

"WE WANT GOOD ROADS."

By A. W. Campbell, C. E., Road Commissioner of Ontario.

The Great Need of This Country is Good Roads--How to Build Them Economically Explained by an Expert--Useful Hints and Diagrams to the Road Builders of this Country.

BROKEN STONE.

There are localities in Canada where good gravel is not obtainable, but where stone can be had, either as bed rock or as field boulders. Some towns have used stone broken by hand, but a stone crusher, with a screen attachment affords a much cheaper method.

The stone should be separated into grades according to size, the coarsest stone to be placed in bottom of the road, and the finer at the top. This grading of the stone is done by means of the screen attachment. If the stones are placed in the road without being graded in this manner, the smaller stones wear more rapidly than the larger and a rough surface results. Large stones at the surface, moreover, are more apt to become loose, to roll under the horses' feet or the wheels. For a country road, there should be placed in the roadbed, 1st, a layer of stones such as will pass through a 2-1/2 inch ring; 2nd, on this a layer of stones such as will pass through a one inch ring; 3rd, on this a coating of screenings—that is, the dust and chips created in crushing.

Care must be taken in choosing the stone to be used. Some limestones make good metal; but limestone of a silty nature, or limestones which decay rapidly on exposure to the air should be rejected. Sandstones are brittle and do not unite well in the road. Granites, which are found in many parts of Canada, make good road metal. Trap rock is the best obtainable. Gneiss is very frequently a good rock. The latter is often found in boulders scattered over the southern parts of Canada. In using field boulders, care must be taken to reject such stones as are evidently softened by exposure. Rocks which crumble readily under successive blows of a hammer, or which show a stain when broken, should be discarded. A little experience will quickly teach a judicious roadman to detect boulder stone which is unfit for road purposes.

There must be sufficient body of broken stone to consolidate into a compact layer. A sprinkling of stones over the surface is useless. It merely impedes travel on what might otherwise be a good dirt road. Six inches of broken stone is the least which should be used in making a good road; for any purpose, it should be the aim of the contractor to thicken this covering as circumstances will permit.

PLACING THE ROAD METAL.

To know how gravel or stone should be placed on the road, it is necessary to have a knowledge of why it is placed on the road. This is a matter to which very few of our roadmakers have given slightest attention, and very few could give an intelligent answer to the question. The popular idea is that the stone makes a sort of carpet for a while, in which it is placed on the road, and that so long as it remains on the road it will do the actual work of the road; but that the only means of accomplishing the desired end is to pile on gravel year after year; and that water, unless it actually flows over the top of the road, has little to do with the matter; and that so long as the actual surface of the road does not get wet it does not matter how boggy it may be underneath.

In the intelligent construction of a road, the intention of the gravel or stone covering is to form a wearing surface and protect the soil underneath. Of course, gravel and broken stone cannot as a matter of fact, be entirely impervious; but so far as the coating of these materials does prevent the water passing through to the sub-soil, it fulfills the greatest portion of its mission.

CROWNING.

By having the road crowned or rounded up in the centre, water is at once thrown to the sides where it can be carried away in the drains. If the road is flat on the top, or if hollow, as many roads of Canada are, water stands on the road, soaks down through the road covering, and softens the soil beneath. Then the trouble begins. There is nothing to support the gravel, so that when a loaded vehicle passes over it, the wheels are forced down through the gravel and into the soil. The soil is plover up, mixed with the gravel, and the serviceability of the road is largely destroyed.

The means of providing a proper crown must depend on circumstances. For an average country road on which a grading machine is used the best method will be to first round up the natural soil, giving off to less crown than it is intended the finished road shall have. This completed, pass the grader over one side of the centre, cutting off the top and turning the loosened dirt to the side; then pass the grader back along the other side, turning the loosened dirt to the side. This will leave a flat surface in the centre of the roadway, along each side of which is a shoulder of loose earth, forming a shallow trench. In this the gravel should be placed, spread with a rounded surface and the loose dirt at the sides levelled off to conform to the shape of the roadway.

Old gravel roads are commonly flat, in ridges, with square shoulders at the edge of the ditches. In this case, the better plan is to cut off these shoulders, throwing the loosened earth outward. The ditches are usually very shallow, flat, the road having been graded by

drawing the earth out of the ditches with a scraper, so that these shoulders thus turned outward merely widen the graded roadway without interfering with the drain. If, however, these ditches are sharp and deep, the loosened earth may drop down so as to obstruct the water in which case it will have to be thrown across the drain to the roadside by hand—a proceeding seldom necessary.

