CHAPTER VI.

PERSPECTIVE—ITS PRINCIPLES, RULES, AND PRACTICAL APPLICATION.

ERSPECTIVE is an art which develops the principles, and fixes, by established and certain rules, the practical methods of representation of that diminution of objects to the eye, in proportion as they are more or less remote from the observer, which is so evident to all—an art, without which the draughtsman must for ever wander in uncertainty and error, while in its knowledge he secures a faithful and unerring guide. To all, whose occupations may be in any way connected with design, it is as important an auxiliary as to the artist it is indispensable. Apart from its importance in a practical view, its knowledge may justly be regarded as worthy of high consideration in the purposes of general education; for, surely, the design of education
should extend to all that tends to the elucidation and perception of truth, and that qualifies the senses for its faithful impression on the mind.

37. **Perspective** may be considered as a Science and as an Art: as a science, in the investigation of the principles upon which is based its theory—as an art, in the mechanical or mathematical operations, by which we reach the truthful representation of any object, or objects, we desire, in any position, or at any distance from the observer, or from one another, at which such may be visible to the eye.

38. Perspective admits of yet another division, viz.: Aerial and Linear. Aerial perspective has reference, more particularly, to those peculiar atmospheric and other influences, by which objects, more or less remote, are affected in color, light, shadow, and gradation of tints, according to their distances or relative position; the rules for which are best acquired by close observation and study of nature, less reducible to systematic methods, and to the beginner of less practical importance, than linear perspective, a knowledge of which forms the best basis for its study. In its place we shall have occasion to refer to the subject of aerial perspective; our business, at present, with the art, is more directly as a linear operation. First, therefore, should the pupil learn to look at nature with an eye capable of the comprehension of the principles of the art therein so beautifully and clearly developed; and, next to the application of these principles to practical results, by which the representation may most nearly approximate to the truth of the reality. In all this there lies no mystery. The precepts and principles of the art are few and simple; although capable of endless elaboration and application, based in truth, they never vary from it. If the learner will go to the work in the same spirit which has been required of him in all that he has thus far acquired—when he can understandingly place a single point or line in perspective, with a perfect knowledge of the why-and-wherefore of the operation—he is safely in the way to pursue the more elaborate and various applications of the art with certainty, and the task may be thus overcome at the outset.

39. As preparation for the course that lies before us, let us consider the few technicalities that have been assigned to the art; for of these, few as they may be, more is required than mere familiarity with their names. If we dwell more on this subject than may be deemed necessary by those already familiar with the art, again let such be reminded, that our ambition reaches not to the teaching of the learned, but our highest aim is to make plain and simple the first steps of knowledge to the unlearned; and, reverting to our own experience, we are not ashamed to confess
how long, tedious, and dark, were the labors of our beginning, through volumes of abstruse diagrams and mathematical operations, for want of clearer light and more practical exemplification at the outset. Nor have these deficiencies, not to say errors of the books, been confined in their operation to our own experience, but generally confessed. “After having studied Perspective at Rome, under an excellent professor of mathematics, and after having filled more than five hundred pages, in folio, with drawings and figures in perspective,” says Valenciennes, an eminent French artist, and author of one of the best works extant on the subject of Perspective, “I may have been allowed to have considered myself thoroughly proficient in that science. But, on my arrival in Paris, having shown my work to my friend Joseph Vernet (the celebrated landscape painter)—‘I see very clearly,’ said he, ‘that you have learned perspective, but I also see as well that you do not understand it. Be not alarmed,’ he continued, seeing my surprise; ‘you know enough that I can explain it to you in a single lesson,’ and this he did.”—But back to ourselves, and let us not become involved in geometrical labors until we can comprehend the end to which they may conduct us. Let us look to nature for our first lessons, and evidences of the principles of the art, and then to the books to teach us the means of their practical application in our representations.

40. When the eye is directed to any view or scene in nature, it embraces no more than most agreeably fills its power of vision. This is the Picture impressed on the mind through the organ of sight. It is the business of the art of perspective truthfully to represent this picture; and, even if it be an ideal creation, the rules and principles that govern its production are still the same. Now, as to the true form of this picture, it would most naturally be embraced by a circular limit, or frame, having, of course, its Centre as its Point of Sight; and in
whatever direction the eye may be turned, this *circular* picture will be presented, its centre, or *point of sight*, naturally moving with it. But custom, and other considerations not necessary to dwell upon at this time, have given more generally acceptable forms to pictures, such as the *square*, the *parallelogram*, the *ellipse*, etc. Whatever be the form of the *artificial*, it must still be considered as but a portion of the *natural* picture, which distinction the examples just given will more fully explain. It is important that this distinction should be impressed upon the mind of the student of perspective; for, perspectively considered, *the point of sight must in all cases be in the centre of the picture*, although it does not follow that it should be so in regard to such portion thereof as we may desire to embrace within the limit or frame to which we prescribe ourselves in our graphic representation. Still, however, this privilege which we assume should be kept within the limits of propriety; and we certainly exceed them when we carry our point of sight *out of the picture*, as we more closely approach them by placing it near its centre. To see a view or object, the eye must be directed to it: if so, its point of sight must be upon it; and Art must recognise the laws of Nature to harmonize with her in her impressions on the senses and thence to the mind.

41. Referring to the example on the next page—Let us suppose a square (1234) described upon a table, or board, placed in a perfectly level or horizontal position, and that eight balls of equal size (ABCDEFGH) be placed upon its four corners and divisions, as indicated—and let us, for the sake of elucidating the principles involved more clearly, imagine these balls to be transparent. If the eye were placed at a point, on a level with the centre of these balls (as at X), so that the centre (a) of the ball b would exactly cover the centre (r) of the ball r, as indicated by the line mb, the several balls would appear in their relative positions and proportions compared with the three (ABC) nearest to the eye, as thus exemplified; b being the *point of sight*, and X the *distance of view*—the ball r being covered by the ball b, and only the balls ABC exhibiting their entire outline, or circumference—the imaginary line passing through their centres expressing the true and natural *Line of the Horizon*; that is, a line on a level with the eye of the observer, which must necessarily pass through the point of sight. Now, let us suppose perpendicular lines drawn through the centres of these balls, they will evidently give the points (abcdedfgb) which correspond, exactly to the corners and divisions of the original square in their true per-
perspective position; and consequently acse gives the true perspective representation of such square—the lines, or sides (ac—se), terminating, if continued to an intersection of each other, in the centre of the ball E, as it appears in the perspective picture—which point corresponds to the point r, the point of sight, as just shown; the sides (ac—se) of the square being parallel with the line of the horizon (z). Hence it is evident, that—All lines running parallel with an imaginary line drawn, from the eye of the observer to the point of sight, in the perspective picture, terminate in that point; and farther that—all lines at right-angles to such imaginary line must be parallel to the Line of the Horizon.

Having now shown the truth of the perspective production of the original square, upon which we arranged these balls, as well as the diminution of the five balls DEFGB, compared with ABC, which we have represented of the size of the original scale—as resting on the front line of the square, which corresponds with the Base or Ground Line of the perspective picture. We are led at once, while these diagrams are before us, to the consideration of one of the most beautiful exemplifications of the accuracy of the art, and its application to practical results. If we extend the line of the horizon on either side of our perspective picture, and draw the diagonals of the square thus perspectively represented (as in second example), and farther continue the lines of such diagonals to their intersection with the line of the horizon, on either side of the point of sight, we will find the point of their intersection (L) with the line of the horizon, to be exactly distant from the point of sight—corresponding with the distance of the observer from the base or ground line of the picture; that is, that the distance from r to L (in the second example before us) corresponds exactly with the distance from m to v, as above shown in the representation of the actual position of the eye, as well as of the square and balls in question. The distance, therefore, between r and L, in the perspective picture, truly repre-
sents the Distance of the Picture. Hereafter, when we measure off, or point our assumed Distance, on the line of the horizon, the pupil must remember the basis upon which we do so. It would be a long, though an agreeable task, to enter into the mathematical operation by which the diagonal of the square, placed in perspective, thus verifies the point of distance with the line of the horizon and point of sight; and, working both ways—the surest test of all good rules—gives us the means, from the known data of the real point of sight and distance, to produce, not only an accurate perspective representation of the square, but, by its aid, any other point, line, or form.

42. If, without increasing our distance of view, we elevate the position of the eye so as to bring it on a level with the top of the eight balls, or even higher, and consequently the point of sight and line of the horizon with it, no change occurs in the relative size of these balls as presented to the eye; the sides of the square lying parallel to the base line of the picture are still of the same length, the point of distance is unchanged, the line of the diagonal of the square still directs to it, and the lines of the other sides vanish in the point of sight, as before.

