PERSPECTIVE DRAWING

HERMANN VON BARAVALLE, Ph.D.

WALDORF SCHOOL MONOGRAPHS
25 PERSHING ROAD
ENGLEWOOD, N. J. 07631, U.S.A.

PREFACE

Perspective Drawing involves both the application of geometric laws and artistic skill. It has immediate practical value for almost everyone who wishes to make a correct drawing of a house, of the interior of a room or of specific details of a staircase, for instance. Perspective constructions open up a distinct awareness and sense of observation. We all deal with perspective; every photograph is a perspective presentation.

Perspective is one of the required subjects in the Waldorf School Plan in the 7th grade curriculum. The 6th grade takes up geometric drawing, and the 8th grade the making of models in solid geometry. Thus, Perspective Drawing holds a middle position between the study of the two-dimensional forms of Geometric Drawing and the three-dimensional studies of Solid Geometry. It is a welcome subject, specifically fitted for this age—which can be characterized as realistic.

The materials recommended for Perspective Drawing are a drawing board, a T-square for horizontal lines, a ruler, triangles of 30° and 60° and good mechanical drawing paper. A triangle erected on the horizontal T-square serves for vertical lines. India ink and ruling pens can finish a drawing for printing or permanent use.

The Perspective Middle

In order to lead directly into the essential nature of perspective, one may begin by drawing two vertical lines on the blackboard, one long and strong and the other short and thin (see Figure 1). When asked what these lines might represent, the students may respond in various ways. One of these is: "The two lines look like poles, one of them nearer and the other farther away."

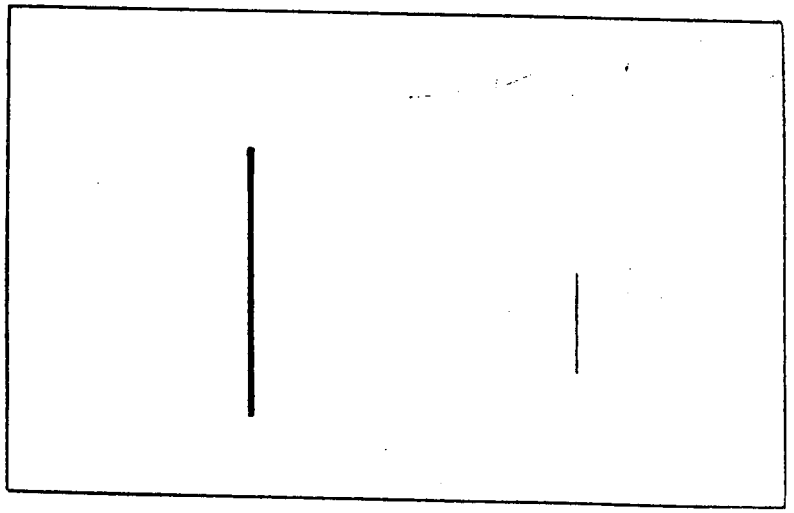

Figure 1. Near and Far

One might continue to ask: "Assuming these lines represent poles of the same height and that their different sizes are merely due to their respective distances, where would a third pole have to be placed to be in the exact middle between the other two?" One of the students might give his answer by measuring the distances between the two poles and placing the third halfway between, as in Figure 2.

As soon as this diagram appears on the blackboard the reaction will come from the class: "No, this is wrong. This pole is too close to the left one." Asking for another trial, the students might use the judgement of their eyes. After several attempts one may wish to arrive at more than a mere

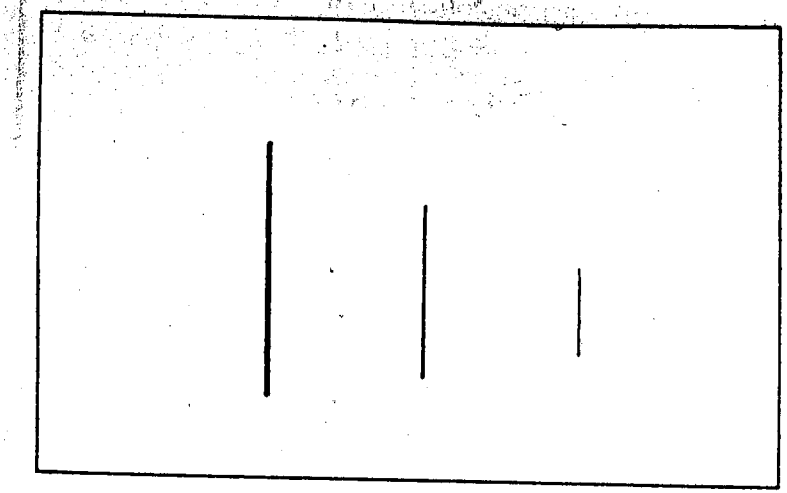

Figure 2. Wrong Solution of Finding the Middle Pole

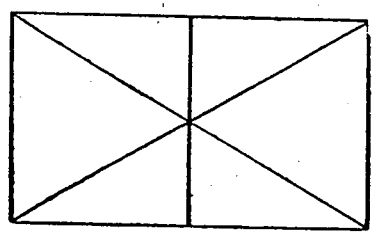

Figure 3
Bisecting With Diagonals

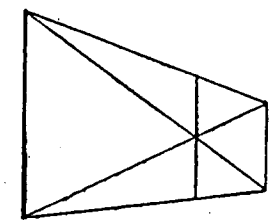

Figure 4
Perspective Bisecting With Diagonals

The point of intersection of the diagonals furnishes the middle between the poles and the same principle applies to the perspective distances of the poles, as shown in Figure 4. A photograph would substantiate the construction.

Perspective Divisions in 4 and 8 Parts

From the perspective bisection one can take further steps. Applying the bisection repeatedly one arrives at di-

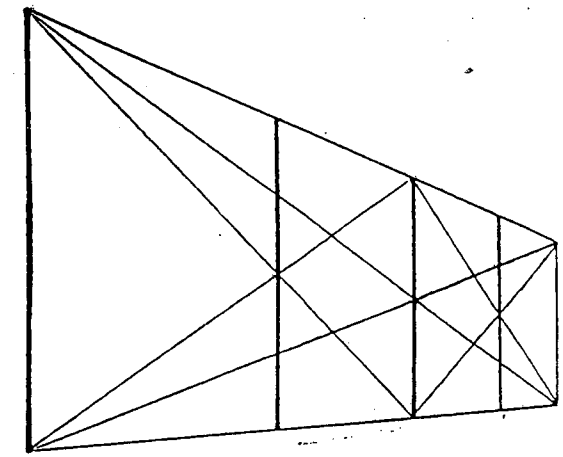

Figure 5. Perspective Division into 4 Parts

construction again join the tops to the bases of the given poles. This furnishes a pair of diagonals whose intersection-point determines the position of the middle pole. Then the diagonals between the middle and first poles, as well as between the middle and the last poles, are added.

Continuing in the same way one arrives at 8; 16 . . . divisions. Practical applications are manifold. In Figure 6, an 8-division is used to find the positions of the trees along the roadside.

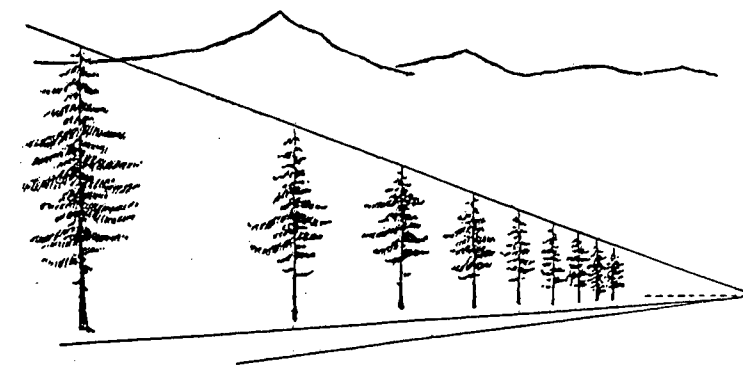

Figure 6. Application of the Perspective Division into 8 Parts

The student can then freely complete the picture, by the use of colored pencils. Also, water colors can be used successfully. Thus the drawing combines strict geometric constructions with a free artistic creative element.

Perspective Trisection

After some perspective divisions have been taken up with the students they likely will ask for further divisions, for instance, the division into three parts, the perspective trisection. It is shown in the Figures 7 to 9. First, the two given poles are in frontal position, both with the same height (Figure 7).

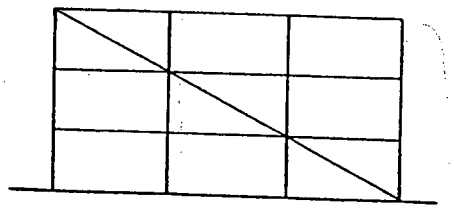

Figure 7. Trisection of the Distance Between 2 Poles (Frontal Position)

The first step is to divide the height of one of the poles into three equal parts. This can be done either with the help of a ruler which has centimeter- or inch-scale or by means of a geometric construction. The latter is shown in Figure 8.

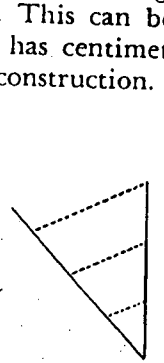

Figure 8. Construction of the Division of a Line Segment into Three Parts

The first step is to draw an inclined line through the base point of the pole. The angle of this line can be selected at will. Along this line any chosen length is cut off three times. The third point reached is then connected with the top of the pole by a dotted line. To this line the two other dotted lines are drawn parallel through the marked points. Their intersections with the pole furnish the points which divide it into three equal parts (based on similar triangles). In figure 7 this construction has been used to draw its horizontal lines. A diagonal is added from the top of one of the given poles to the base of the other. Its points of intersection with the horizontal lines furnish the positions of the poles in the 3-division. In Figure 9 the construction is applied to the perspective division with poles which recede into the background.