Usually a sufficient depth of gravel will be found upon these roads, requiring only that the centre should be raised by cutting off the sides. After this is done as above described, a light coating of clean gravel to fill the holes and depressions and restore the crown will frequently make an excellent road.

CONSOLIDATING THE MATERIAL.

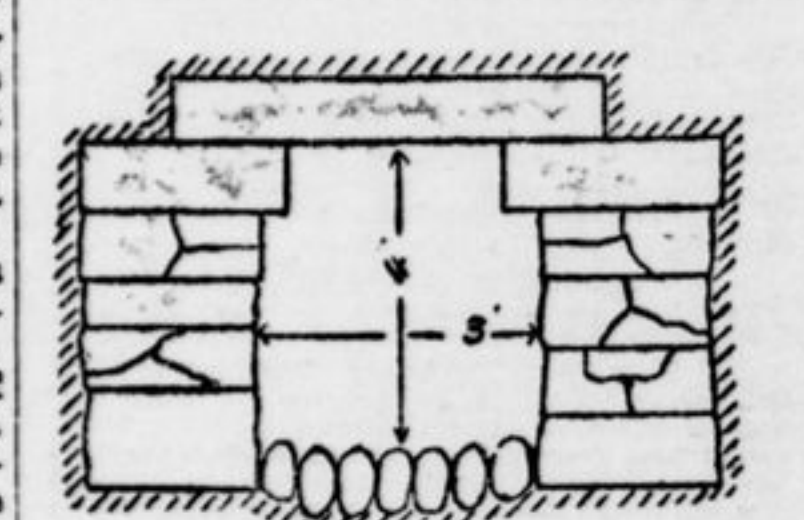
The road covering should be solid and compact in order to shed the water. Under present methods, the gravel or stone is dumped in the centre of the road and left as it falls, a mound of loose material, avoided by the users of the road until late in the fall when the muddy and rutted state of the side of the road compels them to drive along the mound. Gradually it is flattened down and, after a year or so, during which time it has been mixed largely with the soil beneath, it assumes the shape of a road. The utility of roads made in this way is largely wasted. Roads must be made for traffic, not by it.

This loose stuff absorbs the rain as it falls even before it is cut into ridges by wheels and the feet of horses. When it has been cut into ridges it acts as a receptacle to hold all the moisture its surface will receive. In this way the whole surface and foundation of the road is softened, is readily cut up and destroyed.

The best remedy for this waste in roadmaking is to spread the road metal to conform to the required surface of the finished road, and then thoroughly consolidate it by the use of a heavy roller. It can be largely remedied also by taking proper care of the road, if a roller cannot be had. By raking the loose material into the ruts and wheel tracks as fast as they appear, nearly the same end will be accomplished, but less perfectly, and requiring a longer time. The first vehicle passing over the road does comparatively little injury; it is when they have been formed which hold water, and other wheels follow in these tracks, that the greatest damage is done.

A SMOOTH SURFACE.

It is evident that a smooth surface is essential to a good road. A rough surface is necessarily such as will impede the flow of water. Ruts running lengthways with the road form trenches to cut off the flow of water from the centre to the drains. To



AN EASILY MADE STONE CULVERT.—Cross-section.

such roads rain is always an injury. With roads properly built, on the contrary, a good dash of rain will flush away the dust which has accumulated; and which if it remains on the road in time of steady rain and slush acts as a sponge to absorb moisture and soften the surface of the road.

KEEP THE ROAD DRY.

Keep the roads dry, and with very little attention they will remain good roads. A little moisture does comparatively little injury. Against some moisture it is impossible to guard. But with proper precautions, the excess moisture can be removed before great damage is done. The means to be taken with regard to the actual surface of the road have already been commented upon.

THE OPEN DRAIN.

The open drains at the sides of the road should be sufficiently deep to hold water in times of freshets, and should have a sufficient fall to carry it quickly away. The fall should be uniform, not a series of rises and falls, knolls and holes.

Most important of all, in view of the neglect which it receives, the outlet must be ample, and always free from obstruction. It is useless to dig a drain without providing an outlet for the water, a thing very commonly done. The water merely stands in the trench, soaks into and softens the roadbed. Unless a drain carries the water away, it is useless.

FOUNDATION.

The importance of keeping the roadbed dry, cannot be too thoroughly impressed. Clay in thick beds when dry, will support from 4 to 6 tons per square foot, of surface, according to the quality of the clay. If only moderately dry it will support only from 2 to 4 tons per square foot of surface. If the clay is wet and soft it will yield to almost any load.

