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On Some *of the* Materials Used *for* Construction *in* Madras Presidency. By T. H. Going, F.L.M.

TIMBER.

One of the most vexed questions of railway making in India has been the supply of timber for sleepers.

It is exceedingly difficult to procure woods of good quality which can be cut up into scantlings of the dimensions required (10 ft.×10″×5″). More than forty different varieties of wood have been sanctioned by the Madras government as suitable for railway sleepers, and in some respects many of these are excellent, being for the most part hard and close-grained; some of them to such a degree as to resist the attacks of the white ant.

Unfortunately, however, they abound in knots, shakes and crookedness, and their very hardness, though in one respect a desirable quality, renders them most difficult to work into shape.

Another great cause of the failure of Indian jungle sleepers has been the injudicious method of felling the timber, totally irrespective of the season when the least sap is in circulation. This is principally due to the fact that the railway companies did not, in the early stages of their operations, take care to lay up a stock of well-selected timber; so that in practice it has become necessary to use such sleepers as first came to hand.

It is true that none of the objections enumerated against jungle woods can be urged against the use of teak, in which there is a large trade on the Malabar coast. The chief value of this timber consists in its freedom from knots and shakes, the readiness with which it is worked up by the carpenter, and its exemption from dry rot. This latter quality is owing to the judicious method adopted by the teak merchants in

felling the trees. In the month of October they are sawn across the roots as they stand, and allowed to remain some time to absorb all the sap.

After being felled, they lie on the ground till thoroughly seasoned. It is a slow-growing tree, and requires to reach the age of 80 or 100 years before attaining the size of six or eight feet in girth. The *cost* of teak, however, precludes it from use in sleepers, being about four shillings per cubic foot in the log at Madras. This would make the cost of a teak sleeper about thirteen shillings.

Creasoted pine sleepers had been sent out from England at the cost of about 8s. 6d. each. Pine in the unprepared state is exceedingly perishable in India; creasoted, it has been found to resist the effects of the climate very well. The author had occasion to remove some sleepers of this material for the purpose of slewing the line over a bridge for repairs in the course of last year, and found them as sound as when first laid down—nearly five years previously. These were of rectangular section. There were some of triangular section taken out at the same time, which were found, for the most part, decayed. These latter were the first which had been sent to the country, and, it is probable, were not perfectly impregnated. The creasote appeared to have quite evaporated, whereas in those of rectangular section, it was still strong.

Experiment was made of an Australian wood named jarra, which is very dense, weighing 64 lb. to the cubic foot. This, as regards endurance, proved satisfactory, but its high cost and liability to shakes, rendered it unsuitable.

The Madras Railway Company are at present making experiment of the Boucherie process of impregnating timber. This consists in applying a moderate pressure to one end only of the sap tubes of the tree, the effect of which is to expel the sap by the preserving liquid, which takes its place. It is

founded on the fact that no connexion exists between the sap tubes laterally. The injection is the more rapid in proportion, as the tree contains more sap, and is the more recently felled; and some kinds of timber are altogether impenetrable to the solution. The solution used is sulphate of copper and water, mixed in the proportion of 1 to 100 by weight. The specific gravity of water at 60°, being 1000, if 1 per cent. sulphate of copper be added, the specific gravity will be 1006. Hence the hydrometer is used to maintain the solution in the proper proportion. Prussiate of potash is applied as a test to determine when the tree has been saturated.

As this experiment has only been recently initiated, its value cannot be at present reported on.

Since the substitution of cast-iron sleepers on the Madras Railway, the question of timber has, indeed, lost much of its importance. Timber sleepers are now only used on about 140 miles of the western portion of the south-west line, where the steady supply of a superior quality of timber can be depended on. Where the cast-iron (or pot) sleeper is laid, the only item of timber used in the permanent way is that for the keys, and teak is found to be the best wood for the purpose. It is also the cheapest, because the refuse timber of the locomotive workshops, which is for the most part of well-seasoned teak, is utilized by cutting into keys.

Large quantities of pressed elm and oak keys and trenails from England have been used, but native woods are better and more economical. There are many jungle woods of intense hardness and toughness, which, though they cannot be procured sufficiently sound and shapely for sleepers, are yet capable of supplying keys and trenails. These have been found to endure far longer than oak or elm. The author was himself witness to an instance where, in a siding at Arconum station, a passing engine burst out the rails, and dropped through. On examining the trenails, they were found to be

shaved off flush with the surface of the sleepers, presenting the fracture of charcoal. These were English pressed oak trenails, and had not been driven longer than ten months.

In the construction of roofs, doors, windows, &c., and in carriages and waggons, teak is the wood principally used.

IRON.

The serious objections to the use of timber sleepers on the Madras Railway led to the introduction of the cast iron one. The variety used is that known as Greaves' patent. Each sleeper weighs 84lbs., and covers an area of 2·2 square feet. Six pair of pots are laid to a 20 foot rail of 75lbs. to the yard. The space between the two central pair of pots is 4 feet, and the spaces between the others diminish towards the ends of the rails. Each pair of pots is connected by a tie-bar of wrought-iron, secured by Cottars and Gibs. The rail is of the double headed pattern, and is fish-jointed.

