Pet is to carry a traffic consisting largely of automobiles, the coarser material does not become as necessary, although it appears to be preferable.

The kind of bituminous material that it is preferable to use in a carpet is still a debatable subject, particularly as to whether tar or asphalt products are preferable, and in the use of asphalts, whether a heavy asphalt requiring high temps temperature (200 deg. F. or more) before application is pre-feral ferable to one that does not require such high temperature. It has been the experience and observation of the writer, however, that the asphalts requiring high temperature before application give better and more permanent results under a mixed traffic than do the lighter asphalts. By mixed traffic, the writer means a combination of trucks, automobiles and heavy and light horse-drawn vehicles. A carpet formed with with a heavy asphaltic material, however, does not with-stand the stand the standard the standar stand traffic consisting largely of heavy steel tired vehicles, the effort the effect of such being to cut the blanket and cause it to crumble and to soon disappear from the surface.

The third principal feature, namely, the character of traffic, must necessarily be considered in connection with the second second principal feature, already discussed. In fact, meither one of these three features hereinbefore mentiond can be discussed. In the can be discussed entirely by itself, as each is dependent somewhat upon the others. With a suitable road crust to sustain a bitumin bituminous carpet, traffic is an extremely important factor in determined to the second secon in determining what type of materials to use for such a carpet . The what type of materials to use for such a carpet. The amount, type and weight of vehicles must necessarily be considered. It has been demonstrated that a tar con a tar carpet will carry economically 100 automobiles per day per for day per foot in width of roadway, together with a horse-drawn to get in width of roadway, together width of drawn traffic of 15 vehicles per day per foot in width of roadway. roadway. On the other hand, a similar tar carpet failed under a traffic consisting of 20 heavy, horse-drawn, steel tired value, with tired vehicles per foot in width of roadway per day, with only 8 arts only 8 automobiles per foot. This clearly demonstrates that a tar bland to be a tar blanket is not suitable and should never be used to sustain heavy horse-drawn traffic, but is suitable and economical in carrying automobile traffic. Inasmuch as no particular particular wear appeared to be caused by the above mentioned automobile traffic, it is safe to assume that a much larger traffic kept larger traffic could be economically carried. Records kept by the writer show that what has been stated above regarding the tar carpet is true also of the heavy asphaltic oil Carpet. Doing the writer's obcarpet. Failures that have occurred under the writer's observation with a heavy asphaltic oil carpet have occurred where the where the ratio of the number of automobiles to the num-ber of have ber of horse-drawn vehicles was not any greater than two to one to one, and if the horse-drawn vehicles are of the heavy two-horse two-horse type, with narrow tyres, no amount of automobile traffic app. traffic appears to be sufficient to counterbalance the destruc-tive effect of the sufficient to counterbalance per foot in tive effect of 15 heavy horse-drawn vehicles per foot in width per a width per day.

The writer is of the opinion that it is not wise at the sent time of the opinion that it is not wise at the present time to state general positive conclusions regarding Such limitations in the use of bituminous carpet surfaces. Such surfaces have the use of bituminous carpet surfaces four four Surfaces have been in use in this country only about four years, and the been in use in this country of the bitumen used years, and the character and quality of the bitumen used at various times and in various places are so unequal, and the character the character of traffic over the highways is and has been changing so changing so rapidly, that the results of experiments and definite conobservations have been variable. Positive and definite con-clusions as have been variable. clusions have been variable. Positive and dennice clusions as to limitations can be drawn only after careful to be the servation of the servat observation through a period of years, keeping a record of the kind and the kind and quality and amounts of material used in the carpet, and quality and amounts of material used in the carpet, and quality and amounts of material used weights of vehicles of the kinds, number and approximate weights of vehicles passing over the sections under observation.

THE ELECTRIFICATION OF TUNNELS.

With the announcement of the construction of several large tunnels by the different steam railways in the West, and the general electrification of tunnels in New York, etc., it is perhaps not out of place to recall and briefly describe the one large tunnel in use in Canada which, originally built for steam-operated trains, was electrolized and so operated in 1908, and has continued to give splendid satisfaction as such ever since.

The St. Clair tunnel under the St. Clair River, and connecting Sarnia, Ont., Canada, with Port Huron, Mich., United States of America, is more than two miles in length, including its approaches. The length of the tunnel proper is 6.025 feet, and the length of electric trackage, including yards, is approximately 12 miles. The tunnel has a maximum grade of two per cent., and was built under the St. Clair River by the Grand Trunk Railway under the supervision of Mr. Joseph Hobson, the chief engineer; Mr. T. E. Hillman, first assistant engineer, and Mr. M. S. Black-



Western Portal of Tunnel.

lock, second assistant engineer. It was constructed in order to overcome the obstacles presented by a navigable stream, alive with commerce during the summer, and often blocked by ice in winter, and previous to its opening the Grand Trunk Railway freighted the trains across the river by means of car-ferries. The tunnel is a continuous iron tube, nineteen feet ten inches in diameter, the total weight of iron being 56,000,000 pounds. Work was commenced in 1888, and the tunnel was opened for freight traffic in October, 1891, and passenger traffic in December of the same year. The cost was \$2,700,000.

Shortly after the opening of the tunnel for freight traffic the need of some method of doing away with the noxious and injurious gases, which formed from the smoke of the steam engines, was at once obvious. The natural remedy was the use of electric locomotives, and after mature deliberation, the Grand Trunk decided in favor of operating the tunnel by electricity. The power plant was located on the Port Huron bank of the St. Clair River and the length of zone electrified was four miles. The single-phase system was adopted, and the single catenary supported by structural steel bridges was the structural method used; the normal voltage being 3,300 volts. The Westinghouse Company finished the contract in May, 1908, and the cost was \$600,000.

A comparison of the haulage before and after electrification is also interesting. The normal weight of trains hauled through the tunnel before electrification was 760 tons; after electrification it was 1,500 tons. The weight of the steam engines formerly used, which, when built, were the largest