

In the Tunisian war this railroad of 20 ins. gauge with 14 lbs. rails was replaced by that of 2 feet gauge, with 14 lbs. and 19 lbs. rails. There were quite as great difficulties as in the Turcoman campaign, and the country to be crossed was entirely unknown. The observations made before the war spoke of a flat and sandy country. In reality a more uneven country could not be imagined: alternating slopes of about 1 in 10 continually succeeded each other, and before reaching Kairouan 7½ miles of a swamp had to be crossed. Nevertheless the horses harnessed to the railway carriages did on an average twelve to seventeen times the work of those working ordinary carriages. In this campaign also, on account of the steep ascents, the use of locomotives had to be given up. The track served for the conveyance not only of victuals, war material, and cannon, but also of the wounded; and a large number of the survivors owe their lives to this railway, which supplied the means of their speedy removal, and without great sufferings, from the temporary hospitals, and of carrying them to places where more care could be bestowed upon them.

The carriages which did duty in this campaign are shown on Pages 233 and 236. They are wagons with a platform entirely of metal, resting upon eight wheels. The platform is 13 ft. 1 in. long and 2 ft. 11 ins. wide. The total length over buffers is 14 ft. 9 ins., as shown. This carriage may be turned at will into a goods wagon; or into a passenger carriage for sixteen persons, with seats back to back, as in Figs. 21 and 22, Page 233; or into an ambulance wagon for eight wounded persons, as in Figs. 23 and 24.

For the transport of cannon the French military engineers have adopted small trucks similar to Figs. 15 and 16, Pages 229 and 232. A complete equipage, capable of carrying guns weighing from 3 to 9 tons, is composed of trucks with two or three axles, each being fitted with a pivot support, by means of which it is rendered possible to turn the trucks, carrying the heaviest pieces of ordnance, on turntables, and to push them forward without their going off the rails at the curves.

The trucks which have been adopted for the service of the new forts in Paris are drawn by six men, three at each end of the gun; and those are capable of moving with the greatest ease guns weighing 3 tons.

The narrow-gauge railway was tested during the war in Tunis more thoroughly than in any preceding campaign; and the military authorities decided, after peace had been restored in that country, to maintain the narrow-gauge railways permanently; this is a satisfactory proof of their having rendered good service. The line from Sousse to Kairouan is still open for regular traffic. In January, 1883, an express was established, which leaves Sousse every morning and arrives at Kairouan—a distance of forty miles—in five hours, by means of regularly organized relays. The number of carriages and trucks, for the transport of passengers and goods, is 113.

The success thus attained by the narrow-gauge line goes far to prove how unfounded is the opinion that light railways will never suffice for continuous traffic. The opinion is based on certain cases in the Colonies, where it was thought fit to adopt a light rail weighing about 13 to 27 lbs. per yard, but keeping to the old normal gauge. It is nevertheless evident that it is impossible to construct cheap railways on the normal gauge system, as the maintenance as such would be light railways is far more costly in proportion than that of standard railways.

The narrow-gauge is altogether in its right place in countries where, as notable in the case of the Colonies, the traffic is not sufficient to warrant capitalising the expense of constructing a normal-gauge railway.

Very recently the Eastern Railway Company of the Province of Buenos Ayres have adopted narrow-gauge for connecting two of their stations, the gauge being 24 ins. and the weight of the rails 19 lbs. per yard. They have constructed altogether six miles of narrow-gauge road, with a rolling stock of thirty passenger carriages and goods trucks and two engines, at a net cost price of £7,500, engines included. This line works as regularly as the main line with which it is connected. The composite carriages in use are shown in Figs. 25 and 26, Page 237, and leaves nothing to be desired with regard to their appearance and the comfort they offer. Third-class carriages, covered and open, and covered goods wagons, are also employed.

All these carriages are constructed according to the model of those on the Festiniog Railway. The engines weigh 4 tons, and run at 12½ miles per hour for express trains with a live load of 16 tons; while for goods trains carrying 35 tons the rate is 7½ mile an hour.

