

days in a solution of sulphuric acid it should not show any signs of flaking or softening.¹

In general, Welsh slates are blue and Westmorland slates are green, but there are certain exceptions to this. Thus Bangor (Carnarvon) slates vary from blue, blue-purple and purple; Dinorwic or Velinhelli (Llanberis, North Wales) slates vary from red (maroon), blue-grey, green and wrinkled (purple with green markings and slightly furrowed surface) or mottled (blue-grey with rather indefinite green markings); Penrhyn (Bethesda, North Wales) slates, similar to Dinorwic; Festiniog or Portmadoc (Wales) slates, uniform blue-grey; Vronlog (North Wales) slates, various shades of green and grey; Precelly (South Wales) slates, green, grey and khaki. Westmorland slates include those quarried in Cumberland and North Lancashire as well as Westmorland; those from Buttermere, Coniston, Elterwater, Kentmere and Tilberthwaite are of various textures and many shades of green; most are light green, others are a darker green (olive) and at least one is grey-green; those from the Burlington Quarries (Kirkby-in-Furness) are dark blue in colour; Cornish (Delabole) slates are green, grey-green, green and rustic red. Some of the Welsh slates are very durable, whilst the best Westmorland slates are practically indestructible; the attractive colours and coarse texture (with spalled edges) increase the artistic merit of the latter slates.

PREPARATION OF SLATES ON SITE OR IN SLATER'S YARD.—This consists of holing and cutting the slates to various shapes and sizes. With the exception of small randoms (each of which may be secured at the head by one nail only), each slate is fixed to the roof by two nails (see p. 135). This holing is done by the slater either by (a) hand punching or (b) machine drilling.

(a) *Hand Punching*.—The position of the holes is marked on the slate by a *gauge stick* or *scantel*; this is a piece of lath through which two nails are driven at a distance apart equal to that between the bottom or tail of the slate and the centres of the nail holes; one of these nails scores a line across the slate to mark the position of the holes as the gauge is passed along with the second nail traversing the bottom edge or tail. The *axe*, *sax* or *chopper* (see J, Fig. 68) is used to punch each hole by striking the slate with the spike. The smooth or bed surface of the slate is uppermost when it is being holed so that when the spike penetrates the slate small pieces are burst off round the margin and on the underside to form a rough irregular countersinking of the hole; as the slates are fixed on the roof with the surface having the rough edges uppermost the heads of the nails can be driven in flush with the surface because of this countersinking; otherwise the heads would project to cause "riding" of the slates above them and this would admit rain or snow.

(b) *Machine Drilling*.—This is performed by the portable *slate holing machine* shown at N, Fig. 68 which can be bolted to a bench or clamped to a plank. The latter is at a convenient height, and after the machine has been clamped a

¹ The British Standard Specification for Welsh Roofing Slates (1936) gives full details of these tests.

brick is fixed on the plank on each side of the machine and at the correct distance from it, the distance between the bricks being equal to the length of the slate; the slate is placed between the bricks, with the smooth surface uppermost and one edge against the plate shown in the sketch and which is $1\frac{1}{4}$ -in. from the point of the drill; the handle is given a partial turn, the drill descends and punctures the slate, the point is withdrawn by reversing the handle, the slate is removed and replaced with the ends reversed (but with the smooth surface still uppermost) and the second hole is drilled. This is a much quicker process than hand punching and is less liable to crack the slates.

A *cutting iron*, *dog* or *dressing iron* (see M) is used when slates have to be cut to certain sizes or shapes on the job; it is often used on the roof, the slater driving the pointed ends into a spar or other convenient member. After being marked to the required shape, the slate is placed on the iron with the edge to be cut projecting the required amount, and a few smart blows with the axe neatly trim off the edge.

The *hammer*, *pick* or *peck* (see K) is used for driving the nails through the slates, the claw at the side is useful for withdrawing nails and the point is used for holing.

A *lath hammer* (see L) is used for fixing slate laths or battens; laths are cut to length by using the sharpened blade and nails may be withdrawn by means of the notch in the blade.

The *ripper* (see O) is used for removing defective slates from a roof; the blade is passed under the slate, and each nail is gripped and cut by the hooked end as the ripper is given a sharp pull.

NAILS.—The quality of the nails used for securing slates is most important, as the cost of maintenance of a roof depends very largely upon their durability. Roofs quickly become defective if the nails corrode and heads disappear, the loose slates being easily removed by the wind.

Copper nails (see D, Fig. 68) or composition nails should always be used for good work¹; the latter, also called "compo" or "yellow metal," are made of antimony, lead and tin or copper and zinc, and are harder than copper nails.

Galvanized wrought iron nails (see D) and zinc nails are often used for cheaper work, but they are unsuitable for industrial and coastal districts. The former are invariably used for good work for fixing laths to the spars as the zinc covering offers a protection against corrosion.

Nails are specified according to length and weight, the size depending upon the thickness of the slates, and the length should equal twice the thickness of the slates plus 1-in.; if too small, "tight nailing" results, and this may cause

¹ Copper, galvanized wrought iron and zinc nails should not be used for roofs which are in the vicinity of gas works or chemical works or where the slating is subjected to strong acid fumes, as the gases may destroy them. Lead nails or chrome-iron nails should be used for such roofs; the former are about 4-in. long, the stems being passed through the holes of the slates and bent round the steel purlins, etc., of the roof.