those of other bodies, that is, by parallels both from underneath the figure, and from the sun; with this difference only, that the shadow of other bodies or objects is found by means of their plan, whereas figures have none. But in lieu of such plans, a line must be drawn underneath the figure, and on this line, the several remarkable points of the figure to be let fall perpendicularly, which line is to serve as a plan.

For example, *In a figure naked, or undressed without a cloak or gown*, as the first figure hereto adjoining, with its back towards us; from under its feet, as A, draw a line to the point of sight B, and to this line A B draw occult lines from all the points that may contribute to the true shadow; thus from the hand C; let fall a perpendicular, cutting the line A B in the point D, and from the elbow E let fall another to the point F, and a third from the head G to the point H, and from all these points D F H, as also from the end of the staff I, draw parallels to the base line.

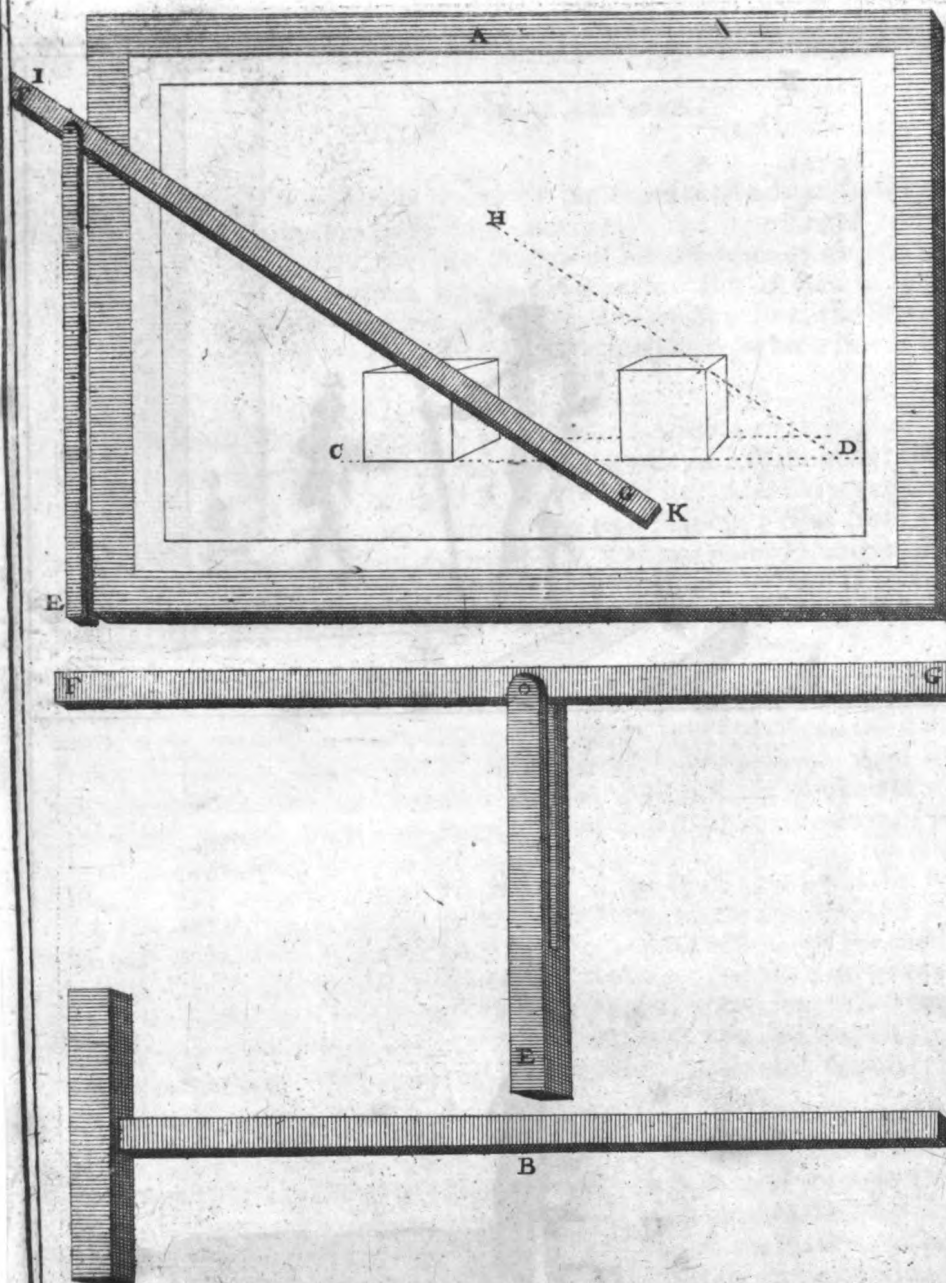
Then having determined the height of the sun, a line must be drawn from the same, as K, passing over the edge of the hat G, and continued till it cut the line H in the point L, which will be the extreme of the shadow. And again, from the hind edge of the hat M, draw a parallel to K G L, till it likewise cut the line H in the point N, these two points N and L will be the shadow of the hat. A third parallel must be drawn through the point C, till it cut the line D in the point O, this point O will be the shadow of the hand that holds the staff; drawing therefore a line from the point O, to the point I, the line O I will be the shadow of the staff. A fourth parallel is to be drawn through the point E, which cutting F in P, will be the shadow of the elbow. The same do from all the other parts, as the knees, the feet, &c. These several points connected together, give the shadow of the whole figure. The shadow of the little figure Q is done by the same method. I have not expressed all the points and parallels therein, in order to avoid confusion.

To find the shadows of figures clothed in long garments; draw a line from under their feet to the point of sight, as here the line S R, and through the bottom of the robe draw two parallels to the base line, each way, as the lines T and V, and between the two another line X for the middle of the figure. Then from the top of the head draw a line Y, for the ray of the sun, to be continued till it cut the line X in the point Z; which point Z will be the extreme where the shadow is to terminate. The rest of the shadow will be drawn between the two parallels T and V. If any thing comes over them, as the two plaits or folds † and *, they must be drawn by parallels to Y Z, till they cut the line V. And thus † gives the shadow of the elbow, and * that of the folds of the gown.



Z

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An easy Method of finding the Shadow of a Body from the Sun.

WERE I here to add the shadows of all the objects that might be given, it would be a work without end, objects being multipliable to infinity ; in effect, besides the greatness of their number, each particular one might furnish out a whole book, as being capable to be turned, inclined, and disposed in many and various manners, each of which has its several shadows. But the labour would be useless, inasmuch as every body will be prepared to make any at pleasure, provided he be master of two or three rules already laid down for the shadows of objects taken from the sun, two kinds of lines have been shewn to contain the means for finding all shadows imaginable ; one of the lines coming from under the sun, and passing over the plan, and the other proceeding from the sun itself, and passing over the object, and cutting the former line in the place where the shadow is to terminate. But as these lines are to be all parallel, that is, those from under the sun parallel to each other, and those from the sun likewise parallels among themselves, it may be necessary to give a method of drawing them with expedition and advantage.

I have already shewn how to draw parallels to the base by means of a square board, as A, and a ruler B, which same may serve to draw the lines from under the sun, when found directly over the face of the object; as the line C D. But where he illuminates the object from an angle, another instrument must be used, as that here represented E. which is a rule fastened to the end of another piece of wood, well squared, and grooved quite through, so as the rule F G may be moveable therein with some force, and that having taken an inclined line, as H D, another parallel thereto I K may be taken by means of this bevel, which is the name the workmen give this moveable square E F G. This instrument shortens the work exceedingly, when shadows are to be made by the sun, on which occasion there is no line of any inclination whatever, but parallels will be required thereto. The application will evince its usefulness. For shadows by the candle or torch, it is of no importance, by reason all the lines are there drawn from a centre.

Z.

Shadows from a Torch, Flambeau, Candle, and Lamp.