43. These important and elementary principles, therefore, may be considered as established—

i. The Point of Sight must be in the centre of the perspective picture.

ii. All lines parallel to an imaginary line drawn from the eye of the observer to the Point of Sight, must terminate or vanish in that point.

iii. The Line of the Horizon must necessarily rise or descend with the position of the eye, and consequently with the Point of Sight.

iv. The Base or Ground Line of the picture, and all others parallel with it, must be parallel with the Line of the Horizon.

v. The Diagonal of the Square, perspectively represented, directs to a point on the Line of the Horizon—the distance from which point to the Point of Sight represents the true Distance of the eye of the observer from the picture.
Upon these are based all the leading principles and practical operations of Perspective, in the perfect comprehension of which the pupil may consider himself fortified with all the mysteries of the art. So important may they be justly considered, both as regards the clear perception of their evidence in nature, and their practical application to art, that we return to them again; and in doing so, look again to nature for their illustration and verification.

44. Let us suppose an observer to sit at a prescribed distance from a window, and occupied in drawing the view without—which, as it suits our purpose better, we may imagine to be that of a street running directly from, or at right angles to the window. Observe that the eye is on a level with the first bar of the sash of the window: this bar, therefore, is equivalent to our **Line of the Horizon**; and the point on this line directly opposite to the eye is the **Point of Sight**—to which point the lines of the eaves of the houses, those of the street (supposing it to be level), and all others running parallel to them, or at right angles to the window, in the natural picture, are directed in their receding terminations (41); thus, assuming the frame of the window as that of our proposed picture or drawing, we have the first bar of the sash as our **Line of the Horizon**—the **Point of Sight** defined on that line—the distance from the eye to that point—the **Distance of the picture**, etc. But the point of sight is not in the centre of the picture, embraced by the window-frame; still it must be the centre of the **perspective picture** (40), our picture or drawing being only a portion of the field of vision embraced by the eye.

45. This leads to the consideration of, if not a palpable error, at least an unwarrantable violation of perspective truth, too often committed by draughtsmen, and even by artists, whom we know not to commit such error for want of knowledge, but from sheer carelessness, or unnecessary sacrifice of truth, to gain certain ends, perhaps, in the composition of lines and masses, which might as well be obtained without such sacrifice. Thus we sometimes see the point of sight assumed on the very edge of the canvass, or border of the picture, and even entirely out of the frame of the picture. It must be evident to all, that the eye instinctively seeks a point to view a picture, whether it be in nature or art, under which it receives its most agreeable impression, and not only this, but where the delicately-constructed organ of sight may with least effort receive such impression. If, therefore, the eye must necessarily be directed to the picture, the point of sight can concentrate
nowhere else than within its frame somewhere, and as near its centre as possible, especially with reference to its horizontal breadth; for it is manifest that the farther we remove the point of sight from the centre of our picture, the farther do we lessen that harmony between nature and art which should ever exist. When we have exhausted all the power of art, there is enough left in which we fall short, without diminishing our resources by wilful and unnecessary perversion of truth. Would it not be absurd to imagine that any one desiring to look at a view through a window, should direct his sight anywhere else than within its frame? What right have we, therefore, to assume a larger liberty in our representations of nature?

46. With regard to the elevation and depression of the **Point of Sight, and Line of the Horizon.**

Let us imagine ourselves upon the seashore, our eye on a level with that of the first figure in the example before us. The line that limits our view of the ocean answers to our **Line of the Horizon**; it is on a level with our own eye, as well as his, and touches all other points or objects of the same height; we can not see the deck of the small fishing-boat ashore, and the hull of the distant ship rises above it. But, we climb the cliff, until we come on a level with the standing figure on the rock in shadow. The **Line of the Horizon** follows, as it were, our movement: we now see the deck of the small vessel ashore, and the round tops of the ship range with the horizon; one small vessel near the ship becomes more visible, and another, which was before hidden by the rock in shadow, is seen. We climb still higher, until we reach a point on a level with the highest figure in the examples; the line of the horizon ascends with us, and, on the smooth surface of the tranquil sea, we have, as it were, a vast perspective plain, defined by an actual line,
which is the **Line of the Horizon**—on which line must be our **Point of Sight**, corresponding, in our perspective picture, to our actual point of view, being directly facing, or opposite to it.

47. Let us suppose ourselves placed in a position to look directly up the centre of a long canal, and, for the sake of better exemplification, let us assume the circular, as the most natural form for our illustration (40). Our point of sight concentrates on that point which limits our utmost vision, and to it are directed all lines, in the scene before us, running parallel to an imaginary line drawn from our point of actual observation to the point of sight—such as those of the banks of the canal, the side of the house facing it, the wall on our left, etc.; while all level lines, which in nature are at right angles to this imaginary line, such as the weather-boarding of the gable end of the house, the roof of the shed, etc., necessarily are in the perspective picture parallel with the line of the horizon, and, if the frame of our picture were rectangular, would also be parallel to its base or ground line. We change our position, and stand immediately on the left bank of the canal, so as to bring its line as an actual perpendicular to the line of the horizon, preserving our extreme view up the canal as our **Point of Sight**, as at first. More of the front of the house now comes within the range of our vision, and the relative position of the various objects are perspectively changed, but not their proportions, as our distance is the same. As before, the same rules apply with reference to the lines terminating, or directed to the point of sight, and those running parallel with the line of the horizon, etc. Without moving our position, we **change our point of sight** from the extremity of the canal, by looking directly to the corner of the house, where now must concentrate our point of sight. This changes, of course, the imaginary and governing line from the eye to that point. We have not, now, perhaps, a single line in our picture which is either parallel, or at right angles to this imaginary line—not one, therefore, directing to, or concentrating in, the point of sight; and those that were before parallel with the horizon are so no longer—and, if not parallel to the line of the horizon, they must necessarily, if elongated or continued, come in contact
with it at some point, and at such point they must as necessarily meet, or form a vanishing point for all other lines that may, in nature, be parallel with them. Thus, as will be seen in the last example, the lines that before sought the point of sight as their vanishing point on the line of the horizon, do so no longer, but they must still concentrate, as before, at some point on the line of the horizon and harmonize together. While those that were before parallel to the line of the horizon, from their being in nature at right angles to the imaginary line from the eye of the observer to the point of sight, are so no longer, as this governing line has been changed; they therefore must be directed to and terminate in some point on the line of the horizon, harmonizing with their true position.

48. This brings us to a distinction recognised between Parallel and Oblique Perspective—a distinction which has nothing to do with the principles of the art beyond a classification of their results. The more the art, and its rules, can be simplified and generalized, the better. — As the eye recognises but one general rule in the diminution of objects, as they are more or less remote from it, so should it be in the art, which teaches the just linear representation of such effects in nature, and fortunately its rules of practical application are so simple and concise that the intelligence of their governing principles leaves no necessity for such classification, and consequently useless amplification. In the following examples are given instances of oblique perspective. As it is evident, that, in one and the same picture, objects may be presented in every possible position, it is best to discard such classification in assuming a general principle for our operations, which will be found to serve in all the variety of position and circumstances under which nature may present itself, and art be required in pictorial representation. In the beginning we have endeavored to show a natural progress from points to lines, and from lines to forms, as the basis of design: thus we proceed in perspective. Having consumed as much space as our limits would allow in endeavoring to make plain to the student the first principles of the art, as developed in nature, and in showing their palpable evidences, therein so clearly and beautifully exemplified, let us now look to the means which it affords of their practical application to the purposes of design.
49. The square has been selected in our first lesson on the geometrical application of the art, as a form not only most intelligible, but at the same time valuable in consequence of the unerring verification of its diagonal with the point of distance, and for other considerations which will be made evident to the student as he progresses. Above we have the GEOMETRICAL or GROUND PLAN of a square in connexion with its perspective representation or Perspective Plan in the picture, viewed under the governing circumstances of its Point of Sight, Line of the Horizon, Distance, etc. It will be perceived at once that the square of the perspective picture in every way corresponds with that of the geometrical plan. Now, every one who essays to make a drawing or picture, can readily decide upon these points in advance—the Size of his picture, the Line of the horizon, and Point of sight, and lastly the DISTANCE at which it is to be viewed, which distance it is necessary to have accurately defined, and here the Diagonal of the Square at once comes to his aid. Having drawn the lines of the two sides of the square, which vanish in the point of sight (as explained, 41)—one being already given in the base or ground line—the fourth alone remains to
be ascertained; in other words, having the lines of three sides of the square, he seeks by means of its diagonals to verify the position of the two points that remain to be established in harmony with the perspective circumstances of distance and elevation of the eye under which it is viewed. He therefore measures off on the line of the horizon, from the point of sight, the true distance, from which point a line drawn to the extreme points of the base line, representing the side of the square, lying, as it were, on the edge of the picture, and he has its diagonals, and consequently its fourth required side. And further, if he is able to produce the square of the geometrical plan thus accurately placed in perspective, he has the basis therein of any other form or figure, as above shown, observing, however, that there is a necessary reversion of the geometrical plan in its perspective reproduction. Before going further, it is desirable that the student should exercise himself in this simple and easy application of the geometrical plan of a square to the perspective picture; in doing which, the larger he makes his drawings the better, as error is thus more evident and accuracy more certainly attained—extending the points of distance, elevating and depressing the line of the
horizon, etc., closely observing and making himself familiar with the existing harmony between the geometrical and perspective square in all its details. Thus, having ascertained the four cardinal points, angles, or corners of the square in perspective, he finds, as in the geometrical square, the diagonals at their intersection give its centre; this found, he may divide it as readily as the real square into four equal rectangular divisions—again, into triangles, etc.; and thus, on the basis of such like divisions, points, and angles, he has the means of ascertaining the truthful representation of any form or object he may desire. It will be as easy for him in the end to draw a perspective as a geometrical plan, and with equal accuracy. After a perfect comprehension of the principles involved in the process, it will be no longer necessary for him, in all cases, to draw the entire ground plan of his perspective picture in his practical operations.

