

higher and higher until it finds a lateral outlet. Underdrains supply such an outlet at a sufficient depth below the surface of the road, to preserve a firm strata of the natural soil. The natural soil has in every case to support the weight of traffic. The paving material merely forms a covering to shed water from the roadway and prevent it sinking into and softening the natural foundation beneath; that is its more important duty, that of secondary importance being to form a wearing surface. Drainage is a fundamental feature of all good pavements. If sewers exist with capacity for storm water—and I am not so enthusiastically in favor of a separate system as are some—they will materially aid in providing outlets for the underdrains, as well as surface gutters.

A system of separate sewers has its advantages, and is the only one which can be used in some instances, but the advantages derived from more perfect street drainage will in many cases more than compensate for the disadvantages of the combined system. If sewers do not exist, drains should be emptied as often as convenient into natural water courses. One secret of successful surface drainage is to dispose of water in small quantities before it gains force and headway. With underdrains, a certain amount of flushing in this way is not objectionable. The tile should ordinarily be four inches in diameter, and placed below frost line for the best effect. This is seldom done, however, two and one-half or three feet being the usual depth. The fall should average one foot in 100; the minimum never less than one in 1,000 feet. It is well to fill over the tile with gravel or some other porous material, especially if the subsoil is a stiff clay. In quick or water sand, sawdust is the best material to place around the tile to prevent the silt passing into and choking the bore. Care must be taken to see that the tile is placed with a constant and uniform grade.

#### ROLLER AND ROLLING SUB-GRADE.

The sub-grade and under drainage completed, the roadway will be ready for its first rolling. A heavy steam roller weighing from ten to twenty tons is indispensable in making a good broken stone or other pavement. A greater weight than twelve tons is apt to be too heavy on loose stone or earth, unless consolidation has been first commenced by a lighter horse roller of six or eight tons. The natural earth should be compressed until perfectly smooth and solid,