effects of some of the foregoing destructive agencies. Much of the wear and damage sustained by roads subjected to increasingly heavy traffic are due to the inconsideration of the users of the road. To counteract this negligence educative steps will in some cases be necessary, while in others legislation has been brought into play, and further steps along similar lines would be justified. In the former class may be mentioned the tendency to drive in a single track, thereby hastening the formation of ruts. This is frequently encouraged by building narrow roads with high crowns, and a partial remedy is found in widening the metalled portion and reducing the crown. Prevention of abuses of the latter class, which can usually be achieved only with the assistance of the law, includes limiting the speed of automobiles and the weight and speed of motor trucks. The advantage attending the use of wider tires for heavy horse-drawn traffic has frequently been discussed, but the only hope of securing their adoption appears to be in legislation prohibiting the use of narrow-tired vehicles carrying heavy loads on improved roads. The same remarks apply to the question of having front and rear wagon axles of different lengths.

But when all is said on the causes of road deterioration and methods of preventing it, the fact remains that road maintenance consists largely of labor expended on the road surface itself. The question of how the road may be best maintained in the good condition which, we shall assume, followed construction, is the vital question on thousands of miles of road at the present moment. Not only must the maintenance be effective, but it must be carried on at a cost commensurate with the original cost of the road, the nature and amount of traffic using it, and the financial capabilities of the municipality on whose shoulders rests the burden of meeting the cost.

No matter how good the construction, wear will occur, and it is the chief object of maintenance to take care of this wear before it goes so far as to require heavy repair work. Ruts and depressions will form, especially in a newly built road which has been laid on an earth sub-grade. The second season is usually the road's worst time. Ruts, caused by the sinking of the stone into the sub-grade must be filled, the occasional ravelled spots found on almost any road must be re-rolled, and the contour of the surface restored if necessary.

It is frequently desirable to repair ruts which have been formed in the foregoing manner, or which are caused directly by the concentration of traffic in one line. Two courses are open, either of which will be found effective and inexpensive. The first consists of spiking up the ruts with the roller, and filling with new stone. It will be found that the rear roller wheels just cover the ruts, which may be picked without moving the roller from its tracks, and without loosening the remainder of the road. Short spikes should be used in this operation. Two to three round trips over a given section will usually loosen the stone sufficiently to permit a bond with the new material. In the ruts thus loosened, fresh stone from one inch to one and one-half inches in size is carefully placed, in quantity sufficient to restore, after consolidation, the old cross-section. This is then rolled and bound with screenings and water, as in the case of the original road. The second plan eliminates the loosening of the road surface, and depends on the use of tar or asphalt to keep the new stone in place. The ruts or depressions are first thoroughly swept out till the bare stone is exposed over their entire area. The surface of the hollow is then painted with bituminous material, usually a heavy asphaltic oil, or medium grade refined tar. New stone is next placed over the bitumen in the quantity mentioned, and rolled. A small amount of bituminous binder is applied to the surface and the whole finished with stone chips and rolling. This process is an application of the penetration method of bituminous road construction on a small scale, and possesses the advantage of providing a bituminous bound surface on that part of the road which receives the greatest wear.

Experience has shown that the surface of a water-bound macadam road cannot be expected to withstand the effects of rapidly moving motor traffic. While still the mainstay in the body of thousands of miles of the country's main roads, stone screenings as a binder for wearing surfaces subjected to much of this class of traffic has reached the end of its usefulness, and substitutes must be, and are being, provided.

The use of oils on road surfaces is usually considered in connection with the prevention of dust, but systematic treatment with a good asphaltic oil ranks with the most efficient methods of road maintenance. If a good grade of asphalt oil, say, 40 per cent., is applied regularly to a properly prepared surface, the effects are soon seen to be in a measure permanent, the asphaltic base remaining on, and penetrating into, the road after the volatile constituents have evaporated, and forming a permanent binder for the surface. The same penetration may be obtained from the use of a light refined tar, the grade known as Tarvia B, being generally used for this purpose. In either of these cases, sand sprinkled on the road after the application of the bitumen will furnish a wearing surface which will effectively protect the stone during the life of the treatment.

The most lasting and generally the most satisfactory treatment of a macadam surface, particularly when subjected to much motor traffic, is found in what has been termed the "carpet coat." This consists of a thin covering of bitumen, filled with stone chips, pea gravel, or coarse sand. The result is a surface from one-eighth to one-half inch thick composed of stone and a bituminous binder, the former taking the wear of the traffic and the latter binding the stone together and holding it on the road.

While more expensive than treatment with light oils, a bituminous carpet coat is usually cheaper in the end, owing to the greater durability of a single application, and the better condition in which the road is preserved. When properly applied a carpet coat may last, with a small amount of maintenance, for from two to five seasons, and the road thus treated has many advantages equal to those of a bituminous macadam road. In some respects a well-built waterbound road with a bituminous carpet coat is to be preferred to one with several inches of a bituminous bound surface. The cost is less, being equal to that of an ordinary waterbound road plus eight to ten cents per square yard. The body of the road, if built on a firm sub-grade, is perhaps more rigid than the bituminous macadam, owing to the danger in the construction of the latter type of using an excessive quantity of bitumen. This is especially true in the case of country roads, where experience in the use of bituminous binders is not so general as in city street paving. If a suitable system of maintenance is organized, the only work necessary is that required for keeping the carpet coat in good condition, correct practice being to repair any defects in the surface before the body of the stone is injured. This follows the principle of maintenance of city streets, where the concrete base is considered permanent, and the wearing surface, of whatever character, is renewed as occasion requires.

The successful application of a carpet coat depends on a number of details, neglect of which may result in partial or total failure.