50. Suppose, for example, he desires to place two squares in perspective—the one (A) lying on the edge of his picture, and parallel to it—the other (B) at a distance from the base line, equal to a b, and also parallel to it. The assumed point of sight (c) secures the direction of two of the sides of each square, and the point of distance (n) giving the diagonals, leaves nothing more to be desired. For the square A he has to proceed as before shown; but for B he requires a diagonal equal to that of a square of which the measure of one of its sides should be equal to a c: this he readily ascertains by placing his compasses on the point a, and either striking an arc to its intersection with the base line, or simply making a d on the base line equal to a c—thus having (in a d—a c) two sides of a square of which a c would be the diagonal, a line drawn from b, (the point of distance,) gives this diagonal in perspective, and by its intersection with the lines c s—c a, the points which verify and represent the perspective view of the square B under all the circumstances it was desired to place it in the picture.

51. Having by this process ascertained the true perspective view of the two squares, always supposing them lying in a horizontal or level position—which for the sake of exemplification we may suppose to represent the bottom of a box, which, if its sides were all put together, would make a cube—it is evident that if two sides were added, corresponding in size to the squares already drawn, which may be said to represent the bottom of such a box, or base of a cube, and fitted thereto as shown on the following page—first on the sides lying parallel to the base line
of the picture, and next against those at right angles to it—they would perspectively appear as figured, the true measures assumed upon the base line of the picture, as indicated by the line $\text{BCDE}$, for the perpendicular sides and which may be made to serve as well for those lying horizontal, by their simple adaptation thereto.

52. Let us presume this cube, or square box, to be exactly six feet high: it gives us, as it were, a scale, by the aid of which, and by an analogous operation, we can, upon the same principles, place any other object or figure, of any given height or size, on the perspective plan of our picture, with as much certainty as if it rested on the base line and represented its exact dimensions. The example of a figure, the height of the box, holding a pole, say fourteen feet high, will show the simplicity of the operation.

53. Once more it may be desirable to refer to the value of the geometrical or ground plan, not so much for the necessity of its use in general practice, as to insure a perfect comprehension of the principles of its connexion and harmony with its perspective representation. When these are properly understood, there exists no necessity for a ground plan in most cases, beyond its distinct impression on the mind. In the example on the next page, to which we now refer, assuming our picture $\text{ABCD}$ to be of the proportion of twelve by eight parts, according to the scale which we intend our design to be, in reference to the true and natural size of the objects, we may call these parts the representations of feet. Having the size of our intended picture secured, we have next to decide upon the Line of the Horizon, Points of Sight and Distance, and by the aid of these to produce a perspective square $\text{AEFD}$ by the easy process already shown (49). Ad representing one side of this square on the scale which the picture is assumed to be in reference to the natural size of the objects it is to represent, we next proceed to measure off on this line twelve parts; and first having drawn lines from each of these points of measurement to the point of sight (1), we then by the aid of the diagonals $\text{DEAF}$ get by their intersection with these lines the points which secure us the further division, with as perfect perspective certainty, of the sides $\text{DFAE}$ into twelve equal parts, as we have on $\text{AD}$ and $\text{EF}$; and our
perspective plan as accurately divided into one hundred and forty-four squares, each perspectively representing a square foot, as we could have it thus divided and proportioned in a geometrical plan. The lines $\text{A} \text{E} - \text{D} \text{F}$, therefore, being in every respect perspectively equivalent to $\text{A} \text{D}$ and $\text{E} \text{F}$, as well in their twelve equal divisions as in their whole length, vertical lines erected on the points marking these divisions, must necessarily correspond in their perspective proportions with the scale of the horizontal line on which they rest (51, 52). Thus, if we measure off eight parts on $\text{A} \text{B}$ equal to the divisions on $\text{A} \text{D}$, we have on $\text{A} \text{B}$ as accurate a scale for perpendicular lines and objects as we have on $\text{A} \text{D}$ for those lying level or horizontal.

54. Let us suppose we desired to erect a perpendicular line on the line $\text{E} \text{F}$ at the point $\text{a}$—which shall be eight parts (or feet) high. This we may do at once by drawing a line from the point of sight through the point $\text{a}$, and extending it to the base line (as $\text{i} \text{a} \text{c}$); on the point $\text{c}$ erect a perpendicular (as $\text{c} \text{b}$), and on this perpendicular measure off eight parts, which in this instance the height of the picture gives us; then draw a line from $\text{b}$ to the point of sight, and its intersection with a perpendicular drawn from $\text{a}$ will give the line $\text{a} \text{e}$ required. If this perpendicular falls, or be erected, on any point along the line $\text{E} \text{F}$, its length and proportions must be the same, and correspond to the proportions of $\text{E} \text{F}$ in every respect. Should we desire to place this perpendicular on any part of the square (as $\text{f} \text{g}$), the process is precisely the same, as well as its verification; or a still shorter way may be adopted, based upon this process, by measuring the height of the perpendicular by the parts of the horizontal line on which it rests. Thus it will be found that $\text{f} \text{g}$ is equal to eight parts taken on the line $\text{n} \text{f} \text{k}$, on which it rests; and $\text{a} \text{e}$ is equal to eight parts of the line $\text{E} \text{a} \text{F}$, as the lines $\text{A} \text{B} - \text{c} \text{b} - \text{D} \text{C}$ are severally equal to eight parts of $\text{A} \text{D}$ or $\text{B} \text{C}$.

55. It must be remembered that, in the division and subdivision of all perspective forms or figures, they should be treated precisely as though they were drawn on a geometrical or ground plan. As $\text{A} \text{E} \text{F} \text{D}$ truly represents an actual square, so do all its parts and proportions. All the
angles of its one hundred and forty-four divisions represent right angles, and all their sides are equal to one another: consequently, all their diagonals must be considered as intersecting each other at right angles, etc.; and, further, all less regular forms are thus equally effected. Let us take, for instance, the parallelogram formed by \( f \times m \) in the example we have just considered, as best suited to our purpose, and by repeating its front and side view, as perspectively seen under different modifications, exemplify the harmony of this operation, which is placed before the student for his study and practical exercise, preparatory to that which we have now to consider.