Gravel, if well compacted, forms a much stronger roadbed, is less yielding to the action of moisture and for this reason, even for a thin surface coating, strengthens the road somewhat. But the real strength of the roadmost are in the subsoil. Vegetable moulds and alluvial soils are weak, having a sustaining power of only one-half to one ton per square foot; and for this reason it is well to remove such soils, securing, if possible, a gravel, clay or sand foundation.

UNDERDRAINING.

In order to keep the roadbed dry, and

secure a strong foundation, it is frequently advisable to use tile underdrains. Owing to the weakening effect of water on clay, also to the retentive nature of clay, soil is usually most in need of underdrainage. In gravel and sand, water is not ordinarily so destructive unless when acted upon by frost; at the same time, these latter soils usually provide better natural underdrainage, as they are more porous, and artificial means of underdrainage are usually less necessary.

Underdrainage may be had by means of common field tile. It is usually best to place two such drains, one on the open side of the roadway underneath the centre of the roadbed is sometimes used. The extra cost of two drains is largely reduced, however, by the lesser cost of excavation, since, on the majority of road allowances, deep softer soils now exist, and the soil is that in the hardened centre of the road. It is very unwise to excavate and soften the hardened centre of the road when it can be avoided, as settlement is very slow. At the same time, two drains are more effective, carrying away water more rapidly and thoroughly; they intercept the soaking water from the adjoining land before it passes under the roadbed.

Any thoughtful farmer who knows the effect of underdrainage in his fields will at once recognize its usefulness in road-making. The fall, water will be rapidly removed from the bed of the road and the destructive action of frost lessened. In the spring, the frost will come out of the ground more quickly, and each of those periods in fall and spring are shortened, when, with the drainage of surface through saturated roads, the roads are not only impassable on account of the mud, but are injured by traffic more than in all the remaining nine or ten months of the year. One year's statute labor with the annual appropriation spent in providing proper drains for the roads of the province would do more than can be done in five years with the present method of merely filling the holes which appear, with gravel or crushed stone.

Underdrainage and grading should be carried on simultaneously. Unless drained, the traffic during the ensuing



A GOOD ROAD COVERING.—Cross-section.

The largest stones in the bottom and the smallest at the surface, free from sand and clay; and thoroughly rolled.

ROAD GRADERS.

A road grader is one of the most necessary implements for a township to possess. To depend upon manual labor for the first grading of roads, and the repair of others that require reshaping is a useless waste of labor and money. Improved road machinery is as great a saving in roading as is the self binder or the steam thrasher in farming operations. To neglect to use a road grader is as unwise as it would be to return to the old time cradle and flail. If every ratepayer could see the same personal interest in the roads as he does in his own farm, the municipalities would be without modern machinery for road work. The grader in the hands of a skillful operator will do the work of fifty to seventy-five men in grading and levelling the roadway.

A ROAD ROLLER.

A most valuable implement in road construction is the road roller. On town streets it is indispensable. To thoroughly consolidate the gravel or stone into a smooth, hard layer, before it can be mixed up with the sub-soil, renders the surface coating more durable and serviceable in every way. A steam roller of ten tons is too expensive for the majority of rural municipalities, but in some instances townships could rent from a town in the district, which owns one. A horse roller of six or eight tons is less expensive and some municipalities may see fit to purchase. In the construction of broken stone roads the loose stone compacted under traffic less readily than does gravel, and without rolling remains for some time very loose and rough.

A STONE CRUSHER.

Wherever good gravel cannot be had, where stone for crushing is obtainable, a stone crusher is most useful. Stone can be broken by this means at a price within the range of every well-populated township, although a very expensive work when performed by hand. A crusher can be operated by the steam engine used for a threshing machine which can generally be rented. A crusher will prepare from 10 to 15 cords per day.

A ROTARY SCREEN ATTACHED TO THE CRUSHER WILL SEPARATE THE STONE INTO GRADES ACCORDING TO SIZE, READY TO BE PLACED ON THE ROAD IN LAYERS, THE COARSEST IN THE BOTTOM OF THE ROAD.

WAGON TIRES.

It would seem as though in everything the present methods in regard to roads in Canada are contrary to good judgment. Gravel or broken stone is dumped loosely without even spread-

ing, on a badly graded, badly drained sub-soil. In the use of these roads the same recklessness is glaringly apparent. When wide tires have universally replaced the narrow tires which are now found on farm wagons, a great part of the road question will be solved. Narrow tires of two and one-half inches in width have only one half of the bearing on the road which would be provided by tires of proper width. By referring to the supporting power of soils discussed in the paragraph on "Foundations," the effect of this is more apparent. By the use of a six inch tire, the roadway will support, without yielding, twice the load which it could support with a three inch tire.

