

attempts to raise the fertility of soils, drainage is an imperative need. Let us now consider a few advantages a thorough drainage system affords. It counteracts all the conditions that are adverse to high fertility and easy and effective cultivation. It ensures earlier cultivation and earlier seeding, consequently a great deal of moisture is conserved in the soil for further use by the plants, and by gaining an early growth plants mature earlier, withstand drouth more effectively, and resist attacks of fungous diseases, such as rust and smut. It renders cultivation easier and more effective. It improves the capillary capacity of the soil, and may be termed the regulator of soil moisture. Drainage renders manuring and fertilizing more effective, as any manure or other fertilizer deposited upon the soil is carried into the soil with the water as it percolates downward from the surface, and so becomes thoroughly incorporated with the soil. The rain water, which is a needed solvent, and carries fertilizer of some value, passes through the soil, enriching it by dissolving and preparing crude material for the nourishment of plant life. In drained soils the effect of frost is moderated; the frost goes out earlier in spring, so that the seeding season is one or two weeks earlier than in the case of undrained soils. Drainage, to a considerable extent, prevents surface washing; the surface soil is being retained, instead of the finest and most fertile parts being carried off with every heavy rainfall. A drainage system improves the quality of natural grasses, weeds are retarded by smothering crops, and the sanitary condition of a place greatly improved. Drainage also aids in making new soil out of the crude elements, by allowing a freer entrance of frost, air and heat, the agents which disintegrate soil material previously unavailable for use of plants.

Let us next consider how we are to ascertain whether lands require drainage, but first I would just like to clearly set forth my meaning of two terms I shall use, viz., the term water table and the term root zone. By the term water table we understand just the level of the fill water in the soil. This may be at any distance from the surface, and variable at different seasons of the year. That it be at a depth of at least two feet from the surface is very important, in order that the roots of the plants may have ample room to forage for plant food, as roots do not penetrate below the water table to any appreciable extent. The lower this line, accordingly, the owner may be said to have so much more land; although the area of arable land is not changed, the foraging ground of the roots is extended; more room for root development means a more vigorous and rapid growth of the plants.

The term "root-zone" indicates the depth of soil from the surface to the water-table, more definitely the region in which the roots of the plants forage, feed and develop. All plant food consumed by the plants in growth is obtained in the region of the root-zone; if the water table is lowered the depth and extent of the root-zone is added to, as the plants' roots will then delve more deeply into the soil for food, and more available food will be at their disposal.

Dundas Co., Ont.

CLARK HAMILTON.

Our Bad Roads Illustrations.

Editor "The Farmer's Advocate":

The illustrations of bad roads which appeared in your issue of the 10th inst., are typical of conditions which prevail throughout the Province. They show in a most forcible manner some of the chief defects of roadmaking, and taken as they are, in one of the most wealthy counties in Ontario, they speak volumes in behalf of the road-reform movement. Looking at these illustrations, it is evident that the road in each case has received a large amount of work, extending over a considerable period of years. The adjoining farm lands and property evince prosperity, painstaking effort, and an application of the best principles of agriculture. As such, they stand in striking contrast to the roads leading to them, in which every good principle of road construction appears to have been violated.

Good drainage is the first requirement in securing a good road. In not one instance is there a reasonable attempt to observe this rule. The travelled roadway is, in every case, too wide, and no effort is made to turn the water to the side drains. The side drains, if such they can be called, are irregular, shallow, and have no definite outlet. In two cases, at least, the only outlet appears to be to turn the water over the center of the road, where it will stand, and create a series of bogs and pitch-holes.

Every road should have a distinct crown, with a fall of at least one inch to the foot from the center to the side drains. A width of 24 feet for a graded roadway is ample, whereas, in the illustrations, practically the whole road allowance has been prepared for travel. Such roadways are actually wider than the average pavement in our largest cities, where a width of from 20 to 30 feet is considered sufficient, except on leading thoroughfares and main business streets. With a total width of 24 feet, the center of the travelled roadway should be from a foot to a foot and a half higher in the center than on the inside edges of the open drains.

In laying out the open drains on each side of

the road, the first thing to consider is the outlets. When these have been decided upon, the drain should be graded evenly and uniformly to them in such a way that there will be no depressions or holes to retain water. The depth of these drains below the roadway need not be so great as to be dangerous, but they should have sufficient capacity to receive all surface water flowing into them. Where a greater depth is required to dry out the ground and carry off the subsoil water, tile drains should be used, one on each side of the roadway, and underneath the bottom of the drains. The effect of tile drainage on farm lands is well known throughout Western Ontario, and it is equally efficacious in road construction.

The roads in your illustration are all cases in which gravel has been repeatedly placed upon them, but it is steadily being swallowed up in mud, and this will continue until the roads are properly graded and drained. When this has been done, gravel can be placed upon them in such a way that it will stand well above the water line, with a base of firm, dry soil between, and a considerable saving in the amount of material required will be accomplished. Many townships in the Province, by the wasteful use of gravel in the manner shown in your illustrations, are exhausting their gravel pits, and in the course of a few years will have to secure broken stone to metal their roads.

In the case of the road in which unbroken cobblestone has been left to wreck rigs, a simple and inexpensive remedy is to send a man over the road with a rake, to draw the loose stones into piles at the sides of the road, where they can be picked up and carried away to assist in making fills, or to be put through a crusher and returned to the road. This is done in many parts of the Province, is inexpensive, and a great improvement to the roads. [Note.—Or send a man with a hammer and shovel, to break them, and fill adjacent ruts which generally exist.—Editor.]

