Valley is formed by the intersection of two roof surfaces having an external angle which is less than 180° (see Fig. 35) and the wood member at the intersection is called a *valley rafter*. The feet of short spars are nailed to a valley rafter.

Jack Rafters.—These are short spars which run from a hip to the eaves or from a ridge to a valley (see Fig. 35).

Verge is the edge of a roof which runs from eaves to ridge at a gable (see Fig. 35).

Purlins are horizontal timbers which provide intermediate supports to spars, and are supported by walls, hip and valley rafters, and roof trusses (see Figs. 35, 37, 38 and 40).

Roof Trusses are wood structures formed of members which are framed together. They support purlins in the absence of cross-walls. The king post roof truss is one form and is illustrated in Fig. 40.

Boarding or *Sarking* consists of 1-in. (nominal thickness) boards which are nailed to the *backs* (upper edges) of spars, and to which slates and other roofing materials are secured.

Battens are small pieces of wood to which slates, tiles, etc., are secured. They are generally fixed by the slater or tiler and are referred to in Chapter Five.

Classification of Roofs.—This is similar to the classification of boarded and joisted floors set out on p. 59, *i.e.* :

(*a*) *Single Roofs* consist only of spars which are secured at the ridge and wall plates. The various forms of this type are : (i) flat, (ii) lean-to, (iii) double lean-to, (iv) couple, (v) close couple and (vi) collar roofs.

(*b*) *Double or Purlin Roofs*.—In this type additional members, called purlins, are introduced to support the spars.

(*c*) *Triple or Framed Roofs* consist of three sets of members, *i.e.*, spars that are partially supported by purlins, which in turn are carried by trusses.

(*a*) Single Roofs.—The various forms of this class are illustrated in Fig. 36. Before considering each in detail it should be explained that the sizes of the spars specified on the drawings must not be taken to be the economical sizes in all cases, for, in addition to the span, these sizes depend upon the weight of the covering material, the distance centre and centre, and the wood employed. The following table gives the approximate average weights of various covering materials :—

Table IV

Material.	Weight (lb. per sq. ft.).	Material.	Weight (lb. per sq. ft.).
Zinc and copper	½	Lead (including rolls)	7
Asphalt felt	¾	Thatch	7
Corrugated iron	2½	Asphalt, ¾-in. thick	9
Boarding, 1-in. thick	3	Slates	9
Shingles, cedar	1½	Pantiles	10
Corrugated asbestos-cement	3½	Plain tiles	13
Patent glazing	6	Stone slabs	18

The approximate depth of 2-in. thick spars spaced at 15-in. centres may be obtained from the following rule :—

$$\text{Depth (in inches)} = \frac{\text{Span}}{2} \text{ (in feet)}.$$

Thus for a span of 8-ft., the size of spar would be 4-in. by 2-in. The spars most commonly used are 2-in. thick and for average good class work they are of redwood.

(i) *Flat Roof*.—This is shown in Fig. 36 by the small-scale plan and section at F and A, and enlarged details at Q, R and S. The construction is similar to that of a floor. The upper surface must be inclined sufficiently to throw off the water, and, as felt is the covering material, the minimum inclination is 1-ft. in 10-ft. run (see p. 69).[1] If the under surface is not required to be level, the inclination is obtained by inclining the joists to the required fall towards the eaves. If a level ceiling is required, the fall may be obtained by either tapering the joists with the top edge of each sloped to the required fall, or alternatively the joists may be fixed level and a small tapered piece of wood nailed on top of each. The latter method is usually applied as it is effective and comparatively cheap. The tapered pieces are called *firring pieces* or *firrings*. As shown at R, they are the same width as the joists, and the depth varies from a maximum of 2-in. at S (which is a detail of C) to ½-in. at Q (a detail of B). Tongued and grooved boards are nailed on top of the firrings, and this boarding should be dressed smooth in order to remove any sharp edges which may cause damage to the covering material. A fascia board is nailed to the ends of the joists to provide a suitable finish. The herring bone strutting is necessary if the ceiling is to be plastered, otherwise it may be dispensed with.

Bituminous felt and lead are the most common covering materials employed for this class of roof. Lead flats are detailed in Chapter Six. That shown in Fig. 36 is covered with felt, of which there are many varieties.

In the example, three layers of the felt are used, with a coat of bituminous solution between and on top. The felt (which may be similar to that described on p. 18) is in 3-ft. wide rolls. The first layer is laid direct upon the boarding, lapped 3-in. at the joints with solution between and nailed along the joints at 3-in. intervals. Hot solution is now applied over this first layer and a second layer of felt is laid with 3-in. joints (not nailed). This is brushed over with solution and a third layer of felt is laid as described and given a coat of the hot mastic. Grit (or slate granules) is now rolled into the solution to protect the felt from the action of the sun. The intersection between the flat and the wall is made watertight by continuing the layers of felt over the triangular fillet fixed in the angle. The upturned edges of the felt are covered with a lead cover flashing as described on p. 143. Roofs of temporary buildings are usually covered with one layer of felt.

Lead Covered Flat.—The lead details of the flat shown in Fig. 72 are described in Chapter Six, and reference is there made to the groundwork, *i.e.*, the timber construction. The flat is divided into two by a drip and each half is subdivided by two rolls. The boarding is given a fall towards the gutter,

[1] As three layers of felt have been used, the minimum inclination may be reduced to that for lead, *i.e.*, 1½-in. in 10-ft. run.