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Roads and Roadmaking.

In the construction of roads a minimum of expense is, of course, highly desirable, but the road which is truly cheapest is not the one which has cost the least money but the one which makes the most profitable returns in proportion to the amount which has been expended upon it. To lessen the cost of the construction of a road while striving to attain the attributes which we have found to be desirable, we should endeavor to avoid the necessity of making high embankments or deep excavations or any rock cuttings; the cuttings through the hills should just suffice to fill up the valleys crossed; the line of the road should be carried over firm ground and such as will form a good surface. If no artificial covering is used, or if it is not to be macadamized, it should pass near some locality of good stone, and it should be so located as to require but few and small mechanical structures, such as bridges, culverts, retaining walls, etc.

The more nearly, however, the road is made to approximate towards what it ought to be, the more difficult it will be to satisfy the demands of economy. Some medium between these extremes must therefore be adopted, and the choice of it may be determined by the amount and character of the traffic on the road which it is proposed to make or improve. For this purpose an accurate estimate is to be made of the cost of the proposed improvement and also of the annual saving of labor in the carriage of goods and passengers which its adoption will produce. If the latter exceed the interest of the former at whatever per centage money for the investment can be obtained, then the proposed road will be what it ought to be as to its cost. From these considerations it will appear that it may be truly cheaper to expend ten thousand dollars per mile upon a road which is an important thoroughfare than one thousand upon another road in a different locality.

Let us suppose that it is proposed to improve a road in any way, whether by macadamizing its surface, or by shortening or carrying it around a hill which it now goes over. The first point to be ascertained is the quality and nature of the traffic which already passes over the line. The cost of conveying this amount of traffic is next to be calculated. To simplify the question we will neglect the gain in speed and consider only the saving in heavy transportation. Assume that over a road, 30 miles in length, 50,000 tons of freight are annually carried and that the average friction of its surface, as determined by a dynamometer, is 1-20 of the weight. The annual force of draught required is therefore 2,500 tons, or 5,000,000 pounds. If the average power of draught of a horse at three miles an hour for ten hours a day be taken at 100 pounds, there would be required $\frac{5,000,000}{100} = 50,000$ horses working three miles per hour. At this rate they would traverse the road in ten hours, or a working day, and the total amount of labor would be equal to 50,000 days' work of a horse, or $37,500, taking 75 cents for the value of one day's work.

Suppose now that the road is to be macadamized or planked, or in any way to have its friction reduced 1-50. The total force of draught will then be $\frac{50,000 \times 2,000}{50}$ = 2,000,000 pounds = 20,000 horse power at three miles per hour for 30 miles, or 10 hours, equals 20,000 days' work for a horse. This is a saving from the former amount of 30,000. Taking the value of the day's work at 75 cents, $22,000 would be the actual saving of labor in each year by the improvement proposed, which amount the teamsters could afford to pay for the diminished expenditure on horses. If money were borrowed at 6 per cent., $375,000 would be the amount which could be expended in making the improvement, supposing the data to be correctly assumed. If the improvement can be made for any amount less than this the difference will be that much clear gain.

Next, suppose that the improvement is only shortening the road a mile by a new location of part of it. One-thirtieth of the original distance and therefore labor is saved, or $\frac{5,000,000}{30} = 1,667$ days' work of a horse, equals $1,250, equals interest of $20,833. Add to this amount which the construction of this extra mile would have cost and if the proposed improvement can be made for the sum of the two or even a little more it should be at once carried into effect; for, besides the saving in the original cost and in the annual labor there is also that of time and of the former cost of repairs of the extra mile which is now dispensed with.

If the improvement be avoiding a hill, the resistance of gravity is to be compared with that of friction. Suppose that a certain road ascends a hill which is a mile long and has an inclination of one in ten, and descends the other side which has the same slope and that a level route can be obtained by making the road a mile longer. It is demanded how much may be expended for this purpose. Suppose that the friction of this road is one-fortieth, and that 50,000 tons, as before, pass over it annually. On the original road of two miles the force of draught required to overcome friction is $\frac{50,000 \times 2,000}{40 \times 100} = 25,000$ horse power at three miles per hour, or $\frac{25,000 \times 2}{3} = 16,667$ hours for the two miles, equals 1,667 days' work for a horse. To overcome the gravity of the loads on the inclination of one in ten requires $\frac{50,000 \times 2,000}{10}$ = 10,000,000 pounds for one mile, equals 333,333 loss for 30 miles, equals 3,333 days' work of a horse. The descent of a mile on the other side of the hill is not a compensation. For a horse will have no more to take down the descent than he had dragged up the ascent. The total annual labor to overcome both friction and gravity on these two miles is therefore 1,667 plus 3,333, equals 5,000 days' work of a horse. Upon the new road proposed there is no inclination to overcome but an extra mile of length. The force of draught upon it due to friction is $\frac{50,000 \times 2,000}{40} = 2,500,000$ pounds for three miles. equals 250,000 pounds for 30 miles, equals 2,500 days' work for a horse. The saving of labor is therefore 5,000 – 2,500, = 2,500 days' work of a horse, equals $1,875, equals interest of $31,250, which amount, deducting cost of repairs of the extra mile, may be expended on making the new road.

These calculations have been made for extreme cases in order to make the principal more striking, but the advantages deducted from them have fallen short of the truth, since only the original amount of traffic has been considered while all experience shows that this is very greatly increased by any improvement in the means of transport particularly by the increased speed which is an incidental advantage which we have not taken into account. This increase of traffic cannot, however, be determined in advance by mathematical calculation, though we can readily see from how wide a belt of country the inhabitants might profitably avail themselves of the improved road and will do so eventually; but how many of them will at once profit by it depends on considerations of taste, feeling and prejudice which are beyond the power of numbers.

A cynical writer has produced a book on the vagaries of sanitary science which contains a number of wholesome truths. In endeavoring to impress on the public the importance of keeping disease at a distance and avoiding contagion, some writers have over-stepped the mark and have made suggestions which would bring the whole subject into ridicule. Again, many ideas are good but they cannot be carried out because the public does not recognize their importance. One State Board of Health advises against kissing because of the danger of contagion; another proposes to do away with the communion cup and to use individual vessels. These measures may have some element of reform in them, but they are extreme. There are plenty of simple and important suggestions which can always be brought to the attention of the public, but extreme views should not be pushed forward lest the whole subject of sanitary reformation become an object of ridicule.

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In France the public schools are supplied with sterilized water for the scholars and the floors are cleansed with a moist cloth and not with dry dusters and brooms, as was the custom heretofore.