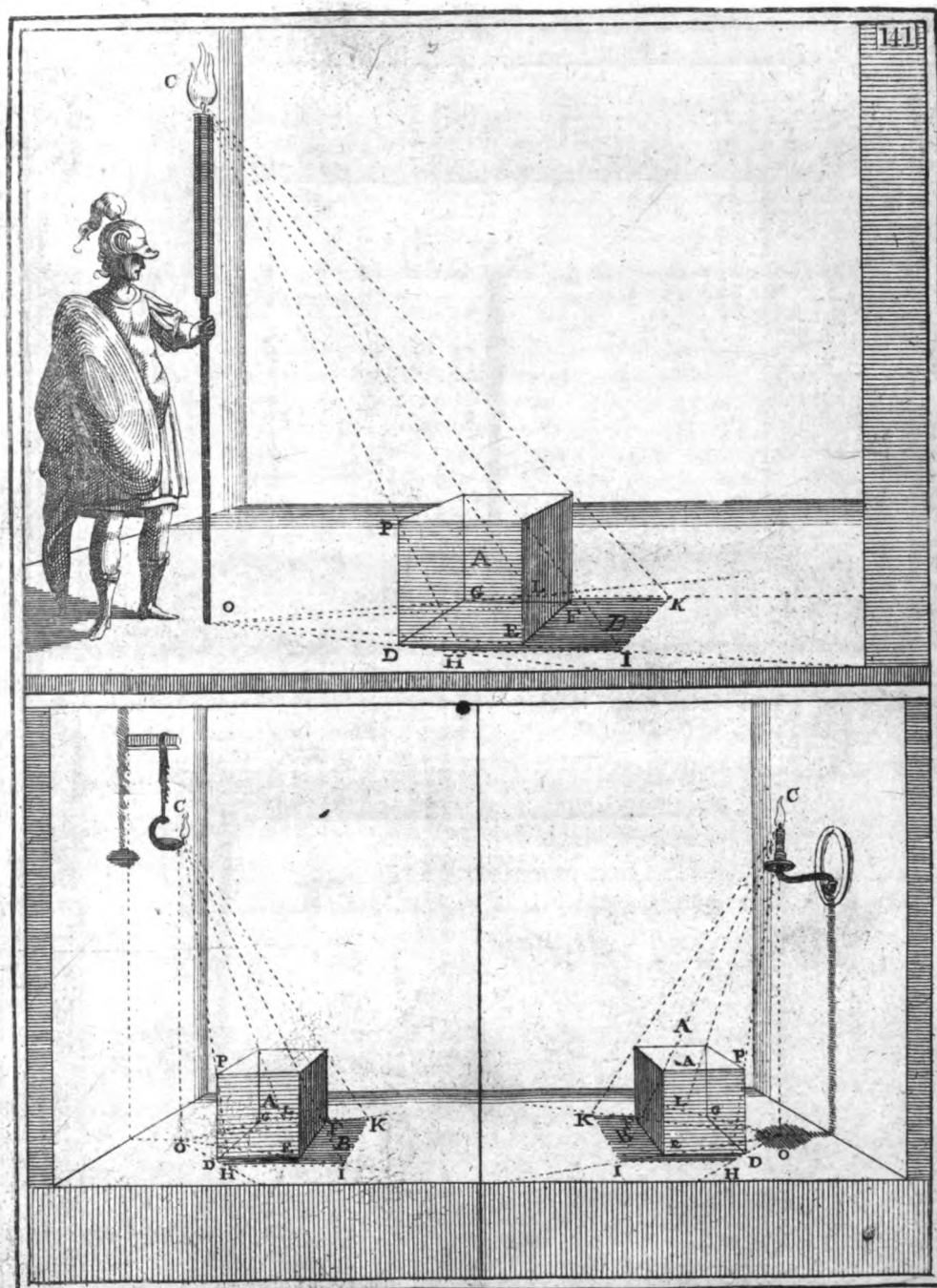
IT has been already observed, that there are two points required for the finding of shadows; the one the foot of the flambeau, candle, lamp, &c. which is always found on the plane where the object is placed, the other in the fire, or flame of those luminaries.

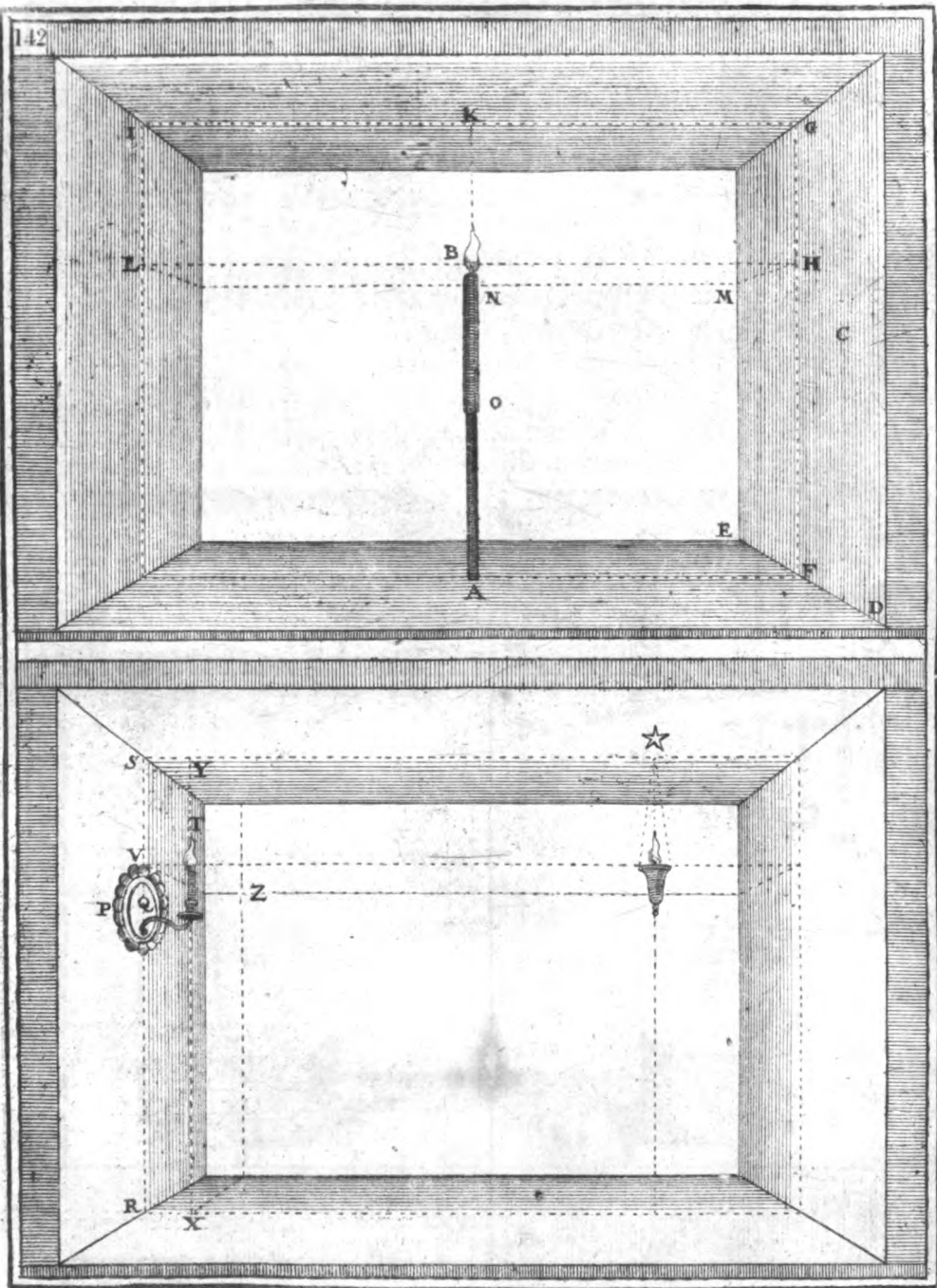
From the first point, which is the foot of the flambeau, or beneath the lamp, &c. lines must be drawn through all the angles of the plan of the object, whose shadow is required; and the second point gives other rays, which passing through the angles of those objects, intersect the former lines, and shew where the shadow is to terminate. I shall illustrate this by an example, wherein the same letters shall be used for all the three luminaries, from which it will readily appear, that the practice is the same in all. With this only difference, that the foot of the flambeau or torch actually stands on the plane, and that the others are only conceived to do so.

