The stone is put on and compacted in the same manner as described for building the road. The tools used in road-making may be classed under tools for grading. draining tools, tools for excavating, tools for preparing material, and tools for laying and compacting the surface. For grading, besides picks and shovels, grading ploughs, scrapers, etc., there are used various kinds of mechanical graders, known as road machines. These have a rigid frame carried on four wheels and having, attached to it, a long curved blade, which is adjustable so that it can be raised or lowered, and set at any desired angle. Such a machine is very useful, both for bringing the road-bed surface to required shape, as also for scraping a road. Hammers used for breaking stone are generally of three sizes: Sledges, 5 lbs. and over; hand hammers, 3 to 5 lbs., and smaller ones 11 to 2 lbs. For measuring size of broken stone, ring gauges are used, of diameter equal to largest dimension of the stone wanted. There are many kinds of mechanical stone breakers or crushers, varying in capacity from 1 cub. yd. per hour to 20 and over. A good serviceable crusher, furnishing 5 to 8 cub. yds. of broken stone per hour, depending on quality of stone, requires about 15 H. P. to drive it, and costs \$750.00 to \$800.00. Such a crusher will do the work of about 35 men breaking stone by hand.

Rollers are also of many kinds. Steam rollers are the best, but a properly proportioned horse roller will do very good work. The Aveling & Porter, an English roller, is one of the best types of steam rollers. It has a wide roller, in two parts, for forward support, and two narrower ones, spaced outside of it, for the rear wheels, which are the drivers. This roller is made in 10, 15 and 20 ton sizes. The 15 ton gives about the best service for the amount of coal consumed. It has 48 in. diameter front roll, 72 in. drivers, is 87 in. wide and exerts a pressure of about 550 lbs. per running inch of width. A good steam roller will cost \$3,500 to \$4,000. Steam rollers will ascend grades of 17 per cent., and even steeper, on good surface.

Horse rollers have, preferably, the weight on one pair of rolls on one axle, and should have a small forward guide truck to which the horses are attached. The guide truck should be so arranged that it can be readily hooked on to, or be detached from, either end of the roller, so that this need not be turned around on the roadway. Horse rollers vary in weight from three tons to ten tons and over, and cost about \$100 per ton. Hand rammers are very useful tools for evening down small inequalities, &c. They are made either of iron, or of wood bound with iron, and vary in weight from twenty to fifty-five pounds, the latter being for use by two men. A framed straight edge, with adjustable cleats, spaced  $1\frac{1}{2}$  to 2 feet apart, is required for shaping the transverse contour. The points of the cleats are set to the desired contour by setting them up or down on the straight edge. The required shape of the roadway is obtained when all the points touch the surface when the straight edge is held on it.

## A NECESSARY DRAINAGE PROJECT FOR MANITOBA.

## BY J. BAWDEN, KINGSTON.

Various schemes for utilizing the rapids of the Assiniboine River on the west end of Red River on the north of Winnipeg have been presented. Mr. Rutten, C.E., of Winnipeg, has devoted much attention to the project. A considerable fall in the Assiniboine, where it flows through the parish of St. James, is said to afford a large water power. A fall in the Red River, in the parish of St. Andrews, a few miles north of Winnigeg, is occasionally discussed in connection with a scheme for building a lock to admit the passage of vessels from Lake Winnipeg to the city of that name. These projects become of perennial interest whenever the "crop prospects" of the Prairie Province raise the price of land, and a few cents addition to the price of wheat leads to large estimates of the future prosperity of our north-western plains. The value of a river basin at Winnipeg, with navigation from Lakes Manitoba and Winnipeg, has been lost sight of in the desire for increased railway facilities, and the accompanying chances for that silly gambling in land values in which so much of the enterprise of this country, like that of the United States, runs to pernicious seed.

The latter project has not been discussed, so far as the writer is aware, with a full comprehension of the facts. The most striking phenomenon confronts us at the outset of enquiry. The volume of water flowing in the Assiniboine River is at several points in its course very much larger than is discharged into the Red River at Winnipeg.

Prof. H. Y. Hind, in his Report of the Assiniboine and Saskatchewan Exploring Expedition, 1859, gives the following figures :---

VOLUME OF WATER IN	THE ASSINIBOINE.	
	Cubic feet per hour.	Distance from Ft. Garry.
Lane's Post	5,702,400	22 miles.
Mouth of Little Souris	12,899,840	140 ''
Opposite Mt. Ellice	9,979,200	280 "

The existence of one or more subterranean discharges into Lake Manitoba is alleged. An effort to drain a tract of savanne in the vicinity of Long Lake near Poplar Point Station, by cutting an outlet into the Assiniboine, has, in accordance with traditions of a contrary current there, proved abortive. Prof. Hind's report credits Rat River with carrying the freshets from the Assiniboine into Lake Manitoba. At page 71, he states that "down its valley the water of that river (the Assiniboine) during freshets, flows into Lake Manitoba, and by making a very shallow cut a permanent communication in time of high water could always be maintained.

Lake Manitoba is some 40 feet higher than Lake Winnipeg, in a distance of 40 miles measured across Shoal Lake. This lake and numerous ponds afford facilities for constructing a canal waterway between the larger lakes, the motion of which would, it is assumed, be of incalculable benefit to the Province.

Outside of the great savanne between these lakes there is comparatively little wet land west of the Red River. Settlement has not penetrated into this region, much of which is a morass, but one in which the canal mentioned would be an arterial drainage work. Can there be any doubt that over this vast "wet blanket" of country the great evaporation in progress in July and early August converts the region into a refrigerator whence icy currents move southward over the ripening wheat fields?

Arterial drainage offers the only means of checking the frost-generating influences of the extensive plain between Lakes Manitoba and Winnipeg. The erection of a dam for hydraulic purposes is not only unlikely to win any revenue from imagined mills; but is very likely to increase the damage from frost by the maintenance of subterranean backwater. At the same time, it will be unwise to divert any large part of the