The S.W. line of the Madras Railway, which was originally all laid with wooden sleepers, is being gradually renewed by cast-iron ones, except that portion before alluded to, on the west coast. The N.W. line has been, from the commencement laid entirely with pots, and the advantage thus obtained will appear by comparing the cost of maintaining the two lines, as shown by the last report, dated March 31st, 1865.

Thus—

S.W. line per mile per annum, £165
N.W. line ,, ,, 73

It appears that in Madras Presidency, the use of cast-iron sleepers is productive of great economy in the maintenance of line, and according to the testimony of the locomotive superintendent, this is further experienced in the diminished wear and tear of rolling stock. It does not, however, follow from this, that pot-sleepers are universally applicable, even in India. The abundance of good sand ballast procurable along

the Madras Railway is the chief reason of the success there of this kind of permanent way. In Bengal such material is not available, and baked ballast has to be substituted. A free, open ballast is absolutely necessary to the success of pot-sleepers, unless, indeed, it be in a climate such as that of Chili or Egypt, where rain is the exception, as under these circumstances there is no danger of the ballast caking.

In Bengal objections have been raised against this kind of sleeper, on the score of its liability to fracture. This is entirely due to the nature of the ballast. The author has known a few instances of fractured pot-sleepers having been removed from the permanent way of the Madras Railway, but in each case this was due either to the pot having rested on a large stone among the ballast, or else to the bottom of a cutting not having been fully taken out. On that portion of the line originally laid with pot-sleepers in 1860, there has been practically no renewal of sleepers required, and to all present appearance they bid fair to outlast the rail There is one precaution, however, which has been found necessary on the Madras Railway, and that is, to avoid laying pot-sleepers over the crowns of arches, because, owing to the small bearing surface compared to the ordinary wooden sleeper, the pressure is concentrated, and unless there be an unusually large space allowed for the ballast between the arch and the base of the permanent way, the arch is liable to be shaken.

Iron is largely used in the Madras Railway, in the superstructure of bridges. The form of girder used is the double flange plate beam, and it is applied to spans from 10 feet to 70 feet.

The larger bridges are usually divided by piers into openings of 70 feet, 5 from centre to centre of pier, and the girders are made continuous over every three piers, being fastened to the middle one, and movable on rollers at the two ends. Each 140 ft. length thus spanning two openings, is composed

of three pieces for convenience of transport, and these three pieces are riveted together at the bridge site, previous to rolling the girder into its position. The centre piece is 36 feet long, and its centre rests on the middle pier. The other two pieces are each 52 feet long. The riveted joints are by this arrangement placed at the point of contrary flexure calculated for the mean condition of the load.

The method of rolling a pair of girders to their place on the pier is thus:—After being braced together, they are lifted by screw-jacks and allowed to rest on rollers fixed on the abutments. Rollers are also fixed on each of the piers, and rails on the flat are attached to the under sides of the girders. Motion is given by means of a crab winch placed on the girders, and strongly fastened to them, while the tackle is attached to a forward pier.

A gang of twenty moplahs, from Malabar, was employed in rolling some of the large girders on the north-west line in the early part of the past year, and were able to move a pair of girders forward in the manner described, about 300 feet in a day.

Mitchell's wrought-iron screw piles are used to a considerable extent for bridge piers in crossing the rivers of the N.W. line, which, for the most part, have deep sand beds. They are the means of saving much trouble and cost in foundations.

STONE.

Amongst Madras building materials may be classed laterite, which is found of various ages in most parts of Southern India; some quite recent, indeed, at present in process of formation from peroxydation of magnetic iron; most likely also, in sub-marine localities, as many of the rivers carry down immense quantities of magnetic iron sand.

The enormous quantity of hornblende minerals is a very

peculiar feature in South India. The author has observed, on the Neilgherry Hills, instances where, from the weakening of hornblende rock, a laterite was being formed *in situ* as a coating over the undecomposed portion of the rock, while the lime of the hornblende was carried away in a soluble salt, and afterwards deposited as an incrustation. The great abundance of concretionary limestone (or kunkur) in this part of the world is probably due to the weathering of these hornblende rocks.

Beds of laterite, several hundred feet thick, occur largely on the western side of the Peninsula, and are very extensively quarried for house and bridge building, and for road ballast. It is not, however, by any means a good building stone, being very porous, and rapidly destroyed by exposure to the weather.

The most general stone, and that principally used for building purposes in Madras Presidency, is gneiss. It dresses well, and is easily quarried. The ordinary method of doing this is by burning logs of wood on the surface. The upper bed thus buckles from expansion, and becomes detached from that beneath; wedges are then driven in, and the bed of stone is broken into convenient pieces by throwing trap boulders forcibly down on it. When, however, stones of great size are required, they are quarried by drilling square holes in line at short intervals, and inserting wedges, which are struck reiterated blows by a hammer.

The walls of Mosques, Pagodas, &c., are built of long, thin stones, closely jointed together, and without cement, many of the stones being cut to fit most accurately the natural inequalities of the contiguous ones. The old fort-walls, and those enclosing temples and such places, are generally built with a double batter, each face being composed of thin stones of very great length, forming a mere shell to the body of the wall, which consists of loose fragments of brick and stone, with