I add then, that if the shadows B of the cubes A be required, lines must be drawn from the point O, which is the foot of the luminary, through all the angles of the plans of those cubes, as O D, O E, O F, O G, and then from the point C, which is the light or fire of the luminaries, other lines must be drawn through the angles of the objects, and continued till they intersect the former lines from O.

Thus having drawn a line from the point O through the angle of the plan D, drawing another line from C, through the correspondent angle of the object P, this latter line being continued, will cut the first from the angle D in the point H, which point will be the shadow of that angle D P. From the same point C, do the same for all the other angles of the plan in the points H I K L, which points being connected by right lines, give the shadow of the cubes, as in the three figures. From this instance it readily appears, that the method is the same in one as another.

In the following page we shall shew how to find the bottoms or feet of candles and lamps.





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Of the foot of the Luminary.

SINCE the method of finding shadows by the torch, candle and lamp is the same in all, as already observed, there is no occasion for distinguishing between them in any of the following rules. For when I put a candle, a torch or a lamp might as well be put in its place, the light of one having the same effect as that of any of the rest. So that for the future, we shall use the word light indifferently for all three.

As to the foot of these luminaries, which must stand on the plans where the objects are placed, it is found after the following method.

A lighted torch being in a chamber, whether in a corner, at a side, or in the middle thereof (instances of each hereof we have in the erected figure) we must consider all the parts of the room, namely, the ceiling, floor, sides, &c. as having points wherein the foot of the luminary may be placed, and that from these points lines may be drawn through all the angles of the plan of the object whose shadow is required, as shall be expressed more at large in the following page, my chief design in this being to shew how that point is to be found. The torch then being placed in A, this point A is the foot of the light, and B the light or fire of the torch, which fire is there supposed immovable, though the foot may be found on all sides.

To find the foot of the luminary on the side of the wall C, draw a parallel to the base line from the point A, till it cut the ray D E in the point F, from which point erect a perpendicular F G. Then from the point B, which is the fire, draw another parallel to the base line till it cut F G in the point H, which H will be the foot of the luminary; as if the torch were laid all along, its fire still remaining in the point B.

To find the foot of the same luminary on the ceiling, from the point G draw a parallel to the base line, as G I, and from the point B erect a perpendicular to the same G I; this gives the point K for the foot of the luminary, as if the torch were turned upside down.

To find it on the other side of the room, the same method must be observed as for the side C, and you will have the point L.

To find the foot of the luminary in the middle of the room, draw a line from the point H to the point of sight, till it cut the perpendicular E in the point M. Then from M draw a parallel to the base line, intersecting the torch in the point N; this point will be the foot of the luminary for the middle of the room.

The foot of a candle is found after the same manner as that of a torch, taking the middle of the foot of the candlestick for the foot of the luminary; but when it is a plate, or an arm fixed in the wall, it is this arm or branch, that determines the line where the foot of the luminary shall be. For instance, in the plate P, through the arm Q draw a perpendicular to the base line, as R S. Then from the fire T, draw a line parallel to the base line, which cutting R S in the point V, gives the foot of the luminary for that side. The point X will be the foot for the floor, the point Y for the ceiling, and Z for the front wall of the room.

As to lamps, it is the place they are hung in that determines the foot, as here the character *; from which place a parallel to the base line is drawn as far as the first ray, &c. The rest the same as in the torch or candle.

To find the Shadows of a Torch on all the Sides of a Room.

THE shadows taken from the sun always tend towards the earth, by reason that star never gives us any of its light, but when above our horizon, and of consequence raised above our ordinary objects, and so occasioning their shadows to descend. But the case is different in torches, candles, and lamps, which may be placed either above, below, or on the sides of objects, and therefore may yield shadows on all sides, as we are now to shew.

The preceeding figure will help to find the shadows of objects disposed on all sides of the room, for having found the foot of the luminary as already directed, there is nothing difficult behind, the method throughout being the same with that for the cube in page 141, to which recourse may be had. However, to save you the trouble of going so far back, I shall here observe, that to find the shadow of the table the torch is placed in, you must draw lines from the foot of the torch A, through all the feet of the table C. Then from the point of light B, draw lines over all the points of the table III, &c. till they intersect the rays C C, &c. in the point O O, &c. which will give the bounds of the shadow of the table.

The shadow of the object D is found by drawing lines from the point A, through all the angles of the plan, as far as the angle of the wall D, and from that angle raising them perpendicularly. Then from the point of the light B, drawing lines over the object D, and observing the angles corresponding to the lines of the plan, you will have the shadow F of the object D.

The shadows of all the other pieces are found after the same manner: so that all we shall here note, is the foot of the luminary, the fire itself being supposed to be fixed in the point B.

For finding the shadow of figure G, the point L is the foot of the luminary.

To find the shadow of figure N, the point H is the foot of the luminary.

To find the shadows of the figures I and M, the point K is the foot of the luminary.

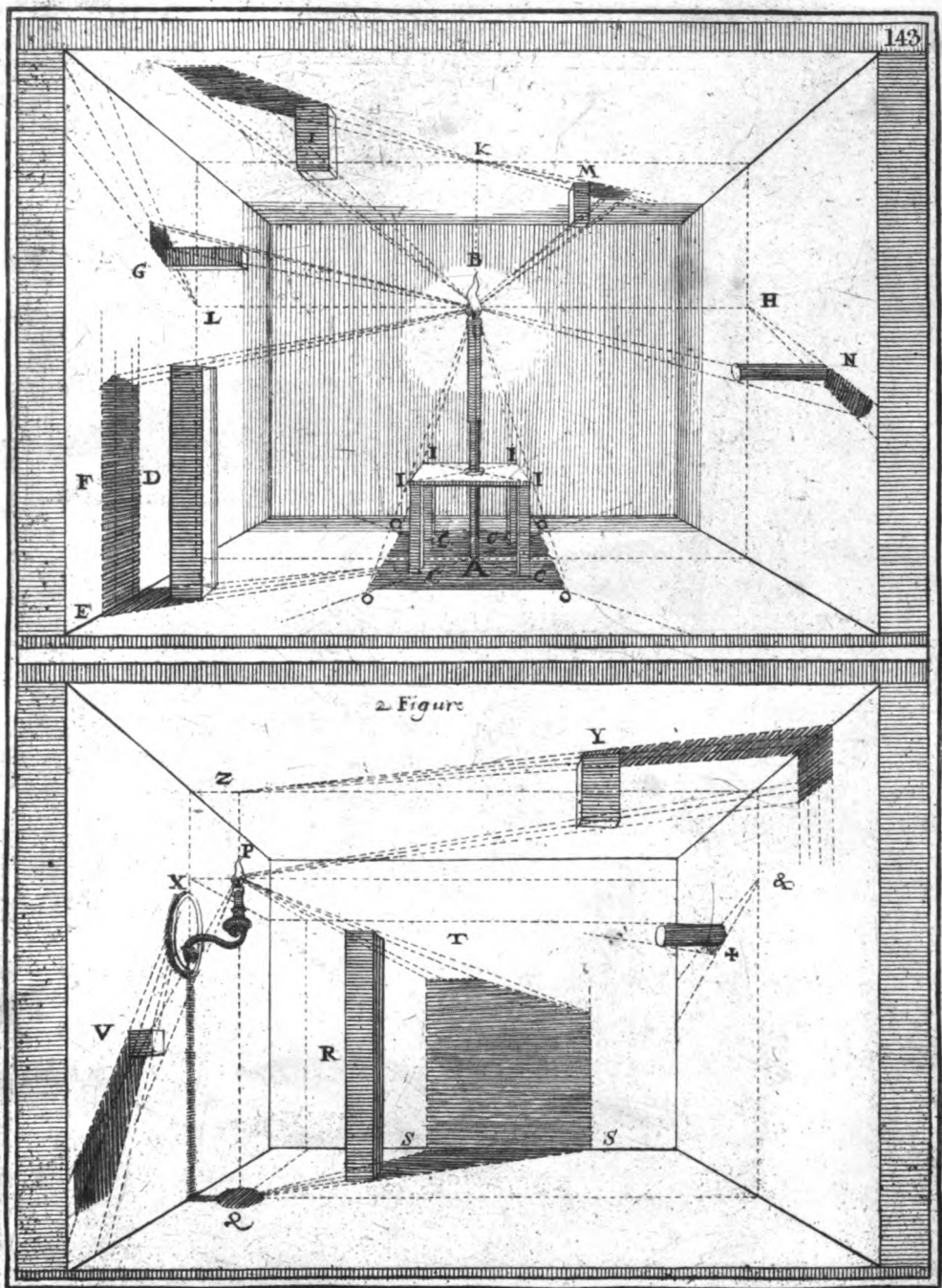
For the second figure; having found the foot of the luminary on all the sides of a room, as directed in the preceding page, the shadows of objects are found in any place at pleasure by the rule now delivered. For example, having found the foot of the luminary Q and its fire P, if you would have the shadow of the object R, draw rays from the point Q over the plan of the object, continuing them indefinitely. But inasmuch as they meet with the wall, or side of the room T, in the places S and S, where they meet the same, they must all be raised; then drawing other lines from P over the same object R, they will cut those of the plan, and mark the place of the shadow upon each, observing that the angles refer to the lines drawn from the plan,