Another purpose for which the narrow gauge road is of the

highest importance in colonial commerce is the transport of sugar cane. There are two systems in use for the service of sugar plantations:

1. Traction by horses, mules or oxen.
2. Traction by steam-engine.

In the former case, the narrow-gauge of 20 ins. with 14 lbs. rails is used, with platform trucks and iron tipping cradles about 5 ft. long and 4 ft. wide, as shown in Figs. 27 and 28, Page 237. The use of these wagons is particularly advantageous for clearing away the sugar cane from the fields, because, as the crop to be carried off is followed by another harvest, it is important to prevent the injury done by the wheels of heavily laden wagons. The cradles may be made to contain as much as 1300 lbs. of cane for animal traction, and 2000 lbs. for steam traction; the cane is cut up into pieces of 4 to 5 ft. length, which are laid transversely across the cradle. In those colonies where the cane is not cut up into pieces, long platform wagons are used, made entirely of metal, and on eight wheels, in which the cane is laid longitudinally. When the traction is effected by horses or mules, a chain 14½ ft. long is used, and the animals are driven alongside the road. Oxen are harnessed to a yoke, longer by 20 to 24 ins. than the ordinary yoke, and are driven along on each side of the road. On plantations where it is desirable to have passenger carriages, or where the narrow-gauge line may come to be required for the regular transport of passengers and goods, the 20-inch line is replaced by one of 24 ins. gauge.

The transport of refuse of sugar cane is effected by means of tilting basket-wagons, the lower part of which consists of plate iron, as in earthwork wagons, while the upper consists of an open grating or network, offering thus a very great holding capacity without being excessively heavy. The content of these wagons is 90 cubic feet (2500 litres.) To use them for the transport of earth, sand, or rubbish, the grating has merely to be taken off. The cost of one mile of the 20-inch road, with 14 lbs. rails, thirty basket wagons, and accessories for the transport of sugar cane, is £700; and the total weight of this plant amounts to 35 tons.

In case where the transport of sugar cane has to be effected by steam power, the most suitable width of road is 24 ins., with 19 lbs. rails; and this line should be laid down and ballasted most carefully.

Owing to the great lightness of the portable railways, and the facility with which they can be worked, the attention of explorers has repeatedly been attracted by them. The expedition of the Ogové in October 1880, that of the Upper Congo in November 1881, and the Congo mission under Savorgnan de Brazza, have all made use of the Decauville narrow-gauge railways system.

During these expeditions to Central Africa, one of the greatest obstacles to be surmounted was the transport of boats, where the rivers ceased to be navigable; for it was then necessary to employ a great number of negroes for carrying both the boats and the luggage. The explorers, were, more or less, left to the mercy of the natives, and but very slow progress could be made.

On returning from one of these expeditions in Africa, Dr. Balap and M. Mizon consulted the author as to whether the narrow-gauge line might not be profitably adapted for the next expedition. He accordingly proposed to transport their boats, without either taking them to pieces or unloading them, by placing them on to pivot trollies, in the same manner as guns are transported in fortifications and in the field. The first experiments were made at Petit-Bourg with a pleasure yacht. The hull, weighing 4 tons, was placed on two gun-trollies, and was moved about easily across country by means of a portable line of 20 ins. gauge, with 14 lbs. rails. The length of the hull was about 45 ft., depth 6 ft. 7 ins., and breadth of beam 8 ft. 2 ins., that is to say, five times the width of the narrow-gauge: notwithstanding which the wheels never left the rails. The sections of line were taken up and replaced as the boat advanced, and a speed of ½ mile per hour was attained. Dr. Balap and M. Mizon declared that this result far exceeded their hopes, because during their last voyage the passage of the rapids had sometimes required a whole week for one kilometre (½ mile), and they had considered themselves very lucky indeed if they could attain a speed of one kilometre per day. The same narrow-gauge system has since been three times adopted by African explorers, on which occasions it was found that the 20-inch line, with 9 lbs. or 14 lbs. rails, was the most suitable for scientific expeditions of this nature.

The trucks used are of the kind usually employed for military