Prevention, however, is better than cure. Where a gravel pit consists largely of such coarse material, it is a good plan to put a rock crusher in the pit, pass all the material through, and screen out a considerable percentage of the clay and sand, if the latter exists in excess. Where there is not sufficient large stone in the gravel to require this, it can be removed by stationing a man in the pit with a rake, who will draw out as many large stones as possible. It is of much further benefit to station a man on the road, also, to spread the gravel and draw forward the large stones, spreading these at the point on which the next load of gravel will be dropped. In this way the fine stone is kept on top, and the coarse stone is placed in the bottom of the road, where they assist in providing a strong foundation.

Whatever is worth doing, is worth doing well. The work of roadmaking has so long been regarded as a simple matter, which any one is competent to direct, that many pathmasters are inclined to resent suggestions and advice. Such advice as is given in connection with roadmaking is not of a complex nature, but, like most other inventions, when understood, they are all found to be of a simple character. The steam engine, the telephone, the threshing machine—are all easily understood, but it took, not merely years, but centuries, to discover and convert them to our use. The same is true of the principles of roadmaking, and those who have made a study of the subject find that, while the scientific knowledge necessary to an understanding of road construction is not of a complicated character, yet it is none the less essential. The further point thus apparent from your illustrations is that roadmaking must be put in the hands of a few competent commissioners who will retain office as permanently as a township clerk or treasurer, who will make a study of their work, and carry it out uniformly, and in accordance with right principles.

Much improvement is being effected in a number of counties under the Highway Improvement Act, whereby the Provincial Government contributes one-third of the cost of constructing certain roads. The roads to be improved in this way are selected by agreement between the county and township councils, the work being in charge of the former. The roads built in this way are usually such as lead to market towns, and are thus heavily travelled, collecting traffic from a considerable area, and benefiting all citizens. While not always connected, a network of roads throughout the county is aimed at. In Wentworth, Simcoe, Lanark, Hastings, Wellington, and elsewhere, the work on the county roads is producing excellent results. The system is not costly, for expensive work is not demanded. All the money, together with the Government grant, is returned to districts that contribute it. Middlesex is one of the more recent recruits under the Highway Improvement Act, and it is evident that the people of that county have awakened to the condition of their roads, and that a substantial effort will be made to better them. Middlesex money may be squandered in making roads such as the samples

you have illustrated, but the County will require to change its methods considerably before Provincial aid can be expected.

A. W. CAMPBELL.
Provincial Commissioner of Highways.
Toronto, May 22, 1906.

The Country Road Problem.

Editor "The Farmer's Advocate":

I may say, so far as I know, there is not a county in the whole Province where there is heavy clay land but you would find such results this spring as you photographed on pages 770 and 771 of "The Farmer's Advocate" for May 10th. In Eastern Ontario, at least, on account of there being no snow, the frost went to a great depth last winter, and the heaving has consequently damaged the road more than in any other year within the memory of our oldest residents.

With respect to the question asked in regard to the remedy for this state of affairs, I may say, for the last four or five years, I have given the matter considerable thought in connection with the good roads system in the County of Lanark, whereby we tax all the ratepayers of the County about 47 cents on each \$1,000 of assessment.

We have several miles of good roads built under the County system, and they are generally giving the greatest satisfaction, but you will understand, the roads so built are only leading roads. I am of the opinion that the leading roads throughout the country should be under the jurisdiction of the county council, and I feel that the Provincial Government should assist the counties in the building of the roads. I think that at least \$1.00 per \$1,000.00 should be charged by all county councils on both town and country alike, per annum, to make and maintain good roads between important points in the several counties. This, however, can only be reached by the ratepayers themselves earnestly requiring that they should be taxed to that extent. I feel that such taxation, within 10 years, would put the Province in a good condition with respect to roads.

From our experience here, drainage is a very important point, as in many cases we have rock to contend with, and the road without proper drainage is useless. As a consequence, the building of good roads is expensive.

If persons are desirous to further the good work in any community, I would suggest that a representative meeting be called, of say all the municipal officers of the county—that is, the township and county councillors—and to that same meeting some of the most public-spirited and enthusiastic merchants in the cities and towns interested be invited to meet and discuss the matter. I have no doubt some plan would then be reached by which the people would be willing to have themselves taxed.

In my opinion, the merchants and town taxpayers have just as much right to help to build roads as the farmers, but I fancy you will have some difficulty in convincing the town people of this. By getting public-spirited men together, however, you might be able to reach such a conclusion.

Lanark Co., Ont.

J. M. ROGERS.

[Note.—Mr. Rogers, who writes the foregoing, is ex-warden of the County of Lanark, and was instrumental in framing a by-law for the inauguration of a system of county roads in Lanark, under which an immense amount of work has been done. In our observation, he very properly draws attention to proper drainage as the foundation of roadmaking. As a preliminary step, nothing will give more immediate and satisfactory results than opening the side drains properly, putting in culverts at the intersection of highways, so that the water will not be intercepted, and, in some exceptional cases, putting tile in the roadbed itself. Perhaps the prime cause of the roads of a large proportion of the Province of Ontario getting into their present deplorable condition has arisen from sheer negligence. No doubt it is a problem with municipalities where to get the money for proper roadmaking and repair, but it is equally certain that the longer the work is delayed, the more costly will it become, and sooner or later the people will insist upon the problem being faced and solved. When an intelligent community begins to realize the handicaps under which it labors by reason of such abominable highways, the people will insist upon reform by the municipal powers that be.—Editor.]

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