heavy, the asphaltic concrete is usually laid on a cement concrete foundation; but for ordinary traffic, a Telford or Macadam foundation is sufficient. Should a Telford or Macadam be used, then a 1-in. binder is needed.

The method of construction is as follows: The matrix, which consists of 1½-in. crushed stone, sand and asphaltic cement, having been thoroughly mixed, is applied in a heated state to the prepared surface of foundation and spread with iron rakes. This surface is rolled until properly compacted. A seal coat of heated bituminous cement is spread thereon and, if possible, while surface is still warm, spread with rubber squeegees. Very little of this seal coat is required, only sufficient to fill surface voids. The top dressing is composed of stone chips or torpedo sand which is rolled into surface. The proportions of materials should be: Stone, 55%; sand, 35%; asphaltic cement, 10%.

Concrete Roadway.—This is a class of road that is very largely in the public's eye at present and is one requiring a great deal of study. There are two methods of construction: (1) One-course; (2) two-course.

The one-course pavement is constructed in the following manner: The concrete is mixed in the proportions, usually, 1:2:4, and is laid to a compacted depth of 7 inches, on a subgrade, well compacted and well drained. Should the subgrade be of clay, a layer of cinders or gravel should be spread on same. The surface of concrete is floated over with a heavy template. Each day's work is finished at an expansion joint, such joints being constructed every 30 feet or thereby.

The two-course method is as follows: A layer of concrete 5 in. thick is laid on prepared subgrade. This having been shaped and compacted, and before it has begun to set, a wearing course 2 in. thick is laid thereon. This wearing course usually consists of a mixture of cement, sand and stone chippings in proportions 1:1:1, or may be of sand and cement.

Reinforcement is used in both methods and is placed near the bottom of concrete when sub-soil is weak.

A wearing surface of bitumen and sand is now being used extensively on concrete roads, but here again we are up against patent infringement.

The concrete surface having been thoroughly cleaned and dried, the bitumen is applied hot by means of a sprinkler and is evenly spread by using squeegees. This is then covered by a slight layer of sand. The quantity of bitumen used per square yard is usually ¹/₄ gallon.

In conclusion, the author pointed out that one of the most important factors in successful road construction is supervision; a good foreman is essential if work is to be carried out satisfactorily and economically. Weather has the most powerful influence on the breaking up of roads. This can be minimized by effective waterproofing.

A few points that should be observed in construction of macadam roads were given as follows:

(1) The removal from roadbed of all vegetable matter.

(2) Sub-surface drainage.

(3) Use of the very best material afforded by locality, and if traffic calls for it, the importation of suitable material.

(4) Classification of stone, tailings down to $\frac{1}{2}$ in.

(5) Complete exclusion of loam and clay from stones.
(6) Use of stone dust and screenings, same quality of stone used to fill crevices.

(7) Thorough consolidation of stone by using a 10ton steam roller. (8) Stone should be hard and tough, but hardness without toughness is of no use.

In using tar or bitumen, the following items should be kept in view:

(1) The stones must be dry and heated.

(2) Top crust never to be laid on damp foundation, and work should be carried out in dry weather.

(3) Only a sufficient quantity of binder to be used.

(4) Tar not to be overheated; if so, has tendency to cause weakness.

(5) Heating and mixing of stones and tar to be carried out on work.

ROAD LOCATION, GRADING AND ALIGN-MENT. By C. R. Wheelock, county engineer of Peel.

The paper claimed that this important phase of permanent improvement of roads had been largely lost sight of during recent years, in the great attention paid to the merits and demerits of surfacing materials. While the latter must be renewed more or less frequently the road location and grade, once established, will become more fixed.

When the improvement of a road is contemplated under the provisions of the Highway Improvement Act the first duty of the county engineer or superintendent should be to make a thorough examination of the locality, and to carefully consider all the conditions in connection therewith. Probably the first matter to be considered to determine the amount of re-alignment and grading to be done in connection with the improvement, will be the amount and nature of the traffic that the road will be asked to take care of. This must not be based on present traffic census, for as soon as the road is improved the traffic increases so greatly that all former traffic data are of little or no value and the greatest foresight is required in making estimates even for five years in advance. Local points, between which the greatest amount of traffic has existed in the past, are no longer the governing factors in the value of a road. The improvement of main roads must be considered as a whole, one link in a chain of improved highways.

Having arrived at an intelligent decision as to the extent of the improvements required for the road, the next step will be the re-alignment and fixing of grade lines.

Road allowances in Ontario were laid out, in the original surveys of townships, to follow property boundary lines without regard to the suitability of these lines for the location of roads, and as a result our roads are of the most expensive description, both to build and maintain. Since then it has been learned that the first considerations in the choice of locations should be the most direct, easiest grade and minimum cost of construction and maintenance.

Upon a careful examination of the locality and conditions in making the re-alignment it may yet be found practical to remedy some of the defects. In some cases the expenditure of a small sum for land will provide for a detour around a hill which would cost much more to cut to a proper grade or around a swamp where an expensive foundation would be required to support the surfacing, or perhaps a change of location of a bridge might be desirable. In considering the benefits of such changes the matter of maintenance should be taken into consideration. This saving alone may often be sufficient reason for making a change.

Pioneer roads in Ontario, in passing along the allowances, generally followed the line of least resistance, avoiding stumps, logs, large boulders, etc. Many of