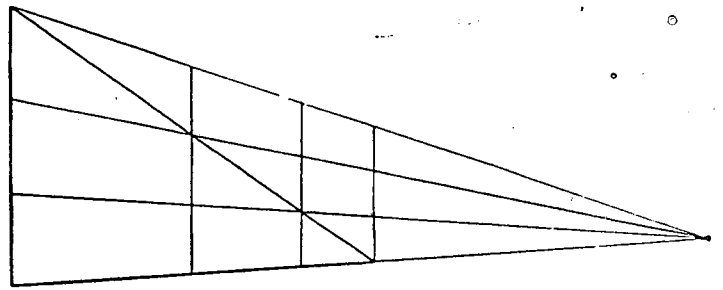

Figure 9. Perspective Trisection (Unequal Distances)

Given are the first and the last poles. Their tops and their bases are connected and the connecting lines extend to their vanishing point. The first pole is divided into three equal parts and the points of division are joined with the vanishing point. The top of the first pole then is connected to the base of the last. This diagonal intersects the hori-

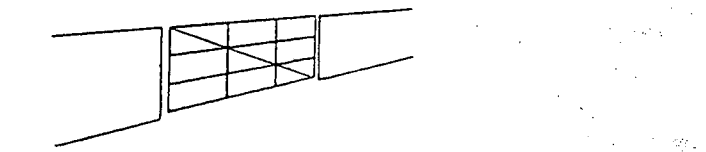

Figure 10. New England Fence Showing an Application of the Construction of the Perspective 3-Division

zontal lines. The intersection points furnish the positions of the inserted poles of the perspective 3-division.

An application of this construction is the drawing of a fence or door such as is frequently found in New England. The diagonal is actually contained in the door as its supporting wire.

Another application of the 3-division is drawn in Figures 11 and 12, showing a window of colonial style. There is always an odd number of window panes in each row. The reason for this is that one does not wish to have a partition in front of one's eyes when standing before the middle of the window.

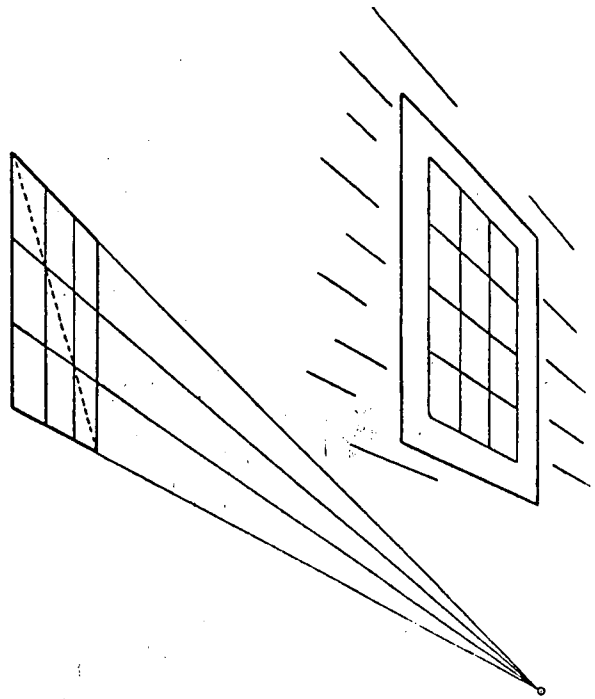

Figure 11 Figure 12

Window in the Colonial Style

In Figure 11 the construction of the 3-division is carried out using the vanishing point. In this case the latter is lower than the window, which means that the window is above the

eye level of the spectator. In Figure 12, the 3-division is combined with a vertical 4-division into equal parts.

Constructions of this kind readily can be applied to any division of even or odd numbers.

Perspective Extrapolation

All perspective divisions so far have been by inserting dividing lines between given limits. These are called perspective interpolations. But one is also frequently confronted with the task of starting a perspective series from the first two poles and extending them to the 3rd, 4th, etc., poles. This is called perspective extrapolation. In Figures 13 and 14 poles 1 and 2 are given. In each case the third pole has to be found.

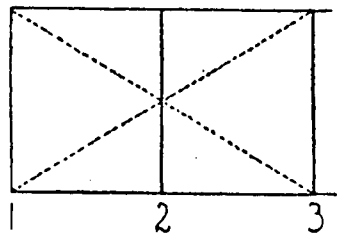

Figure 13

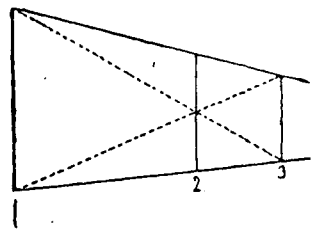

Figure 14

Perspective Extrapolation

The solutions in Figures 13 and 14 are based on the fact that the diagonals intercept in the middle of the second pole. As the poles stand in vertical position this is not a perspective but an ordinary division. The construction is as follows: Bisect the second pole, draw and extend the dotted diagonals. Connect the tops and the bases of poles 1 and 2. The end points of the 3rd pole are located where the lines intersect with the dotted diagonals.

Construction can be continued in the same way to a 4th and 5th pole. Instead of bisecting the poles repeatedly, one can draw a line connecting all the mid-points of the poles and the vanishing point (See Figure 15.)

One does not need to use both diagonals to get the position of a pole. A continued construction with a single diagonal for each step is shown in Figure 15.

An application of this construction is drawn in Figure 16, showing the railing of a boardwalk or on board a ship

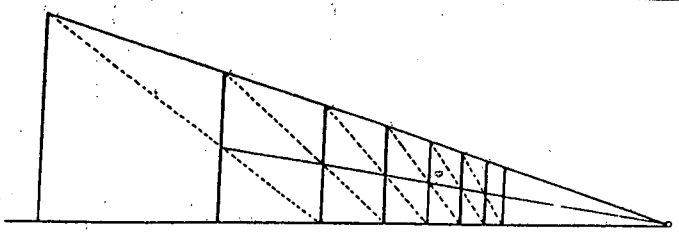

Figure 15. Continued Extrapolation of a Perspective Series

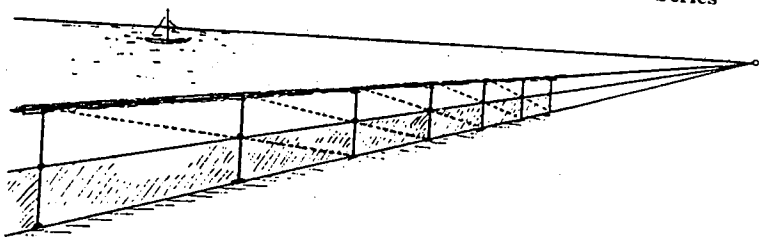

Figure 16. Application of a Continued Perspective Series

The horizon at sea is always on the same level as the vanishing point of the railing, or of any other group of horizontal lines.

Perspective Series of Horizontal Lines

Each of the constructions which have been used for vertical poles also can be applied to horizontal lines. Compare, for instance, Figure 17 with Figure 15.

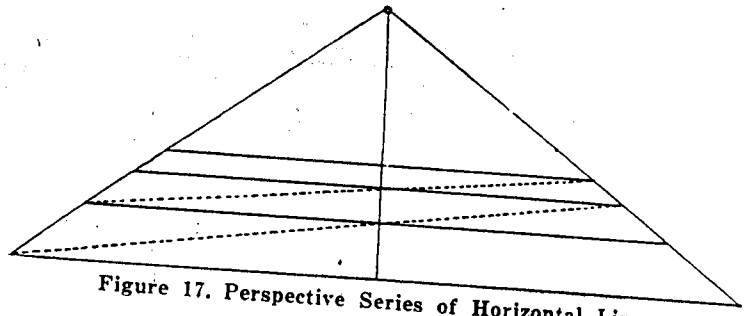

Figure 17. Perspective Series of Horizontal Lines

Figure 18 is begun by drawing a horizontal line on which a chosen line segment is cut off an odd number of times. The vanishing point is selected above the middle of the base line which is connected with all points marked on the horizontal base line. The dotted diagonal is drawn across

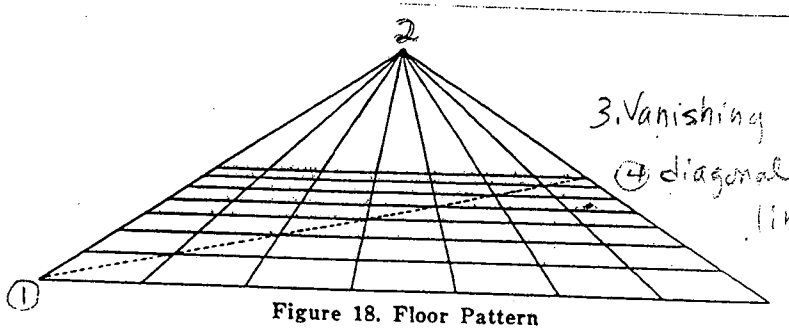

Figure 18. Floor Pattern

these lines at any chosen angle. Through its intersections with the concurrent lines, one draws horizontal lines. By making the spaces between the horizontal and the concurrent lines alternately black and white, the floor pattern of Figure 19 emerges.

