## ENGINEERING DEPARTMENT.

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### Municipal Engineering.

It is one of the most important things in the wide world to supervise the construction of public works, and provide for the public safety with regard to its health, drainage and so on. And the words of the article do not apply so much to the engineer who in his office plans large and important works, the details of which are to be carried out by others, or to the subordinate who with little thought of responsibility lays out the work of another, as to that large class of engineers scattered broad cast over our land, found in every county and town of any considerable size, who have both to devise and supervise, to plan and to execute, and that of every variety of work, whether it be to survey a town lot, an acre of ground or a farm; to improve streets and roads, build bridges, lay out systems of drainage for rural districts, or sanitary works for towns and cities, in short to that class of engineers who are called upon in every county to plan and carry out in detail every needed improvement.

Now this engineer in his capacity as a public servant sustains relations to himself, to the public which he represents, to the contractor whose work he superintends, and to the individuals whose private interests are affected by the work in progress. And as to himself, aside from pecuniary necessities, he must maintain himself as a man of honor, one who can be trusted as an honorable citizens, and as an expert whose work will do him honor. Then he, in the management of public works, stands as a representative of the public and to him are committed matters of great public importance. Important as to cost, important as to their adaptability to the end designed and also to the manner of their execution, and so he is expected to see that the means are suited to the end sought, and that the public get value received for every dollar expended. While he thus looks to the interest of the public he should as far as possible maintain amicable relations with the contractor, and in insisting that the contract should be fulfilled, it should be done in the spirit of "right is right." While temporarily placed in a position of authority it should not be exercised in an arbitrary way, but rather in a spirit of stewardship. While the interest of the public are well subserved, those of the contractor should not be lost sight of, and he unnecessarily and arbitrarily burdened with things not really essential. He should be a man of good judgment, able to see the end to be accomplished, and ready in the adaptation of means to that end. He should not be visionary, chimerical—such a man may be useful somehow or somewhere perhaps, but I do not think in the ordinary affairs of life. While not deficient in theory, he should be eminently a practical man. He should be a man of tact, ready to adjust himself to circumstances as they come up. Without this a man is liable to frequent collisions of more or less disastrous consequences, while by a little dextrous sidetracking these are avoided and he moves forward in an open and unobstructed way. In short, the common every-day engineer need not be a genius, but he does need to be largely endowed with that very uncommon thing commonly called common sense.

### Roads and Roadmaking.

If several depressions are found very near each other, cover the worst and attend to the next after the first has become solid. The ruts which are formed should not be filled with loose stone, for this would make longitudional ridges of harder material, but "the laborer should work the rake backwards and forwards on each side of the rut and across it; and if he do it with his eyes shut he will do more good than by taking pains to gather all the stones he can find to place in it."

The number of men required by this system of constant watchfulness may at first seem an objection to it, but the expenses will be amply repaid by the advantages obtained. Each laborer should have a certain length of road assigned to his special care, and the most intelligent and trustworthy among them should be made inspectors over the others for a certain distance. At times unfavorable for work on the road they should be employed in breaking stone. The labor of one man will keep in repair three miles of well made and well drained road for the first two years after its formation, and four miles for the next two years, by constantly spreading loose stones in the hollows raking them from the middle to the sides, opening the ditches, etc.

The friction or resistance to draught on a road with deep ruts and thick mud is four times as great as on one in good order. This shows the importance of very perfectly "keeping up" the road. An incidental advantage is that the prompt removal of the mud after every shower will prevent the annoyance of dust, so generally an objection to McAdam roads, but not at all their necessary concomitant.

Where the materials of the road are very brittle stone they wear away very rapidly in dry weather, and their consumption may be much lessened by watering the road judiciously, not so little as to form a crust which adheres to the wheel nor so much as to make the draught heavy. A moderate use of the watering cart preserves the material from pulverization and keeps them settled in their places at the same time that the comfort of the traveller is greatly enhanced. This is particularly necessary on roads in this country during our hot and dry summers; for after a long drought the crust of the road sometimes becomes to dried out that it ceases to bind and permits loose stones to be detatched from it to the great injury to the surface. An excess of moisture must, however, be avoided since it increases the grinding power of the pulverised stones, as marble is sawn and jewels are cut by their own powder combined with water.

The queston may arise whether the materials thus gradually added to the road for alimentation rather than reparation, are sufficient to make up for its annual loss, and diminution of depth, which is too small for direct measurement. Experiments on this point indicate that the amount of materials annually consumed and therefore to be replaced, is one cubic yard per mile for each dollar or beast of burden passing over it.

A road properly kept up by daily attention needs no repairs, but if it be put in order only at intervals the injuries to it which have been increasing in geometrical progression which render very serious repairs necessary. It will be found cut into ruts, deep holes and irregular projections; and often lower in the middle than at the sides. It must be put into shape and restored to its proper cross-section by cutting down the sides and filling up the middle parts. Only a single thin coat of stone should be applied at one time, not more than a cubic yard to a rod superficial. The surface of the old road may be lightly picked or lifted with strong, short picks, merely burying the point of the pick one or two inches deep, so that the new materials may be more easily united to the old ones. This is especially necessary on declivities to prevent the stones rolling down the slopes.

When the road to be repaired is one which has been originally formed of large stones, and of superfluous thickness no new materials should be brought upon it, but the old stones should be loosened with picks gathered by strong rakes to the side of the road and there broken to the proper size. The surface of the road having been put in proper shape the broken stones are to be returned to it being scattered uniformly and thinly over the surface. Only a small piece of road should be thus broken up at once, say six or eight feet in length, but the whole width. The old plan of repairing would be to fill up the holes with an additional supply of the same large materials. But the methods here recommended makes more work for men and less for horses, and produces a great saving in expense.

The best season for repairing broken stone roads is in the spring or early summer when the weather is neither very wet or very dry, for either of these extremes prevents the materials from consolidating and therefore produces either a heavy or dusty road. If made at this season the roads are left in a good state for the summer and become consolidated and hard so as to be in a condition to resist the work of the ensuing winter.