

# "WE WANT GOOD ROADS."

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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 townships 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 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 2-2 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 limestone make good metal; but limestone of a silty nature, or limestone that air rapidly on exposure to the air should be rejected. Sandstones are brittle and do not unite well in 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 with other hardstones, are frequently found as 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 iron stains 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 durable roadway for any purpose; and it should be the aim of councils 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 a short time it will be forced down into the soil to form a bottom; on this more gravel or stone will have to be placed; and that this process will have to be continued indefinitely until a good road is made. There is even a very general belief that it is not necessary to drain a 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 floods 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 coating 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.

To accomplish this to the greatest possible extent there are several points which it is necessary to pay attention to, 1st, the road must be crowned or rounded up in the centre; 2nd, the material must be as compact and as solid as possible; 3rd, the surface of the road must be smooth.

## 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 plowed 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 it a 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 wide and 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.

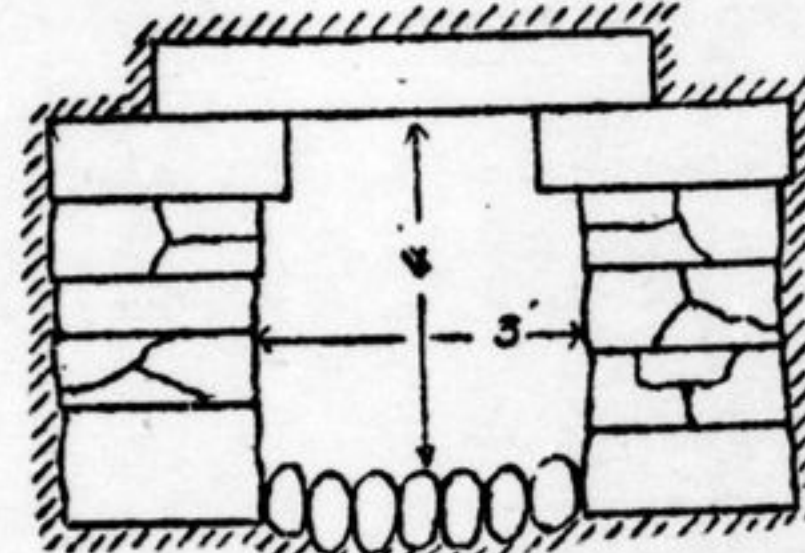
Usually a sufficient depth of gravel will be found upon these roads, requiring only that the centre should be raised by cutting off the sides. After this is done as above described, a light coating of clean gravel to fill the ruts and depressions and restore the crown will frequently make an excellent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



AN EASILY MADE STONE CULVERT.—Cross-section.

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 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 road

bed 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 road must lie 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, that soil is usually moist 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 each side of the roadway underneath the open drains. One tile drain placed 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 open drains now exist, and the soil is softer and more cheaply handled than 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 soakage water from the adjoining land before it passes under the roadbed.

Any thoughtful farmer who knows the effect of underdraining in his fields will at once recognize its usefulness in road-making. In 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 foundation and surface thoroughly saturated, 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 pro-



A GOOD ROAD COVERING.—Cross-section.

vide 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.

Underdraining and grading should be carried on simultaneously. Unless drained, the traffic during the ensuing autumn and spring will usually leave a graded road as shapeless and rough as a pioneer wagon track can be. If drained, there will be a foundation for the gravel or crushed stone to rest on when applied.

A porous soil, like a sponge, retains in its texture, by attraction, a certain amount of water. When water in excess of this is added, it sinks to the first impenetrable strata, and from there it rises higher and higher until it finds a lateral outlet; just as water poured into a pail will rise higher and higher, until it finds an outlet in the side of the pail, or until it flows over the top. Underdraining supplies the necessary outlet for this excess moisture at a proper depth from the surface; it "lowers the water line."

With plastic clays the process is slightly different. Clay will absorb nearly one-half its bulk and weight of water. In drying, it shrinks and is torn in different directions. The fissures thus commenced by a tile drain become new drains to lead water to the tile, and so the process of contracting and cracking continues until a network of fissures is produced, and the stiffest clay is thereby drained.

