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# Public Highways

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The roads of a country are accurate tests of the degree of its civilization. Their construction is one of the first indications of the emergence of a people from the savage state; and their improvement keeps pace with the advances of the nation in population, wealth, industry and science _ of all which they are at once an element and an evidence.

In the construction of highways it will be found, on referring to the records of history, that the first place must be given to the Romans. Even at the present day, after the lapse of nearly two thousand years, their roads may be traced for miles as perfect as when first constructed. The most modern constructions appear to be only imperfect and incomplete imitations. They were dressed-stone pavements, with foundations of concrete resting on sub-pavements, the whole being about three feet thick.

The first notable change in the methods of construction was in 1764. Up to that time all the main or military roads through a country had been built by the government upon the same plan as the Roman highways, regardless of cost, while the so-called country roads were the most conceivable constructions.

A French engineer named Trésagnet had been studying methods of economy and, in the year just referred to, began to put his studies to some practical use. He rejected the old plans and reduced the thickness of the roadway to nine or ten inches, by which means he lessened the expense of construction about one half. Tresagnet used pavements of rough stones set on edge: on these was placed the stone metal broken to small angular pieces and spread in one or more layers; then the surface was finished by adding a thin layer of gravel as binding material. The roads made according to their method proved very serviceable, and being quite economical, were rapidly introduced into the agricultural districts of France.

As the French progressed in the science of roadmaking the English began to gain in practical knowledge of the subject, and finally to improve upon the methods of the French themselves. In using small angular pieces of stone laid upon a foundation pavement of rough stone set on edge, Tresagnet anticipated both Macadam and Telford, whose methods involved the same principles more than thirty years later. But this fact will detract nothing from the credit of John L. Macadam. He was a man of sterling honesty and rare intelligence; and these qualities with his practical

knowledge and good administrative ability, accomplished the great work which made him famous. Macadam rejected all methods of construction previously followed and adopted one which soon proved its excellence and is today, nearly always used in making the country roads of Europe.

In tracing the roads of America we find they had their origin in the old Indian trails. In the early history of this country, when the settlements were few, all intercourse was carried on by water. As there was no necessity for roads they were omitted; but as settlements were made in the interior, the need of highways was felt. As the country grew the roads, being the only means of communication between the colonies, became very important and soon the people realized the necessity of having better ones.

As the result of this feeling numerous corporations were formed for the purpose of constructing better roads throughout the country. One was required to pay a certain amount for the privilege of traveling over them, the sum depending upon the number of horses and the size of the wagon.

A few of these toll roads, as they were called, proved a success; but the majority failed to gain the favor of the people, and in 1802 Congress passed an act providing for the building of nation

al roads for the purpose of facilitating intercourse between the western states and the Atlantic coast. These roads were to be laid out under the direct authority of Congress; accordingly in 1811, work was commenced on the Cumberland road, which was to connect Ohio with the coast. This great work, however, was never completed by the Government; for upon the introduction of railroads, the manner of transportation changed, and in 1834 Congress turned over to each state the finishing of such parts of the national roads as were under their jurisdiction. That left the matter directly in the hands of the people, and through them we have the roads as we find them today.

Rapidity, safety, and economy of carriage are the objects of roads. They should therefore be so located and constructed that merchandise and passengers, may be transported from one place to another in the least possible time, with the least possible labor, and consequently, with the least possible expense.

To attain these important ends, a road should fulfil certain conditions as regards location, grades, drainage, surface, and cost. The locating, or laying out, of a road consists in determining and marking out on the ground those points through which the road should pass, in order to satisfy as nearly as possible the re-

quirements of a good road. These requirements, so far as they effect the location of a road, are as follows: as to direction-- that the road should be as straight as possible, but that the straightness should be considered subordinate to easiness of grade; as to slope-- that the road should be as level as possible, and that it should avoid all unnecessary undulations; as to cost-- that the amount of excavation, embankment, and mechanical structures should be the least which will make the road what it should be for the quantity of traffic upon it.

The grading of the road and making it suitable for the stone bed is one of the most important features of road construction. This once properly done is permanent. Wherever possible all hills should be cut and low places filled, so that the maximum grade will not exceed five or six feet rise in one hundred feet; where hills cannot be reduced to the grade without incurring too much expense, the should be avoided by relaying the road in another place.

On every mile of country road within the United States there falls an average of twenty seven thousand tons of water each year. Beside this there is the underground water and that which comes from springs; and as water is the great destroyer of all roads,

it is always necessary to form some plan in regard to drainage. First the foundation upon which the road is to rest must be underdrained; this gives a compact earth bottom upon which can be placed a solid road. The surplus water which falls on the surface is disposed of by means of side-ditches; these should be deep and wide enough to carry all the water to the nearest natural water-way.

