AC 475
Box Folder

Notes on Perspective, [1893]

Architecture 1893

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

Notes on Perspective.

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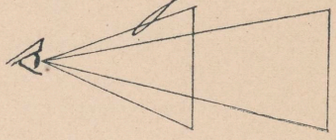
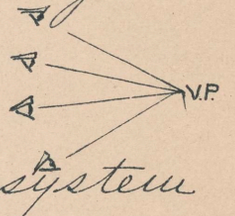
(1) A perspective drawing undertakes to represent objects as they appear from a given point without regard to their true size or shape.

(2) Of several objects having the same dimensions, the nearer ones seem to an observer to be larger than those farther from him; i.e. the nearer objects subtend a greater visual angle than the more distant ones.



(3) Thus parallel lines as they recede from the eye appear to converge. The distance between them seeming less and less, the farther it is taken from the eye. At an infinite distance they seem to meet in a point. This is called the vanishing point of the lines.

(4) All lines that are parallel to one another are said to belong to the same system. Every system has its own vanishing point.



(5) If we look along any line of any system, the vanishing point of that system will be seen full in front of the eye.

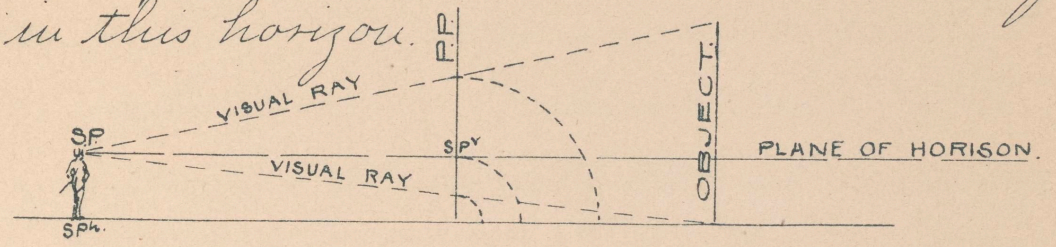
(6) All planes that are parallel belong to the same system. All the planes of one system appear to meet in an infinitely distant straight line, called the vanishing trace of that system.

(7) The vanishing trace of any system may be

seen by looking along any plane of that system.

(8) All horizontal planes will vanish in a horizontal line, directly in front of the eye and on a level with it. This line is known as the horizon.

All systems of horizontal lines as they are portions (8) of horizontal planes will have their vanishing points in this horizon.

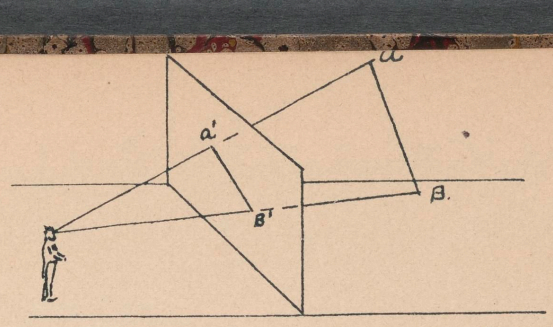


(9) A perspective drawing is the projection of an object upon a plane surface called the Perspective Plane, or the Picture Plane (P.P.) This takes the place of the vertical plane in ordinary projections. The position of the eye of the observer is called the Station Point. (S.P.)

(10) The perspective drawing is a conical projection on the P.P.; i.e. the projectors instead of being perpendicular to the surface receiving the projection, all converge to a single point. This point is the eye of the observer. The projectors are called Visual rays.

Thus the conical projection on the P.P., or the perspective, of any point is where the line passing through that point and entering the observer's eye pierces the P.P.

[See figure on next page.]



A and B are points in space
a' and B' are the perspectives
of those points.

(11) The perspective of a given line, is a line passing through the perspectives of any number of points in the given line.

(12) The perspective of all lines which are parallel to the P.P. are drawn parallel to themselves. As P.P. is generally a vertical plane, all vertical lines come under this statement.

