

Badnall's Undulating Railway

from the book "The Engineer's And Mechanic's Encyclopaedia", by Luke Hebert (1849).

A very singular and interesting proposition has been made by Mr. Richard Badnall, for travelling upon undulating lines of railway in preference to straight or level lines, with the view of saving locomotive power, by the application of the natural force of gravity in the descent, so as to obtain a great momentum in making the succeeding ascent. His plan is best explained by himself in the specification of a patent, dated the 8th of September, 1832, which he obtained for that object.

"If a plummet suspended by a string, (as in Fig. 1 in the annexed engraving,) from the point *z*, be drawn away from the perpendicular line to the point *a*, and there let go, it will fall by its gravity to *b*, in the arc *a b*; but, in its falling, it will have acquired so much momentum, as will carry it forward up to a similar altitude at the point *c*."

Fig. 1.

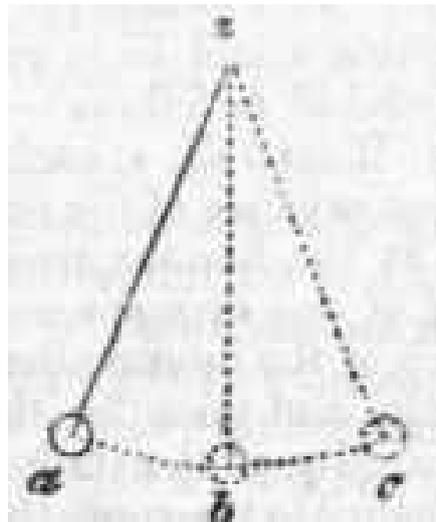


Fig. 2



"Let it be supposed that a line of rails, or tram-way for carriages, be so constructed from the summit of two hills, as Fig. 2, across a valley, that the descent from one hill, as *a*, to the valley *b*, shall subtend a similar angle from the horizontal line to the ascent up the other hill from *b* to *c*. Now if a train-waggon, as *d*, be placed at the summit of the declivity *a*, it will, by its gravity alone, run down the descending line of rails, to the lowest point *b*; but in so running, according to the principles of the oscillating pendulum, it should have acquired a momentum that would carry it forward without any additional force up the ascending line to the summit of the hill *c*, being at the same altitude as the hill *a*. It is quite certain that this would really take place if the force acquired by the momentum was not impeded by the friction of the wheels of the carriage upon their axles, and upon the rails on which they run. Hence, subtracting the amount of friction as a retarding force from the momentum which the carriage has acquired in descending from *a* to *b*, it will be perceived, that the force of momentum alone would only impel the carriage part of the way up the ascent *b c*, say as far as *z*.

It must now be evident, the carriage *d* would not only pass down the descending line of road from *a* to *b* by its gravity, but that the momentum acquired in the descent would also impel it up the second hill as far as *z*, unassisted by any locomotive power. In order, therefore, to raise the carriage to the top of the second hill, I have only to employ such an impelling force as would be sufficient to drive it from *z* to *c*, the whole expense of locomotive power for bringing the carriage from *a* to *z* being saved. If now I employ a locomotive power to assist in impelling my carriage from *a* to *b*, I, by that means, obtain a greater momentum than would result from the descent of the carriage by gravity alone, and am enabled by that means to surmount the hill *c*, having travelled the whole distance from *a* to *c*, on the undulating line of road, with the exertion of much less locomotive power than would have been requisite to have impelled the carriage the same distance upon a perfectly horizontal plane." Having thus explained the principle of his invention, Mr. Badnall claims the formation of tram and railroads, with such undulating curves as are adapted to his object.

This invention has been the subject of much able controversy in the Mechanics' Magazine, and some other public journals, of which our limits render it impossible to give any account. The plausible arguments which were raised in support of the inventor's theory, led to some public trials on the Manchester and Liverpool railway; which, although conclusive as to its inefficacy in the minds of most persons who doubted before, has apparently had the effect of confirming the patentee in his prepossessions of its utility.