After the foundation has been thoroughly prepared the real work of construction is then in order. The excavating of the roadbed consists in making a trench the entire width of the road proper, the depth of which depends on the thickness of the material to be used but is generally from four to six inches. The bottom of this trench should be compacted by rolling and should have a slight downward slope from center to sides corresponding with the slope of the finished roadway. The roadbed being completed the stone metal, which is made up of irregular broken stone about one and one-half inches in diameter, is spread in the trench and rolled until thoroughly compacted, when the surface or wearing stone is put on. This layer being harder will not disintegrate so rapidly as the other. With this a thin layer of binding material is applied, then the whole is rolled until solid. Last is spread the surface dressing, which is generally about one inch of screenings; this is kept damp by sprinkling, and is thoroughly rolled until the surface is smooth, hard, and dressed off in a uniform slope from cen-

ter to side ditches.

It has been truly said that good roads are a paying investment. They are not only a benifit to the section of the country which they traverse, but also to the towns serving as a market to these sections. They help agricultural districts, in that they improve the facilities for conveying the farm products to the market or lines of commerce, thus saving time in transporting and increasing the amount of burden carried with each load. In this manner they have a great influence on the price of commodities. The price of wheat is increased for a locality having improved transportation facilities. If it costs a farmer one dollar to haul one hundred bushels of wheat one mile on dirt roads, and by macadamizing the roads this cost can be reduced to twenty cents per mile, the price of wheat is raised accordingly. One mile saves eighty cents, ten miles saves eight dollars per hundred bushels, or eight cents per bushel-- the increase in price in price of each bushel-- not considering the larger load that can be carried on macadamized roads. The price of wheat is thus permanently raised by improved facilities for transportation, and the value of farm land is also relatively increased. As the time needed to reach the market is lessened, the farm is relatively nearer the town and its market. If improved roads make the trip an hour shorter, the farm

is brought one hour nearer the market. Towns are benefitted by improved roads in that they increase the scope of their market, and therefore a larger area will bring in its products and take away its supplies.

Elaborate experiments have been made by Morin, Rumford, Gordon and others, to determine the force required to draw a given load on various surfaces. The results agree fairly well, and show that the force is from 1/20 to 1/133 of the load, depending on the surface. The result of all the experiments, as regards the relative value of different surfaces is as follows. The force necessary to draw one ton on a surface of Iron is 10 pounds

of Asphalt is 15 pounds

Best stone blocks 33 pounds

Average cobble stone 90 pounds

Macadam 100 pounds

Earth 200 pounds

These results show that a horse can draw twenty times as much on iron rails or twice as much on a macadam, as he can on an earth road. But as cost is one of the important considerations in construction, one can readily see that it would be poor economy to have our common highways built with an iron or asphalt surface.

However, it is generally accepted that the macadam system is preferable for general road construction, in that it requires less repairing, is more likely to be permanent, and, considering the amount of money expended, gives the best results as regards the important quality of ease of traction.

Notwithstanding these facts the public highways of the United States are inferior to those of any other civilized country. Since there is a general deficiency in all the attributes of good roads. Some of the defects are indeed the unavoidable results of the scantiness of capital and labor in a new country; but most of them arise from an ignorance either of the true principles of road making, or of the advantages of putting these principles into practice. They may therefore be removed by a more general diffusion of scientific instruction upon the subject; and to assist in bringing about the consummation, is one of the objects of the League of American Wheelmen. It is noteworthy that this body is doing more for the improvement of roads throughout the country than any other one society.

The bad condition of our roads began to attract widespread attention something over ten years ago. It was evident that an improvement in these conditions was imperative. Acting on this im-

pulse, Congress on October third, 1893 passed an act which instituted the office of Road Inquiry. The work of this bureau divided itself into four branches; namely, to make inquiries concerning the systems of road management throughout the United States; to investigate the best methods of road construction; to prepare articles on that subject, suitable for publication; and to assist the Agricultural Colleges and Experiment Stations in disseminating information. All this has been done, and furthermore under directions of this bureau there have been built in nearly all parts of the country small sections of macadam road for the purpose of demonstrating to the public the advantages of it.

The first move prompted by the universal agitation was to advance road legislation. This advance proceeded on several distinct lines, which resulted in the advocacy of more rigid provisions for carrying out the old systems without radical change in the systems themselves: more libual tax levies; substitution of money for labor taxes; local assessment, according to benefits, for construction of new roads; construction by townships with power to issue bonds; state highway commissions; provision for working convicts; direct state aid to road-building; and the building of state roads. Many of these laws have been passed as a result of

the people being stimulated by a knowledge of the benefits of improved highways.

Economy in transportation as derived from good roads has been already spoken of, but there are other benefits to be considered. By their means the laboring man who finds his occupation in some manufacturing village may have his home beyond the town limits, where he has pure air, ground for a garden, and a restful place in which to spend his leisure time.

We must also consider the improved educational advantages resulting from good roads. They bring us into closer proximity to better schools, to lectures, and to churches. They facilitate more general intercommunication in the rural districts, elevate the moral plane of a community, and advance civilization.

No one it seems to me can doubt the desirability of good roads The education has been complete, and the whole country comprehends the movement which is covering the land. Now comes the practical road making. For better results, to carry on road-making on an extension scale, not only must there be a radical change in the manner of paying road taxes, but the money thus paid must be expended in a different way. In order to accomplish this, the offices of highway commissioner and road supervisor must be taken out of

politics and given to those who have made a scientific study of the subject and understand the fundamental principles and how to apply them.

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