(13) The first step in laying out a perspective, is to make the perspective diagram. This is a plan of the object to be drawn, showing all the features that are to appear in the drawing

(14) An elevation of the object, often two elevations, drawn to the scale of the diagram, will be needed.

(15) Let us consider the house shown in plate I. The diagram is tacked to the top of the drawing board at any desired angle.

(16) Through the nearest corner of the main wall draw a horizontal line. This represents the plan or horizontal trace of the P.P. Now imagine this P.P. to be revolved about its trace into the plane of the paper, and then moved towards the bottom of the drawing board far enough, so that our perspective drawing on this plane will not interfere with the diagram. Just as we can

separate the vertical and horizontal co-ordinates in ordinary projections, only in a perspective drawing, for convenience, the vertical plane or P.P. is generally moved below the plan or diagram.

(17) From the outer corners of the diagram drop perpendicular lines to P.P. Midway between these drop another line perpendicular to P.P. This line is called the axis and its only use is to determine the S.P. Assume S.P. anywhere on this line. It is well to assume it as far from the diagram as possible.

(18) This station point represents the eye of the observer. It is only when the eye of the person looking at the drawing is at this same distance from the P.P. that the drawing will appear correct. The real observer will seldom be very near the drawing, thus you will not be likely to assume the S.P. too far away. This is also why the axis is taken in the centre of the picture.

(19) Now assume the horizon — a horizontal line situated in P.P. and at the same height above the ground as the observer's eye. (HP) If we imagine the observer to be standing on the ground, assume the horizon about five feet above it. If we wish a bird's-eye-view, assume the horizon much higher.

The next step is to find the vanishing points In the house there are four separate systems of parallel lines, each system having its own vanishing point. [HP]

Two systems of horizontal lines forming the walls and ridge of house, and two other systems forming the sloping sides of the roof

(20) Now as the horizon and the eye of the observer are on the same level, (¶ 8.) we can imagine a horizontal plane passing through both. In determining the vanishing points we use this plane as our horizontal co-ordinate, and the P.P. as our vertical coordinate. Thus the horizon will be our ground line and $\overline{PP'}$ we will, for the time, ignore.

(21) Now if we look along any line of any system, we see its vanishing point directly in front of the eye. (¶ 5). The projection (conical of course) of this vanishing point on the P.P. is where the line along which we are looking pierces the P.P. Hence to find the vanishing point of any system of lines, we draw through S.P. (eye of the observer) a line of that system and find where this line pierces P.P.

Thus to find vanishing point of the system of which AB (Plate I) is an element, draw through $\overline{S.P.}^h$ a line representing the horizontal projection of AB, and through $\overline{S.P.}^v$ a line representing the vertical projection of AB. Find where lide pierces the vertical, or picture plane. (VR Plate I.) In a like manner the vanishing point of system AC = VL, both of these vanishing points coming in the horizon (¶ 8)

In finding the vanishing points of the

systems CE and AE, we first have to find the plan and elevation of CE and AE, corresponding with the revolved position of the diagram. Vanishing points of the systems = VDE and VAE.

The position of the roof could be found without using these points VDE and VAE., i.e. by means of an auxilliary line of measure. (Explained later. Method shown on plate I).

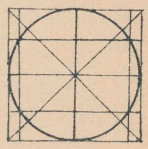
(22) From the outer corner of the diagram which touches P.P. drop a vertical line to P.P.' This line is called the Line of Measure. It is a line in the P.P. We assume all portions of the object which are in P.P. to show in their true size. This line represents the corner of the building in P.P., hence the dimensions may be laid off on it immediately In this case, the length A.G. taken directly from the elevation.

(23) Any line that is in the P.P. may be used as a line of measure, thus if we continue the plane of any surface until it intersects P.P., this intersection will be an auxilliary line of measure for that surface. See plate.

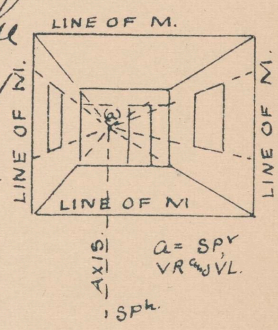
(24) Start the lower corner of the building on the ground, i.e. at the intersection of the line of measure with P.P.' From A and G we start the horizontal lines of the house, converging to their respective vanishing points.