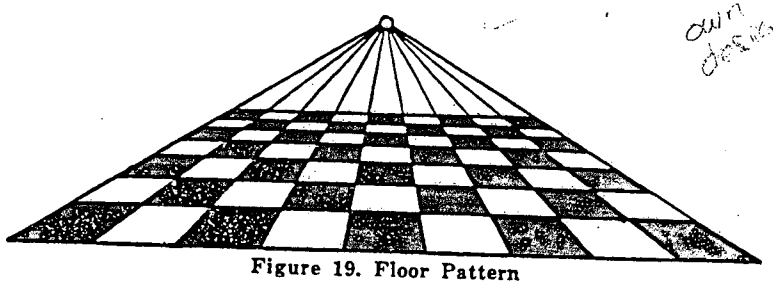

Figure 19. Floor Pattern

An application of this construction is drawn in Figure 20.

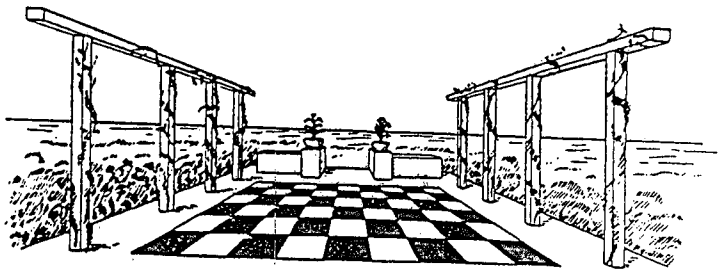

Figure 20. Application of the Preceding Constructions

Different floor patterns can be obtained by using the same construction in variations. For instance, with alternat-

ing smaller and larger distances measured off on the base lines (See Figures 21 and 22).

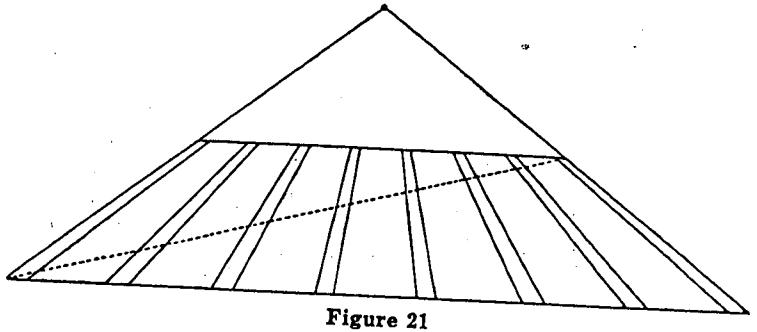

Figure 21

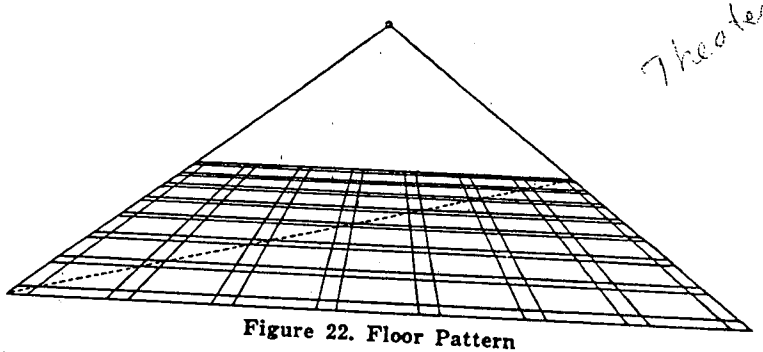

Figure 22. Floor Pattern

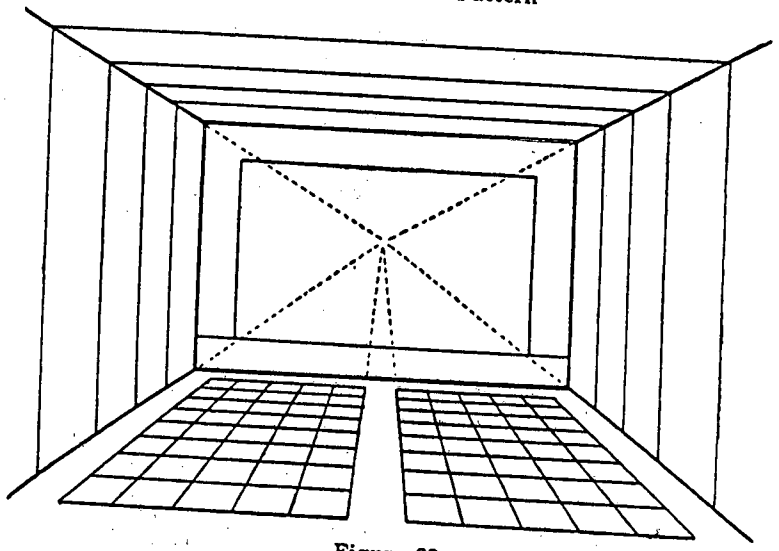

Figure 23

The difference between Figures 23 and 24 lies in the position of their vanishing points. In Figure 23 the vanishing point, and with it the eye level, is higher and one sees the theater from a balcony. In Figure 24 the vanishing point, and with it the eye level, is lower and the theater is viewed from the parterre.

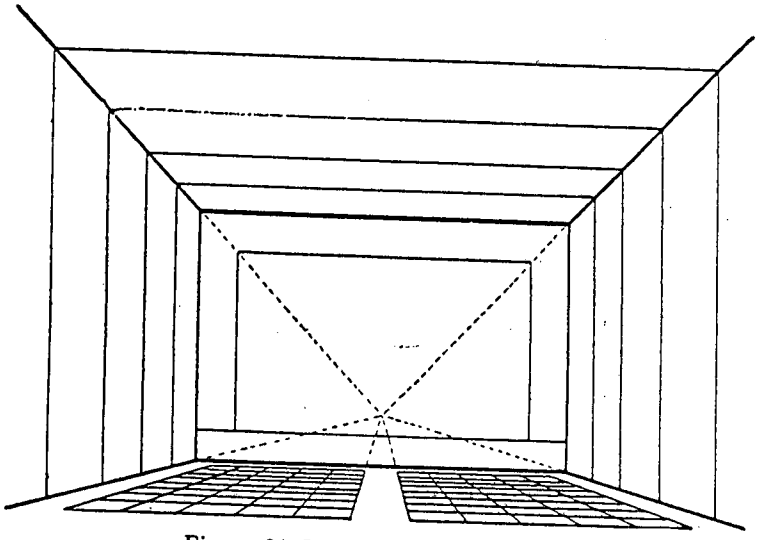

Figure 24. Inside view of a Theater

In Figure 25 a perspective series of horizontal lines is constructed once more, and the diagonals of the squares are extended to their vanishing point. The vanishing points of those lines which go straight back lies on the same level.

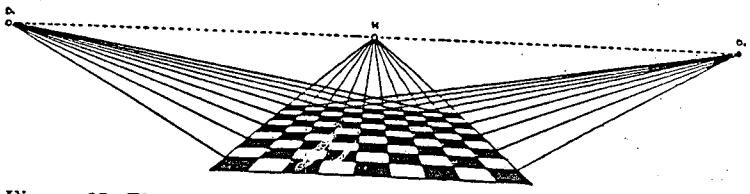

Figure 25. Floor Pattern with the Vanishing Point of the Diagonals

A related diagram, also a floor pattern in a horizontal plane, is drawn in both Figures 26 and 27. It starts by placing nine equal line segments on a horizontal line, as seen in Figure 26. The points thus obtained are joined with a vanishing point selected at will above the middle of the

horizontal base line. A horizontal line is drawn through this vanishing point and two more vanishing points are selected on it, one to the right and one to the left.

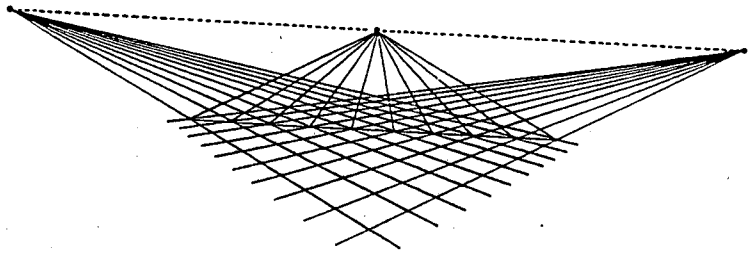

Figure 26

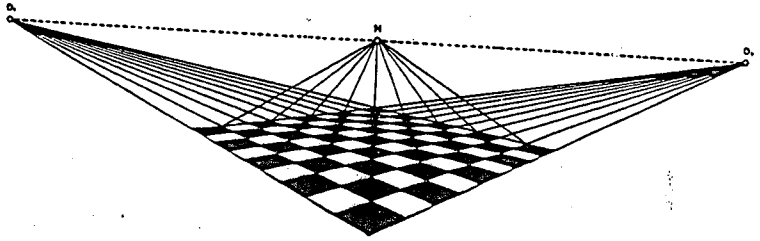

Figure 27

Finally, these two vanishing points are joined with each of the points marked on the horizontal base line. By making these spaces alternately black and white, one obtains Figure 27.

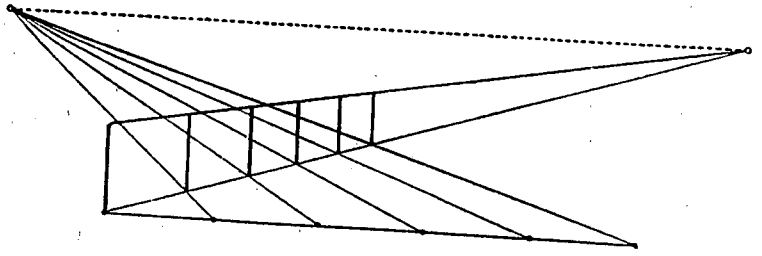

Figure 28

From studies of this kind, another construction of a perspective series can be obtained. Assuming that a perspective series of poles is to be inserted in a given space, their positions can be constructed as shown in Figure 28.