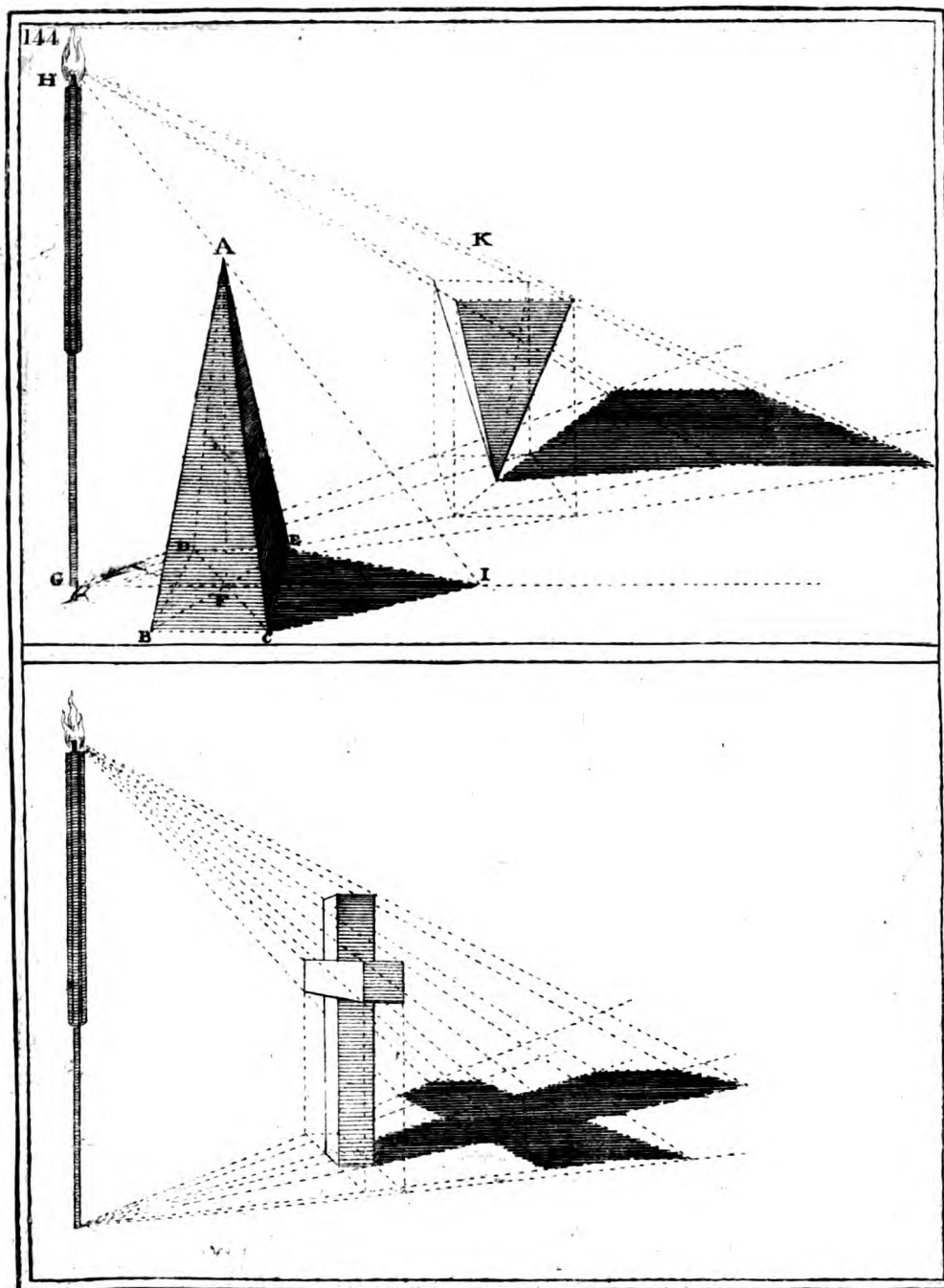
This method is so universal, that a person who only knows how to take the shadow of a cube, will make no difficulty of finding the shadow of any other object whatever. For this reason, having described that method for the cube in page 141, and added this above, which in effect is the same; I imagine I have given abundant instruction for the managing of all shadows, and may be excused from repeating the same in the several figures following. Wherein all I shall note, is the point for the foot of the luminary.

To find the shadow of the figure V, the point X is the foot of the luminary.

To find the shadow of figure Y, the point Z is the foot of the luminary.

To find the shadow of the figure $\dagger$, the point & is the foot of the luminary. P is the fire, or light itself, for all the objects in the second figure.





The Shadow of an erect and inverted Pyramid by Torch-light.

THE shadow of an erect pyramid by torch-light, falls as it would by the light of the sun, and in both cases there is but one line wherein the vertical point of the pyramid will be found. Upon the plane B C D E draw the diagonals E B and D C, through the central point F raise the perpendicular F A, and from the four points B C D E draw lines to the point A, and the pyramid will be erected. Then to find its shadow, draw an indefinite line from the basis G of the illuminating body, passing through F, and from the central flame of the torch H draw another line over the vertex of the pyramid in the line G F, till it cut the point I, which point will limit the shadow of the pyramid. Lastly, draw a line from C to I, and another from E to I, and the triangle C I E will be the shadow of the pyramid.

To gain the shadow of an inverted pyramid, draw perpendicular lines from the angular points of its base, and form the subjacent plane by means thereof, after the manner directed for the sun, page 138. And from all the angles of this plane, draw lines to the base of the torch G, then from H, the central point of the flame draw other lines, touching all the angles of the base of the inverted pyramid, and dividing those of the plane, whereby the shadow will be defined; as we before observed, in other instructions relating to the torch.

The Shadow of a Cross.

WE before considered the shadow of a cross by the sun, let us now suppose the same object placed in the light of a torch, that we may find the difference between the two cases. The construction of the latter is obvious enough, particularly if compared with the method of finding the plane, delivered in page 137, and the other directions laid down for shadows by torch-light.

To find the Shadows of round Objects by Torch-light.