## THE EFFECT OF FROST.

The injury done to roads by frost is caused entirely by the presence of water. Water expands on freezing, and the more there is under a road, and above frost line, the greater is the injury. In freezing, water expands. The particles of soil in immediate contact with the water are first compacted. When room for expansion ceases within the body of the soil itself, the surface is upheaved. When thawing takes place the sub-soil will be found honey-combed, ready to settle and sink beneath traffic. It is therefore of the utmost importance that the soil should be relieved of the water of saturation as quickly as possible by underdrainage. The impassable condition of most roads in Canada during the spring, often axle deep with mud, is to be attributed very largely to a wet sub-soil which has been honey-combed by frost.

## MAINTENANCE.

It is not merely necessary to make the roads good; they must be kept good. It is not sufficient to provide drains; care must be exercised to keep the drains open and free from obstructions. It is not enough to merely place the gravel or broken stone on the road as it ought to be placed; care must be

taken to see that the covering is kept in place. It is not sufficient to build culverts; it is further necessary that the culverts be kept in order. It is folly to build roads properly if they are afterwards neglected and allowed to remain out of repair. Every farmer knows that if the repairs of his barns, his outhouses, and his fences were neglected as is the repair of the roads, a great personal loss would result.

Probably one of the greatest defects of the present system of road construction is that the roads are not repaired when the need of repairs arises. Unless in a very dangerous state, work is done on the roads only once a year at the time of performing statute labor; or ruts, hollows and other defects are permitted to remain without attention and when these defects commence, they increase with great rapidity. Culverts are permitted to fall to pieces for want of repair at the proper time. Drains become obstructed, and the roadway is allowed to be flooded and saturated for want of a little timely attention.

Repairs are made once a year and that at a season when least required, having a tendency to destroy the usefulness of the road at the only time when our roads can be called serviceable. When the weather is dry for several months in summer the ordinary clay road baked by the sun, is kept in proper shape, is an excellent roadway; but our novel system—as if to checkmate Providence—provides otherwise.

As soon as such roads dry up showing signs of being fairly serviceable, it is the duty of each pathmaster to turn out, say in the month of June, and to the extent of his ability, with the statute labor at his disposal, plow up the sides of the road in the most irregular manner possible and then with drag scrapers bring the earth towards the centre of the road and there dump it so that each scraper full will stand out separately and alone, making the road surface as rough and impassable as possible. Wherever such earth is brought from the side of the grade it appears to be unwritten law that it shall be done by gouging with the scraper so as to leave depressions and pockets, which will hold water. Where a road has been gravelled, but in the spring becomes rutted, with an occasional depression, offering an excuse for repairs, it appears to be the policy of our roadmakers to fill up the ruts with the coarsest gravel obtainable. Wherever there is a slight depression they dump a load of gravel large enough to form a mound. Should these repairs force the traffic to the sides of the road, the work is considered complete, except that it may be thought a further necessity to lay rails, logs, stumps, etc., crosswise on the sides of the roadway, obliging the travel to follow the centre or take another road.

It is absolutely essential to the maintenance of a good and economical system of roads that provision be made by

men in grading and levelling the roadway.

## A ROAD ROLLER.

A most valuable implement in road construction is the road roller. The town streets it is indispensable. It thoroughly consolidates the gravel and stone into a smooth, hard layer, and it can be mixed up with the surface 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 municipalities 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 stones are solidated 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 desirable. It can be broken by this means at a price within the range of every well-to-do township, although a very expensive work when performed by hand. A crusher can be operated by a steam engine used for a threshing machine, which can generally be rented. A crusher will prepare from 100 to 200 cords per day.

A rotary screen attached to a crusher will separate the stone into grades according to size, ready to be placed on the road in layers, the smaller in the bottom of the road.

## WAGON TIRES.

It would seem as though in nothing the present methods in using roads in Canada are contrary to good judgment. Gravel or broken stone dumped loosely without even spreading, on a badly graded, badly finished sub-soil. In the use of these materials some recklessness is glaringly apparent. When wide tires have been replaced the narrow tires which are now found on farm wagons a part of the road question will be the bearing on the road which will be provided by tires of proper size. By referring to the supporting power of soils discussed in the paragraphs "Foundations," the effect of the inch tire, the roadway will appear without yielding, twice the load it could support with a three inch tire.