(25) Now from every point in the diagram draw the projectors, i.e. lines running from these points and passing through S.P. When these lines intersect P.P. will be the projection of these points on the P.P, or in other words, the perspective of these points. Lines dropped vertically from these intersections will give the position of all the vertical lines in the picture, and also, by their intersection with the horizontal lines, will determine the length of the latter.

(26) If we wish to draw the perspective of a circle or other curve, the simplest way is to circumscribe about it a rectangle. Find the perspective of the rectangle. The intersection of its sides and diameters will give four points on the circle. If for greater accuracy more points are required, The rectangle may be subdivided as shown.



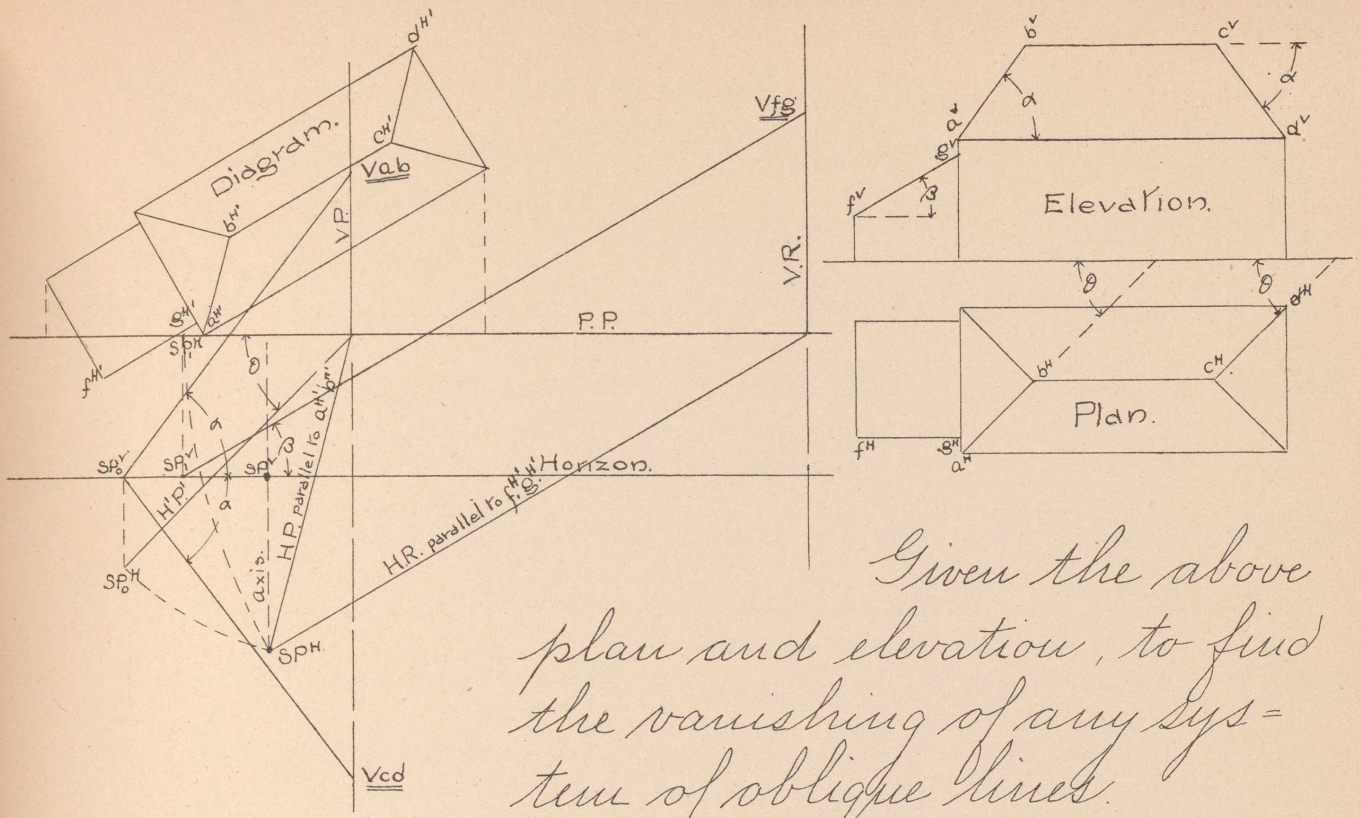
(27) When the P.P is taken parallel to one of the systems of horizontal lines, the result is one-point or parallel perspective. This is generally the case in interior perspective. The axis in order to give a better effect is, in this case, often assumed to one side or the other of the center. If the method of finding vanishing points is applied to this case, it will be seen that VR, VL, and SP^V coincide.