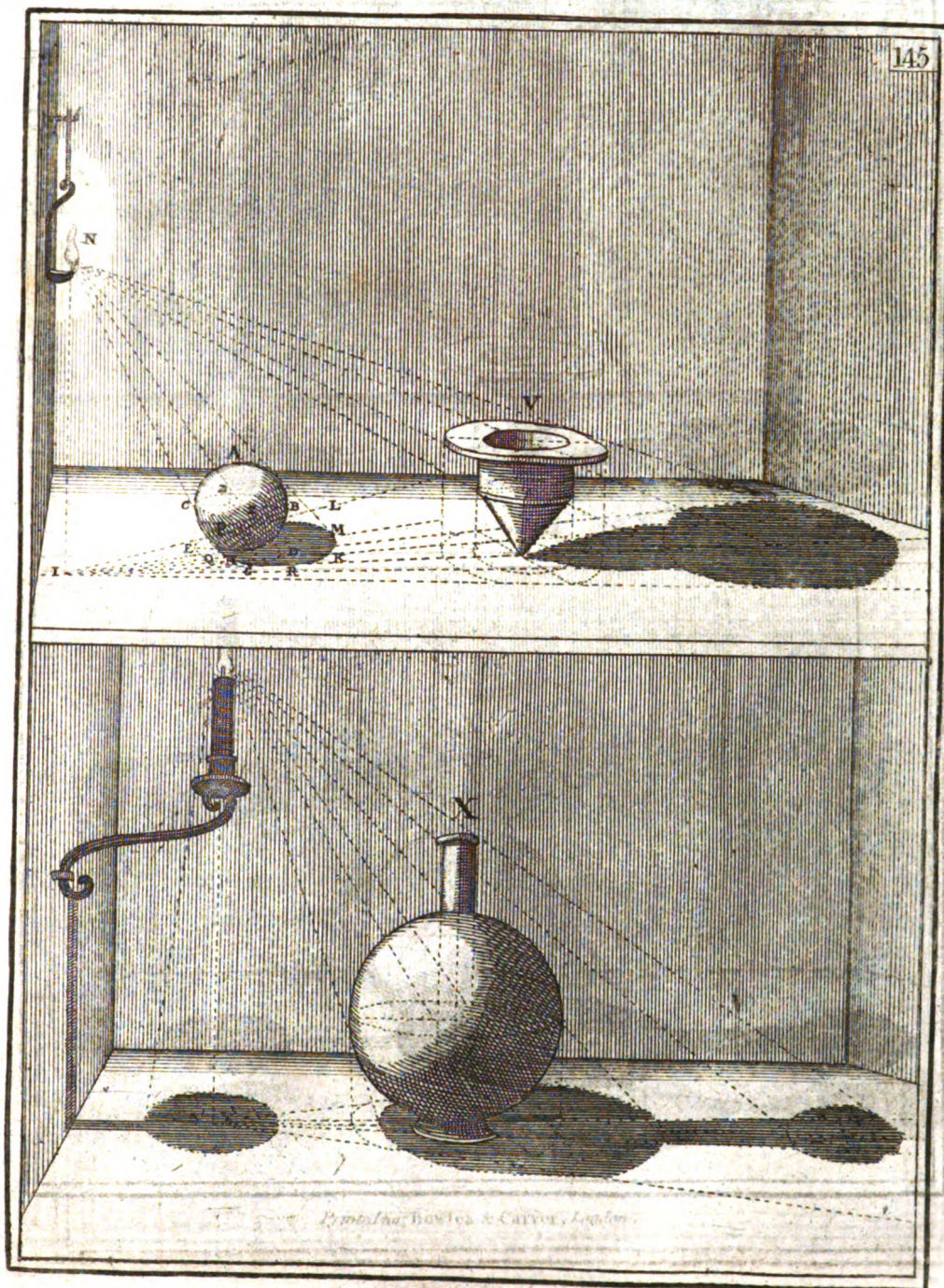
THERE may seem to be more difficulty in representing the shadows of globes, bottles, drinking vessels, and other bellied objects, by torch-light, than in those of square ones, but the directions already given will serve for these also; for there is nothing more required here, but to reduce squares to rounds, as we taught in pages 19, 20, 28, 29, and 86; which contain all the necessary instructions for giving the plans of round objects in perspective, whence all other cases of that kind may be easily understood.

We gave in page 138, the method for finding the plan of a ball, and by means of that plan, the precise magnitude of the shadow by the sun. But as the case of the torch differs from that, we shall be a little more particular upon the ball, because it will facilitate all the other directions relating to rounds.

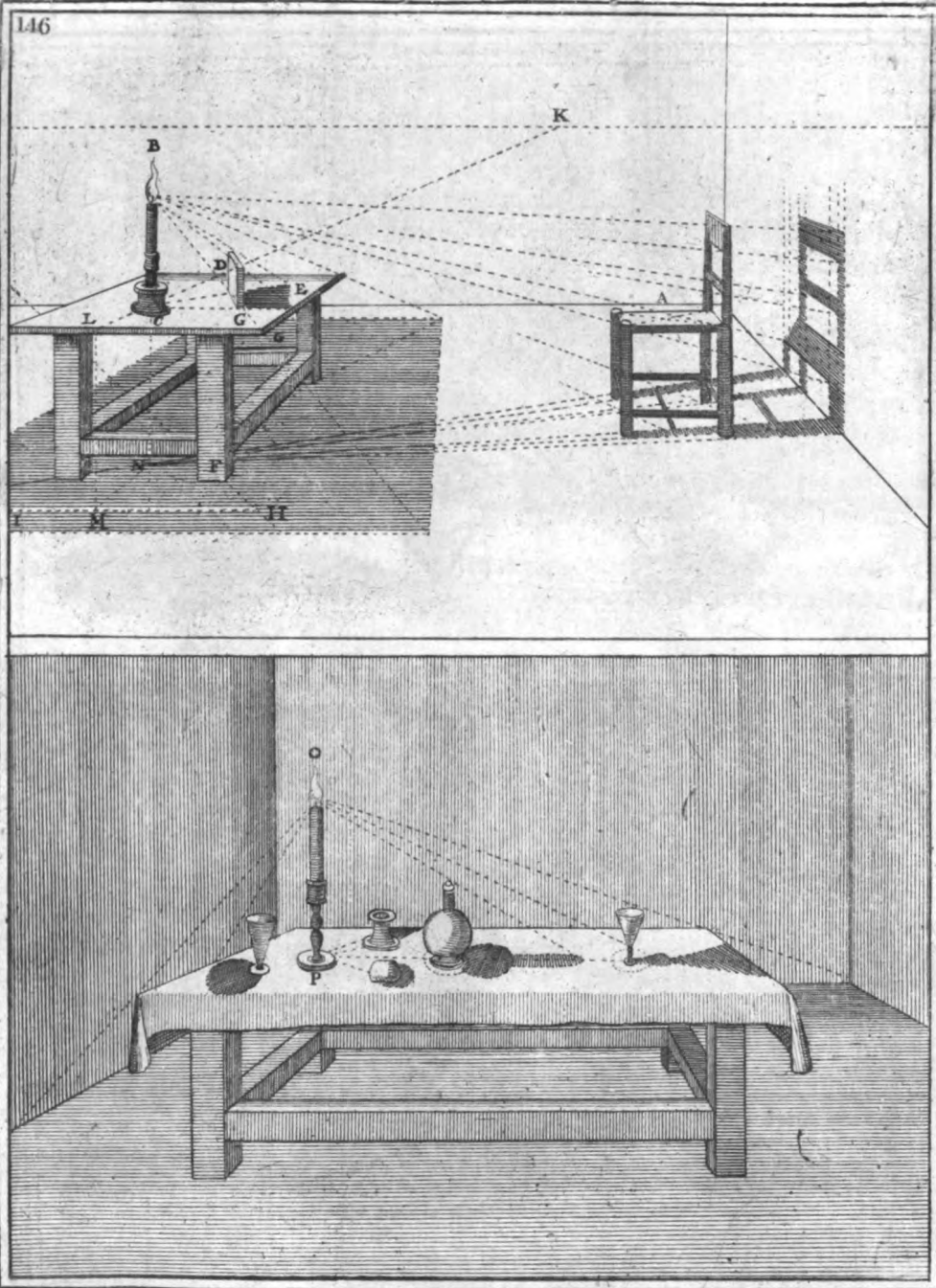
Having by means of a pair of compasses marked out the great circle of the ball A, draw its diameter B C, and below this circle draw a line parallel to B C touching the circle in the point H. Then from the extremes of the diameter B C let fall perpendiculars upon the line below, as B D and C E, and with these points D and E make a plan D E F G in the usual manner, the diameter whereof F G, will divide D E at the point H. And this plan will serve to find the shadow of the ball A. Now, having drawn from the basis of the illuminating body I, lines touching this plane on both sides, as I K and I L, and another I H M, through the centre of the plane H, as also lines from the centre of the flame N, which touching the ball between A and B, shall divide the line I H at the point M: this point must terminate the shadow. To gain the first part of this shadow, draw from the same point N another line, touching the fore-part of the ball, and dividing also the line I H at the point Q, then the distances between Q and M will be the length of the shadow. And for its breadth, draw from the same point N two lines touching the extremes of the diameter of the ball Z Z, and dividing the lines I K at the point R, and I L at the point S. Now then, as R S is the breadth for the shadow, and Q M the length of it, if the four points R S Q M be joined with curve lines, there will be an oval formed for the shadow of the ball A.