56. It may have appeared that the way of the beginning in the study of the art of perspective has been long, and as yet no practical results have been attained. We gladly, therefore, hasten to convince the student, who has carefully pursued the course thus far laid down, that he has secured, in the possession of a comprehension of its elementary and leading principles, a solid basis that leaves but little more than his own intelligence, practical observation, and application, to complete the work. The guide may now safely assume the part of companionship, and both may now reason together more understandably. Having in view the design presented, in connexion with the exemplifications which follow on the next page, it will be easy to show that every principle and rule of perspective involved in its production have already been explained and placed within the means of practical application. In reviewing the ground which we have passed over, we make ourselves more secure of its possession, and may recover something lost sight of or perchance neglected, the want of which we may sensibly require hereafter. Let us therefore do it carefully, for the profit will well repay the pains.
57. We have here the general perspective outline of an apartment corresponding with its geometrical or ground plan annexed, which has been produced precisely as that already presented and explained (53, 54, 55). We therefore know that its walls represent the height of eight feet; that its floor is twelve feet in depth, from the base line of the picture to its extremity; that it is of the same width until it reaches the distance of six feet, at which it becomes narrower by a little over four feet, which are taken from it by the projection of the doorway or entry. Every foot of its floor, which, for the sake of making the end to which we aim more clear, we may consider as tessellated in squares of a foot each. Every foot of this floor is therefore laid off as accurately in the perspective as in the geometrical plan—and thus, if desired, every inch of it might be as positively defined; and not only on the floor, but on the walls, ceiling, etc., in like manner. It would argue little for our progress, even thus far, in the acquirement of knowledge of the art, were we not able, upon such data, to place any object, we desired to introduce in this apartment, in its just perspective position and its right proportions. Referring to the geometrical plan rather to bear in mind the matter-of-fact premises assumed by the artist in making out his design, let us follow his practical movements. Having previously fortified himself with a general idea or impression of his subject, and perhaps with a memorandum or sketch before him, he has arranged the dimensions and general outline of the apartment, and marked off the various measurements and divisions which he will most likely have occasion to require. This he can do in chalk, charcoal, soft lead pencil, or some such substance, whose marks may be easily erased after their service has secured the end desired. As yet he has nothing but the tessellated floor and blank walls defined. The floor in its squares gives him as certain and well-defined a basis upon which to place the
figures and objects he may desire to introduce in his picture, as to place the men upon a chess-board. Whether the floor is tesselated or not, the same expedient equally serves; for after having fulfilled the service of their intention, all vestiges of these lines may be easily erased. In like manner as the floor, every portion of the interior of the apartment, the walls, ceiling, etc., may be thus laid off, if required—leaving the artist a freedom as unlimited as his design in placing the principal and accessory objects and details of the picture at once in their true perspective position. If, for instance, he should desire, as in the case before us, to place a window four feet square, whose sill shall be three feet from the floor, in the middle of the left-hand wall, the divisions already described thereon give him at once all the points he requires, which the example we have just had under consideration will sufficiently show, aided by what has been before explained (55). Immediately in front of this window he desires to place a table (A) five feet long and two feet eight inches broad and high; again the dimensions described on the wall and floor come as efficiently to his aid. To decide upon the points on which the figures (B–C) stand, will be found equally as easy; and even the position of the chairs (D–E), although presented obliquely, will occasion no insurmountable difficulty, especially after the careful study of that which will presently be offered on the subject. The position of the various objects and figures of the picture being thus accurately defined, their perpendicular measurements in reference to such perspective position alone remains to be ascertained.

58. To prevent entanglement of thought and operation by a multiplicity of lines, we avail ourselves of so much of the example, which we have under consideration, as may be required for our immediate purposes. Beginning with the principal standing figure, we find his position four feet from the base line of the picture. On the line of the floor, therefore, corresponding to four feet from the base line, we take the measure of six of its parts, representing feet, (being the ordinary standard of a man’s height,) and making some little allowance for his stooping attitude, the perpendicular line drawn from his left heel, being equal to the six parts taken from the horizontal line on which he stands, gives us all that we require. This is perhaps the easiest and shortest method. In the instance of the figure of the girl standing behind the table, a similar course might
be pursued; but let us select another, as well to show the agreement in the results of the art, as further to discover to the student its resources. Having decided upon the position on the floor, or pavement, on which the figure may be supposed to stand, we connect it by a right line, from the point of sight, extending to the base line of the picture, on which, from the point of such connexion, we erect a perpendicular, which, by the original scale of proportions laid off, or assumed, upon the base line, we make equal to the real height of the figure (say five and a third parts, representing five feet, four inches), as if it stood upon that line. A line drawn from the height of this perpendicular of the base line to the point of sight, must necessarily give, by its meeting a perpendicular erected from the position on the floor, or perspective plane or plan, the just perspective height or measure of that figure in reference to its distance from the base line (51, etc.). Thus, by either this or other methods, based upon the elementary laws of the art, may we proceed throughout our picture; beginning with certainty, no matter where, and keeping all in harmony with that beginning throughout our progress; adapting the graphic representation to the instinctive impulses and requirements of that delicate sense by which the impressions of art are conveyed to the mind, so that in its perfect accordance with the habits of observation with which the eye most agreeably receives the impressions of nature, it meets an equal reception, acknowledged and unquestioned, as the reality. The sympathetic language of the thought makes it welcome and intelligible. Art accomplishes its ends, and acceptation rewards the artist.

59. To some, even these operations, simple as they are, may prove embarrassing, and an inverse method more desirable, by first adapting the perspective operation to the principal figure, group, or motive of the picture, and thence proceeding to its details and accessories. This, it must be admitted, is the more artist-like, the other the more mechanical method of procedure. In both, however, will be found the utmost harmony of results, and in the principles of the art involved in their attainment, which, when once perfectly understood, the artist may set to work with more latitude in his methods of reaching his object of just representation. Instead of beginning with the perspective of the apartment, and other details, which perhaps it may be desirable to make subservient to the leading group or subject, to insure certain effects of light, shadow, color, or composition, and which it may be better to leave as an after-consideration—the artist makes his beginning with the principal group, by first deciding as to the space it shall fill on the field of the picture, leaving as yet unsettled the distance, horizon line, etc. Having sketched in the general idea of this commencement, he assumes its proportions to represent the standard or scale of all other details or objects he may desire to introduce in his composition; and drawing a
horizontal line through the point on which his leading figure stands, he takes the height of that figure (say six parts, or six feet), which, reduced to a scale on that line, gives all that he requires as a basis for after-operations. He must now decide upon the point of sight, which necessarily gives with it the line of the horizon, then the distance of the picture, etc. If he desires to tessellate the floor, for instance, lines drawn from the point of sight through the divisions on this horizontal line will repeat the scale as justly on the ground line and throughout the whole perspective plan of the picture as if he had begun as first suggested; the horizontal line first assumed, serving the practical purposes of a base line and with equal efficiency.

60. Again, as in the case of a view that it would be almost impracticable, if it were even necessary, to reduce to a measured perspective plan, we may select any one object which may be considered as a definite standard, and on such premises reduce all other objects and details into perfect perspective harmony, by means most simple and easy. In the case before us, it would be as difficult as unnecessary to draw a geometrical plan. It is easier to tessellate a pavement and define every inch of it than to tessellate the traceless ocean, and yet do objects floating on its calm or disturbed surface come as equally within the government of the laws of perspective. Here we have all our lines of operation and verification to assume, except our line of the horizon and point of sight. Whichever object we select as our standard, if it be the sloop (b) nearest to us, for instance, we take its full height by a perpendicular from its vane to a central point between the water lines which mark its floating position on the perspective plane of the picture (64), and connect the extreme points of this perpendicular with the point of sight. We next decide upon the position of the ship (a) by the line F F. Supposing the ship (a) to be three times the height of the sloop (b), a perpendicular elevated anywhere on the line F F three times the height that the sloop would be if she were perspectively on that line (F F), will give the true height of the ship as exemplified; for it is evident that if the sloop were at the same distance as the ship (a), that is, on the line F F, her height would appear as indicated—a b—etc. Again, still more remote from us, let us suppose another ship (d) four times the height of the sloop, the horizontal line e e expressing that distance. By a like process do we attain the height of the ship d under such circumstances; while another ship (h), still more remote, supposed to be of the same height as a, may be thus equally, and by a similar method, brought into true
perspective proportion. It matters not which object we begin with, or upon what point on the line of the horizon we fix as our vanishing line or point of sight: the result will be the same.

61. If we choose, however, to have recourse to horizontal instead of perpendicular measurements, we can do so. As one method illustrates and verifies the other, let us take an outline of the picture under consideration, and select as our standard of proportion the ship \( A \). We take her height \((a, b)\), and (as indicated by an arc or by measurement) transfer it to the horizontal line \( FF \); then from the point of sight, or vanishing point \((e)\), we draw a line passing through the extreme as well as the dividing points of this horizontal measure. Now, it is plain that if the numerical points \( 1 \ 2 \ 3 \), measured from \( b \), on the line \( FF \), are equal to the corresponding points on the perpendicular lines \( a \ b \), drawn through them and extended to the line \( EE \) will give \( 1 \ 2 \ 3 \) on \( EE \) perspectively equivalent to those on \( FF \)—which, being equal to the like divisions on \( a \ b \) (the height of the ship \( A \)), and the measure of one of these divisions, as \( e \) taken on the line \( EE \), must necessarily give the true height of the sloop floating on the line \( EE \). And, further, if the ship \( A \) were on the line \( EE \) instead of \( FF \), her height would be equal to the measure between \( e \) and \( 3 \) on that line. In like manner we may proceed with \( F \), and so on throughout the picture; keeping always in mind the principles of the art, and working in harmony with them, our methods of operation can not lead to error.