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

## DIMENSIONS OF ROADS.

For the average country road the graded roadway twenty-four feet wide between the inside edges of the open drains, will be ample to accommodate travel. For the average road the central eight feet is metalled with gravel or broken stone, it will be sufficient. The depth and width of open drains will have to be governed by circumstances. Sufficient capacity should be provided to carry away all surface water. The depth must be dependent also on the fall obtainable. With underdrains, deep open drains are needed to drain the road foundation. The use of tile does away with the deep and dangerous open ditches which may otherwise be necessary. The depth of the road should be such as to give a fall of one inch to the foot to the centre to the edge of the ditch.

## HILLS.

Hills are among the difficult portions of the road to construct, and a constant source of expense for repairs. The reason of this usually is that drainage is imperfect. Water brought long distances in open ditches by the roadside, and poured over the hills, frequently to flood over the surface. It is not uncommon for the centre of the road over the hill to be lower than the open drains at the sides if there are drains at all. The result is that washouts are common. For conditions of this kind the simple remedy is to dispose of the water before it reaches the hill by veing it through the adjoining low ground. The probability is that if necessary, the greater amount of water carried in deep ditches past the hill, course after watercourse in open ditches through farm land in the neighborhood. The secret of successful drainage with respect to hills is to dispose of water in small quantities before it can gain force and do damage.

Another common occurrence is water oozing from the surface of the road on hills. This is especially noticeable after the frost leaves the spots. The surface is soft and spongy, and is cut readily by wheels. The hills should be drained by the line of tile down each side of the road carrying these underdrains to the wet spot leading to the side of the roadway in a diagonal course. The drains in a diagonal course will at intervals catch basins should be dug to arrest the flow of water to the gutters leading it into the ditches.

The roadway on a hill should be crowned. This will draw the water quickly to the drains at the sides of the road, instead of permitting it to flow down the wheel tracks, deepening the ruts.

To Be Continued.

...ance of a Roman Queen

...ornella, the daughter of Cinna, was sitting in a chair dead, her eyes open looking toward the sky, with a look of horror, her hands up as if to ward off a blow or push away some awful object. In her view some awful object. In her view some awful object. In her view some awful object.

...Decided it was better for him to have more money than she. She had broken the girl's heart, there was no sign of disease or pain in a coach in the Triclinium. The house in Herculaneum. Pomponella, the Roman senator, lay beside him an imperial soldier in a shadow his old and faithful friend. Suddenly he said to the soldier, "Julius Cinna that I forgive me if he asks him to forgive me if he asks me as false to him as—" The soldier gave a vicious spitter and we left a snaky coil of green.

...the Forum the Romans wept. Tullus Cicero pronounced an oration the good and virtuous senator. With the first blush of spring Julius Cinna, the proprietor of Father Spaulding's steps toward Rome to return from the emperor's hand a citizen.

...stating in the morning sun a soldier stands silently before the gate of Winged Victory. Julius Cinna, at the head of his army, approached. Something in the soldier's pose arrested his attention. Julius Cinna, the soldier made acquaintance with the death of Cornelia and the perfidy of Dolabella.

...not a muscle quivered, not a sound escaped him, but a deadly color slowly over his face. When the soldier retired to retire Cinna's hair was as marble.

...will not forget that I am a Roman soldier. No one shall know the name of the emperor. The imperial edict forbade the name of Pompeius Dolabella in the senatorial tablets was a myrtle leaf.

...Julia, if I mistake not, Cinna had sought for thee, my beautiful sister. Dear father, as I live, I love him as my heart."

...Cinna was hid to the wedding feast of Cinna and Julia, daughter of Escalapius, the philosopher. The emperor himself joined their hands, the bride and groom, the oracle of Escalapius for a story.

...the old philosopher began to weep. He was taken from the body of a beautiful girl who had been buried only the day before. Being removed to a secret chamber it was at once placed on a wall of the block with the hands and feet on a crystal discus. A slay of Cinna rubbed the crystal with leather and blue flashes of faint light were seen to jump to and from the body like lightning of Jove.

...they tinged overspread the girl's eyes, escaped the beautiful lips. She was not dead, as I had reasoned. To her, then, did I some secret her minister, blotting from out her mind. Quickly she came back to life and knew me only as her father, she who stands before you now daughter of Julius Cinna is not my wife, but Cornelia, the daughter of...