I have been the larger upon this shadow, because I judge the direction given about it alone sufficient for finding the other shadows of rounds, as of the object V, for example, which having two unequal breadths, ought to have a plan of two circles. And the figure X having three, should have its plans corresponding thereto, one for the neck of the bottle, another for its belly, and a third for its foot; all which are to be made as those for the ball.

An inspection of the figures will render any farther explanation of them unnecessary.



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Shadows on several parallel planes.

THE first plane here is the floor whereon the chair A stands ; the second plane is the upper part of the table, parallel to the first, and may be either above or below it. There might also be more of these planes wherein to find the foot of the illuminating body, in order to come at the shadow of the object. Suppose the foot of the illuminating body to be C, and the flame B ; from these points C and B draw lines through the upper and under part of the object D ; which will give the shadow E upon the table.

To find the shadow of the chair A, which is placed on the ground ; determine the foot of the luminary on the table in C, on the ground : this is cleared by the instructions following.

From the point of distance, which is here supposed without the limits of the paper, draw a line through the foot of the table F ; then from the angle G upon the table, let fall a perpendicular cutting the line F in the point H ; and from H draw a parallel to the base H I, which is equal to the upper part of the table, and will direct us to the thing required. For, drawing a line from the point of sight K through the foot of the luminary C, to the extremity of the table L ; from the same point L, let fall a perpendicular to H I, which will give the point M. Then from M draw a line to the point of sight K ; in which line M K will the foot of the luminary be found. To determine the precise point let fall a perpendicular from the point C, which, cutting the line M K will give the point N for the foot of the luminary. This point N thus found, there will be no difficulty in finding the shadow of the chair A, the method being the same as for the other objects taught in the preceding pages : that is, from the foot of the luminary N draw lines through all the angles of the plan of the chair, and other lines through the upper part of the chair, from the luminary B ; these latter by intersecting the former express the bounds of the shadow. For the rest the figure gives sufficient directions.

The second figure is not here added as if there were any particular circumstances different from those of the figure above, but only to put you upon recollecting what has been already taught ; namely, that objects cast their shadows differently, according to their different dispositions about the luminary. Thus the little objects on the table project their shadows this or that way as the luminary is on this or that side, as is found from the common rules relating to the foot of the luminary, and the light itself. Most of the objects here represented are broader at the tops than bottom ; so that it will be necessary to make plans thereof, after the manner already shewn.

Shadows of Cielings by Torch-light.

THESE figures are not placed in the sun's light, because that luminary is high above all the objects of the earth, and consequently can give no shadow where the illuminating body is supposed to be under the object. If it be said, though the sun's rays enter a room, yet the shadows of bodies continue to appear; I answer, that such shadows are not immediately caused by the sun, but by the light reflected into the room from other objects; and that they cannot be represented by parallel lines, as those of the sun, but by rays issuing from the same centre, as those of a torch, taking the reflecting body for the illuminating point, and proceeding in drawing such a shadow as in the case of a torch.

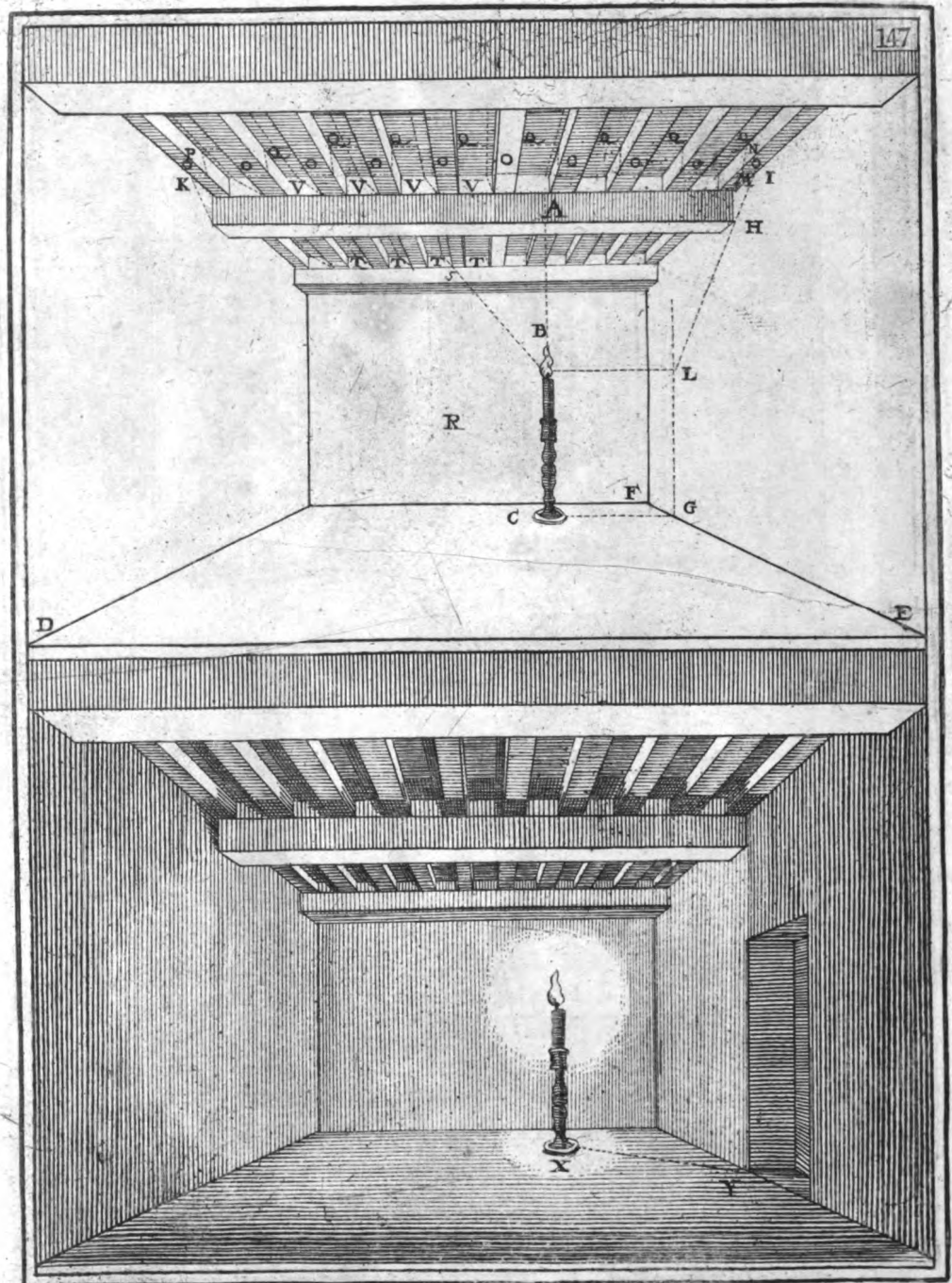
The directions hitherto given, which turn upon the forming of plans, and drawing of lines from the angles of objects, to find the bounds of the shadow, would be too tedious here, and the great number of lines necessary to be drawn, would render the figure exceeding intricate, on account of the several beams, supporters, and rafters that would occur. This inconvenience drove me to invent a short, easy, practical method for the same purpose, without departing from the rules of art.

The floor being put in perspective, as was taught in pages 55, and 57, and the illuminating body fixed, we must find by means of the basis of that body, where the illuminating point ought to be. To find this point, when the illuminating body is at B, draw from the foot of it C, a parallel to the base D E, till it cut the ray E F in the point G, from this point G raise a perpendicular G L, and from the flame of the torch B draw a parallel to D E, dividing the perpendicular G L at the point L, and this point L will give the place and length of the shadow.