62. It should be remembered that in ascertaining the height of an object in perspective, we must do so by means of a perpendicular drawn or imagined to fall from the highest point of such object to the perspective plane. Thus, as in the following examples, the perspective height of the pyramidal figures is not to be measured on their outline, but by a perpendicular \((A \ b)\) falling from their highest \((A)\) to the central point \((b)\) of their base. In like manner, we are not to measure the height of the vessels, in the examples we have just had under consideration, from the top of their masts to the water-line nearest to us, but to a central line and point between the water-lines on either side of their hulls—presuming the vessels to be becalmed, sitting perfectly even on the water, and their masts to be perpendicular. If otherwise, either by the action of the wind or other causes, we must still have recourse to a perpendicular as the basis of
regulating their just perspective proportions as to height; and the same observations are applicable to any other objects, as will be more fully shown hereafter.

63. The judicious selection of a Point of Distance for a picture should be one of the first considerations with an artist, and here again he has but to apply to art the practical teachings of nature. The size, the subject, the situation it is destined to occupy, the circumstances under which it is to be viewed, all require to be thought of in deciding upon the Point of Distance of a picture. It will be found that the delicately-constructed organ of sight instinctively refuses to receive more than a certain field of vision; and that as this field is increased, it seeks relief by increase of view. Thus, if we have a little picture of three inches in size, a point to view it less than nine inches distant from it is painful to the eye. A more distant point may be agreeable, but rarely one nearer, except with persons of defective vision—and even then the eye wanders over, rather than embraces the whole. If it be nine inches in size, eighteen inches may be fairly regarded as the most pleasing point of distance; thus, also, if of eighteen inches in size, at least fifty-four inches of distance should be allowed. Increase these sizes for the picture to feet, and like will be the result. Hence we may set it down as a general rule, to be consistent with the instinctive laws of vision, that the distance of a picture should be at least equal to three times its size.
64. It is from neglect or disregard of this rule that pictures often offend by the violence of their perspective. The eye instinctively rejects such impressions when they do not harmonize with its accustomed habits of observation of nature: everything seems disordered and disorganized, as they really are; it forms no just ideas of the relative positions and proportions of the scene or objects represented; and falling back upon its own impulsive conclusions, subjects art to a severer ordeal and a truer one than the most learned jury of the schools, who are too often blinded by the letter of the law, and forgetful of that simplicity of truth which is its soul, as it should be its substance, purpose, and end. In the first example, we have an outline of an apartment equal in depth and width, with three figures viewed at the distance of three times the width of the picture; in the second and third of the same apartment, with like figures, this distance is reduced with evident progress to disproportion, and in the fourth the error becomes still more palpable—which a solitary column and a square block or cube presented on the two extremes of these examples will render still more apparent. The least practised eye will be struck by the comparison.

65. To carry out our illustration of violation of a proper selection of the distance of a picture, we have at the head of the next page the same view taken at two distances—the one equal to three times the width of the picture, the other at but one half its breadth, thereby reducing it, especially in the foreground, into positive distortion. In other words, with a point
of distance assumed so near that the eye recognises neither unity nor harmony in its proportions. If the eye were placed so near to the first object in the picture (the corner post of the fence) as the distance of the second example indicates, it would naturally discard from its picture the nearer objects, and, as it were, select a more remote base line—naturally seeking to supply the want of distance by concentrating the extent of its field of vision into a narrower space, and consequently reducing the size of the picture to its distance, where it can not increase the distance, to embrace a more agreeable view of the picture. For, as objects are more remote in the perspective picture, the exaggeration in relation to them, produced by an injudicious selection of distance between the point of observation and the picture, is gradually lost, the size of the picture being reduced, and consequently the point of distance increased in proportion to such reduction. Take as much of the view in the second as we have in the first example for our picture, discarding the nearer objects, and we have thus a nearer approach to a proper and well-proportioned distance by such reduction of its size. (Chap. VII., 40.)

66. The difficulty often felt by artists for want of space to extend a proper distance on the line of the horizon as far out of the frame of the picture as may be necessary, fortunately admits of easy remedy. In truth, for most purposes of practical operation, there will seldom be found occasion to go beyond the limits of the drawing-board or canvass, however it may be better in the study thereof for the clearer elucidation of its principles. As well secured and certain points upon our perspective plan, which are governed by the point of distance, in connexion with the diagonal of the square, form the basis of most perspective operations, the following method of fixing a fictitious point of any required distance within the frame of the picture can not fail, from its value, of eliciting the serious consideration of the student, and induce his earnest study and attention. Let us suppose our intended picture to be of the width of six parts (which we may call inches, feet, etc.), and we require therefor a working point within its frame that shall
be equivalent to a point of distance of three times its width— that is, eighteen parts measured on the line of the horizon from the point of sight.

Without entering upon a more minute mathematical investigation of the principles involved than may be necessary for the practical application of the rule, and which a reference to the geometrical and perspective square sufficiently illustrate, let us begin by marking off on the base line six equal divisions, to represent the six parts which make the width of the picture. We have the geometrical square \( ABFE \) truly represented by the perspective square \( ACDB \); its diagonal \( AD \) verifying the distance (1G) of eighteen parts; and the geometrical parallelogram \( ABFC \) perspectively produced in \( ABD \). It is plain that the line \( CD \) gives a perspective depth equal to any side of the geometrical square: it therefore represents the depth of six parts. The perspective diagonal \( AD \) of the square, and the perspective diagonal \( AD \) of the parallelogram, unite on one common point \( D \), as do the diagonals \( FA - FA \) of the geometrical plan at \( F \); and \( H \) is as veritable a vanishing point on the line of the horizon for the diagonal of the parallelogram as \( G \) is for the diagonal of the square. Now, by the aid of the diagonal of the square, we have at \( G \) our true working distance, but it is out of the picture. We therefore, to secure a working point upon a similar basis within the limits of the picture, make as it were a fictitious square of the parallelogram, by dividing its side \( AB \) into six parts, and assuming these six fictitious parts of \( AB \) equal to the six actual parts laid off on \( AB \); in other words, we press the perspective parallelogram \( ABD \) into the service of a square \( (ACDB) \), together with its diagonal, by giving to its defective sides six fictitious parts to stand for the six real parts of the square. The sides \( BD - AB \) being real, and terminating in the point of sight, are not affected by our assumption, but the diagonal \( AD \) is, as it thereby represents the diagonal of six such parallelograms united; and of course, instead of a distance of three parts at the point \( H \), it gives six times that, and all that we require as a fictitious point of distance, fully equivalent, for all practical purposes, to the real point of distance \( G \), and yet within the frame of the picture. Let us, as in the next example, for the sake of clearer illustration, reduce our distance to twelve parts. The result will be precisely the
same. In this case we take two parts measured on the line of the horizon, and make that our fictitious distance—two multiplied by the number of fictitious parts on our base line proving an equivalent to twelve real parts, or the true distance. And thus we have in the perspective of the parallelogram and its diagonal an efficient representation of the square, not only in the verification of our point of distance, but, working from a fictitious point of distance, to which it either directs or from which it originates, we are enabled to produce not only the perspective of a square, but all its parts and divisions, as perfectly as if we had the real point of distance measured on the line of the horizon—and with the advantage of having all our operations within the limits of the picture.

67. Again, if we desire to increase, to any degree, the perspective depth or plane of our picture, it is even easier to do so by this process; for the lines drawn to the fictitious point are shorter and more definite in their
intersection with those terminating in the point of sight or vanishing point, than those seeking a more lengthened termination in the real point of distance. It is evident, however, that as a distance equal to three times the width of the picture brings the fictitious point at \( a \) on its very edge, a greater distance—say five times the width thereof, or of thirty instead of eighteen parts—must necessarily carry such point beyond the field of the picture. To obviate this, and still secure a working point for our distance within the limits of the picture, we have but to double the scale on the line of the horizon, and also the fictitious scale on the base line to harmonize therewith, as shown in the concluding example on the last page, by which the point \( e \) gives as certain a point of operation in connexion with the doubled proportions on the base line. A distance of five times the width of the picture, however excessive it may appear, may in many cases be required, wherein this method will be found of great value. Suppose a picture twelve feet wide, destined to occupy a position which rendered it essential that its perspective should be calculated for a distance of sixty feet: few apartments could be found of sufficient extent for operation by a veritable point of such distance; and even in smaller works of the drawing-board or easel, the application of this method will be found to obviate a difficulty constantly encountered by the artist and draughtsman.

