If the low and medium maintenance types are grouped in one class, we have slightly over half the improved highways upon which the expenditure for maintenance is about $440 per mile per year, and slightly under one-half the total mileage upon which the expenditure for maintenance and repairs was $1,060 per mile per year.

It is contended that with the present system of maintenance in many cases the life of a pavement may be extended indefinitely. The method referred to is that of treating the surface of the pavement with a light application of asphaltic oil or refined tar, and a cover of fine crushed stone, sand or gravel. This treatment consists of spraying on the surface of the pavement about one-quarter of a gallon of oil or tar and covering the same with from ten to fifteen pounds of cover material per square yard of pavement. These materials are worked and kneaded into the existing pavement by the traffic, and most efficiently by rubber tire traffic, and results in filling up the small interstices between the larger fragments of the existing pavement and increasing the thickness of the pavement from an eighth to a quarter of an inch. This increase in thickness should more than offset the constant wearing away of the surface by the abrasion caused by the pounding of the iron-shod feet of the horses and the iron-tire vehicles. The repetition of this treatment from year to year will gradually increase the thickness of the existing pavement. The ideal condition being where this treatment approximately maintains the pavement at its original thickness, as it has been found that where the treatment has been too heavy or too frequently applied and the oil and stone mat is built up to a greater thickness than one-half inch, it is liable to creep and become displaced by traffic, particularly in hot weather.

The experience in our state would indicate that a waterbound macadam pavement under the average condition of rubber-tire traffic, should be treated once each year for two years, after construction, then perhaps the treatment may be omitted the third year, and in subsequent years treatment is required two years out of three.

With the penetration type of bituminous macadam, a surface treatment is not generally required until the second or third year after improvement, and thereafter a treatment every second or third year. The advantage of this type of treatment is the ability to thereby incorporate a thin layer of new material with the existing pavement at a minimum cost and restore, at more or less frequent intervals, the part which has been worn away by traffic.

The most efficient material seems to be one that carries 65 to 70 percentum of bitumen or pitch and which can be applied in a spray under pressure at a temperature of from 80 to 100 degrees F. This grade of material is sufficiently liquid for several days after being applied that it may be worked and kneaded into the porous surface of the pavement by the rubber-tire traffic.

A heavier material that requires heating to a temperature higher than 130 degrees F. in order that it may be applied, cools after application and before receiving traffic, and assumes a consistency of rubber gum, and while it may be united with the stone chips by rolling, it cannot be as thoroughly worked into the body of the pavement, and simply lies on the surface as a mat which shifts around under traffic and is worked into waves and hollows. An example of the principle is the painting and varnishing of wood surfaces. A thin paint or varnish is applied and is worked into the pores of the wood by brushing and rubbing and a more desirable and permanent surface is obtained than by using a heavier or thicker varnish applied by pouring the same on the wood surface. The varnish being so heavy it is necessary to heat the material to make it sufficiently liquid to be poured over the surface. No one would expect such a finish to a hard wood floor to be very desirable or lasting. The floor could be opened to use very much quicker, but permanent results could not be expected. This simile is set—an explanation for the necessity of the disagreeable condition of the road surface for a few days after the bituminous treatment is applied, during which period the traffic is working and kneading the more or less liquid material into the existing pavement.

There is also the necessity for the use of the light material in the subsequent treatments in that the light carrier oils soften the hardened material of the former treatments and allow new material to unite and combine therewith.

The best results are also obtained where the least amount of cover material permissible is used. This can best be explained by comparing the bituminous material to Portland cement when used with sand in mortar. A surplus of sand weakens the cementing qualities of the cement. The same results are obtained by using a surplus quantity of sand to cover the application sufficiently to eliminate the disagreeable condition of the freshly treated pavement. Where the pavement is not open, requiring a filler for the interstices, and where previous treatments have been given, better results will be obtained where no cover is used, but a freshly treated surface with no cover is dangerous to fast-moving vehicles and such treatment is seldom resorted to in the country districts.

While the best results with surface treatments are obtained with a semi-liquid bituminous product and a minimum amount of cover, the disagreeable features of this treatment from a traffic standpoint have been given serious consideration, and changes have been made in the specifications for surface treatments, which it is hoped will materially reduce the period during which the treated surface is objectionable from a traffic standpoint.

The light surface treatment with bituminous material and cover does not appear to be suited to pavements where horse-drawn, iron-tire traffic largely predominates. The iron-tire traffic appears to grind the bituminous material with the mineral aggregate and keep the surface roughened and loosened, allowing the volatile oils to more readily evaporate. The bituminous material then loses its adhesive qualities, and is ultimately ground to dust and is washed or blown away.

The bituminous mat tends to make the surface waterproof, and as the moisture in the macadam leaches away through the foundation and not being renewed from the surface the so-called waterbound macadam is no longer waterbound but is simply dustbound and is ready to be loosened by traffic in any spot where the bituminous surface mat is worn through, and it is necessary to either provide a heavy mat or constant patching of the areas where the mat has worn through. The tendency is therefore with the waterbound type to give a general treatment more often than should be necessary, which results in building up a heavy mat which finally creeps and displaces under traffic in hot weather, and it is then necessary to remove the entire mat and start over with the light surface treatments.

With the bituminous bound macadam this precaution is not as necessary. While the bituminous carpet sheds off the surface water and the macadam dries out, the individual fragments are bound together with a bituminous material and are not susceptible to the loosening effect of traffic as they are in the dried-out, waterbound type. The results being that a much thinner bituminous surface can be maintained without constant patching, which re-