portability. The main requirements of the principal machinery used in road construction were given in brief as follows:—

Graders.—In the operation of these, mechanical traction is advised. The cost of operation of a steam or gasoline tractor is about equal to the wages of two teams. The amount of work is from 25 to 100 per cent. greater, depending upon its character. Skill, acquired only through experience, is necessary on the part of the operator, for efficient and scientific work.

The author advised against the practice of drawing sods to the centre of the road and leaving them there. They should be thrown out as they tend to prevent consolidation of the surface and to provide dirt and mud in wet weather.

Tractors.—The cost of team haulage varies, roughly, between 20c. and 30c. per yard-mile. Mechanical haulage averages approximately 10c. to 15c., while under favorable conditions large contracts have been accomplished in which the haulage was as low as 5c. per yard-mile. Economy demands that stoppages be reduced to a minimum. The tractor outfit is a paying proposition only when it is in continuous operation. This necessitates system in loading and unloading. Several devices were described by the author as suitable for saving time in these operations.

Steam vs. gas traction engines should be studied carefully. The former are more thoroughly understood and less complicated, although, with careful operation, the latter have been very successful and economical. It is essential that the operator knows his engine. In such case the gasoline tractor has a number of advantages, no time being required for starting, firing, etc.; also, the smoke and soot nuisance is eliminated.

Conditions producing greatest economy in the operation of mechanical tractors as opposed to team haulage are: long haul, fairly good roads and bridges and culverts in good repair. The mistake is often made of purchasing too heavy and too slow a machine, together with wagons of too large a capacity. A light tractor, capable of hauling about four 3-yard wagons at a speed of 3 miles per hour loaded, or four miles per hour empty, is more serviceable on work of this nature than one that will haul larger loads at a decreased speed.

Considerable advantage is attached to the use of reversible spreading wagons in 3-yard capacity, adaptable to either team or traction haulage.

The motor truck, while as yet confined largely to city work, will soon be found hauling materials for county roads. It is more easily manipulated than steam or gasoline tractors with their accompanying trains of wagons, and can travel at more than twice their speed. Two 5-ton trucks carrying, for example, 3½ or 4 cubic yards, could be made do the work of a 20-h.p. tractor hauling 14 to 16 yards per trip. A single truck can be made to do the work of about 4 teams.

Crushers.—The usual practice on county road work is to crush the stone and place it directly on the road. Economical practice requires that it be rolled and finished immediately after placing. In this way the crusher and roller are expected to work together. The amount of stone which a roller can consolidate into a finished road in one day is limited to from 60 to 100 cubic yards, depending on the quality of the stone, width and depth of metal, condition of subgrade, ability of engineer, etc. To supply more stone to the road each day than the roller can finish is to encourage partly finished and generally unscientific work. A crusher capable of turning out 100 cubic yards per day has been found the most satisfactory. Any surplus over the roller's capacity should be stored for future use, but the crusher should be worked to full capacity.

A crusher will not work efficiently when resting only on its wheels. The vibration will cause the axle bearings to wear, making the outfit draw heavier on the road. The size of all stone fed into the crusher should be such as to permit it to easily enter the jaws. Special attention must be given to lubrication. Automatic oiling devices, owing to the dust, have not been found reliable. Care should be taken to prevent dust from entering oil holes. For hot weather a heavier grade should be used than for cold.

Crusher bearings are subject to heavy wear. Wearing parts should be replaceable. Babbit bearings that can be changed in a few minutes are a decided advantage. Another factor influencing output is the condition of the jaw plates. They are usually of chilled cast iron and wear rapidly. In spite of a much higher cost, jaw plates of manganese steel are more economical, and owing to their durability, give a more uniform product.

The selection of screens is important. A portable bin with bucket elevator and rotary screen is indispensable. The latter should consist of two sections giving three sizes of stone. For limestone, the perforations should be 1 inch and 3 inches respectively. For granite or trap rock the 3-inch screen should be replaced by a 2½-inch screen.

For ordinary road work a 12-ton roller is sufficiently heavy. In many cases a 10-ton roller will do better work, depending upon the subgrade, which should not be disturbed. The relative merits of steam and gasoline apply to rollers as to traction engines. When steam is used a double cylinder engine is considered the the only satisfactory type. The cross compound engine supplied on some rollers of English manufacture possesses the same advantage together with additional ones, of being more economical of steam, and of permitting live steam to be turned into the low-pressure cylinder when extra power is required.

A roller with a low centre of gravity is more staple on highly crowned roads and on earth shoulders in slippery weather. There is a great difference in machines as to ease of manipulation, and this should be carefully considered when purchasing. The roller, being the most expensive item in the outfit, should be worked to its limit and the other parts of the organization should be regulated to suit its capacity. Its efficiency depends largely on the ability of the operator. The author showed clearly how poor firing and incompetent operation are detrimental to efficiency. The machine must be kept in first-class state of repair. Rear rolls should have a straight surface, and must be renewed, their life depending upon the iron, the hardness of the stone, etc. The necessity for renewing the rolls should be kept in mind when purchasing. Care of boiler and of the entire machine in all seasons is strongly emphasized.

CANADIAN MINING INSTITUTE.

At the recent meeting in Toronto of the Canadian Mining Institute the officers elected for the ensuing year were:—President, G. G. S. Lindsey, K.C.; vice-presidents, Thomas Cantley, New Glasgow, N.S., and Arthur A. Cole, Cobalt, Ont.; councillors, M. B. Baker, Kingston, Ont.; J. W. Bell, Montreal; R. W. Brock, Vancouver; T. Denny, Quebec; D. A. Dunlop, Toronto; M. B. R. Gordon, Cobalt; G. C. Mackenzie, Ottawa; D. H. McDougall, Sydney, N.S.; J. T. Stirling, Edmonton, and A. J. Young, Toronto.