68. Further to illustrate the operation of adjustment of extreme distances of objects on the perspective plan: let us take ten parts for the width of our picture, which are justly expressed by the numerical points on the line of the horizon, and giving to those on the base line a fictitious proportion of ten to each real measure; thus, we have one hundred fictitious parts laid off on the base line, by points of ten each. Assuming our point of distance to be three times the width of the picture, that is, thirty parts, the numerical point \( a \) on the line of the horizon gives us a fictitious point of distance corresponding to the fictitious points on our base line. Thus we have the means of accurately defining on our perspective plan the length of the line \( A \ B \) at any distance in the picture we require. In the example before us, the verification of the first four lines at the distances of 10, 20, 30, and 40 parts, is proved by the diagonals running out of the picture to the right, which, if space would allow for their extension to an intersection of a continuation of the line of the horizon, would be found
to terminate and unite in the real point of distance, as those on the left terminate and unite in the fictitious point of distance on the line of the horizon. Without requiring another example, suppose we had, say, an extensive view, and we desired to ascertain the perspective proportions of objects extremely remote; and further, that instead of allowing ten real parts (call them feet if you will) for the space embraced by the foreground or base line, we make it one hundred—thus by multiplying all our numerical points, real and fictitious, by ten, we have all that we desire. If we have an accurately laid down horizontal line, to get the perpendicular height of objects, no matter what they may be, at the distance of this line, is an operation already too familiar to need repetition.

69. It will be found that in many of the examples given we have been forced to the use of a shorter distance of view than has been recommended. This the limits of our page have in a great measure compelled, in the first place; and in the next, by exaggerating or making the perspective more violent than would be proper in a picture, the principles it was desired to illustrate may have been made more evident.

It is earnestly desired to impress upon the mind of the student the importance of resting satisfied with nothing short of a thorough comprehension of all as it is placed before him, testing and verifying each and every operation for himself. If less has been said and exemplified on the subject of the elementary principles of the art, with a more strictly mathematical analysis of these principles, it has been from the fear, based upon experience, that the learner might either wear out his patience in groping through geometrical labyrinths to little useful purpose, for want of consciousness of the ends for which he labored, or else break down in the very outset, as many a one has done before him, in terror of the long and cheerless way that presented itself—through mysterious-looking diagrams and geometrical problems, which not every head, if it has the capacity, possesses the resolution to encounter. Indeed, it may be fairly doubted if ever yet any ponderous volume of perspective complicities, however full of geometrical learning and research, was gone through in downright earnestness by the student; and if it may have been, it has been to comparatively little practical utility. The study of perspective, like that of all others connected with design, is not to be gone through by the book alone, page by page, to its accomplishment; but its knowledge must be attained by an eye rendered susceptible to the evidences of the truth of its principles, as they are developed in nature, and a mind gradually strengthened to their investigation and application in design, to which it holds the place of an accessory, not that of a primary motive. It comes to the aid of the artist in the development and expression of his art, as do many other branches of knowledge—any one, or all of which, acquired to the
utmost extent of learning, would tend but little to constitute an artist, independent of the pri-
mary and mere leading qualifications requisite for the imitative and inventive art. As the
poetry of thought precedes the measured line and its rules of harmonious expression, and as no
rules of prosody can make a poet, or gift the mind with power of expansion to the bright and
privileged world of fancy, yet is their assistance indispensable to reduce to order the pictures of
its gathering or creation.

70. Here the artist-student of perspective might perhaps be safely left to pursue his course
alone, and to rely upon his own judgment in following out the elementary principles of the art
in their various and endless applications, as all that remains is chiefly based upon merely geo-
metrical operations. To meet every case that may occur by an example, would swell our work
to more volumes than there are pages at our disposal; and, after all, if such could be done, it
would be scarcely worth the pains, and its place upon the book-shelf might be far better and
more usefully occupied. Besides, the artist and draughtsman should hold the art in his mind,
and eye, and hand—ready, quick as the thought or the impression, to give it utterance and
expression. To be thus learned it is not necessary to be for ever bending over dull diagrams
and untangling knotty problems. The field of art is too wide, its privileges too free for this.
The artist's best school is abroad, in the bright, beautiful world of nature, for ever developing
subjects for admiration, and tempting his imitation. There is nothing on which his eye can
rest that does not teach him lessons of his art, when once his perceptions are awakened and
trained to their comprehension. Endless as may be his work of knowledge, so are his re-
sources; while others plod on a duller way through life, he reaps while he sows, and bright
blossoms mingle their perfume with the ripened fruit, which repays his labors and makes glad
his toil.

71. In resuming the consideration of the geometrical operations of perspective, we are natu-
really led back to the beginning, but to that beginning with a degree of preparation that leaves
little more to be required than mere hints to assist the student in the application of the princi-
bles of the art, with which he must be already familiar. It is scarcely necessary to remark that
we must have a distinct and definite idea of the forms and objects we desire to place in our
picture under the influence of the laws of perspective. We must consider them as real and
tangible, and upon the basis of this knowledge we are enabled perspectively to define their
positions, proportions, parts, and details. In many cases we may be compelled to have recourse
to imaginary data in the course of our operations, but still these data, governed by harmonious
laws are sufficiently reliable for our purposes; brought, as they are, in constant contact, comparison, and trial, with self-evident truth, they can never deviate far from it without detection and consequently ready means of correction are thus afforded.

72. To place a Point in Perspective.—Although this is but the repetition of an operation which has been repeatedly performed already, it comes in place, as the beginning of our geometrical exercises. Here we have no other geometrical plan than an indication of the actual distances of two given points (A and B) from the base line, which distances being carried to the base line, as indicated, and repeated thereon, by arcs, or measurement, give two points (a and b) equivalent to the diagonal points of squares equal to the distances of A and B from the base line. Hence the lines connecting the points (c and a) marking the distances of A and B to the base line, with D, the point of sight—and the connexion of the diagonal points (a and b) with C, the point of distance of the picture, give in the intersection E the perspective position of A, and in F that of B—under the circumstances of C D C, the line of the horizon—D, the point of sight—D C, the distance of the picture, and A a, B b, the distances of A and B from the base line of the picture.

73. To place a Line in Perspective—having once secured its extreme points, as above,
will certainly present no difficulty, no matter in what direction that line may be in reference to the base line of the picture. That done, it will be as easy to place three points in perspective as two, and four as three; therefore—

74. To place a triangle or irregular figure in perspective, by merely connecting such points thus attained, is a process equally as plain, without regard to the distinction between parallel or oblique perspective (48). All that is required to be known is the actual position in which it is desired to place such figures on the perspective plane in reference to the base line. In this example there is not a single line of the figures either at right angles or parallel with the base line; hence, not one in their perspective representation seeking a vanishing point in the point of sight, or running parallel with the base line and line of the horizon, as in the numerous instances of the square lying parallel to the picture, to which we have so often referred, and which must be sufficiently familiar to the student to render a repetition unnecessary; nor would it appear more requisite to renew our example.

75. To place a perpendicular line or figure in perspective, except to preserve progression in our operations, and recall to mind those of a similar character which have been previously considered more at length.—Here, as in the case of all before us, we have no square or its diagonal expressed, but we have its governing principles throughout, working in as perfect harmony as to results. With a little careful practice and proper understanding of the principles involved in the few cases which will now be added, in connexion with what has been previously said and exemplified, the student may be safely considered in the possession of the elements of the art, and he should learn to look to himself for the perfection of the knowledge he may require, rather than to desire that all should be prepared for his hand. In the field of art, he that would reap must toil, however light may be made that toil if entered upon with a right spirit. He toils most painfully
who pursues its course in darkness and obscurity, and the light of truth is surest gained by earnest seeking.

76. To place a circle in perspective, whether as a simple form, lying flat upon the perspective plane, perpendicular to it, or in any other position—or taken as the basis of more solid forms, such as the cylinder, cone, etc.—requires to have recourse to its relation to a square, as best illustrated by the examples, and the working operation by which they are perspectively produced; the points of the contact of the circle with those of the square, as \(A B - C D - E F - G H - K\) forming the basis upon which in their reproduction in the picture as \(a b - c d - e f - g h - k\), we can by their connexion, by an easy and harmonious line, in which we must depend upon accuracy of the eye and judgment, as well as decision of hand, attain the desired end. If the operation holds good in one case it will in another, and we have but to transfer such points to other required positions, under precisely the same circumstances that we would if we desired merely to place the square itself in
perspective. In the example m, the operation is more simple, from the parallel position of the circle in reference to the base line; here we have but to decide upon the central points, and the assistance of the compasses secures the circles.