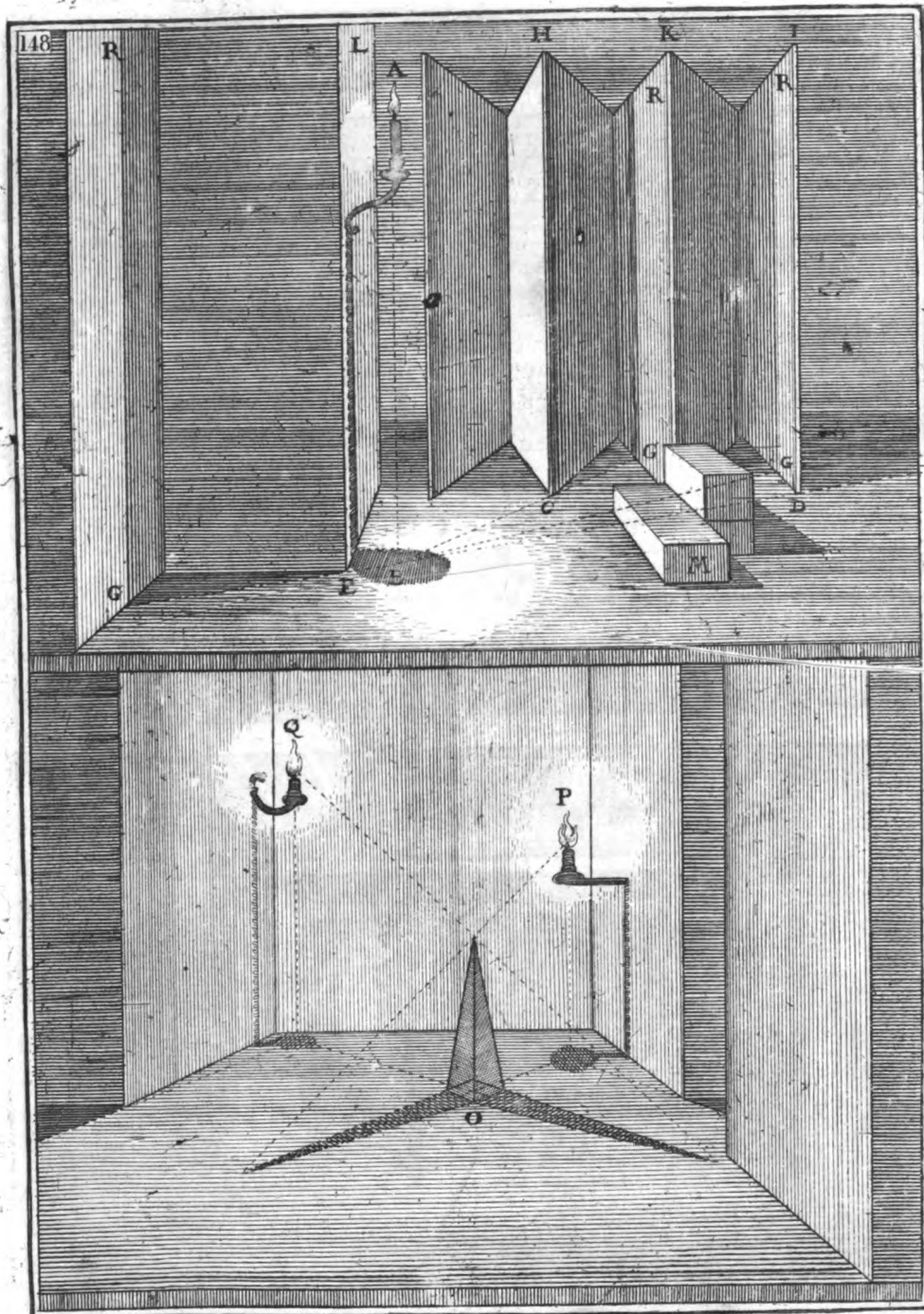
For example: to find the shadow of the band A, from the point L draw a line touching the vertex of the angle H, and observe where this line L divides the first rib, as at the point I, which is the place of the shadow's ending. From this point draw a parallel I K, and mark upon the ribs the place of the shadow O. And to find the shadow of the space betwixt them, draw another line from the point L, touching the vertex of the angle of the first rib M, which will divide the angle of the interval at the point N. Now then, from the point N draw a parallel N P, and you will thence have all the shadow Q for the beam A.

To find the shadow of the joists, draw a line from the illuminating point B, touching the angle S, and dividing the bottom of the entablature at the point T. Proceed thus with all the other ribs, and the shadow will appear to be longer the farther it is removed from the luminous body. Then mark upon one beam all the points T, and from the point of sight R, draw lines through each of these points, and then the shadows of all the other ribs will fall exactly between the bands, as we see in the points V V.

The second figure is the same with the former, and differs from it only in being shadowed, which would have obscured the letters and the fine lines necessary in the other: only here the shadow of the jambs of the gate must be taken from the foot or the illuminating body, as in X and Y.



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To find the Shadow by the Foot of the Luminary.

IF the objects be perpendicular to the base line, and higher than the flame of the candle A, we need only draw lines from the foot of the luminary B through the most advanced angles of the objects ; for example, C and D of the skreen, *fig. I.* and others from the angle of the wall E. These lines B C, B D, and B E, give the place of the shadow in the points where the angles made by the leaves of the skreen, meet the floor ; as also the return of the wall in the point G, from whence perpendiculars must be raised, as G R, which will terminate the shadows given by the candle A.

The reason hereof is, that the line A B being parallel to the line C H, D I, K and E L, occasions the flame, in what part soever of the line A B it be found, whether on high in the middle or below, to give a like shadow.

It must here be observed, that this rule only holds good of objects raised above the flame, as these are in the present figure. For such as shew their upper part, as here the object M, the preceding rules take place ; that is, lines must be drawn from the foot and flame of the luminary.

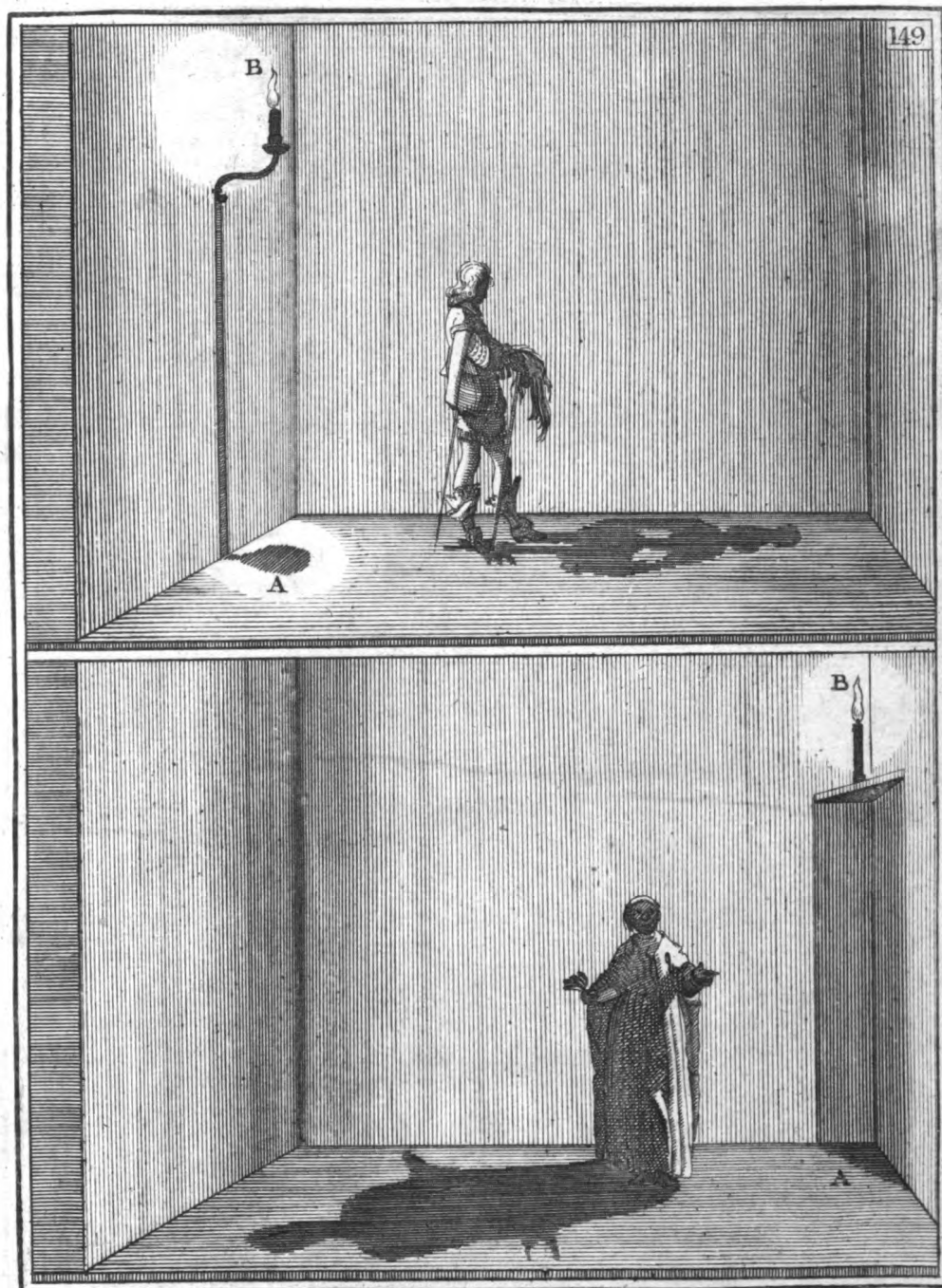
The Shadow doubled.

