POINTS IN ROAD DESIGN.

At the First Canadian and International Good Roads Congress, held in Montreal in May last (see *The Canadian Engineer*, May 28, 1914), the subject of road design was dealt with by Mr. Robt. A. Meeker, State Highway Engineer for New Jersey. Mr. Meeker touched upon the essential factors: width, alignment, grade and drainage, in the following way:

Width.—The first point to be considered in designing a road is its width. It may be generally stated as axiomatic that the width of roads should be in multiples of eight, this being the width that should be allowed for each vehicle using the road. A road 8 ft. wide might more properly be termed a lane leading to one building or a small group. The next in importance should be 16 ft. in width, in order that two vehicles might have sufficient width in which to pass. The third width, or 24 ft., would permit of two vehicles passing while the third was standing along the side of the road—or two loads of hay or other bulky material to pass. The fourth width, or 32 ft., permits two vehicles to stand along the sides and leaves sufficient space for two other vehicles, moving in opposite directions, to pass each other in safety. These widths refer to the traveled carriageway alone, no allowance whatever being made for the accommodation of pedestrians, nor for any drainage structures.

In order to obtain a roadway of sufficient width to accommodate travel passing in both directions, 24 ft. may well be taken as the minimum allowable, and if there is the prospect of an increase of traffic in the near future, a proper addition to the width of the surface, necessary for the accommodation of the traffic, should be provided for in the original design. It is almost impossible to properly grade and drain a road of less than 24 ft., and the wider the roadway the more easily it is drained, and also maintained, due to the fact that the traffic is distributed over a greater area, and that the surface is more freely exposed to the drying action of the wind and sun, thereby preventing the formation of mud and ruts.

Alignment.—The second problem is that of the location of the line. On a new road this is determined by certain well-defined principles. First, the beginning and ending points should be connected by the most direct line; second, the grades should be kept as low as possible; third, for economy's sake, the line should be so located as to reduce the amount of grading to the minimum, likewise the number and size of the bridges.

The factors governing the departure from a straight line are many. In crossing a ridge we seek the lowest point in the summit, in order to avoid expensive cutting or the alternative of steep grades; in following a valley we keep well up on the hillside, to avoid bridging ravines and small water courses; if we encounter a swamp or pond we can frequently, by swinging the line, save the expense of a heavy fill; a stream may be avoided by diverting the line, thus saving the cost of bridges.

On an old road another set of problems has to be solved; these are chiefly those of expediency. Though a straight line between the termini may not only be the best but also the cheapest, the claims of intermediate communities may be so strong that the line must be diverted from its best course to satisfy the wants of the communities to be served. But through it all, in spite of all of these warring factors, the engineer must never lose sight of the straight level line between two points as his ideal. By keeping this constantly before his mind's eye the results that may be achieved will often surprise even the author.

Grade.—The grade, or the angle which the axis of the road makes with a horizontal line, is the most important economic feature in road design, for upon it depends the amount of material a horse can draw over the road. The results of experiments made both in England and France prove that a horse can haul twice as heavy a load up a 2 per cent. grade as he can up a 6 per cent. grade. That being so, the value of a road for heavy traffic, having a maximum grade of 6 per cent., is only one-half of that having a maximum of 2 per cent. This fact is often lost sight of in designing new grades, the object of many road officials being to build as many miles of road as possible for a given amount of money, the first cost, and not the ultimate value of the road to the community, being the basis upon which the improvement is made. This cutting down of hills and the filling of valleys or reduction of gradients is no new idea, for Isaiah wrote, over 2,000 years ago, his idea of a perfect highway as follows: "Every valley shall be exalted and every mountain and hill shall be made low; and the crooked shall be made straight, and the rough places plain."

Drainage.—Having laid out your road as straight as possible, and having reduced your grades as much as your funds will permit, the next important problem is is that of drainage. This is of two kinds—surface and subsurface. Surface drainage is both transverse and longitudinal. Every road must be so planned that the water which falls upon its surface will not remain upon or along it. The first object is attained by giving the road a proper crown or cross-section, so that the water may be conveyed quickly to the gutters on the sides. This crown should have the form of the arc of a circle, drawn through three points—the centre of the road and the gutter on either side. The elevation of these points should be in the following ratio: For earth roads a fall of 1 in. per foot from the centre to the gutters; for waterbound macadam, ¾ in. per foot, and for bituminous concrete ½ in. per foot. This form of cross-section permits of the fullest use of the road, and at the same time conveys the water to the gutters without washing the sides or shoulders of the road. The longitudinal surface drainage is taken care of by the gutters, which must be carefully trimmed to conform to the grade of road, all holes being carefully filled and all humps cut off. In fact, the gutters must be as carefully graded as the centre of the road. Proper inlets to bridges crossing the road should always be constructed if the bridge is as wide as the carriageway. In some soils these precautions are not sufficient, and we are then compelled to lay underdrains. These should be placed about 3 ft. inside of the gutter line, for two reasons: First, to intercept the subsurface water before it reaches the middle of the road, and second, to prevent erosion in case the gutters are gullied. The object of underdrains is to cut off the subsurface water before it can get beneath the traveled road; therefore their place is on one or both sides of the paved way.

The second-hand railway equipment business of Jas. T. Gardner, deceased, Chicago, will continue under the name of Jas. T. Gardner, Inc., with the following officers:—M. Gardner, pres.; R. H. Gardner, vice-pres.; A. V. Talbot, sec.; and A. M. Talbot, treas.

Victoria, B.C., has commenced work on the excavation of the ten-mile trench in which the steel pressure pipe for the Sooke Lake waterworks system will be laid from Humpback Reservoir to the city. This work will be rushed ahead in order that no delay may be encountered when the Burrard Engineering Company of Vancouver, to which has been let the contract for the fabrication and laying of the pipe, starts delivering the pipe lengths.