It is also to be considered that trees and shrubs planted along the roadsides protect and prolong the life of the roads, and the planting or preseravtion of low-growing shrubs or bushes prevents the action of winds in drying up and removing the surface of the roadway, which otherwise would lead to destruction.

It is very plain that where roadways are shaded by trees horses will draw greater loads for greater distances, and that therefore more may be accomplished than under other circumstances.

You will, of course, appreciate that in a paper such as this is, it is impossible to enlarge upon the method of planting trees or other plans, how it should be done, or what kinds of trees should be used. Your conditions in Washington are so different from ours in the east that what would apply here would be wholly or largely inapplicable there.

It is usual with us, for example, to set out rock maples on the uplands which are exposed to severe winds or extreme climatic variations; white, red or pin oaks on less exposed hillsides or gravelly soils; white, red or pitch pines in sandy soils unprotected from the sun's rays; elms on fertile bottom lands; and white maples and willows in swampy reaches. Chestnuts have not been used to any extent for planting, though they become with care very large and handsome trees. They are, however, protected when found growing naturally by the roadside. Other trees such as poplar, ash, sycamore, locust etc., are suited to certain locations, but are not planted by us to any very great extent.

A great variety of native shrubs, such as cornus dogwood, lilac, etc., are used to give a picturesque effect or as wind breaks in exposed places. Such vines as blackberry, upland cranberry, low-growing sumach, etc., are planted on slopes and banks to protect them from disintegration, and to cover the raw appearance of new work. All these means can well be adopted to beautify and improve the sides of the roads, and, from my experience, are well worth the outlay from any point of view.

ASPHALT MACADAM ROADWAYS.*

By Clifford Richardson, M. Am. Soc. C. E.

It is somewhat surprising to one who has been a close observer of the development of the modern sheet asphalt pavement in the United States, during the last forty years, that so little application has been made of the experience gained in that industry to the problem of the construction of bituminous macadam highways, which shall meet the conditions which exist to-day.

There should not be any essential difference in principle in the construction of a sheet of asphalt pavement and a bituminous macadam roadway. Both consist of a mineral aggregate cemented together with a bituminous binding material, the aggregate in one case being fine, and the other, containing coarse particles. Experience has shown that, in either type of surface, the mineral aggregate being of a suitable character, the capacity of the resulting surface to resist travel will depend on the more or less satisfactory nature of the cementing material.

In the early days attempts were made to construct pavements in Washington and elsewhere with both fine and coarse aggregates, using coal tar as a cementing material. All these attempts with both fine and coarse aggregates were failures to a greater or less extent and its use was abandoned on the advent of the form of asphaltic construction developed by DeSmedt, although it was revived for a few years in the late '80's in mixture with asphalt with equally disastrous results. The surfaces having a coarse aggregate were somewhat more lasting than those made with sand and a small portion remained in place until the end of the century. They were known as Evans pavements, and were resurfaced with asphalt after a few years. One of these, protected by an asphalt surface, was found on repaving Connecticut Avenue, in Washington, in 1906. A piece of it was collected by the writer and examined. It appears that a coal tar bituminous macadam was constructed as long ago as 1873 and proved, in a short period of time, not to be a lasting form of construction. Notwithstanding this fact, experiment after experiment has been conducted along the same lines in recent years with similar results. Few, if any, highway engineers seem to have benefited by the experience of their predecessors, and most of them still have the coal tar lesson to learn on their own part, although it is evident that this form of construction cannot give satisfactory results for more than a few years.

On the other hand, referring again to the lessons of the paving industry, the modern sheet asphalt pavement, where constructed on rational lines on a rigid, well-drained foundation, has proved a complete success, as exemplified by the fact that a pavement of this type has satisfactorily resisted the heavy travel which is found on Fifth avenue, in New York City, 14,000 vehicles in the period between 6 a.m. and 7 p.m., for a period of twelve years. In the same way, an asphalt concrete surface constructed with a well graded but coarse mineral aggregate in 1902 in Muskegon, Mich., which has been used as a favorite drive since that time, has been in use with no repairs whatever where many similar surfaces in which coal tar has been the cementing material have deteriorated or required resurfacing under similar circumstances during the same period. The Muskegon work has not only demonstrated the superiority of asphalt as a cementing material, but this has been confirmed by other surfaces of the same form of construction in Owosso, Mich., in Paterson, N.J., Scranton, Pa., Staten Island, N.Y., and elsewhere.

The evident conclusion which may be drawn from past and present experiences is that success can be arrived at in the construction of any form of bituminous road surface only by the use of asphalt as a cementing material. The thing to be considered, however, is: how can asphalt be used in building the cheaper forms of country highways which are now in demand, to resist motor and concentrated traffic, where the aggregate is merely of the grading of the ordinary stone which is employed in surfacing macadam roads? The asphalt surface constructed in Muskegon in 1902, and elsewhere, was an asphaltic concrete. The mineral aggregate was well graded and, in itself, compact. This could only be combined with the cementing material in a hot condition, which required a plant to which the aggregate was hauled and from which it was again hauled to the point where it was put in place. The operation was, therefore, an expensive one, and makes the cost of this form of construction prohibitive for country roads. Recourse must, therefore, be had to some other method of combining a mineral aggregate and asphalt immediately on the spot where the surface is to be constructed.

For many years, tar macadam has been laid in England, France, and to a smaller extent, in this country in Rhode Island, New Jersey, and elsewhere. This form of roadway is arrived at by coating the No. 2 or surface stone of the macadam with coal tar in one way or another, either before or after rolling it, and afterwards filling the voids in the surface with more tar and grit, screenings or sand. Such a surface is desirable when first finished, but it soon begins to deteriorate and ravel, especially when exposed to horse-drawn travel, with the weathering and ageing of the cementing material. From past experience, it is not difficult to arrive at the conclusion that if an asphalt cement were substituted for the coal tar a result would be attained which would correspond to the improvement which was evident on the substitution of asphalt for tar in street pavements. The difficulty lies in the fact that an asphalt cement is much more viscous than tar. It must be used in a much better condition and does not mix with or adhere so readily to cold stone. Experiments have shown, however, that this can be accomplished by using a much softer asphalt than is customary in

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