A first and a last pole are drawn and are connected with a vanishing point. One then draws a horizontal line through the base of the pole and cuts off equal line segments along it (the points are shown by little dots). One now can select a vanishing point on a perspective horizon at will and connect it with the points which are marked with the dots. The intersection of these lines with the inclined line are the footprints of the vertical poles in the perspective series.

This construction can be applied to an alternating series of smaller or larger distances such as is found frequently in the drawing of buildings when window spaces and wall spaces alternate (See Figure 29).

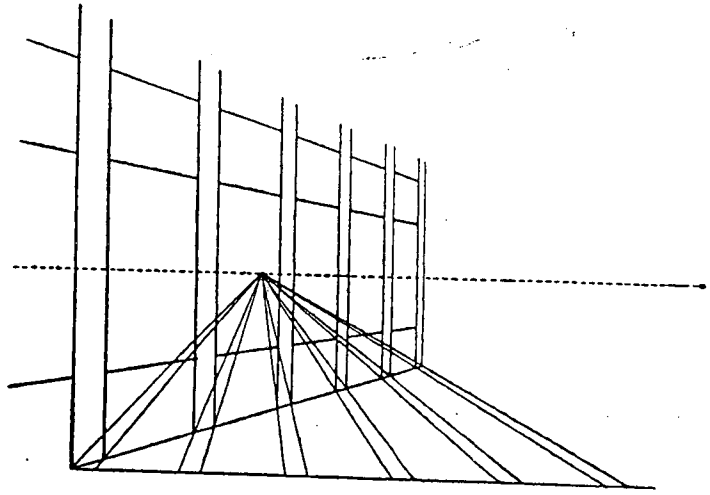

Figure 29. Front of a Building

A house front where the spacing is not repeated but formed according to a given pattern can be transformed into a perspective view. An example is given in Figures 30 and 31. Figure 30 shows a view of a house front as an elevation of the architectural drawing. The measurements of the altitudes are transferred to the left vertical edge in Figure 31, whereas the dimensions of the left-right expansion are carried to the horizontal line, the base of the drawing. From the elevation, the perspective view is obtained

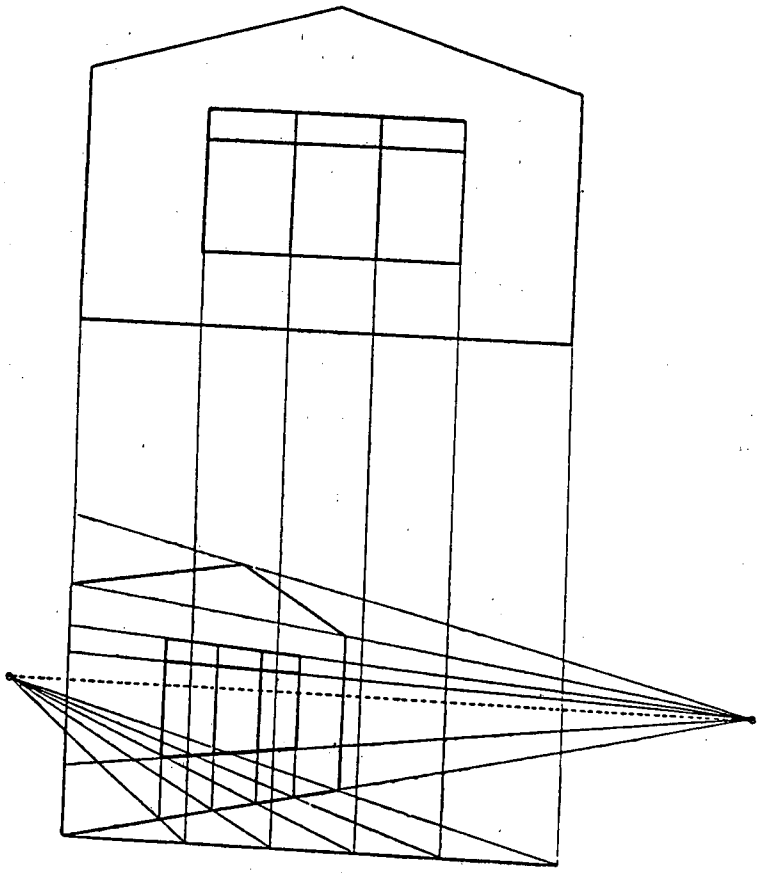

Figure 30

Figure 31. Perspective Drawing of a Given House Front

PERSPECTIVE VIEWS
WITH TWO VANISHING POINTS

Two principal types of skills are conveyed in a course of perspective drawing. One is the application of a number of constructions—as, for instance, that of perspective divisions. The other is the training of observation. The first deals with strictly determined geometrical facts, the other with broad varieties of forms. To the latter belong, for instance, the various proportions of a building. The rectangles of the wall spaces, or of the windows, or of the doors can take all types of shapes from squares to narrow rectangles. They determine the style of a building and are chosen by the architect. Perspective drawing has the task of reproducing them accurately. In the previous chapters the emphasis was on geometric constructions; in the following it will be on the practicing of reproduction of forms.

One procedure can be the following: The students take sheets of paper, all of the same size and form. A rectangular frame of the same shape as the papers is drawn on the blackboard by holding one of the sheets of paper in a vertical position in front of the blackboard, closer or farther from the eyes, so that it projects itself on the blackboard. Any line or group of lines drawn on the blackboard now can be reproduced as closely as possible by the students on their drawing sheets. Begin by drawing a perspective horizon on the board (dotted line in Figure 32) with two vanishing points near the right and left margins, and the students will do likewise on their sheets. Then it will be mentioned that the lines which will be used in following will be of three kinds only:

1. Vertical
2. Those convergent to the right vanishing point
3. Those convergent to the left vanishing point.

The next line to be placed on the blackboard will be a vertical line, as shown in Figure 32. One then adds more lines, as shown in Figure 33. Afterwards, more combinations of lines will be put on the board, as shown in Figure 34.

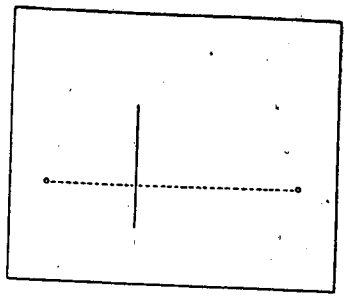

Figure 32

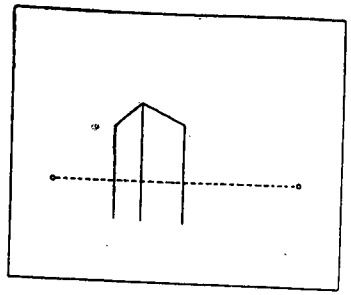

Figure 33

The students will reproduce them one by one with their proportionate sizes and distances. Each time, after completing another step, they will compare their papers with the blackboard and judge how closely they have come to the original.

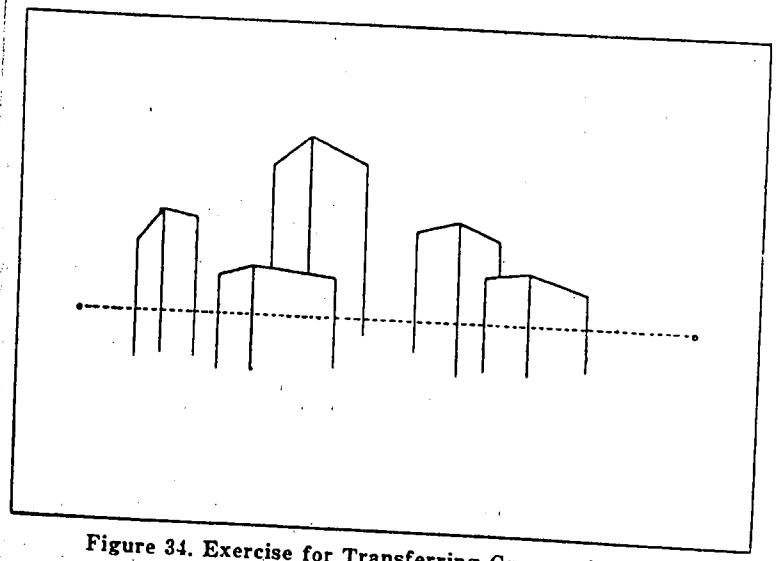

Figure 34. Exercise for Transferring Groups of Lines

In the following picture (Figure 35) the buildings are partly higher and partly lower than the perspective horizon. Those under the perspective horizon show their tops. These appear naturally in the use of the same construction.

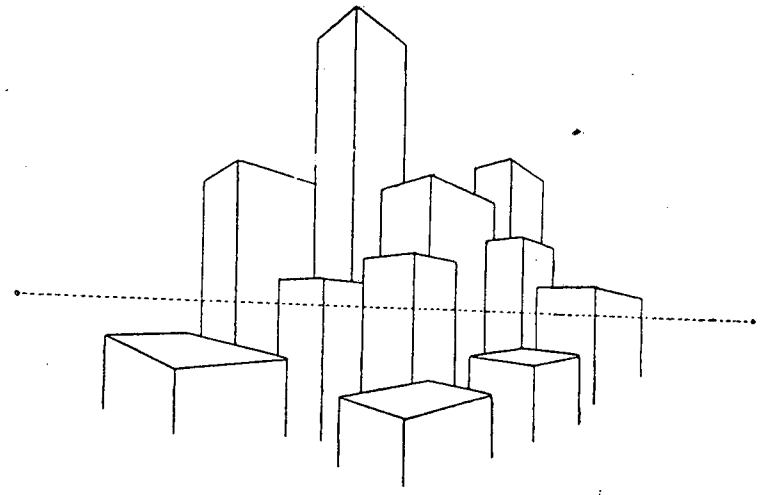

Figure 35. Buildings above and below the Perspective Horizon

A great variety of objects can be selected for perspective drawing with two vanishing points. Figures 36 and 37 show shelves. In Figure 36 they stand on the floor, and in Figure 37 they are attached to the wall.

