

Locomotive Engines on Railways," was a valuable contribution towards the elucidation of the true theory of the application of steam as a motive power, and served to dispossess many of the accepted empirical rules which, being in the main founded on practice, in view of the special conditions under which steam had been theretofore applied, had no adequate scientific basis on which to rest the computation of the duty of the steam-engine under the new conditions imposed by the requirements of the locomotive engine.

The Liverpool and Manchester Railway, therefore, may be regarded as having afforded the pattern and example upon which (with such modifications as the experience of the first few years of its working had suggested) its immediate successors were designed and framed.

It may be of interest to recall a few of the principal steps of development which have led up to the state of efficiency which is now found to prevail, in regard both of road and rolling stock.

The line from Liverpool to Manchester was originally laid on so-called fishbellied rails of 35 lbs. per yard, resting in iron chairs, supported on stone blocks wherever solid ground permitted their use. Wooden sleepers were only availed of as a temporary measure where the road was on embankment, or on soft moss, and simply as affording ready means of lifting and adjustment until the bed had become well consolidated.

So much importance was at that time attached by the engineers to the provision of a firm and rigid foundation for the rails, that we find Mr. George Stephenson availing of the rocky floor of the Olive Mount cutting, near Liverpool, to form a bed on which the chairs should directly rest.

Again, Mr. Jesse Hartley, the engineer to the Liverpool Docks, and possessing large experience and great faith in masonry constructions, when appointed engineer of the Bolton and Manchester Railway, commenced, and carried out to a large extent, the system of building up, from the ground level, solid stone walls on which he rested his rails.

Mr. Brunel, preferring timber supports for the Great Western lines of rail, drove in piles to hold down the longitudinal half balks of timber, on which he placed bridge rails.

All these methods were found, from one cause or another, to be defective; and, chiefly by reason of injury done to the rails through excessive rigidity, had soon to be abandoned.

It was fortunate that, with the exception of the case of the Bolton and Manchester Railway, no great expense was incurred in acquiring the experience these trials afforded.