77. To place two circles of different diameters, lying horizontally, on a common central perpendicular, is but a similar process, as the example will show. To carry out this operation in the numerous cases in which it is applicable, such as columns, vases, and the like, would be an endless undertaking; and the student can for himself do better, by exercising his ingenuity, than if he had placed before him volumes of complicated diagrams, which are better comprehended in working through the progressive details of their operations, than attempting to untangle the unavoidable confusion of points and lines, which often tend more to distract and mislead than to elucidate. One result reached through our own earnest seeking is worth many attained by merely looking on to see how it is done. It becomes our own when we have fairly earned it, and in the way of its earning we may have gathered perhaps more than its value in other useful hints and points of knowledge, which would otherwise have been lost or overlooked by us. It is scarcely necessary to give a rule for the management of the semicircle, or any portion of the circle taken separately, as that which serves for the whole must hold equally good for a part. Above we have an example of a method—
78. To place a line of arches in perspective, which we leave to the student without remark. If it should puzzle him a little at first, it will be all the better for the exercise of his ingenuity. There is no line therein that has not its use and meaning, and every principle of the art connected with the operation has been, in some place or other, already explained.

79. If attention thus far has been almost exclusively directed to the perspective of regular forms and figures, it is that its rules are more plainly demonstrable with reference to them than others of a more complex character. As soon as we leave right lines, all the art can do for us is to fix certain points, and we are left to our skill of hand and judgment for the rest. In the examples of the circle to which our attention has just been directed, we could but secure its perspective points with reference to the square; and had it been an ellipse, oval, or other more irregular form, the art would have done as much, under similar operations, by the selection of such points of the line or figure required as might form the most ready and secure basis of its perspective expression. It will not be necessary to follow the operation of the annexed exam-
are led to its application in reference to open doors, shutters, box-lids, and such like, moving on central points or hinges; for in the opening and shutting of a door it describes nothing more nor less than the arc of a circle, on which arc, in connexion with its central point, we have our governing points. We must therefore look to the circle as the basis of our rule in all such and similar cases.

80. To place an open door, and such like, in perspective.—In reference to the example, the simplicity of this process will at once appear, the perspective plan of the semicircle forming the basis of the operation. The example, however, illustrates another point, to which reference was made some paragraphs back (47, 76), as well as on other occasions. We have, in no one of these open doors, their horizontal lines terminating or vanishing in the point of sight, or running parallel with either the base line or line of the horizon; but still they seek on the line of the horizon vanishing points in harmony with their position, as all the horizontal lines of A find their termination or vanishing point at $\mathbb{B}$, those of $\mathbb{C}$ at $\mathbb{D}$, and those of $\mathbb{E}$ at $\mathbb{F}$—which would not be the case were the three doors closed. In such case, those of $\mathbb{C}$ would run parallel with the line of the horizon and base of the picture, while those of $\mathbb{A}$ and $\mathbb{E}$ would necessarily terminate in the point of sight. And, on the other hand, were the doors opened so as exactly to stand at right angles with the wall—that is, if $\mathbb{A}$ and $\mathbb{E}$ were exactly on the line $\mathbb{a} \mathbb{a} \mathbb{a} \mathbb{a}$—then would their horizontal lines be parallel with the line of the horizon; and if $\mathbb{C}$ were exactly on the line $\mathbb{b} \mathbb{b}$, it would stand in a similar relation to the point of sight that $\mathbb{A}$ and $\mathbb{E}$ would do if closed, its horizontal lines terminating in the point of sight.
81. To place in perspective an open trap-door, or any other object, in a position neither horizontal nor perpendicular, is a process somewhat similar to that we have just had under consideration, and which the last example on the preceding page sufficiently illustrates. If these doors were closed, their outlines would as perfectly harmonize with the base line and point of sight as a square or any other rectangular figure occupying a parallel position in reference to the base line; but when opened or moved from their horizontal position, the lines of their sides \((aa-aa)\), which still retain that position, the one fixed on a central pivot by its hinges, and the other describing an arc of a circle about that centre, alone continue to harmonize with the point of sight, by seeking a vanishing point therein, or the base line by remaining parallel with it. The others \((bb-bb)\) either preserve a parallel with themselves, as in the first figure, having started, as it were, in that relation to each other when the door was closed \((as ee)\), while in the second figure they started from lines \((ee)\) bearing reference to a vanishing point derived from the line of the horizon by virtue of their horizontal position which they lose the moment they are removed from it, and must necessarily seek, in describing the semicircle, a constantly changing termination; or, being never parallel to each other except when the door is perpendicular, that is, when it is even with the vertical line of the semicircle, they must necessarily, if extended, come in contact, and this point of contact is always somewhere on a vertical line drawn through the vanishing point in which they terminated when in a horizontal position, and either above or below the line of the horizon, according to their deviation from a perpendicular. In the first example before us, in which the trap-door lies parallel to the base line, the lines \(ab\) preserve their parallel relation to the base line, under all circumstances of their movement; while in the second example it is placed obliquely, and consequently these same lines being no longer parallel in the perspective, seek a vanishing point on the line of the horizon \((as a)\) to which point they terminate, and with which they constantly agree in the movement of the door, while
the lines of the other sides find their termination on the vertical \( cd \) to their original vanishing point \( b \). Now all this may seem to be a great deal to say about a trap-door, but if the pupil will give it his earnest attention, he will find in this and the previous examples the solution of one of the most beautiful problems of perspective—one well worth remembering.

84. To place a plane, or figure, which is neither horizontal nor perpendicular, in perspective.—This has already been accomplished, in part, in the operations just considered: for, if we regard such planes as the sides or parts of more solid forms, we have, in the rules by which we placed in perspective a simple door, either moving horizontally or vertically, the basis of unlimited application of the process, which assimilates and verifies itself in every respect with that which has just preceded, as will be evident from the examples annexed.

85. There are many cases, however, in which a shorter and more direct method may be adopted; one in which we assume such a solid form as the plane we desire to represent in a certain degree of inclination, may most naturally, and most advantageously for our purpose, form
a part. With proper judgment in the selection of the assumed form, it is easy to see how man ageable it may be made. A certain and decided figure once secured, the lines of its various sides, sections, diagonals, angles, etc., give all that can possibly be required as a basis. We have but to place such original figure in perspective, to acquire safe grounds of operation. If these inclined planes are intended as the basis of round or irregular forms, we must then proceed as in cases already explained, where such forms rested either on the horizontal or perpendicular plan or plane. Before leaving these examples, it is desirable to call attention to the influence of the line of the horizon and vertical line drawn through the point of sight, and their similarity of service with regard to the vanishing points of inclined planes—that is, planes inclined from either a horizontal or perpendicular position.

84. It must be evident that the mere opening or closing of a door in a picture can not affect either the point of sight, line of the horizon, and point of distance; and further, that the point of sight has no other influence on the vanishing point of the lines expressing their oblique position than its government of the line of the horizon in the one case, and vertical in the other, on which they find their concentration, more or less remote from the point of sight in proportion to their obliquity. Hence, the vanishing points of all objects and lines lying obliquely—that is, neither parallel with, nor at right angles to the imaginary line from the eye of the observer to the point of sight—may be considered as independent of the point of sight; however the point of their concentration or vanishing point must find its place upon the line of the horizon, or vertical, as the case may be. This, however, is only when such inclined lines or planes are based upon a horizontal or vertical plane: in others, occupying, as it were, a doubly oblique position—that is, having no coincident agreement with either a parallel or vertical—neither the line of the horizon nor vertical supplies a point of concentration for their vanishing points, but others must be sought in harmony with their position, and these are obtained by the operation of similar principles.

85. So far as the principles of the art of perspective are concerned, the vertical passing through the point of sight may be said to correspond with the line of the horizon; and many cases may occur in practice in which the vertical may serve even better than the line of the horizon; in which, instead of the base, we use the perpendicular side of the picture as its parallel. To illustrate this, we have but to look at an example of perspective by turning it so as to bring its sides in the relation of a base line—that is, change them from perpendiculars to horizontals—to see not only the similarity but unity of principle in consideration. If, for example, we have doors, window-shutters, oblique projections, and the like, to represent on the wall or side of a house,
moving or inclining, like trap-doors, etc., on a level floor, we have but to treat them as if they were on a level, by substituting the perpendicular for the base line or edge of our picture, and the vertical for the line of the horizon, in accordance therewith.