Narrow tires cannot be too strongly condemned. They cut and grind the road, plow and upheave it. Wide tires on the contrary, are a benefit rather than an injury to the road inasmuch as they act as rollers to preserve a smooth, hard surface. In some localities wide tires are objected to under the argument that they increase the draft required to move the load. This may occur under certain occasional conditions of very wet and soft roads. But when wide tires are universally used this objection will disappear, as the increased draft is due to the ruts and mud caused by narrow tires.

DIMENSIONS OF ROADS.

For the average country road, a graded roadway twenty-four feet in width between the inside edges of the open drains, will be ample to accommodate travel. For the average road, if the central eight feet is metalled with gravel or broken stone, it will be sufficient. The depth and width of the open drains will be governed by circumstances. Sufficient capacity must be provided to carry away all surface water. The depth must be dependent also on the fall obtainable. With tile underdrains, deep open ditches are not needed to drain the road foundation. The use of the ditches away with the deep and dangerous open ditches which may otherwise be necessary. The crown of the road should be such as to give a fall of one inch to the foot from centre to the edge of the ditch.

HILLS.

Hills are among the difficult portions of the road to construct, and are a constant source of expense for repairs. The reason of this usually is, that the drainage is imperfect. Water is brought long distances in open drains by the roadside, and poured over the hills, frequently to flood over the whole surface. It is not uncommon to find the centre of the road over the hill lower than the open drains at its side—if there are drains at all. The natural result is that washouts are constantly occurring. For conditions of this kind the simple remedy is to dispose of the water before it reaches the hill, by conveying it through the adjoining fields if necessary. The probability is that the greater amount of water has been carried in deep ditches past water-courses after watercourses in order to dispose of it over the hill; thereby avoiding the necessity of constructing drains through farm land in the natural watercourses. The secret of successful drainage with respect to roads, is to dispose of water in small quantities before it can gain force and headway.

Another common occurrence is to find water oozing from the surface of the road on hills. This is especially noticeable after the frost leaves these spots. The surface is soft and spongy and is cut readily by wheels. Such hills should be drained by placing a line of tile down each side of the roadway between the gutter and the gravel carrying these underdrains to proper outlets. Cross drains should be laid in the wet spot leading to the side underdrains in a diagonal course. Well covered gutters should be made on each side of the roadway and at regular intervals catch basins should be placed to arrest the flow of water in these gutters leading it into the tile underdrains.

MESSAGES OF TRIUMPH.

How Famous Sailors and Generals Have Announced Their Victories.

Caesar: "Veni, vidi, vici" (I came, I saw, I conquered.)

Sobieski: "I came; I saw; God conquered."

Turenne announcing the victory of Dunen over the Spaniards: "The enemy came; was beaten; I am tired; good night."

Gen. Suwarrow, to Catherine of Russia: "Hurrah! Prague, Suwarrow."

Catherine to Suwarrow: "Bravo, Field Marshal, Catherine." In these terms Suwarrow received his promotion.

Sir Charles Napier, after Hyderabad and the capture of Scinde: "Pecavi, I have Scinde." In the dawn of the day which was to see the battle of Meenae, he said: "If I survive I shall soon be with those I love; if I fall I shall soon be with those I have loved."

Gen. Desaix to Napoleon at Marengo: "The battle is lost, but there is time to gain another."

Henry IV. of France, at Ivry, 1590: "If the flags fall you rally to my white plume. You shall always find it in the paths of honor and victory."

Lawrence: "Don't give up the ship!"

Marshal MacMahon, after the capture of the Malakoff by the French during the siege of Sebastopol: "J'y suis; j'y reste." (I am here; I remain here.)

Sebastiani, after the massacre of the Poles in Warsaw during the insurrection of 1830: "Order reigns in Warsaw."

Here are some other pithy short sayings about war that are appropriate at present.

Demosthenes: "A man that runs away may fight again." (Demosthenes had been charged with cowardice in throwing away his shield at the battle of Chevonea, 338 B. C.)

Marshal Saxe: "We are like cloaks—one thinks of us only when it rains." (Said of the soldier after peace was declared.)

Alexander the Great to his disaffected soldiers: "Go home and leave Alexander to conquer the world alone."

Wellington: "A great country can have no such thing as a little war."

Marchal Ney: "Glory is not to be divided."

Marshal Lannes: "No one but a poltroon will boast that he never knew fear."

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