In finding the perspective of a simple object, two vanishing points, (VL and VR) will in general be sufficient. All lines in the drawing may be determined by means of these vanishing points and auxiliary lines of measures.

In a more complex problem, such as finding the perspective of a house with complicated roof lines, or numerous dormer windows, there may be several systems of oblique lines, each system containing a number of elements. In such a problem, a more accurate result may be obtained by finding the vanishing points of the several systems.

To follow out, in detail the theory given in P 21 for finding the vanishing points of the oblique systems (CE and DE), would necessitate the construction of a revolved elevation of the house, to correspond with the position of the diagram. In practice this, of course, is never done. The following is perhaps the simplest and most general way to find such vanishing points without making a revolved elevation.



Given the above plan and elevation, to find the vanishing of any System of oblique lines.

For illustration we will take three systems; one parallel to ab, one parallel to cd, and one parallel to fg. First to find the vanishing point of the system parallel to ab.

Imagine a line of the system passing through the station point. Pass a vertical plane through this line. Its horizontal trace will coincide with the horizontal projection of the line. [HP parallel to a''b''.] Its vertical trace will be a vertical line (V.P.) Ab will pierce the picture plane where its vertical projection through SP^V intersects this trace, giving the required vanishing point of the system. Without a revolved elevation, however, we do not know what

this vertical projection is.

In the given plane, the horizontal projection of ab makes an angle (D) with the vertical coördinate, and for this position, the corresponding vertical projection is that given by the elevation ($a^v b^v$)

Imagine the plane VP, containing the line a'b' and the station point, to be revolved about its vertical trace as an axis. As the vanishing point of a'b' is somewhere on this trace, it will be in no way effected by the revolution. Revolve the plane until its horizontal trace (and therefore the horizontal projection of a'b') is parallel to the horizontal projection of ab, as given by the plane; ie: until it makes an angle of D with the picture plane. In the revolution, SP^H moves to SP_0^H and SP^v moves to SP_0^v

For this position of a'b', its corresponding vertical projection is that given by the elevation ($a^v b^v$ making an angle of a with the horizontal coördinate)

