now becoming very scarce. White Oak lasts 10 to 12 years, and the other woods about 6 years. The Atlantic and Pacific Railroad (Western Division) uses ties 8 inches by 6 inches by 8 feet long, mostly native pine, but on heavy grades and curves, oak ties are used, number to the mile 2616.

The Cincinnati Southern Railway specifies ties of " either white, post, burr or chestnut oak, or other timber approved by the Engineer, cut from sound live timber, free from rotten or loose knots, worm holes, dry rot, wind shakes or other imperfections affecting the strength and durability of the wood. All bark must be removed. They must be 8 feet in length, not "less than 6 or more than 6½ inches in thickness, one-fourth the number must measure not less than 10 inches face for the entire length of the tie, and the remainder not less than 8 inches; the faces must be parallel, not winding, "smooth, free from deep score-marks and "splinters. Ties must be cut square at the ends and be straight in all directions. Not more "than one inch of sap will be allowed on the "face of sawed ties. 2,640 ties are used to the "mile of single track."

The standard hard wood ties of the Chicago & North Western Railway have the following order of value : White Oak, Burr Oak, Red Elm, feet in length and 6 by 8 inches section if sawed, or 6 inches thick with 6 inches face if hewn. The soft wood ties are Cedar and Hemlock, and have 7 inches depth by 7 inches face ; 3,000 ties are The The mile.

The Chicago, Burlington & Quincy Railroad use Oak ties entirely on main line, but cedar on some of the branches, the sizes being the same as for oak. The specifications for Oak ties require all to be hewn from sound live White, Burr, or Post Oak, 8 feet long when squared at the 7 inches than 6 inches and not more than less than 8 inches face and none less than 7 inches face, 3,000 ties are used to the mile on main line and down to a fire on the branches

main line and down to 2,640 on the branches. The cross ties are bedded in what is termed ballast. The embankment or cutting of the road is finished to a certain width depending upon the question of single or double track, and the class of road that is being built. In cuttings sufficient width width must always be allowed for good drainage ditches on each side, and on embankments enough width to rightly sustain the ballast and ties T ties. The road bed should then be sloped from the control of prothe central portion to the sides to drain off properly. Embankments on single track are made from 14 to 16 feet wide at top, and 24 to 28 feet on double track. Cuttings on single track are from 16 to 21 feet wide, and on double track 26 to 32 feet, It may be necessary in some cuttings, depending upon the nature of the material

and its liability to wash down on the track, to have very wide ditches, and these exceptional cases must be provided for. The road-bed being properly prepared, the ballast is laid upon it. This ballast is either broken stone, gravel, sand, burnt clay, cinders, shells, refuse coal siftings from the mines, etc., or simply earth, the latter being really no ballast at all, but merely the ties bedded in the earth, properly rammed, and surfaced with the right slope for drainage between the tiês. The question of material for ballast depends altogether on what can be obtained at a reasonable price, and if inferior material is used of course so much the less perfect the road is.

The ballast acts as an elastic bed, receiving the load from the moving train and spreading it out over a broad surface, and also serves as a drain to carry off the water from rain or snow to the ditches, and not allow it to freeze around the ties in winter, or to form wet holes in the roadbed, into which the ties and ballast will work and sink. First-class ballast material should be clean, hard and always of such consistency as will allow of the passage through it. The best ballast is a hard durable stone, not liable to decomposition or disintegration under the action of the weather, stones like limestone or trap, broken into angular fragments not larger than will pass through a two and a half inch ring. The amount placed under the ties is very variable, the question, unfortunately, not always being now much is best, but how much can the railroad company afford to use. For the best, or a first-class track, there should not be less than 12 inches, although many roads which are considered as high class, do not use over 9 inches.

On the Cincinnati Southern Railway, portions of the road through clay formation have 12 inches of ballast under the ties, other parts where the grading is light, have only 6 inches and the Engineer's estimates were made for the whoie line on an average of 9 ihches for main track and 6 inches for sidings (See Report of Dec. 1877, since which there may have been some modification of the standard). The ballast on this line is specified of gravel or broken stone : the gravel to be clean, free from clay, or boulders larger than two and a half inches in any direction, and must not contain more than onethird of sand; the broken stone to be of good durable and hard limestone or sandstone approved by the Engineer and not larger than two and a half inches in any direction.

The Chicago & North Western Railway Company uses as standard, one foot of ballast under ties, either gravel or broken stone.

The Altantic & Pacific Railroad Company (Western Division) uses gravel, stone or earth ballast.

The Chicago, Burlington & Quincy Railroad Co. has been foo some time experimenting with burnt clay for ballast, having had two miles of