WHEN two luminaries shine on the same object, two shadows must be produced, each by means of the luminaries occasioning the respective shadow, and that in proportion to the circumstances of the luminary. If such luminaries when at equal distances be equal, the shadows themselves must be equal ; but if there be any disproportion, that is, if one of them be a little bigger than the other, or one of them a little nearer the object than the other, the shadows will be unequal. Thus the object O being illumined by two candles, the one near at hand in P, the other farther off in Q, it is evident, the shadow of the candle P will be deeper than that of the candle Q, as is expressed in the figure.

The rules for such shadows are the same with those already given both for the sun and the torch.

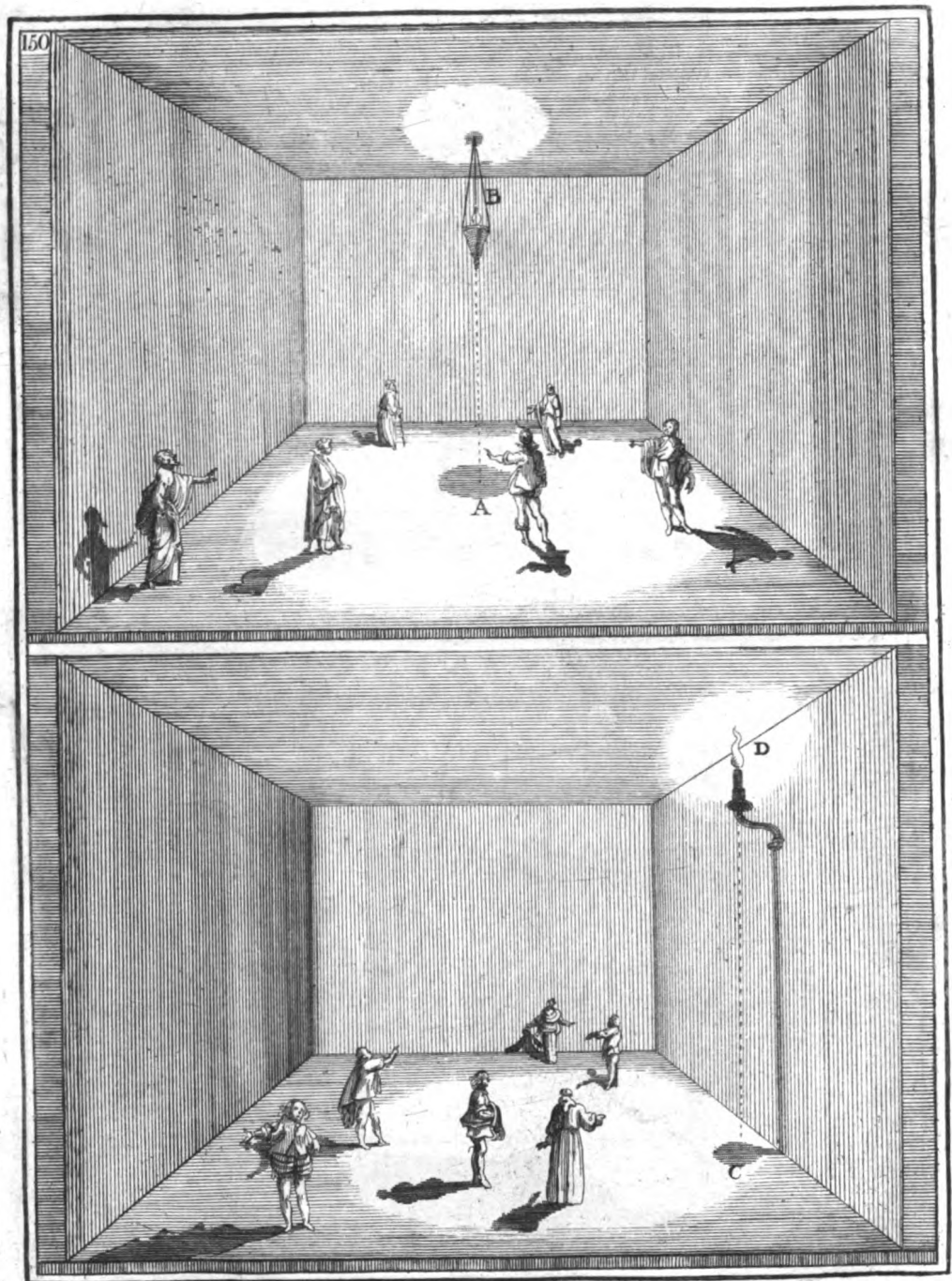
The Shadows of human Figures by Torch-light.

I HAVE reason to hope that the advice already given, not to turn over the page to a new figure, before the preceding one be well understood, has been carefully observed. Supposing therefore my reader to have mastered what was directed in page 139, for finding the shadows of human figures by the sun ; I have little to add as to those in the present plate ; the line drawn under them, which I use as a plan, serving indifferently in either case. But inasmuch as the shadow projected by a torch is not equal to the body, as is the shadow projected by the sun, a farther consideration must here be added ; namely, that instead of drawing the lines parallel to one another, they must here be all drawn from a centre ; that is, all the lines drawn over the plan must proceed from the foot of the luminary A, and those over and about the figure from the point of the flame, in like manner as for the other shadows of the torch ; which it would be needless here to repeat, the figure itself giving abundant satisfaction.



Aa 2

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The different Dispositions and Heights of Shadows by torch-light.

SHADOWS from the sun are all cast the same way, and have the same disposition ; it being impossible the sun should occasion one shadow to tend towards the east, and another towards the west, at the same time. True, in different times of the day it makes this difference : but never in one and the same hour.

But the torch, candle and lamp have always this effect ; for in what place soever one of these luminaries be found, provided there be a number of objects about them, the shadows will be cast various ways ; some to the east, some to the west, some to the north, and others to the south, according to the situation of the objects around the luminary : the foot of which, here represented by A, serves as a common centre from which they all proceed ; and the flame here represented by B shews where they are to terminate, though at different distances ; as the nearest produce the shortest shadows, and the remotest the longest.

Though in the second figure the luminary be not placed in the middle, yet the same rule obtains, with respect to the shadows as in the former figure ; being all drawn from the foot of the luminary C, and terminated by lines from the flame D.

Finis.

DIRECTIONS to the BOOK-BINDER.

FOLD the Letter-prefs, and cut it up at the Head.

Take the quarto Plates marked with the Signature 3, and *Paste* them into the *Middle* of the Sheets of Letter-prefs to which they respectively belong ; the Plate G 4, and the 4 Plates Theory of Perspective, *Paste* in, opposite their respective Pages.

Fold the half-sheet Plates into two Leaves, with the Signatures outside, and *Quire* them into the Letter-prefs in the Manner of interleaving of Books with Writing-paper ; but observe, the Signatures on the Plates, must always *precede* the same Signatures on the Letter-prefs.

N. B. The Plates are printed on 24 Quarters, and 28 Half-sheets, all to be placed, as directed, opposite the same Pages in the Letter-prefs.

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