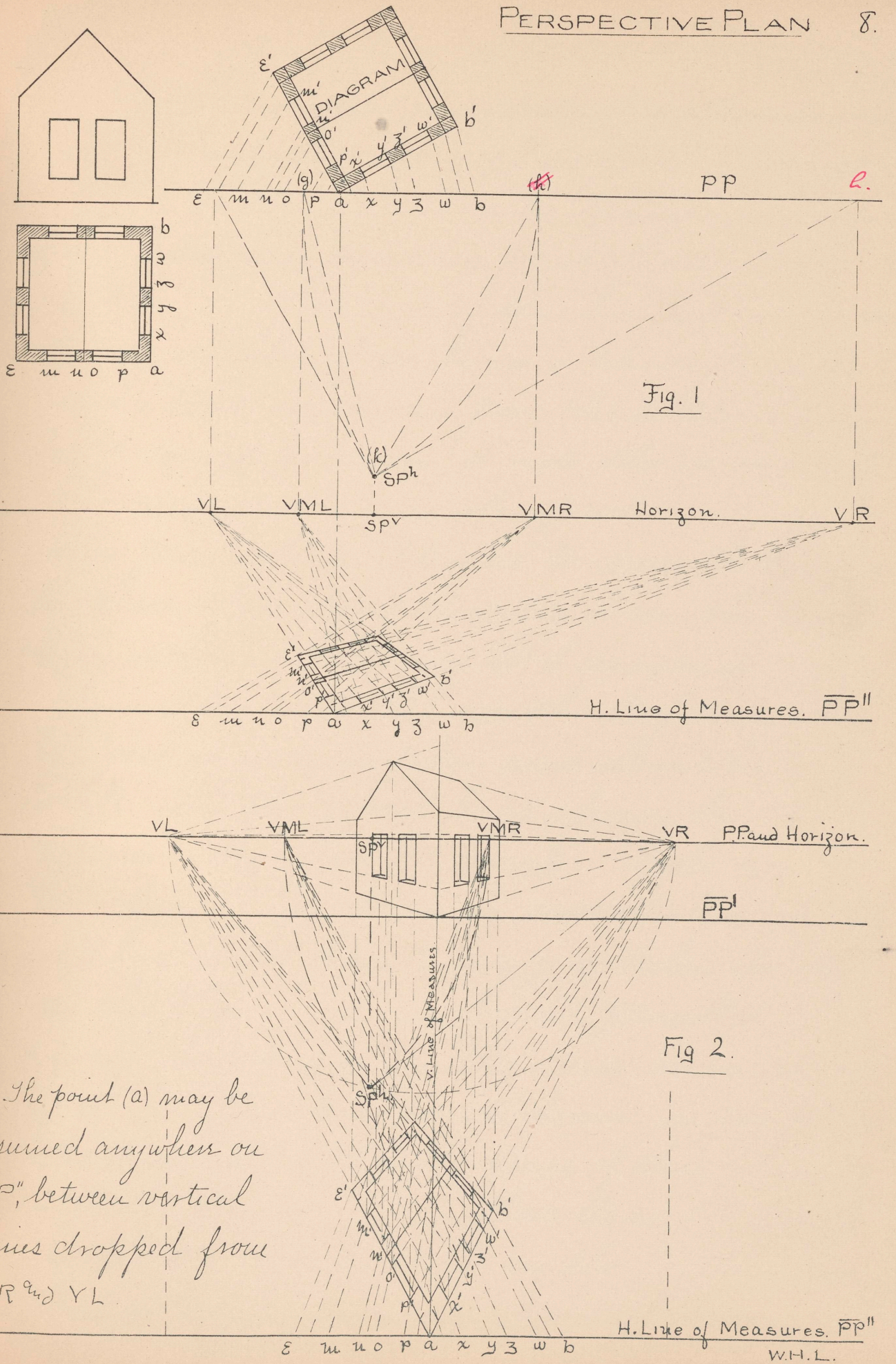
Through SP_0^v draw a line parallel to $a^v b^v$. Where this line pierces VP will give the required vanishing point. (Vab)

To find the vanishing point of the system parallel to cd, imagine a line of the system passing through the station point. Pass a vertical plane through this line, VP, HP. Revolve this plane about its vertical trace, until its horizontal trace makes the same angle with the picture plane, that $c^H d^H$ (in plan) makes with the vertical coördinate. In the revolution the station point moves to SP_0^V, SP_0^H. Through SP_0^V draw a line parallel to $c^V d^V$, (elevation). This line intersects VP at Vcd giving the required vanishing point.

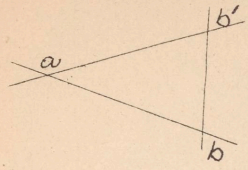
To find the vanishing point of the system parallel to fg, imagine a line of the system passing through the station point. Pass a vertical plane through this line, VR, HR. As $f^H g^H$ (plan) is parallel to the vertical coördinate, the plane R must be revolved until its horizontal trace is parallel to the picture plane. SP_1^H and SP_1^V represent the revolved position of the station point. Through SP_1^V draw a line parallel to $f^V g^V$ (elevation)

When this line intersects VR will give the required vanishing point.

