Unless the curvature is so sharp as to be limiting in its effect, there is no serious objection even on the best class of road to a few sharp curves where the amount saved by their use is sufficient to justify their introduction. The conditions which cause curves to be limiting are when they are so sharp as to prevent the use of the higher grades of modern equipment, and when they limit the haulage capacity of the locomotives, or their speed.

Modern equipment is so constructed as to traverse safely 14 degree curves, and much sharper with guard and hold up rails. The standard compensation for curvature on grades is 0.04 foot per degree. A 10 degree curve is thus equivalent, as far as resistance is concerned, to a 0.4% grade; and a 15 degree curve to a 0.6% grade. On a 0.4% it is only necessary that the grade on a 10 degree curve be made level in order that the resistance be not increased. The same thing applies to a 15 degree curve on a 0.6% grade. It is, therefore, evident that on a road whose ruling grades are 0.4% 10 degree curves are not limiting to the haulage capacity of the locomotives, nor are 15 degree curves on a 0.6% grade.

The easy riding speed is dependent on the amount of the allowable elevation of the outer rail. If the maximum be set at six inches, this speed per hour would be :—

on a 3 degree curve		60 miles per hour	
" 4	"	50	"
" 6	"	40	"
" 8	"	35	"
" 10	"	30	"

The safe or allowable speeds would be 10 miles per hour greater.

With the track properly elevated, equiped with tie plates kept in good line and surface, and curves provided with proper easements, 10 degree curves are no more disagreeable to ride over at speed of 30 miles per hour than are 3 degree curves at 60 miles per hour.

The reduction in speed for one mile from 50 to 30 miles per hour only means the loss of 0.8 minutes. To take an extreme case—the Twentieth Century Limited runs from New York to Chicago, 980 miles in 20 hours, or at an average of 49 miles per hour. The introduction of one hundred 10 degree curves each one of which required a slacking of speed to 30 miles per hour for a distance of one mile would increase the running time of such a train by one hour and twenty minutes. Such an increase on a road 1,000 miles long would in nine cases out of ten have no ill effect. A 10 degree curve so long as to require the reduction of speed to an average of 30 miles per hour for a mile would in practice be a very rare occurrence.

It is evident the use of curves as sharp as 10 degrees does not prohibit the employment of modern equipment or limit the haulage capacity of the locomotives. It has no effect on the speed of freight trains, or on passenger trains where the average speed including stops is not greater than 30 miles per hour. A few such curves only slightly affect the running time where speeds are high.

It is thus clear that a few curves not sharper than 10 degrees are not objectionable on the very best roads where their use results in large savings. As they are not limiting, the use of one such curve is no justification for a second. The introduction of many of them preventing the employment of high speeds for long distances would certainly be objectionable, but an occasional one where large savings result is justifiable on even the highest class of road.

Wooden trestles to replace heavy rock borrow embankments should be used. Such trestles may be designed to safely carry the heaviest class of equipment. When protected by the installation of the best available water supply they are quite safe, and are good for ten years. Such temporary construction also gives time to ascertain the correct requirements for water ways in new countries where there is frequently a dearth of information as to rainfall, flow of streams, &c., and where unless unduly large water ways are left there is danger of washouts. This danger may be even greater than the danger from fire to wooden trestles. Their use instead of heavy rock borrow embankments is of great importance from an economic point of view. One dollar at 5% compound interest amounts in ten years to $1.63. If rock borrow costs on the original construction say $1.75 per cubic yard it will in ten years time have amounted with interest to $2.85. While, under anything like ordinary conditions train hauled earth embankments on an operated road, made when the trestles require replacement, do not cost over 30 cents per cubic yard, or less than one-ninth of the total cost of a permanent rock embankment made during construction.

Momentum grades are a great source of saving in cost without increasing the operating expenses. The use of momentum in overcoming short stretches steeper than the ordinary ruling grade is almost always justifiable. The exception is where the traffic is so congested that the possibility of a delay due to the failure of an occasional train to surmount the grade is more important than the undoubted saving in interest charges which they insure. It will probably be many years before conditions prohibiting their use prevail on any portion of our Canadian railways.

The foregoing are a few of the more important considerations which the locating engineer should keep in view. He should always remember that railways are commercial enterprises, are built for profit, and that the investors are looking for and are entitled to satisfactory interest on their money; and so far as the returns on their investments depend on location they will for a given traffic be the greatest when the sum of the operating expenses and fixed charges is the least amount.

A NEW STREET CLEANER.

A new idea in street sweeping by machinery has recently been introduced into England, having been used for some time previously in Milan, the inventor of the machine being an Italian. About the middle of December one of these machines was demonstrated before a number of municipal engineers and other officials from several English cities, picking up satisfactorily the customary assortment of sand, straw, small stones, etc., which are ordinarily scattered for tests of this kind. The machine is propelled and operated by a 20-30 h.p. 4-cylinder motor. Aside from the motor, it consists of a revolving broom carried between the fore and hind wheels, and a double dirt receiver which is carried behind the rear wheels. The revolving cylindrical broom has a diameter of 52½ inches, is 5 feet long, and is built up of twenty distinct small piassava brushes, each five feet in length, arranged along parallel elements of the cylindrical core of the brush.

The cylindrical broom revolves within a sheet iron shell in which it fits closely, at a speed of 120 revolutions per minute; which results in its not only raising the sweepings and carrying them two-thirds of a revolution and passing them through a specially contrived opening into the receivers behind, but the circumferential speed of the broom is said to create a sufficient suction in the cylinder to draw in all the dust and discharge it likewise into the receivers. It is also claimed that the velocity with which the broom revolves throws the refuse into the receivers with such force as to compress it and thus make the capacity of the receiver greater than if the dust merely settled in it.

The rear end of the compartment of the car which contains the two dust receivers is made in the shape of a large door hinged at the bottom which, when opened, forms an incline platform down which the filled boxes are rolled to the ground, each box being furnished with three small wheels or castors. The receivers or collecting boxes are of sheet iron and have a capacity of 50 cubic feet.

The total weight of the car with the receivers empty is 6,450 lbs. It is claimed that the cost per hundred thousand square feet of cleaning with this machine was $1.86, as compared with $11.18 with horse sweepers.

Report of the Annual Meeting of the Canadian Society of Civil Engineers, held in Montreal, Jan. 28, 29, 30, 1913