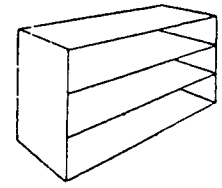

Figure 36

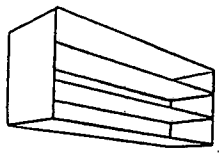

Figure 37. Shelves

Another example shows the entrance into a street (Figure 38). The task of getting the same size for each pillar is achieved by the application of the construction which was shown in Figure 27. This is now used in Figure 39.

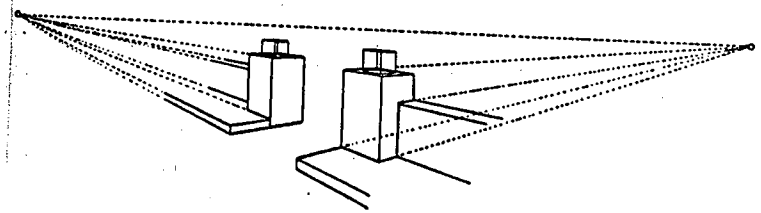

Figure 38. Entrance Into an Estate

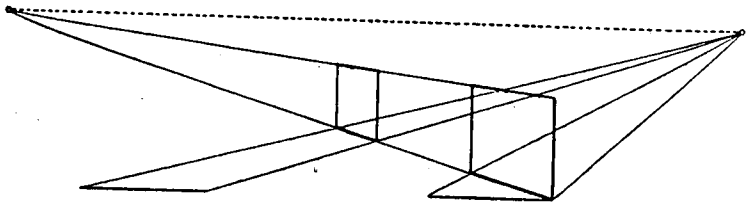

Figure 39. Construction of Two Pillars of Equal Size.

The drawing of the pillar, together with a glass roof, is shown in Figure 40.

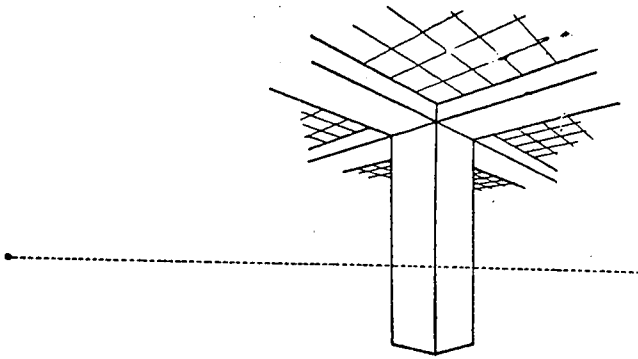

Figure 40. Pillar with Glass Roof

Inside Perspectives

A characteristic contrast between different types of perspective views is that between outside and inside perspective. A view of a group of buildings is outside perspective. In this the vertical middle edge is the nearest edge. The horizontal top and base edges lead from the middle edge towards the vanishing points—the edges of the right wall to the right vanishing point, and the edges of the left wall to the left vanishing point (see Figure 41).

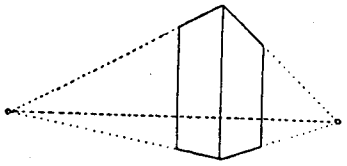

Figure 41
Outside Perspective

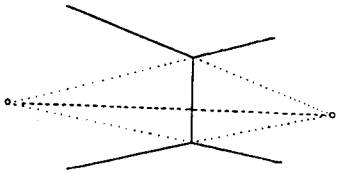

Figure 42
Inside Perspective

The exact reverse is the case with an inside perspective (see Figure 42). Here the vertical edge is the furthest away and the horizontal edges of the right wall converge to the left vanishing point, and vice versa. This applies not only to the walls themselves but to all lines of the same direction.

Figure 43 shows a view of a picture gallery. It has two vanishing points which are marked with rings. The one to the right is used for all horizontal lines parallel to the left wall, and the one to the left for all horizontal lines parallel to the right wall. Check, for instance, the edges of the door, of the carpets, of the picture frames or for the part of the next room as seen through an open door.

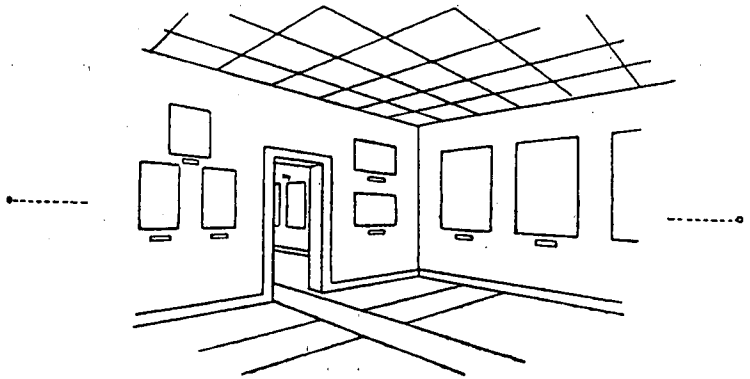

Figure 43. Inside Perspective. View of a Picture Gallery

Construction of Staircases

Figures 44 to 46 show the perspective construction of a staircase. The diagrams start with the perspective horizon. On it two vanishing points are marked with little rings. In Figure 44 only the first step is shown. Its size can be chosen at will. There are high and low steps, wide and narrow steps. But after the drawing of the first step is completed, one has to consider that in any staircase all steps have to be equal in height and width. When running down a staircase we take it very much for granted that all steps are equal. There would be innumerable accidents if the steps failed to be equal. Thus, a perspective drawing of a staircase has to deal with two considerations: Equal steps, but unequal distances from the observer. The steps are drawn unequal in sizes but they represent equality in perspective.

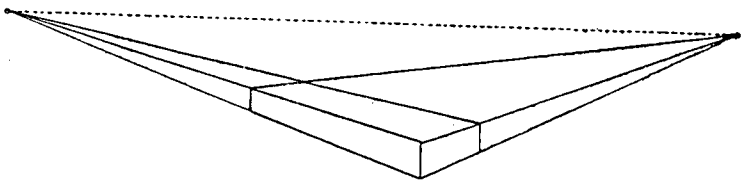

Figure 44

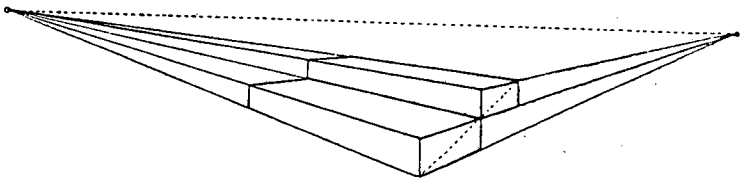

Figure 45

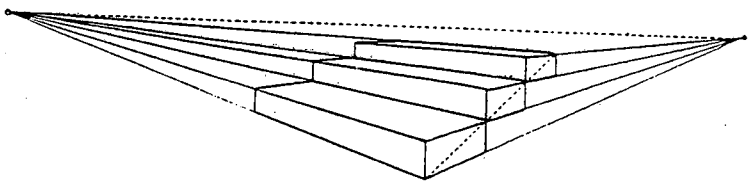

Figure 46. Construction of a Staircase

The drawing of the second step is added in Figure 45. The closest of its vertical edges is the longest. The right edge of the first step is extended vertically upward an equal distance to establish this edge. Its height is the same as that of the first step on the same vertical below it. After transferring this distance to the second step, most of its drawing can be done by the use of the two vanishing points. However, its upper right edge has to be adjusted to the proper width. This is achieved through the dotted diagonal, drawn through the lower step and extended through the second. Its point of intersection with the upper horizontal edge of the second step determines the right size.

The third step is added in Figure 46. Again, its foremost vertical edge is drawn using the height of the second step directly under it. The dotted diagonal is extended again and used in the same way as it was with the second step. Now the third step can be completed with the aid of the vanishing points.

The construction of a staircase is continued further in Figure 47. Corresponding points on the successive steps have been joined. The connecting lines converge towards a third vanishing point.

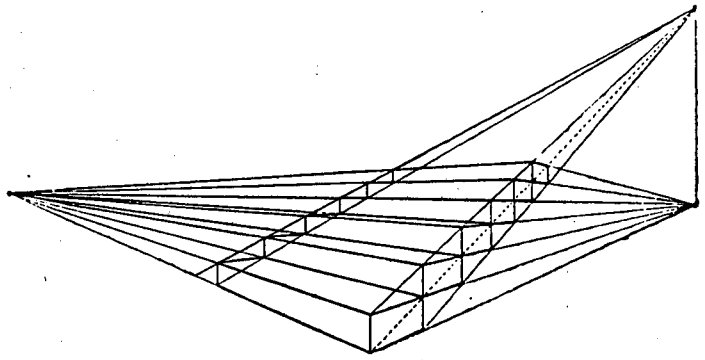

Figure 47 Extended Staircase

As long as parallel lines are horizontal, their vanishing point always will lie on the perspective horizon. But when the parallel lines are rising, their vanishing point lies above the perspective horizon. Two vertical planes which can be placed through the vertical edges of the steps converge towards the right vanishing point. These planes also contain the inclined lines in which the third vanishing point lies. These planes have a line of intersection, a vertical line which contains both vanishing points.

If parallel lines descend towards the distance; their vanishing point is under the perspective horizon. This can be seen with the descending staircase of Figure 48. Its eye level, and with it the perspective horizon, lies above the staircase. All horizontal edges of the steps lead towards the two vanishing points on the perspective horizon, either to the right or to the left. The construction of the steps follows the same procedure as in Figures 44 to 47, including the diagonal.