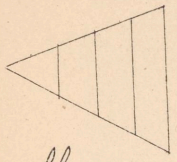
PERSPECTIVE PLAN



The point (a) may be assumed anywhere on P''P'', between vertical lines dropped from VR and VL



If a straight line crosses two other intersecting straight lines at equal angles, it forms with them an isosceles triangle, and cuts off equal distances from their point of intersection. ($ab = ab'$).



If one side of this triangle is divided into any number of parts and through these divisions lines are drawn parallel to the base, these parallel lines will divide the second side in the same manner as the first.

This principle enables us to draw the perspective plan of an object directly from the given plan, without resorting to a diagram.

Fig. 1 illustrates the method of doing this. The object is given in plan and elevation on the left. Let the aspect be as shown by the diagram. Lay off on P.P. $\underline{ab} = \underline{ab'}$. Draw $\underline{bb'}$. These three lines form an isosceles triangle. $\underline{abb'}$. On $\underline{ab}$ lay off the points x, y, z, w, taken directly from the plan. Lines drawn parallel to $\underline{bb'}$ will divide $\underline{ab'}$ in the same manner, — (x', y', z', w'). These lines are all drawn in the plane of the diagram. $\underline{P''P''}$ is the trace of this plane on the Picture Plane. If we draw this triangle in perspective, $\underline{ab}$, as it lies in the Picture Plane, will show in its true size. $\underline{ab'}$ will become one

side of the required perspective plan. (See lower part of fig. 1). From (a), on P"P," the sides of the plan will vanish to VR and VL respectively. From (a) lay off x, y, z, w, and b- taken from the plan.

The lines (xx', yy', zz', ww') all being parallel, belong to one system. Their vanishing point is at VML as shown. Draw these lines. They will determine the length of ab' and the position of the points (x', y', z', w') on this line. aε' is determined in the same way; the vanishing point for (mm', nn', etc.) being at VMR. The rest of the plan may be found immediately as shown.

It will be seen that the only use of the diagram is to show the construction of the triangles abb' and aεε', thus getting the directions of the systems parallel to bb' and εε' and the vanishing points of these systems. (VML and VMR.)

