

The road problem is not new neither is it one that is only of interest to civilized man, for we find that the savage tribes as well as animals of the lower order are prone to move from place to place by the route which offers the least resistance. After having established a route they continue to use it. The roads across many of the mountain passes or into the deep canyons were first made by mountain sheep or deer. The Indian on his hunting trips learned these trails and made use of them as roads in his travels, the trapper packed his furs over them, the frontier settler widened them out for his wagon, and not infrequently the locating engineer followed them with a railway line. Each in turn making and improving a highway that had originally served some animal as an easy route to pass from one feeding ground to another. A road in its earliest stages may be considered as a sign board to show the easiest route of travel between points. In prairie country these roads indicate a route which follows the high lands around swamps and lead to stream crossings. In mountain country, they avoid precipitous slopes, and lead to the more accessible passes. The load hauled over such a road is regulated by the knowledge of the road, the weight and amount of stock attached are fitted to the road. Hence in a newly settled country poor roads are to be expected and cannot be avoided. As a community improves the road requirements change, and the road is built to suit the load. The problem becomes one of constructing a road which will permit the hauling of a maximum load at a maximum speed with minimum motive power. Consequently the road problem is one of development. The game trail through the brush answers for the travel of the Indians, the prairie sod broken by a log dragged from the front wheels of a wagon, or a line of blazes through the timber answers the pioneer's purposes, but the best oil surfaced macadam road is scarcely satisfactory for the modern automobile, and the heavy loads of our well settled and highly intensified farming communities. Roads that a few years ago were considered almost everlasting, and good enough for any community are now a back number and inadequate on account of the increasing automobile traffic. With the steady improvement of automobiles and flying machines it is somewhat difficult to tell just what demands may be made on the road engineer by the end of another twenty-five years.

With this association which has met to consider rural improvement, it would seem to the writer

ROADS

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that it is not necessary to consider roads in the early stages of development, as our agricultural districts have passed that stage; neither is it desirable to take up the higher class of construction which properly belongs to the highway engineer, and which will naturally follow in any community where there is a demand for them, after that community has learned the value of hard roads by the use of good roads. To my mind, our problem is to deal with the agricultural communities which have arrived at the stage of development where the roads should be made to suit the load, and to show these sections if possible, that their roads can be improved with the money and material at hand. In other words we should advocate the improvement of roads with the money and material available.

The qualities to be sought in a road are a flat grade with a smooth, dustless surface of a degree of hardness to withstand the traffic, and still have sufficient elasticity to prevent injury to animals and jar to vehicles when moving at ordinary speed.

The conditions to obtain these requirements will vary with the climate locally and funds available. In the arid region, the roads become dusty from continuous travel, in sandy regions soft from the nature of the soil. In the alluvial areas of the humid region they become soft from excessive moisture, and rough from being traveled while wet. As the road materials vary in each of these regions, the road problem becomes one of studying local conditions, material available, and funds at hand, and with these constructing a road which will approach as near as possible to the ideal qualification of a good road, which are the same under all conditions. In the greater number of localities it is not practical from a financial standpoint to secure the ideal road at once, where this is true attention should be given to future needs such that the work will not be entirely wasted by other improvements. Good locations should be selected, road beds graded and drained so that they will be satisfactory for any type of superstructure. If it is not possible to prepare the road bed entirely, it should be done in such a way as not to increase the cost of future improvement. A sufficient width of roadway can

be left, and the greater part of the earth for grading taken from one side, the other side to be completed at some time in the future. Too often grades are thrown up or ditches made that must be destroyed by future improvement at a greater cost than if they had never been made. Such work has a tendency to retrogression rather than progression. While it is true that the exigency of the case or the shortage of money may compel the construction of road work that may have no value in future improvement, it is very seldom that such work will add to the cost of future improvement if the future is considered at the time of construction.

Water is the natural enemy of roads, and seldom will a community be found in which the road builder will not have to combat this destructive element in some form. Even in the arid regions the sudden downpour of rain that occasionally occurs, renders long reaches of road impassable by erosion. Consequently drainage may be called the foundation of road improvement, and until the water has been provided for there is no permanent road improvement. In our prairie states where the most of us are interested, thorough drainage may safely be said to solve one-half the road problem. Hence work properly spent in draining is an improvement that will be required regardless of the nature of future traffic or materials used in the superstructure. In swamp or wet areas drainage should be encouraged before roads for the reason that drainage means an increased income from the land which makes the road tax less of a burden to the land owner. Drainage of itself improves the roads, and permanent bridges and culverts cannot be economically constructed until the drainage systems are completed. Many of the rural road men are not aware of the fact that the building of a high road grade across wet land is only a make shift for drainage, that a good rille or open ditch would remove the cause for the grade, that water standing along a road-grade saturates the foundation of the road to the level of the standing water, and then is raised by capillarity to the surface of the road and in the end destroys the road regardless of its surface covering.

To secure a road which has the required qualities it is necessary to have a solid foundation which will

not become soft by moisture or destroyed by erosion, and then an impervious covering that will shed the storm water and carry it to the side ditches. The securing of material for the covering is the bone of contention among road builders and is the problem that confronts many of our agricultural communities. It is here that local conditions should be studied and the agricultural engineer use his ingenuity and experimental abilities to find at hand material that will answer the purpose and be within the pocket book of the district. Various materials are now used and approach in a greater or less degree the ideal of road surfacing materials according to the locality where they are used and the care in construction and maintenance.

Common earth by developing its puddling properties and keeping it in good shape with the King road drag.

A mixture of sand and clay.

Burning clay on the road where fuel is plentiful.

Shells along the coast.

Gravel and coarse sand as it is found in natural banks.

Broken stone of the more common geological rocks.

Wood in the form of planks for clay roads, and sawdust, bark, straw, etc., for sand.

Oil and tar as a binder on sand, gravel and broken rock.

Such materials, while they are not what might be desired yet have proven satisfactory in many localities, but it should be clearly understood that the method of treating a road with any one of these materials in one locality may not be satisfactory in another. Consequently the necessity of careful experimental work with road surfacing material in new localities.

Another item of road education in the agricultural districts is a method of systematic and thorough maintenance, for roads like nearly all other works of man require constant repairs or they rapidly disintegrate. The success of many cheaper road surfacing materials depend almost entirely on the care with which they are maintained. If a community can be educated, to properly prepare a road bed by draining and grading and then, in a proper system of maintenance the road problem is practically solved, for the road will be surfaced by the best material obtainable, as rapidly as these is a demand for better roads than natural conditions afford.

To interest the agricultural communities in road improvement often appears a hopeless task. That better roads are needed is readily admitted, but how to pay for them is the stumbling block. After watching the road problem for a number of years, it is the