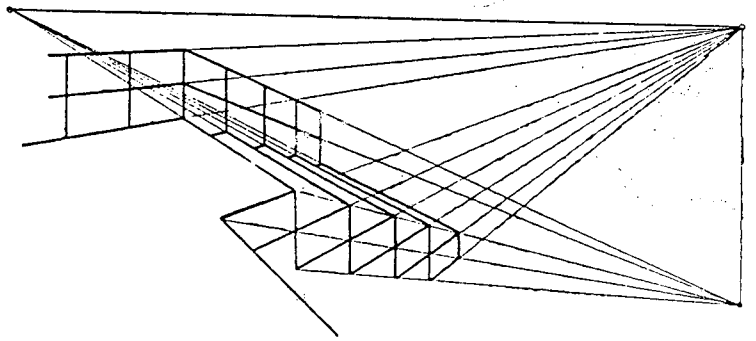

Figure 48. Descending Staircase

The third vanishing point is below the perspective horizon, straight under the right vanishing point. If this staircase is designed to lead down from a platform on top of a mountain giving a wide view, the skyline of the surrounding landscape would be at the perspective horizon.

ROOF CONSTRUCTIONS IN PERSPECTIVE

Perspective views of roofs deal largely with inclined planes and inclined edges. There are various kinds of roofs. Pointed roofs which have a great variety of forms are among the most frequently used.

Pointed Roofs

Pointed roofs come to their highest point straight above the middle of the building. For this construction one draws not only the visible part of the building, but also the invisible section behind it. This is seen in Figure 49.

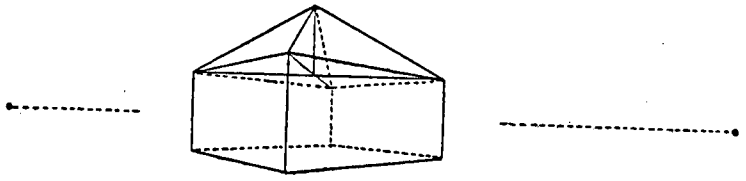

Figure 49. Construction of a Pointed Roof

One starts with a perspective horizon and the two vanishing points on it. One then places the foremost vertical edge and connects its top and its base with the vanishing points. This furnishes the horizontal edges of the walls in front of the building. They are limited by vertical edges to the right and to the left. From them one draws the edges on the back walls, again using the vanishing points. All invisible edges are drawn with dotted lines. These complete the total structure of the building. Now one can draw the diagonals of the rectangle which is formed by the edges on top of the walls (see Figure 49). At their point of intersection one obtains the position of the middle of the building. The roof point lies vertically above it. One draws a vertical line from the intersection point of the diagonals upwards and selects on it the height of the roof top.

There are rather flat roofs, such as those frequently found in Italy. There are also steep roofs so constructed that snow may slide off of them easily. Very steep pointed roofs are seen on church steeples (see Figure 50).

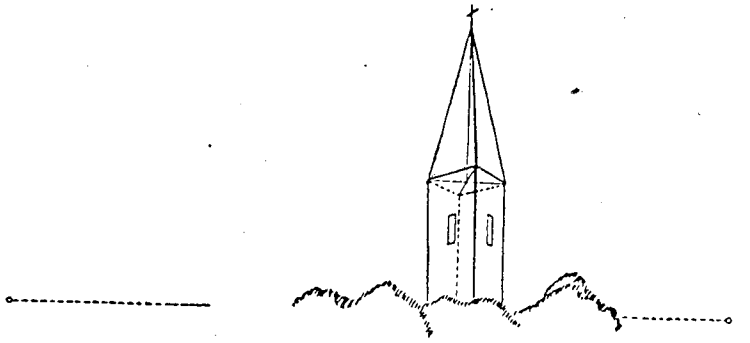

Figure 50. The Steeple

On the other hand, forms of extremely low pointed roofs often are used on grave stones (see Figure 51). The vertical line of the cross at the side of the tombstone is drawn using the same construction.

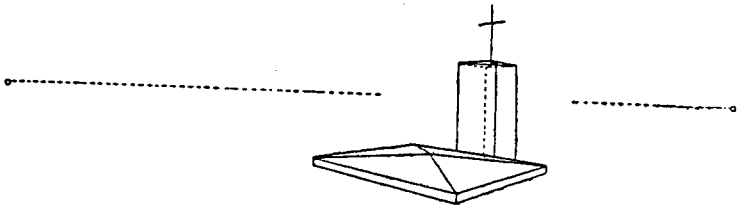

Figure 51. Tombstone and Cross

The perspective view of the pyramids of Egypt also is constructed in the same way (see Figure 52).

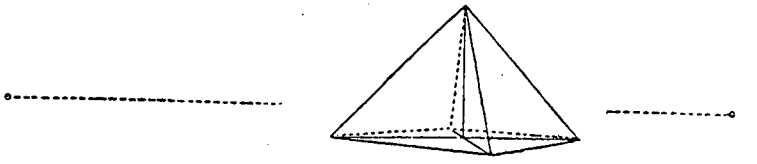

Figure 52. Pyramid in Egypt

The Gable Roofs

Another frequently applied roof form is the gable roof. Whereas the pointed roof comes to a top point, the gable roof has a top line, the gable. It reaches from directly above the middle of one wall to directly above the middle of the opposite wall.

The perspective center of a wall is found again with the aid of diagonals (see Figure 53).

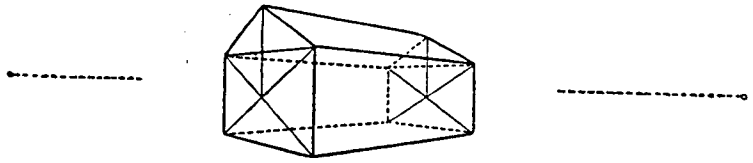

Figure 53. Construction of a Gable Roof

One starts again with a perspective horizon and the two vanishing points located on it. By using them one draws the structure of the walls, including their invisible edges. From those two walls above which the gables are to rise one draws the diagonals and, through their points of intersection, vertical lines upwards. On these verticals one selects the gable points which are connected by the gable line. The latter is directed in Figure 53 towards the right vanishing point.

Frequently the roofs are extended in order to protect the walls from the rain. The edges of the extended roofs, being also horizontal, converge to the same vanishing points as the non-extended roofs. This is seen with the garage drawn in Figure 54. Notice also the short part of the extended roof seen at the back of the garage.

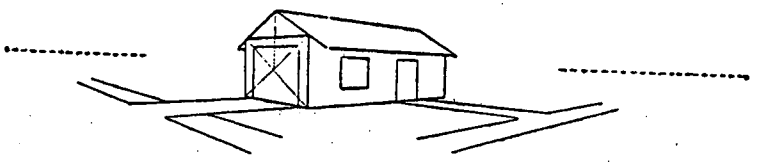

Figure 54. Perspective of a Garage with an extended Gable Roof

The edges of the driveway and the road are also directed towards the vanishing points on the perspective horizon.

Another construction of a gable roof uses a third vanishing point similar to the staircase construction (Compare Figure 45). When one uses a third vanishing point one does not need to draw the invisible part of the house. This type of construction is shown in Figure 55.

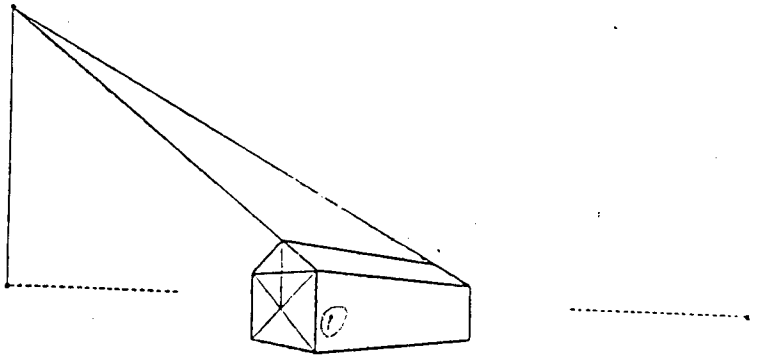

Figure 55. Second Construction of a Gable Roof with a Third Vanishing Point

One starts again with the perspective horizon and two vanishing points on it. Then one adds the foremost edge of the house and the connections of its top and base with the vanishing points. The visible walls then are limited by the left and right vertical edges. The diagonals are drawn within the wall which is to carry the gable, as well as the vertical line above their point of intersection. On this vertical, one selects the top of the gable and by connecting it with the right vanishing point one constructs the line on top of the gable roof. Then one draws the connecting line from the top of the gable to the top of the foremost edge of the house and extends it upward until it intersects the vertical above the left vanishing point. With the aid of this, one limits the gable roof by joining it with the top of the right edge of the house. This construction also can be used for a prolonged gable roof.

The following figure (56) also shows the extension of a gable roof beyond its wall. The drawing of the space on the floor, which is directly under the extended roof, proves particularly helpful.

Figure 56. Extension of a Gable Roof

An application of a prolonged and extended gable roof is seen with a Swiss house in Figure 57.

