The Bee.

"JUSTUM, ET TENACEM PROPOSITI VIRUM, NON CIVIUM ARDOR PRAVA JUBENTIUM, NON VULTUS INSTANTIS TYRANNI MENTE QUATIT SOLIDA."

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ON THE SCIENCE AND PRACTICE OF ROAD MAKING.

[Extracts from an Essay read by Mr. P. CREAR, before the Literary Society, Pictou, 13th Dec. 1835.

CONCLUDED.

THE art of road making, like every other art, must essentially depend for its being successfully conducted, on its being exercised in conformity with certain general principles, and the justness of these principles should be rendered so clear and self-evident as not to admit of any controversy. The right understanding of this principle of road making, is of so great importance, that it is requisite to illustrate and establish the grounds on which it rests; by a reference to the laws of science, concerning moving bodies.

As a carriage for conveying goods or passengers when put in action becomes a moving body, in the language of science, the question to be examined and decided is, how a carriage, when once propelled, can be kept moving onwards with the least quantity of labour to horses, or force of traction?

Sir Isaac Newton has laid it down as a general principle of science, that a body, when once set in motion, will continue to move uniformly forward in a straight line by its momentum, until it be stopped by the action of external force. This proposition is adopted by all natural philosophers as being perfectly true, and therefore, in order to apply it to roads, it is necessary to enquire what kinds of external force act in a manner to destroy the momentum of carriages passing over them.

With respect to these external forces, the general doctrine is, that they consist of, 1st, Collision; 2d, Friction; 3d, Gravity; 4th, Air.

1st. The effect of collision is very great in diminishing the momentum of carriages; it is occasioned by, and is in proportion to the hard protuberances and other inequalities on the surface of a road. These occasion, by the resistance which they make to the wheels, jolts and shocks, which waste the power of draught and considerably check the forward motion of a carriage.

2nd. Friction has a very great influence in checking the motion of the carriage; for, when the wheels come into contact with a soft or elastic surface, the friction which takes place operates powerfully in obstructing the tendency of the carriage to proceed; the motion forward is immediately retarded, and would soon cease if not renewed by the efforts of the horses. The "resistance," Professor Leslie says, "which friction occasions, partakes of the nature of the resistance of fluids; it consists of the consumption of the moving force, or of the horse's labour, occasioned by the soft surface of the road, and the *continually depressing of the spongy and elastic sub-strata* of the road."

An ivory ball, set in motion with a certain velocity over a Turkey carpet, will suffer a visible relaxation of its course; but, with the same impelling force, it will advance further if rolled over a superfine cloth; still further over smooth oaken planks; and it will scarcely seem to abate its velocity over a sheet of pure ice.

This short explanation of the nature and effects of collision and friction is sufficient to show, that smoothness and hardness are the chief qualities to be secured in constructing a road.

But perfect smoothness cannot be obtained without first securing perfect hardness, and therefore the business in making a good road may be said to resolve itself into that of securing perfect hardness.

With the view of taking the right course for securing this object, the first thing a road engineer should do, is to form a correct notion of what hardness is; because the common habit of overlooking this circumstance has been the source of great error in forming opinions upon the qualities of different kinds of roads.

By referring to works of science, it will be seen that hardness is defined to be that property of a body by which it resists the impression of other bodies which impinge upon it; and the degree of hardness is measured by the quantity of this resistance. If the resistance be so complete as to render it totally incapable of any impression, then a body is said to be perfectly hard.

Now this hardness is the hardness which a road ought to have, as far as it is practicable to produce it, and it is the chief business of a scientific road maker to do every thing necessary to produce it. For this purpose, when making a new road, he should first erect or establish a substratum of soil or earth that is not spongy or elastic, for the bed of the road; and then he should so dispose the materials of which the crust of the road is to consist, as to form a body sufficiently strong to oppose the greatest possible quantity of resistance to the weight of heavy carriages passing over it.

That an elastic subsoil is unfit for a road is evident from the nature of the resistance occasioned by friction, as above described by Professor Leslie, and from the terms of the definition of hardness; for however strong the crust of materials may be which is formed over such a subsoil, it will not be capable of opposing a perfect resistance to a heavy moving body. The moving body will sink more or less in proportion as the subsoil is elastic, and the hardness of the road will be imperfect in proportion as this sinking takes place; so that nothing can be more necessary, as a preliminary step in making a new road, than to take every possible precaution to avoid elastic subsoils, or to destroy the elasticity as much as possible, when no other can be found.

Mr. Telford's plan, which has completely succeeded on the Holyhead road, the Glasgow and Carlisle road, and several other roads in Scotland, of making a regular bottoming of rough, close set pavement, is a plan that secures the greatest degree of hardness that can be given to a road; it is also attended with much less expense than when a thick coating of broken stone is used, for six inches of broken stone is sufficient when laid on a pavement, and the pavement may be made with any kind of common stone.

By laying the stones in making the bottoming with their broadest face downwards, and filling up the interstices closely with stone chips well driven in, the earthy bed of the road cannot be pressed up so as to be mixed with the coating of broken stones. This coating, therefore, when consolidated, will form a solid uniform mass of stone, and be infinitely harder than one of broken stones, when unmixed with the earth of the substratum of the road. It is by proceeding in the way here recommended that the friction of wheels on a road will be reduced as much as possible,