86 To place a flight of steps in perspective, as well as figures in their just proportion on such, will prove an easy operation, as it requires but the exercise and application of the most simple rules of the art. In the example now presented, we have a double scale of proportions—

the one (A B) for the figures, the other (C D) for the steps—the one based upon and agreeing with the other. It matters not which we first assume; whether, in the outset, we adapt the scale for the figures to that of the steps, or the steps to the figures, or even which figure or which step we start with in our operation, the result will be the same—the advantage in commencing with the most prominent points only consisting in the readier attainment of accuracy by reducing from a larger rather than increasing from a less scale. It will be seen, by reference to the example, that the lines a—a give the height of the first step at the perspective distance in the picture of the first figure; and moreover, b c being equal to A B, the measure of the figure gives on C D at the point d
an equivalent to its height, equal to that of about nine steps, as indicated by the numerical points on $c d$. Without risking confusion in the example by the introduction of more numerical points and lettered references, we will suppose the process of producing the first four steps and the first figure evident—their proportions agreeing as well in relation to each other as to the figure—such lines as by reason of their position naturally run parallel with the base line and others seeking a concentration in $e$, the point of sight. The lines that, in reference to the first four steps, terminate in the point of sight, define the depth of each step, as well as the width of the whole flight $(1, 2, 3, 4)$; but in those of the next $(5$ to $14)$, such give the direction, but not the depth, either of the individual steps, or that of the whole flight—horizontal lines necessarily performing that service. As, in the first, the lines $(x, x, x, x)$ which express the inclination of the flight, and at the same time its width considered as a plane, are parallel to one another by reason of the parallel position of the base of such inclined plane with the base line of the picture, so must those in the second instance preserve an equal harmony with the base of their inclinations, whose lines $(a f h g)$, terminating or vanishing in the point of sight $(e)$, fix their concentration in a point $(f)$ vertical to and distant from it, according to the degree of inclination of the plane. It will be found as easy on such premises to define and perspectively to represent the second as the first flight. Our measures are still derived from one common scale $(c d)$; in the second case we operate with lines running to the point of sight, precisely as we did with parallel lines in the first instance; and, on the other hand, with parallel lines as we did with those vanishing in the point of sight—the parallel lines of inclination $(x, x, x, x)$ being supplied by others terminating in the point $f$.

Carefully noting these observations and their application, with the assistance of the example, the whole operation will be found more simple than may at first sight appear.—As to the other figures: we know that our average height for the first is about equal to that of nine steps; therefore the position of a figure standing on the fifth step must give for its height, on the scale of our measurement of the steps $(c d)$, considered as a perpendicular from the base line, about fourteen parts; $m = n$ therefore secures a measured perpendicular on the fifth step equal to the height of nine—and hence, by the lines $m = n f = m = n f$, the means of ascertaining the perspective diminution and just proportion of any figure or object on these steps, as well for a railing or other accessory that may be desired. With regard to the steps in the lower left-hand corner of the example, it will be remarked that by the nearer approach of the vanishing point $a$ to the vanishing point $e$ of the lines of their plane, they are deeper than those just considered $(5$ to $14)$, the angle of inclination $(g a p)$ being less than that of $f q p$, and its base $(r p o q)$ longer; for if these steps were of the same depth as those from $5$ to $14$, their base would be as $s t p a$, and $f q p$ their perspective angle of inclination.
87. As to the actual depth of each flight, measured on its base, or that of each individual step in the first case it is plain enough at sight, and perspectively considered it may be equally so with reference to the others. In the one case we have a positive measure by reason of the parallel relation of their profile plan with the base line; and in the other we have but to recur to the diagonal of the square, in connexion with the point of distance, for equally as certain if not as ready premises. Let us take the last-considered flight of steps in illustration. The height of these steps we already know, for it was assumed in the beginning as our original scale, or taken in reference to the figure; if not, it can easily be obtained by a process too simple and familiar to require repetition. The height being laid down on the length, it is found that the step is seven times as long as it is high. Now suppose, it is desired that its depth should be equal to four times its height (let us say four times, as it gives more working room; were it more or less, a like operation would still serve as well): aided by the points of sight and distance, the square $abcd$ is easily obtained, and thus having $ac$ and $ab$ perspectively equal to $cd$, gives as certain a measure of four times the height of the step as $cb$. We have now the base of the block forming the step; we know its height; therefore, to place the whole in just perspective is readily accomplished. Moreover, by the direction of a diagonal $(ce)$, is secured a vanishing point on the vertical, which gives the accurately-defined plane of inclination of any number of such steps; or, on the other hand, if it is desired to assume the base $(cghk)$ of the whole flight as our premises, by its divisions and proportions like results may be attained.

88. To place circular, curved, or other than rectilinear-shaped steps, in perspective, is effected by the application of rules and methods already given, with reference to such like forms in their relation to rectilinear shapes.

89. To place in perspective a winding or spiral flight of steps, requires an operation more complex and laborious than difficult—one involving a perfect intelligence of the principles of the art, and one of the most profitable exercises that can possibly try the knowledge and ingenuity of the student. Complex and incomplete as may appear the example on the next page, without other explanation, it will be found perfectly intelligible, to those who have fairly investigated and practically verified for themselves the operations of the rules of the art.
90. However incomplete a work on perspective may appear, without its rules in reference to shadows, the artist-student, whose eye now looks on nature alive to the just perception of the influences of the art, who can counterfeit the reality in conformity with its laws, can scarcely need a recipe for its shadows; falling, as they do, in masses, more or less defined, of position and form, modified and influenced in their shapes by the recipient object on which they are thrown, and those by whose intervention with the source of light they are produced; perspective pictures traced, as it were, on perspective pictures, and mutually developing each other in perfect harmony with the great and leading truths of the art; doubling the resources of design, in the means of its expression, and placing in the intelligence and hand of the artist a power as unlimited as the mind's imaginings.

91. To place objects reflected in perspective, needs but one general rule, requiring the reflection to be treated as a reality. Consider it, thus, an inverted duplicate, not of the picture,
but of the reality, and the way is plain. To illustrate and verify this, place a mirror level on a table, and upon it any object that first comes to hand, a book, a pen, a letter, anything—the perspective direction of the lines of the reflection will be found perfectly to harmonize with its original, and its image perfectly inverted. Look again to the mirror on the mantelpiece or wall, and remark how perfectly the perspective of the objects presented by it responds to the originals. Should the glass be not perpendicular, an irregularity, as it were a general upsetting of everything, will be perceived; for thus the perpendicular plane of its picture is thrown out of harmony with nature, and all its lines follow. The same would be the case if the mirror were placed flat, but not perfectly level, with regard to all objects retaining their horizontal and perpendicular character, but the reflected images of those resting on its surface would still harmonize with their originals, in the degree of inclination of its plane, etc.

Fortunately, in our most frequent occasions to represent reflections, they are given back by a mirror, ever most true of all other objects to the level—Nature’s mirror—not duplicating her perspective pictures, as presented to the eye, as if by a mere inverted tracing of their outlines, but with all the truth of an actually inverted image of the reality. Such objects as rise or occupy a position perpendicularly in reference to the mirror-like surface of the tranquil water, preserve their real proportions. Thus, the cliff that rises in an unbroken perpendicular above its base, throws its reflection to its full height; while that of the receding hill or distant mountain, although much higher, may scarcely be seen at all, though rising far above it—the boldness of the perpendicular cliff perspectively covering the inclined plane. If the point of observation could be placed exactly on a level with the water, then and then only, would the real picture be repeated; but the slightest elevation of the point of view.
and consequently of the line of the horizon, above the level of the water, affects the general outline of everything reflected that is not perpendicular to the water's edge, as more fully demonstrated in the annexed profiles, showing the perspective relations of the various elevations. In objects projecting over the water, as the beam in the example, the reflection will of course be naturally longer than the receding lines of the original. An arch may repeat its outer semicircle as perfectly in its reflection as it really is, and so may be also its more receding outline, but the archway itself is not perfectly duplicated. In the original we see less of its internal form than we do in the reflection, for the elevation of our point of view enables us to see farther into the reflection than within the arch itself.

Although brought to a conclusion of this chapter without having covered, as it may seem, the whole ground of perspective, the artist-student will find therein, if not a recipe for all his requirements, the elements and principles of the art sufficiently explained to enable him, upon their basis, to meet any difficulty that may be presented in the course of his practical operations. The fear of big books and elaborate treatises drive many a one from the pursuit of knowledge, and most of all, those devoted to the arts of design; whose restless spirits unwillingly bear the control of any established routine; unapt to delve in the mine of abstruse investigations, they hasten to conclusions; and, most fortunately, all their requirements of knowledge are progressive. Discovery and possession beget wants, and he who lives the longest, and knows the most, has more still to learn. In the next chapter it will come in place in some degree to review the subject of perspective as to its practical application in drawing and sketching from nature, when an opportunity will be presented of introducing at least more generally pleasing subjects for illustration than mere diagrams.