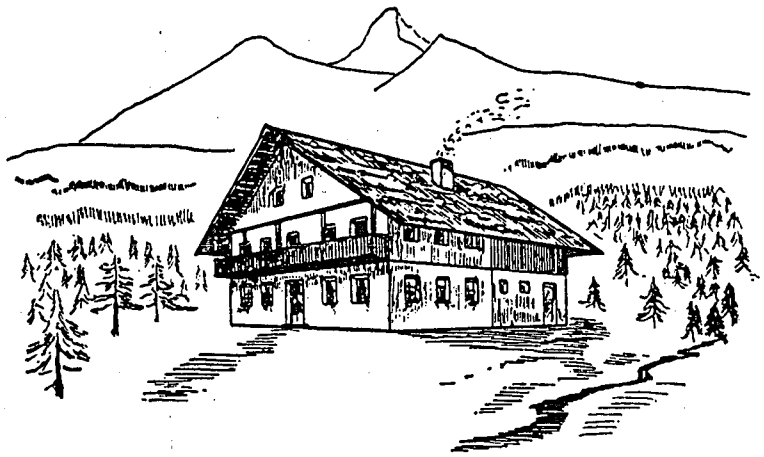

Figure 57. Perspective of a Swiss House

The Mansard Roofs

Still another kind of roof which is used especially in French villas and castles is that called a Mansard Roof. It allows considerable space under the roof and therefore has frequently been used on large New England barns. A mansard roof has two slopes and combines two gable roofs (see Figure 58). After the perspective horizon and its two vanishing points have been placed, one draws a frontal edge of the building with the visible walls. Adding the invisible parts, one gains a view of the total structure. On those walls above which the gables are to be erected, one adds the diagonals and the vertical line rising from their intersection.

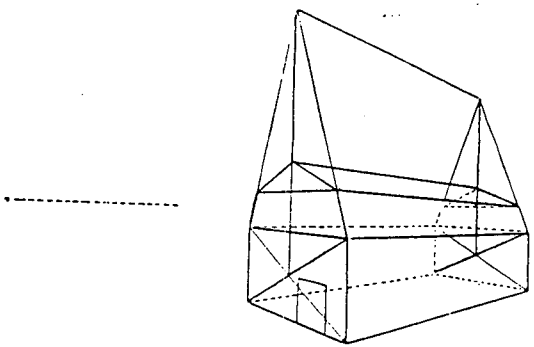

Figure 58. Construction of a Mansard Roof

On this vertical line one selects the top of a very high gable. Only its lowest part will actually be used for the roof; the rest will be cut off by horizontal lines directed to the respective vanishing points on the perspective horizon. Then a second much lower gable completes the first.

The Combined Gables

Other forms of roofs which are very frequently encountered are combinations of several gables with smaller gables standing out from a larger one. This is drawn in Figure 59.

This diagram is drawn for a view from a neighboring building. The perspective horizon rises to the level of the main roof. One starts again with a perspective horizon and its two vanishing points. The principal gable converges to the right vanishing point and the minor gable to the left one. The third vanishing point lies vertically above the left one. The inclined edge of the larger gable-roof and all lines of the same direction converge to it. Then the vertical front edge of the roof-window is added. From its upper end two lines are drawn towards the vanishing points on the perspective horizon. The left line is limited by its intersection with a line which rises up the major gable towards the third vanishing point. The width of the window is chosen at will and a vertical line is drawn correspondingly. The minor gable starts directly above the intersection point of the diagonals of the roof-window. Its gable-line is directed towards the left vanishing point on the perspective horizon. The vertical line through the intersection of the diagonals across the roof-window, has another function in the construction of the roof. Its lower end, connected with the third vanishing point, determines the end of the minor gable. Thus, the diagram can be completed.

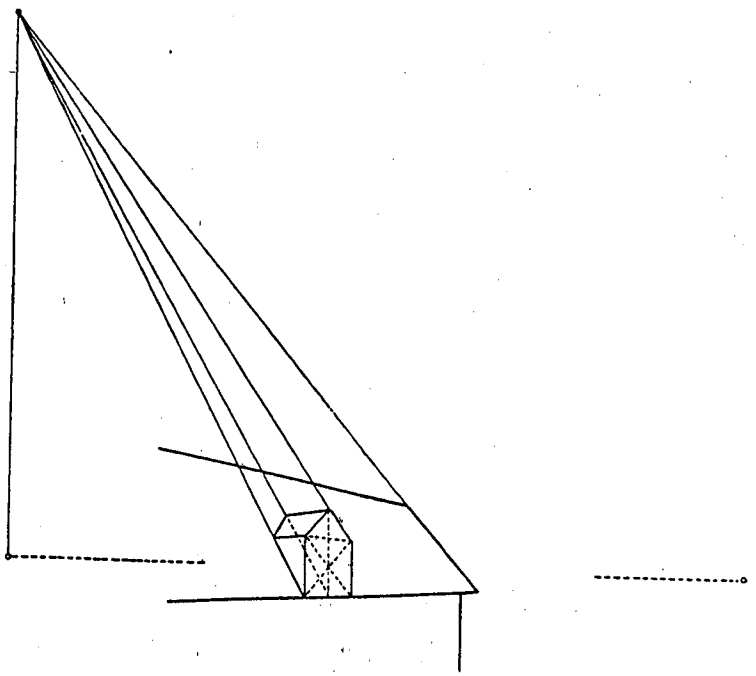

Figure 59. Combination of Gables

THE CONSTRUCTION OF SHADOWS

In order to fit shadows of different objects into a perspective drawing correctly, various constructions are needed. These are shadows from two kinds of light sources—artificial lighting from a light source in a given position, and the light from the sun and the moon. Figure 60 deals with the light in a parking area. The image of the light source alone does not determine its position. It could be nearer or further away. What is needed in addition to the appearance is the ground plan. Figure 60 shows a series of vertical poles as well as the light source and its ground plan.

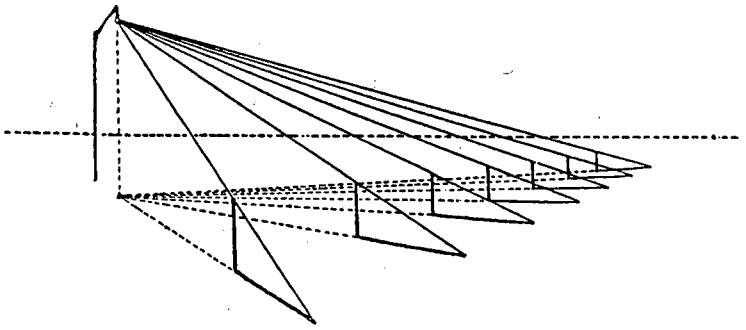

Figure 60. Construction of the Shadows in a Parking Area

The construction of the shadow of a pole contains two elements: 1. its direction and 2. its length. The direction of the shadow of a pole is obtained by connecting its base with the ground-plan of the light source. Its length is determined by the straight line connecting the light source with the top of the pole. Its intersection with the shadow marks its end point. If one imagines for each pole a vertical line placed in such a way that it includes the pole and the ground plan of the light source the shadow is its intersection with the ground. The connecting line of the end points of the shadows has the same vanishing point as the lines connecting the tops and the bases of the poles. As they are all horizontal lines their vanishing point is on the perspective horizon. This fact allows considerable shortening of the construction.

Shadows from the sun are shown in Figure 61 for a fence, including a gate. The difference between the constructions of shadows with artificial light and of that of the sun is determined by the fact that the position of the ground plan of the sun (or the moon) is not at a finite distance but lies on the perspective horizon.

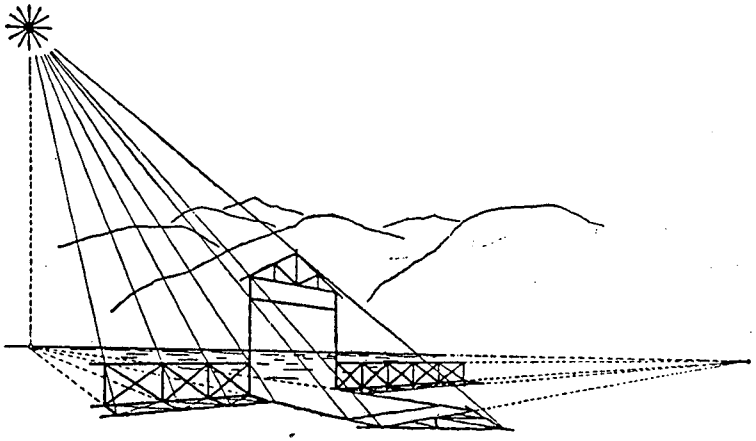

Figure 61. Construction of Shadows Thrown by the Sun

In the construction of the shadow one has to determine again its direction and its length. Its direction is obtained by connecting the foot of the pole with the ground plan of the sun, which is directly under the sun on the perspective horizon. The length of each shadow is obtained by connecting the position of the sun with the top of the pole. The intersection of this connecting-line with the shadow is its end point. The line connecting the end point of the shadows converges at the same vanishing point as the connection of the bases of the poles, or the railing, or the horizontal parts of the door frame, etc.

PERSPECTIVE OF CURVES

In addition to perspective images of objects which are made up of straight lines, there are also perspective views which contain curves, most frequently circles and circular arcs. In general we use a compass for drawing arcs, but in perspective this is not possible. In perspective circular arcs no longer present themselves as circular arcs, but as ellipses. Since straight lines remain straight lines in perspective and the intersection of straight lines remain intersections of straight lines, we seek a construction of circular arcs which builds up the circles through the intersection of straight lines. Such a construction is drawn in Figure 62.

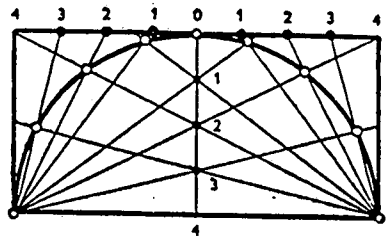

Figure 62. Construction of Circular Arcs Through the Intersection of Straight Lines

This consists of a semi-circle inscribed in a rectangle. In the rectangle the vertical median is drawn and divided into four parts. Each half of the upper horizontal side of the rectangle, to the left and right of the median, is divided into four equal parts. The points of division are marked by black dots and are numbered. From figure zero at the median, the other points are numbered successively from one to four. Then connecting lines are drawn from the end points of the base to the numbered points (see Figure 63). The points of intersection of pairs of connecting lines drawn to the same numbers are marked with little rings. These lie on the semi-circle which passes through them (intersection of perpendicular pairs of lines).