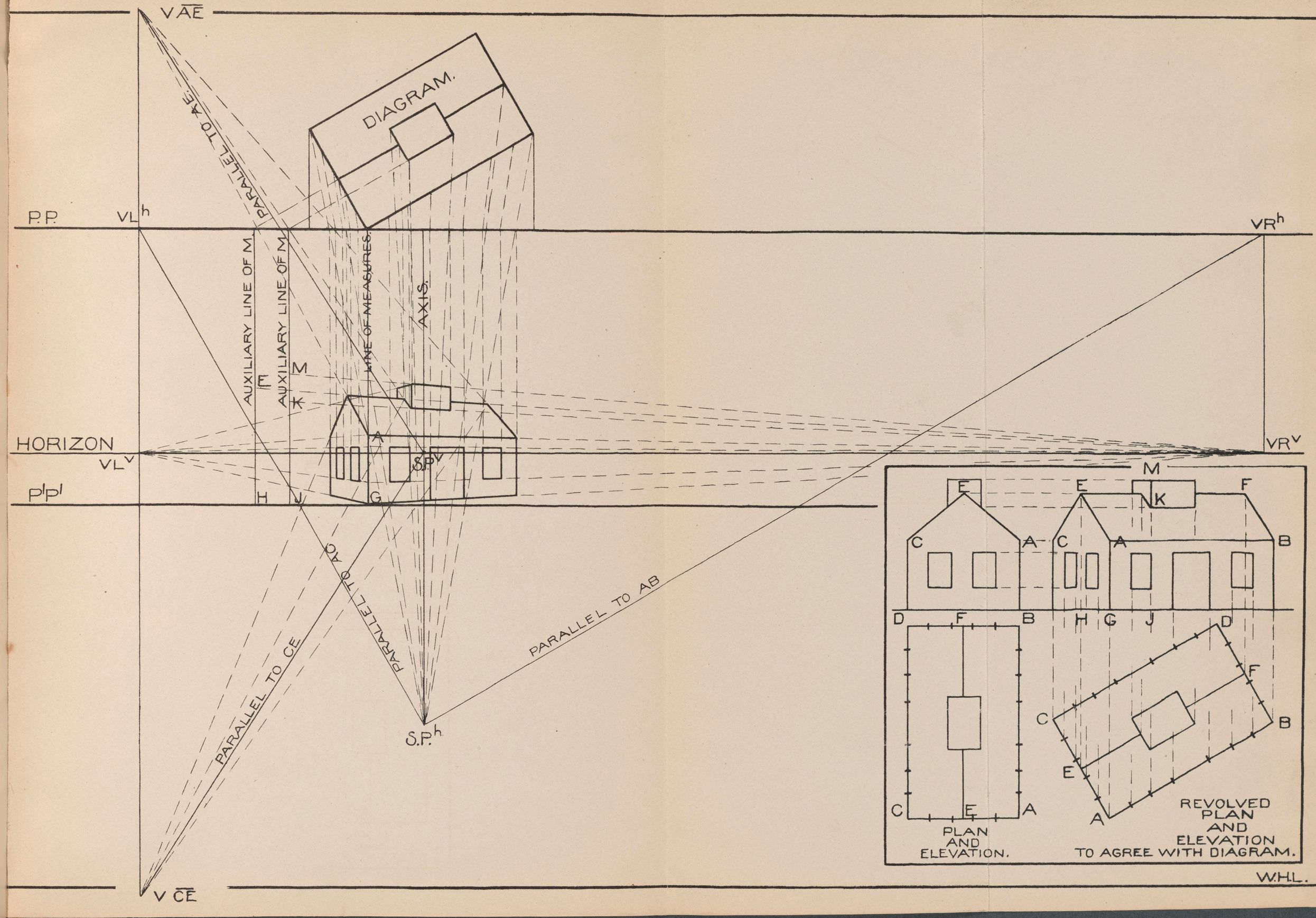
These vanishing points may be found, however, without the use of the diagram. For illustration take the point (VML). As bb'-ww' etc are horizontal lines, their vanishing point must be on the horizon and vertically under the point (g) where a line passing through SP$_h$ and parallel to bb' intersects PP. From construction, the triangle (ghk) must be isosceles and therefore hg must always equal hk. Hence to find VML, lay off hg = hk, and

from (g) drop a vertical line to the horizon as shown in Fig 2.

In this method of perspective plan, P.P. and the horizon are for convenience generally taken as coincident. SP^L is generally assumed somewhere on a semi-circle whose centre is in P.P. and whose radius may be any convenient size. If the two principal systems of horizontal lines in the object make right angles with each other, as is generally the case, VR and VL will be found at the intersection of this semi-circle with P.P., because lines drawn from SP^L to these intersections will always form a right angle. The position of SP^L will determine the aspect of the object. P"P" may be taken anywhere, as it may represent the plan of the cellar, of the ground, or of one of the upper stories of the building. Sometimes several perspective plans are drawn at different distances from the horizon, to correspond with the different stories.

Having drawn the perspective plan, all the other steps are the same as in the method of revolved plan.

Every point in the perspective elevation will be directly over its corresponding point in plan. P'P' may be assumed anywhere. VML and VMR are called the measuring points of ab and aE respectively. Every line drawn in perspective has its measuring point which may be found in the same manner as VML and VMR.


VAE
DIAGRAM.
P.P.
VL h
VR h
AUXILIARY LINE OF M.
AUXILIARY LINE OF M.
LINE OF MEASURES.
AXIS.
M
E
HORIZON
VL v
VR v
S.P v
P'P'
H
J
G
PARALLEL TO AE
PARALLEL TO AO
PARALLEL TO AB
PARALLEL TO CE
S.P h
V CE
M
E
K
F
C
A
B
D
H
G
J
PLAN
AND
ELEVATION.
REVOLVED
PLAN
AND
ELEVATION
TO AGREE WITH DIAGRAM.

W.H.L.