A perspective image of Figure 62 is drawn in Figure 63. Instead of a rectangle the non-vertical lines converge to a vanishing point. The median is obtained through perspective division.

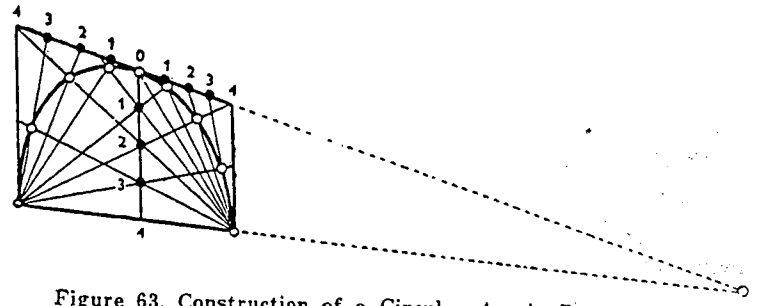

Figure 63. Construction of a Circular Arc in Perspective

The median is divided into four equal parts. The points of division are marked with black dots and numbered in the same way as was done in the previous diagram. The other divisions of the last diagram appear again, though as perspective divisions. The points of division are joined again by straight lines, and their intersection-points are joined by an elliptic arc, the perspective image of a circle.

An application of the same construction is shown in Figure 64. This figure shows an arch.

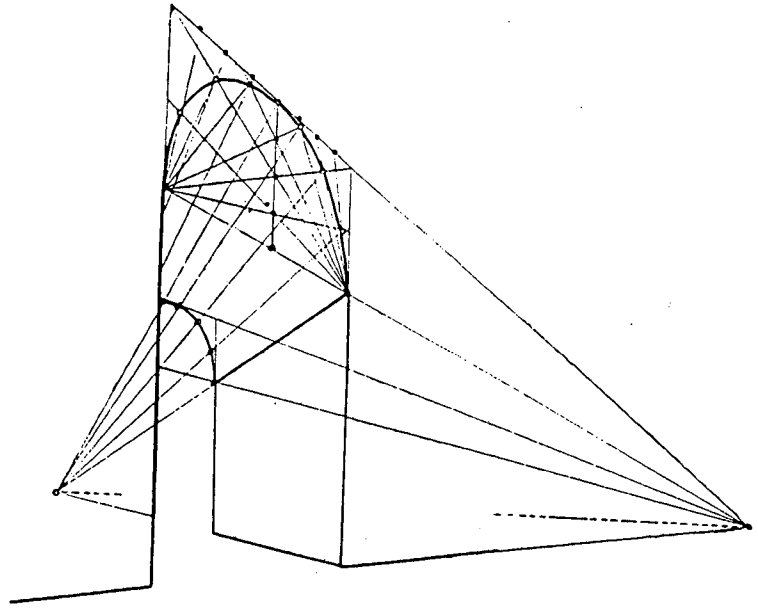

Figure 64

h the following figures, 65 and 66, one sees the form of onstruction changed to elliptic arcs in two different positions.

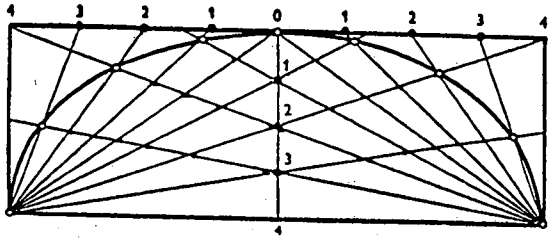

Figure 65

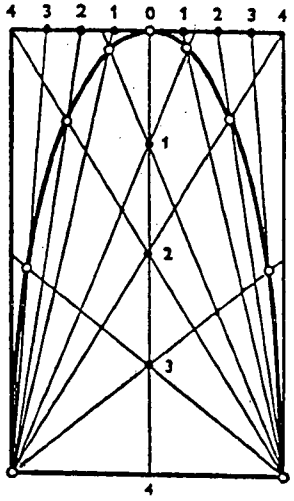

Figure 66
Perspective of Elliptic Arcs

An application of this is shown in Figure 67 with a drawing of a bridge which has elliptic arcs.

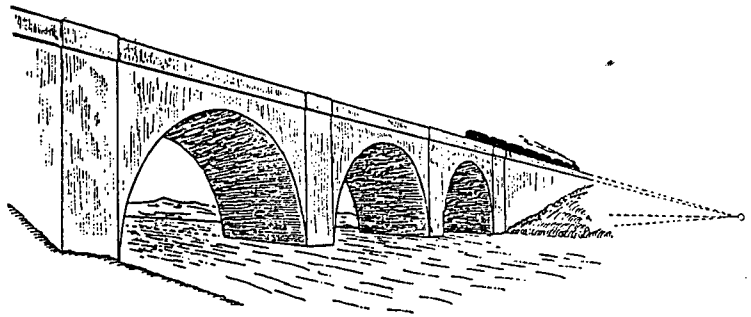

Figure 67. Bridge with Elliptic Arcs

Other kinds of curves also can be drawn in perspective. Figure 68 shows a parabola drawn through its tangents. The construction includes two inclined lines which form a frame for the parabola. These lines are intersected by a set of parallel straight lines in equal distances. The points of intersection with the inclined lines are joined so that the tangents of the parabola are produced.

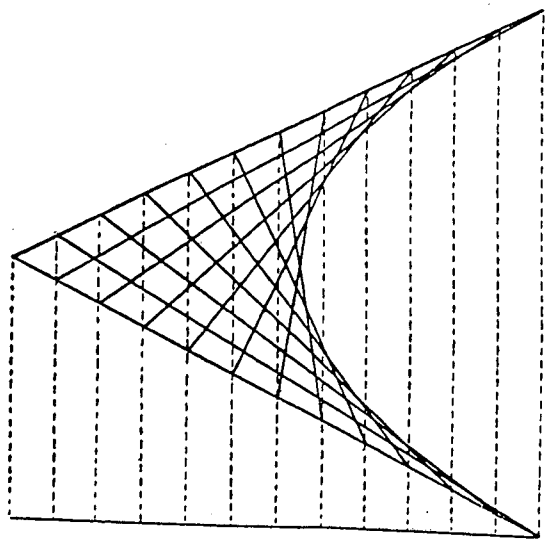

Figure 68. Construction of a Parabola Through its Tangents

The following Figure (68) shows the perspective image of the construction of the parabola. The parallel lines are replaced by lines which converge to a vanishing point. The use of the middle in Figure 68 is replaced by the perspective middle in Figure 69.

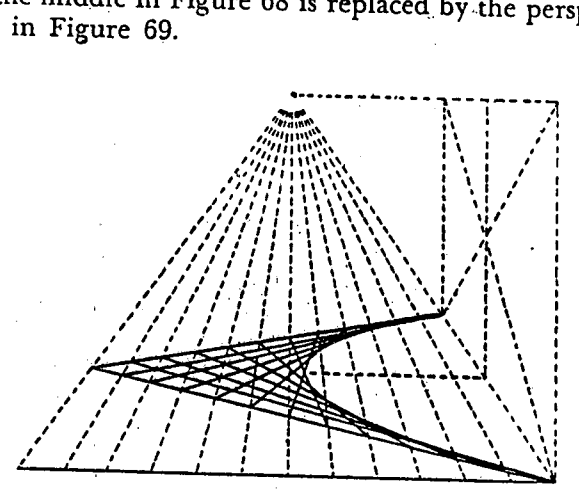

Figure 69. Perspective of the Parabola Construction

The use of intersection points which are joined by the tangents to the parabola is repeated in Figure 69.

PERSPECTIVE VIEWS FROM NATURE

With the background of the constructions at hand, the students can now take up the drawing of various objects around them. Houses offer themselves particularly well for this purpose. One may select either a whole building or take up one or another detail of a building. To start a drawing, one will first place a perspective horizon on the drawing sheet and put the two vanishing points on it near the margins to the left and right. Then one will draw the closest edge, observing which part of it is above the eye-level, above the perspective horizon and which part below. After the closest edge has been placed one will draw the connections of the upper and lower ends with the vanishing points. Thus wall spaces are obtained which one completes with the outer edges to the left and right. Then one will apply, for instance, the construction of the gable roof. This includes the choosing of the height of the gable. Then the proportions within the wall spaces, the sizes and widths of the doors and windows will have to be reproduced. Finally the surrounding areas, the fences, the driveway, the trees, will be drawn, always in connection with the vanishing points.

After drawing an outside perspective one may continue with an inside perspective. One will start again by placing the perspective horizon at the appropriate eye level with its vanishing points to the left and right. Then one will draw—this time not the closest but the fartherest edge. Its upper and lower ends will be joined with the respective vanishing points. The edges of the wall to the right are joined with the left vanishing point and vice versa. The windows and doors include vertical lines combined with those which extend to the vanishing points. Thus one will add more and more details to the view of the room.

For any perspective drawing from nature, one will divide the students in small groups, or single, to different places so that they can go through with their practice individually from the establishment of the perspective horizon to the final steps of putting in the finishing touches. The latter will call upon the students' artistic abilities to select the details to be included and those to be omitted. Mutual stimuli by the achievement and the work of the various students will be fruitful. Individual guidance will be necessary, especially in the final stages of a perspective drawing.